Chapter 9

Cognitive Aspects of Development during Childhood

Outline

Childhood is the most beautiful of all life's seasons.

Author Unknown

How does a 3-year-old view the world? How can parents help children learn to tie their shoes? How do children learn to read or do math? These are all questions you will learn the answers to in this chapter. We will begin by revisiting Piaget's theory of cognitive development, focusing on the preoperational stage and concrete operational stage. Next, we will explore some other theorists' ideas of cognitive development; namely, Vygotsky and Binet. Our attention will then turn to other cognitive processes during childhood, including theory of mind and problem-solving. Finally, we will examine language development and academic skill development.

9.1 Piaget's Cognitive Development Theory

Learning Objectives:

1. Understand the general progression of cognitive development across Piaget's preoperational and concrete operational stages.

9.1a *The Preoperational Stage*

Many significant changes in cognitive abilities occur during early childhood. While children have obtained object permanence, there are still many cognitive skills to achieve. This section explores cognitive changes during early childhood, a period that occurs approximately between 3 and 6 or 7 years after birth. Developmental researchers have concentrated more on this life stage than on any other.

There is a shift in the nature of mental changes at 3 years of age. Piaget (1967) calls this a change to the **preoperational** mode of thinking. Parents and other caregivers readily recognize that a preschooler thinks differently when compared to an infant. This different way of thinking becomes more noticeable as young children solve problems in their play and daily activities. Their memory and information-processing skills are also more noticeable. Additionally, they show indications of the ability to use elementary logic.

Thought during this new period of mental change focuses on internalizing the environment. Children accomplish this by an increasing use of symbols and mental imagery. They come to rely on representational thought more frequently as they progress through the early childhood stage. Between 4 and 6 years of age, children are in transition to the next stage of cognition. They use intuition or hypothesizing to reach decisions. They are increasingly preoccupied with classification and the beginnings of more ordered, logical processing of information.

Preoperational
The kind of thinking young children do when they begin to use mental imagery but are not yet able to use logic; intuition is often used in reaching decisions

Preschoolers make judgments and reach conclusions based on their limited understanding of operations and rules. They use a minimal amount of cues and information in doing so. Piaget refers to this as the *intuitive* period of preoperational thought. It is a time when young children are acquiring a knowledge base

about things, people, and their environment. Later cognitive functioning will make use of this information.

Mental changes are facilitated by new language skills and perceptual abilities and the changes in brain functioning that occur during early childhood. The preoperational label implies that the child's thought processes are *prelogical* in nature. These *prelogical* skills lay the foundation for many other, more complex mental changes at later stages of the life span.

Characteristics of Preoperational Thought

Preoperational thought is relatively inflexible. This means that once young children adopt a particular point of view, they have difficulty understanding another one. It also means that young children's thoughts are dynamically tied to their perception. Preschoolers use sensory information extensively in forming conceptions and reaching conclusions. The maxim "What you see is what you get," is a good way to remember how preschoolers form their ideas of the world. A thing's appearance is often the only means preschoolers use for making judgments or evaluations about that thing.

Piaget uses several concepts to describe the relative rigidity of preschoolers' thought: equation of appearance with reality, egocentrism, centering, irreversibility, inability to solve problems of conservation, preoccupation with classification, animism, and precausal thinking.

Appearance and Reality Young children define reality almost exclusively as what they see. This characteristic of preoperational thought influences many other aspects of preschool-age cognition. It is generally recognized that preschoolers' thoughts are bound by their perceptions. They have almost no ability to generalize beyond the obvious or the information at hand (Flavell, 1986; Wadsworth, 2004).

Judgments, decisions, and conclusions are based on what is seen in the world. For example, a young child is shown a red car. The car is then covered with a special filter that changes its color to black. The filter is then removed to show the red color again. The car is again placed under the filter. When asked to name the color of the car, the child will say that it is black, totally disregarding the reality that the car is actually red and only appears to be black because of the filter. He will do this even though he just saw confirmation that the car is red when the filter was removed. The filter was put back on, and now the car looks black, so it is black as far as he is concerned.

Egocentrism Piaget (1967) believes that the preoperational thought of young children is limited in part by their **egocentrism**. Piaget did not use this word in our usual sense of "selfish" or "conceited." Rather, he used it to describe how young children focus on their own viewpoint and are unable to consider other alternatives. From their perspective, their own vantage point is all that is possible.

Piaget demonstrated the egocentric nature of young children's thoughts in what is now known as the "three mountains experiment" (Piaget & Inhelder, 1967). Preschool-age children were shown a three-dimensional model of three mountains that differed in size and color. The model was placed on a table at which a young child sat on one side. A doll was placed in a chair on an adjacent side of the table. The child was asked to show, by using cardboard cutouts of the mountain models,

Egocentrism
A cognitive trait that limits a child's understanding of the world to their own perception

how the mountains looked to the doll. None of the young children who were the subjects of this experiment were able to do so. They all depicted their own view of the mountains rather than the doll's because they could not understand that an event, object, or situation has a different perspective for someone else.

Young children typically believe that they are the center of their own universe, that things function and happen for their benefit. Appearances fuel this conclusion. For example, a young child on a walk at night might be asked what the moon does. The child will likely explain that the moon follows her everywhere—after all, that is what it appears to be doing. Likewise, a ball does not roll down a hill because it is round or because gravity pulls it. A young child believes it acts this way because he kicked it. This is reason enough for the ball's movement downhill.

Piaget discovered how difficult it is for a child to develop the ability to be knowingly empathic. In early childhood, the individual first learns that each of us has our own interpretation of reality. What must be learned next is that our personal views are not the only representations of reality possible, and certainly not the absolute truth. It is usually a challenge to understand that others have their own views, opinions, problems, perspectives, and knowledge. This understanding will not be completely accomplished by most people until the end of adolescence. In others, it may take even longer to gain an empathic perspective.

Young children begin to overcome their egocentrism and gain a degree of the empathic perspective by the end of early childhood. They start to realize that others see things differently from them and also know or like different things (Flavell, 1985; Hart & Goldin-Meadow, 1984; Taylor, 1988; Wadsworth, 2004).

Critics of Piaget's descriptions of early childhood egocentrism question the conclusiveness of his three mountains experiment (Borke, 1975; Hay, Murray, Cecire, & Nash, 1985). Others have observed that the prosocial behaviors young children demonstrate—such as altruism and sharing—indicate that empathy and responsiveness to others arise earlier than Piaget's schema allows (Leung & Rheingold, 1981; Zahn-Waxler, Radke-Yarrow, & Brady-Smith, 1977). Researchers are continually refining our understanding of childhood egocentrism and illuminating how children make adaptations as they become more self-differentiated and socially oriented to others.

What would be an example of egocentric thought?

Centering Piaget calls another aspect of preoperational thought **centering** or centration (Piaget & Inhelder, 1969). Young children concentrate on only one aspect of an object they see or an activity they do. They have difficulty in perceiving other aspects or elements simultaneously. When young children are attracted to the color of something, for example, they usually can't consider its size or shape at the same time. They can separate all the yellow buttons from a large pile of assorted buttons, but the task of separating the yellow wooden round ones is too difficult for them. Because they can handle only one dimension of something at a time, they are capable of making only broad discriminations. The ability to make fine discriminations develops later in the life span.

Centering (or centration)
A cognitive trait in early childhood that limits information processing to only one aspect or characteristic rather than several simultaneously

Irreversibility Young children typically cannot understand that some operations or processes can be reversed. To a young child, things operate in only one way and that way is irreversible (Piaget, 1967). Some examples will illustrate the **irreversibility** of preschoolers' thinking.

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Reversibility of thought, such as in subtraction, is difficult for young children to comprehend.

When asked if he has a sister, a preschool-age boy can be expected to reply, "Yes. Her name is Julie." However, when asked if his sister has a brother, the boy replies, "No." A preschooler shown a blue ball being placed in a cylinder, followed by a green and a yellow one, can accurately predict that they will appear from the other end in that order. However, if the cylinder is rotated to its opposite end, the child cannot understand that the order of appearance will be reversed as the balls appear from this end. Sequential, or serial, reasoning is difficult for young children because they are unable to trace their thought processes backward. Many young children can add or count upward. However, they find subtraction hard to comprehend. This is because subtraction is the reverse of addition and involves reversibility of thought. Similarly, they usually have difficulty understanding how water can be frozen into ice and then melted back into its liquid state.

Conservation Problems Young children cannot understand that something retains the same properties when it is rearranged or reshaped. It is not until middle childhood that they comprehend that its essential properties are preserved, thus mastering the problem of **conservation**.

What is conservation?

A trip to the supermarket reveals the prevalence of the problem of conservation even for adults. Manufacturers package similar products in differently shaped containers. A gallon in one type of container may not be recognized as a gallon in another. With the help of labels and an understanding of conservation, adults and older children understand that they can purchase equivalent amounts of a substance in these different containers.

Conservation problems illustrate how preschoolers' perceptions are governed largely by appearances. A classic Piagetian experiment shows that they do not understand that the volume of water is conserved (preserved) when it is poured into a container shaped differently from the original one. The preschooler usually concludes that there is a different amount of water in the new container because the physical appearance of the water has changed owing to the container's different shape. The understanding that the volume is the same is mastered in middle childhood. Comprehending problems of conservation among school-age children is facilitated by their developing abilities to decenter.

Irreversibility
The inability of young children to comprehend that some processes and operations can be reversed in sequence

Conservation
The understanding that the essential characteristics of something are preserved even though it is rearranged in different ways

Classification The mastery of **classification** skills is a challenge that is accomplished by age 6. Centering and egocentrism account for the inflexibility of thinking that prevents younger children from being able to group things according to shared likeness. For example, when young children are given an assortment of plastic shapes (circles, squares, triangles) of different colors and asked to sort them according to likeness, they are unable to do so. Any sorting they do is usually by color rather than shape, especially among older preschool children (Ault, 1983). Similarly, irreversible thinking hampers the ability of young children to move back and forth between various groups to sort them correctly (Siegler, 1998; Wadsworth, 2004).

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Sorting different colored shapes according to likeness is a challenge for younger children.

Animism Young children believe that all things, including inanimate objects, are alive (Bullock, 1985). This **animism** is a charming aspect of preschool-age thinking. It is often observed when young children are involved in solitary play and talk to their toys using private speech.

When young children bump into a chair, it is not unusual to hear them scold it for being in their way. They believe things fall because they have a life of their own and can move to a different place. In many respects, animism is an extension of egocentrism and prelogical thinking. Young children may use animistic thought to develop hypotheses about a complicated world.

Precausal Thinking Preschoolers often jump to conclusions. They base their decisions on a limited amount of information or knowledge of circumstances, or on how closely one event follows another (Pines, 1983; Pulaski, 1980; Wadsworth, 2004). Young children seem to reason in this manner: If event A causes event B to happen, then whenever event B is observed, event A will follow. For example, a young child may notice that when her mother is asleep (event A), she doesn't wear her glasses (event B). When her mother removes her glasses (event B) during the day to clean them, the child asks, "Is it time for you to go night-night (event A), Mom?" Removing the glasses is associated with going to sleep by the young child, and vice versa. This appears to be an understanding of reversibility. However, it is a type of reasoning based on what is known as **transductive reasoning**, or reasoning from one event to another.

Adults are often amazed at the tall tales and fanciful statements made with certainty by young children. Piaget and Inhelder (1969) describe two aspects of thought that account for **precausal thinking** among preschoolers: their inability to distinguish physical from psychological events, and their belief in an ultimate cause of events—that is, their conviction that there is a reason or explanation for everything. As we have seen, young children have problems differentiating the real from the imagined. For this reason, nightmares are real and fantasy is confused with reality. Intuitive thinking characterizes precausal thinking processes. Figure 9–1 summarizes the characteristics of preoperational thought.

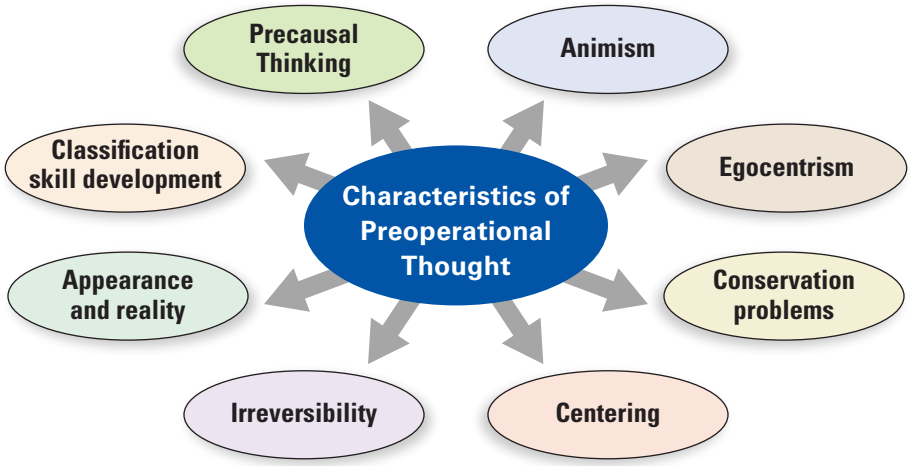
Classification
The cognitive ability to group objects according to traits of similarity or likeness

Animism
The belief of young children that all things, including objects, are alive

Transductive reasoning
Seeing a relationship between two objects or events, when in fact no relationship exists

Precausal thinking
A type of logic unique to young children based on intuition rather than fact

Figure 9–1 Preoperational Thought Characteristics



Revising Piaget's Findings

Contemporary developmental researchers have found that the children they study do not always behave in the ways reported by Piaget. Many of Piaget's findings have been confirmed when the researchers replicated his methods of studying children (Gelman & Baillargeon, 1983). However, Piaget's approaches are not the only possible ways to study changes in individuals' thinking processes over the life span. Contemporary academics have found other ways to study cognitive changes in childhood, and these methods have sometimes yielded results that contradict Piaget's findings (Crain, 2017; Wadsworth, 2004).

One such result is that young children are not as egocentric as Piaget reported. They do understand that an object having a variety of sides (like a house) looks different from various angles than one having similar sides (like a ball) (Flavell, Flavell, Green, & Wilcox, 1981). Preschoolers also can classify objects if they have had experience with the task and it is not too complicated (Brown, Bransford, Ferrara, & Campione, 1983). These findings suggest that young children's abilities are not as limited as Piaget believed.

Pause & Process

- How would you describe preoperational thought?
- How is the preoperational stage different from the sensorimotor stage discussed in Chapter 6?

9.1b *The Concrete Operational Stage*

Although physical changes slow down during middle childhood, cognitive and social changes quicken. The cognitive changes are as significant as the social changes experienced in middle childhood. A new stage of thinking emerges as

children experience the formal education process. Piaget (1967) refers to this as the period of **concrete operations**. They now base decisions more on fact and logic as they learn to reason. Refinements of mental abilities allow for more advanced functioning. Information-processing skills and language skills also continue to develop during middle childhood.

School-age children become more sophisticated in their thought processes. Their advanced cognition is obvious when their ways of thinking are contrasted with those of preschoolers. The trend is toward greater use of logic and reasoning based on advanced information-processing skills (Miller, 1986).

Before they enter the stage of cognition that follows preoperational thought, children experience what Piaget (1967) termed the **5-to-7 shift**. This is a transition to what he called prelogical thought. Between 5 and 7 years of age, children use intuition to guess the answers to problems. They do not fully understand the reasoning process behind a solution.

At about age 7 or 8, children enter the stage of cognition known as concrete operations. Concrete means children's understanding of their environment is limited to the present and to immediate physical realities. Because of these thought limitations, school-age children have problems with the concepts of past and future. Abstract hypothetical problems are difficult for them to understand and solve.

One of the major cognitive accomplishments in middle childhood is the increasing ability to use mental imagery to solve problems. As they acquire this ability, school-age children begin to perform complex operations. These include basic mathematical operations, such as addition, subtraction, multiplication, and division, and classification and grouping. Declining egocentrism throughout this period aids cognitive growth. These advances in cognition are outlined here.

Characteristics of Concrete Operational Thought

Classification An early aspect of a school-age child's application of operations is the ability to classify objects and events. Children become increasingly adept at employing a mental process known as **decentering**, perhaps because the egocentrism so noticeable in early childhood is weakening (Harter, 1983). Decentering allows a child to attend to more than one detail of an object or event simultaneously. It shows a flexible approach to reasoning.

Concrete operations
The stage of cognitive development experienced in middle childhood; thought becomes more logical and based on immediate physical realities and mental imagery abilities become more refined

5-to-7 shift
A transition period in cognitive development between the preoperational and concrete operations stages; thinking is based more on intuition than logic

Decentering
The cognitive ability that allows a school-age child to attend to more than one aspect simultaneously in performing classification operations

Preschoolers have difficulty with classification problems because they center on only one attribute of an object or event at a time. They usually sort objects according to their color. School-age children are able to apply more specific classification schemes to sorting tasks. For example, they recognize that trucks have some of the same attributes as other gasoline-powered vehicles. But they also know that trucks have special features that allow them to perform certain functions other gasoline-powered vehicles cannot do. They can easily distinguish a cow from other four-legged animals with tails. They now may group animals according to whether they provide milk or meat. This ability to decenter—to handle several aspects of something simultaneously—allows school-age children to lead more complex mental lives.

Children this age come to enjoy classification problems. They form collections of objects ranging from stamps and coins to bottle caps, mugs, dolls, rocks, seashells, and sport cards. Initially, collections are general and may appear to be worthless junk. A 6-year-old is prone to collect anything and everything.

However, collections become more specialized and valuable as children's mental operations grow more sophisticated.

Class Inclusion An additional refinement in classification problem solving during middle childhood is known as **class inclusion**. This is the ability to consider simultaneously the whole as well as the parts in grouping objects (Piaget, 1952a). Preschool children cannot do this. They become confused if they are asked, for example, to separate out all the brown wooden beads from an assortment—an assignment school-age children can handle with ease. Preschoolers cannot recognize larger classes of objects such as wooden in this example. They cannot understand that a bead can have both color and texture attributes and be grouped accordingly.

Reversibility Grasping the concept of **reversibility** allows a child to understand classification operations like class inclusion problems and subtraction. School-age children are able to reverse several classification schemes to sort objects by larger, more inclusive classes. They comprehend that subtraction is the reverse of addition. Their ability to decenter enables them to understand other phenomena—for example, that the whole can be divided into parts and reconstructed into a whole again. Children this age can see how sunlight can be split into its component colors by a prism and then restored to sunlight.

Conservation In contrast to preschoolers, school-age children understand the idea of conservation (Piaget & Inhelder, 1969). However, they apply it unevenly in the early part of this stage. This unevenness of application is known as **horizontal decalage** (Piaget, 1952b). For example, a school-age child may understand conservation of volume but find conservation of number confusing. By the end of middle childhood, most children have resolved the horizontal decalage difficulty.

Class inclusion
A cognitive ability of middle childhood that allows a child to consider the whole as well as its parts in classification operations

Reversibility
The cognitive ability of school-age children to understand that certain operations can occur in their reverse order (e.g., subtraction is the reverse of addition)

Horizontal decalage
Unevenness in applying an understanding of conservation problems across different contexts

Seriation
A cognitive ability that allows objects to be scaled according to various dimensions (e.g., large to small)

What is meant by horizontal decalage?

Seriation **Seriation** is an extension of classification problems that school-age children easily accomplish (Wadsworth, 1971, 2004). This is the ability to scale objects according to various dimensions, such as height or weight. It requires an understanding of the concepts of greater than (>) and less than (<). For example, school-age children can easily solve this problem:

> Doll A is taller than (>) Doll B; Doll B is taller than (>) Doll C. Is Doll A taller than (>) or shorter than (<) Doll C?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Understanding the concept of time is an important skill to learn.

Understanding Time Time is an important concept in our culture. Americans' lives tend to be oriented around schedules. Therefore, knowing how to tell time and being familiar with other concepts involving time (days of the week, months of the year) are important skills (Taylor, 1989). Middle-class children have an advantage over poorer children here because clocks are important equipment in middle-class homes. Children from poorer families often have a more difficult time adjusting to a school schedule because a strong sense of time is not emphasized in their households.

Preschoolers are poor judges of time, especially of the duration between events (Levin, 1982; Piaget 1969). Judgment of time spans and knowledge of calendar events improve in middle childhood (Levin, Wilkening, & Dembo, 1984). School-age children have a much better grasp of the idea of the future. They can state accurately what day will occur 3 days from now, for example (Friedman, 1986). However, the ability to work backward in time and an accurate understanding of the concept of past time are not acquired until late adolescence for most individuals.

Cognitive Style School-age children evolve a cognitive style that is distinct from that of preschoolers. This style is less bound by the egocentrism that leads preschoolers to judge by appearances rather than reality. This is a major accomplishment in middle childhood that leads to higher-level mental functioning.

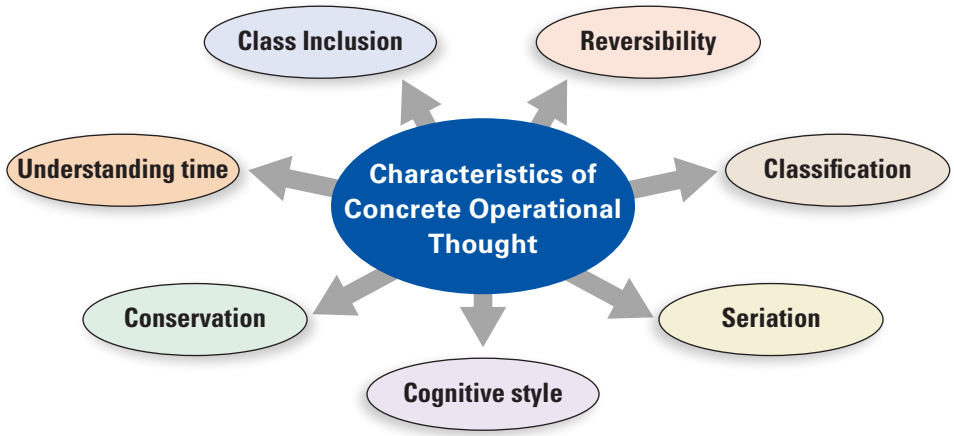
School-age children use elementary logic to infer reality from situations. This is demonstrated by their ability to solve some types of conservation problems. This mental accomplishment permits them to function effectively in the classroom.

The cognition of school-age children is still limited, however. Just as thinking in early childhood was bound by egocentrism, thinking in middle childhood is bound by cognitive distortions in reasoning. School-age children make many errors in logic as they attempt to understand how their world functions, why people act as they do, and so on. The all-or-nothing type of reasoning they use is called **cognitive conceit** (Elkind, 1976). It limits their understanding of the complexities of human behavior.

Cognitive conceit
A characteristic of thought in middle childhood in which individuals perceive situations and people in black-and-white, all-or-nothing

Problems of social cognition illustrate this limitation. School-age children eventually observe a teacher making a mistake. Because of cognitive conceit, they incorrectly conclude that the teacher cannot be trusted to provide correct information. If a teacher is not always right, they think, she must often be wrong. Similarly, a child may reason that because she can give the correct answers on several issues, she is an authority on all issues. This is a type of cognitive distortion that may continue throughout the life span, or it may become resolved at a later life stage (Burns, 1989). Figure 9–2 summarizes the characteristics of concrete operational thought.

Figure 9–2 Concrete Operational Thought Characteristics



Pause & Process

- How is thinking in the concrete operational stage different from thinking in the preoperational stage?
- Why may the development of reversibility and seriation be important for academic success during middle childhood?

9.2 Other Early Theorists

Learning Objectives:

1. Explain the main concepts in Vygotsky's sociocultural theory of development.
2. Describe the contributions of Binet to our understanding of cognition.

9.2a *Vygotsky and Sociocultural Theory*

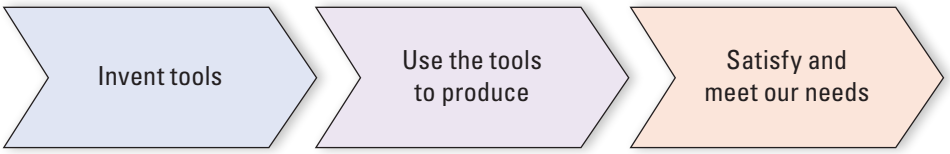
Lev Vygotsky (1896–1934) grew up in a large family in Russia. He loved a variety of fields, but decided to pursue a law degree at the University of Moscow. Due to the political climate at the time, the University of Moscow only allowed 3% of its student population to be Jewish via a lottery system. Luckily, Vygotsky was chosen and he was able to attend. After graduating with his law degree, Vygotsky taught literature and psychology. He went on to obtain his PhD, focusing on the psychology of art, and ultimately went to work at the Moscow Institute of Psychology (Crain, 2017).

While Piaget viewed cognitive development as internally driven, Vygotsky differed. He saw development being driven by two forces: the natural line and the social-historical line. The **natural line** is akin to Piaget's view of development being internally driven. The **sociocultural line** refers to the external environment, including the time period, which influences development. In Vygotsky's own words:

> Within a general process of development, two qualitatively different lines of development, differing in origin, can be distinguished: The elementary processes, which are of biological origin, on the one hand, and the higher psychological functions, of sociocultural origin, on the other. The history of child behavior is born from the interweaving of these two lines. (Vygotsky, 1930/1978).

Vygotsky was a Marxist, and Marxist theory provided the structure for the development of Vygotsky's theory. While Marxism does not discount biological needs, it emphasizes the use of tools to produce goods, which satisfy our needs. The process is social in nature and occurs within the context of historical time period (Crain, 2017). For example, humans developed tools for farming, to produce food, to satisfy our basic need to eat. The types of tools used and the types of food produced vary throughout history and culture (see Figure 9–3).

Figure 9–3 Marxist Theory Emphasis

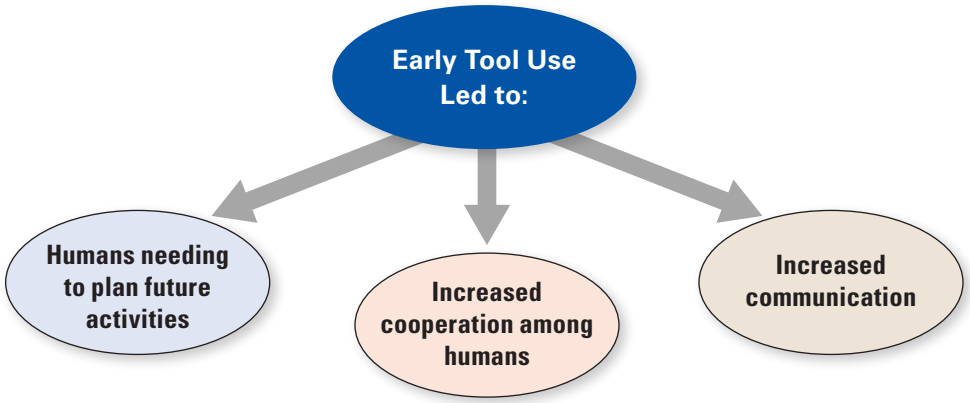


From the Marxist perspective, the development of tools allowed for humans to grow cognitively. Take for example, the use of fire to cook food. Humans' most closely related primates spend about 50% of their waking hours chewing the food that they forage (Pollan, 2014). By using fire as a tool to cook food, humans spend far less time chewing. This frees up time for us to engage in other activities, allowing us to grow cognitively. Another historical example of how tool use increased cognitive growth is the use of spears when hunting. Humans would have needed to be able to efficiently discuss hunting strategies; hence, the use of tools to hunt increased the need to develop language (Crain, 2017). Figure 9–4 demonstrates how the use of tools allowed for humans to grow.

Natural line
The view that development is internally driven

Sociocultural line
The view that the external environment, including time period, influences development

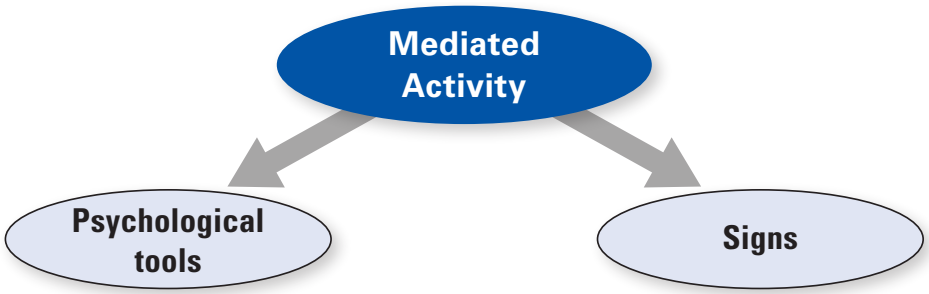
Figure 9–4 Marxist Perspective on Use of Tools



Vygotsky transformed the Marxist use of physical tools to that of psychological tools (or mental tools). A **psychological tool** focuses on mental strategies that we use to direct our behavior. Psychological tool use emphasizes the navigation of our social world and changing our environment. Another important Vygotskian construct is that of signs. **Signs** are the mental strategies that we use to guide our internal life, our thinking. They are critical for self-regulation. Vygotsky viewed tools and signs as mutually connected, yet distinct. Both are important to a child's development and fall under the umbrella construct of mediated activity. **Mediated activity** refers to how a person uses tools and signs to produce a response to some stimulus (Crain, 2017; Vygotsky, 1930/1978; Wellings, 2003).

Figure 9–5 Vygotsky's View of Mental Tools

Vygotsky theorized that signs (mental strategies that guide internal thinking), and psychological tools (mental strategies used to direct behavior), fall under the umbrella of mediated activity (how the tools and signs are used to produce a response to stimulus).



Psychological tool
A tool that focuses on mental strategies used to direct behavior; emphasizes the navigation of our social world and changing our environment

Signs
Vygotsky's theory that mental strategies are used to guide internal life and thinking and are critical for self-regulation

Mediated activity
Vygotsky's theory that refers to how a person uses tools and signs to produce a response to some stimulus

Some examples of sign systems include speaking, writing, counting methods, algebra, and mnemonic devices. Language is considered both a tool and a sign. It organizes our thinking, allows us to refer to information or experiences in the past, and to plan for the future. Speech and writing mediate the exchange of information. Writing provides a permanent record of events beyond the oral tradition. It is easy to see how critical language is for human development as individuals, as well as a culture (Crain, 2017; Vygotsky, 1930/1978; Wellings, 2003).

The natural line drives cognitive development between birth and the second birthday. After that, the sociocultural line becomes increasingly important for

cognitive development. Speech development is part of the reason why the sociocultural line becomes prominent, because it allows a child to engage in social interactions far beyond what was possible in infancy. While speech is often developed through everyday exchanges and experiences, Vygotsky believed that direct instruction was needed for writing, reading, and mathematics. Only through such instruction are humans capable of developing the highest levels of thinking, such as abstract thought (Crain, 2017; Vygotsky, 1930/1978; Wellings, 2003).

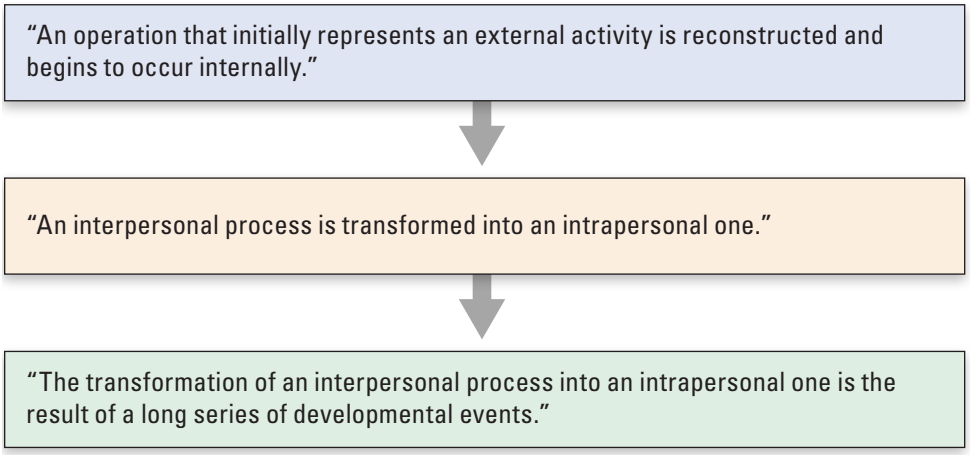
What would be an example of a mediated activity?

Up to now, we have discussed tools and signs and their influence on cognitive development. Language has a special place in Vygotsky's theory, as language and thinking are intertwined. Vygotsky identified three stages in the development of inner speech. In the first stage (up through age 2), the young child will only discuss objects not present during interactions with others. For example, a dad will tell his son to find and put on his shoes, and the child will respond. During the second stage, a child will think and speak of missing objects. Between the ages of 3 and 5, children will speak out loud as they think. For example, a child may say, "Where are my shoes?" By the age of 6, though, more of their thinking is becoming internalized. What they say out loud becomes abbreviated (e.g., "Shoes?"); their thinking is becoming internalized. By the time a child is 8 years old, speech has become completely internalized. This internalized speech is referred to as **inner speech**—it is the internal dialogue that you have within your mind (Crain, 2017; Vygotsky, 1930/1978). Figure 9–6 describes the transformations that must occur as speech becomes internalized.

Inner speech
Internalized speech or dialogue without audible articulation

Figure 9–6 Transformations as Speech Becomes Internalized

Vygotsky explained that internal speech is a transformative process.



Source: Lev Vygotsky. 1930, reprinted 1978, pp. 56–57. *Mind in Society: The Development of Higher Psychological Processes.* Cambridge, MA: Harvard University Press.

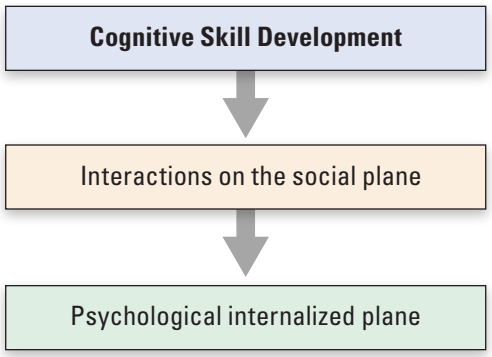
You can see this speech progression if you watch children of various ages play. When a parent plays with a toddler, the parent will often name a toy and help the child play with it. The child is often silent or only repeating words. When you watch children between the ages of 3 and 5 playing, they are giving a scene-by-scene description of what is occurring in their mind and with the toys. By age 6, they are speaking out loud less as they play, and by age 8, they are playing silently (at least when playing alone).

Vygotsky would say that inner speech development follows the social-historical line. Inner speech begins developing through social interactions. Vygotsky believed that all of our cognitive functions and abilities, such as knowing how to read music or regulate our emotions, begin through social interactions, only moving to the intrapsychic or internalized level across time (Crain, 2017; Vygotsky, 1930/1978).

An important concept of Vygotsky's theory of sociocultural development that was discussed in Chapter 2 but bears repeating is the zone of proximal development. Recall that the zone of proximal development is the gap between what a child is capable of achieving on her own and what she can achieve with some guidance from someone who is more skilled (Vygotsky, 1930/1978). For example, take a child learning to read. Think about what a beginning reader would be capable of reading and compare it to what she would be able to read with an adult assisting. That is the zone of proximal development.

Figure 9–7 Vygotsky's Cognitive Development Theory

Vygotsky believed that cognitive skills developed first through social interactions before being internalized.



One way to help a child move more quickly towards independence in any given skill is through scaffolding, which was also discussed in Chapter 2. Scaffolding refers to establishing a setting in which a child is supported by successive steps to allow for self-regulation in mastering a given skill. While the idea of scaffolding comes from a different psychologist by the name of Jerome Bruner, the process provides a nice framework on how to close the gap given in the zone of proximal development. A variety of studies have identified three important ways to pave the way to self-regulation and independence: "The use of reasoning and verbal rationales, the gradual relinquishing of control," and a warm and nurturing relationship between the child and mentor (Diaz, Neal, & Amaya-Williams, 2004, p. 139).

Vygotsky's theory is very complex, yet comprehensive. Many of his works are just now beginning to be explored and researched in the United States. That said, many in education embrace his idea of the zone of proximal development and work to scaffold learning experiences. Vygotsky's interest in how language and thinking are intertwined harkens George Orwell's sentiment in the book, *1984*. You cannot

think about concepts, ideas, experiences, for which you do not have words. This is also a ripe area of research for psychology. How can we process and think about information for which we do not have words?

Pause & Process

- What are the main concepts in Vygotsky's theory of sociocultural development?
- How is Vygotsky's theory similar to Piaget's theory? How are they different?

9.2b *Binet and Cognition*

Alfred Binet (1857–1911) is largely associated with intelligence testing and establishing the construct of IQ. While he did monumental work in this field, he was also a significant contributor to our knowledge of cognitive development. He was born and raised in France and obtained a degree in law, but never practiced it. Instead, he self-studied the field of psychology and wrote articles and books on reasoning, perception, and other timely topics. Eventually, he came to work in Charcot's laboratory in a famous hospital known as the Salpetrière. Charcot was a neurologist interested in studying hypnosis and hysteria. After some time in Charcot's laboratory, Binet moved to the Laboratory of Physiological Psychology, where he stayed for the rest of his life. During his life, he was a prolific researcher and writer, penning over 200 written works (Fancher, 1998).

Many of Binet's ideas are similar to Piaget's. While Binet was not a stage theorist, he did believe that cognitive development is a constructive process, driven by the need to adapt our thinking based on new experiences. While we did not discuss Piaget's ideas regarding play, they are similar to Binet's. More or less, play is crucial to supporting cognitive development. We will return to discussing play in a future chapter.

Do you remember Piaget's ideas regarding centering during the preoperational stage? Centering is when a child will pay attention to one specific aspect of an object and neglect to notice the other aspects or object as a whole. Binet also noticed this phenomenon in young children. He observed that children would often notice a small detail and fail to see the big picture. By the way, adults are sometimes the opposite; they will see the big picture, but neglect to notice the minute details (Siegler, 1995).

Similar to Piaget, Binet appreciated observational research. He felt that there was much to be learned by observing children. Binet felt that experimental lab research was constricting and falsely objective. In a lab, children are given choices in a very controlled setting. When you observe children in a more naturalistic way, you can listen to their reasoning and learn from any mistakes that they make (Siegler, 1995).

Table 9–1 Comparison of Piaget and Binet

Piaget	Binet
Stages (discontinuous)	No stages (continuous)
Adaptation	Adaptation
Play	Play
Centering	Centering

Finally, Binet contributed to our knowledge of memory in children. In studies regarding recall of words in middle and late childhood, children would often recall the "gist" of the words, especially as the time between seeing the words and recalling the words increased. He was also a pioneer in studying suggestibility and memory, which laid the foundation for recent research on eyewitness testimony. As current research supports, children remember things more accurately if they are simply asked to describe what they remember, as opposed to being asked specific questions (Siegler, 1995).

In summary, Binet conducted foundational research in a variety of areas related to cognitive processes in children. While he will forever be remembered as the father of IQ testing, he really did an incredible job of establishing lines of research that are still being explored today.

Pause & Process

- In what areas are Piaget's and Binet's ideas similar?

9.3 Cognitive Processes

Learning Objectives:

1. Explain how attention develops across childhood.
2. Describe how memories are formed.
3. Discuss what theory of mind is and how it develops.
4. Understand problem-solving and metacognition in childhood.

9.3a *Attention*

While preschool children have some understanding of attention, it is limited. They often fail to understand that attention is selective. Instead, they often assume that adults will be able to attend to and process any information in the vicinity.

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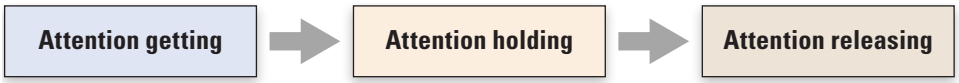
Young children have limited attention.

Compared to preschoolers, school-age children have a better understanding of attention (Flavell, Miller, & Miller, 2002; Galotti, 2017). They understand that attention is selective and requires processing. They are also able to distinguish between attention and comprehension. **Sustained attention** is the ability to direct one's attention and focus to a specific stimulus (Jacknicke, 1995). There is rapid growth in the ability to sustain attention between the ages of 5 and 9 (Betts, McKay, Maruff, & Anderson, 2006). After that, growth levels off with small improvements into adulthood. Figure 9–8 shows the three stages for sustained attention.

Figure 9–8 Three Stages for Sustained Attention



Beyond understanding attention and sustained attention, school-age children possess better attention skills. It is difficult to process information and store it in memory without paying adequate attention. Young children have short attention spans, partly because they are easily distracted (Kaplan, 1990). School-age children show considerable improvement in this area (Flavell, 1985; Flavell, Miller, & Miller, 2002; Galotti, 2017). Their greater ability to differentiate their attention—that is, to determine the relevance of something—comes partially from instruction by parents and teachers (Small, 1990) and partially from brain development, including myelination.

To perform learning activities, school-age children show improvements in another important cognitive skill: **selective attention** (Enns & Girgus, 1985; Galotti, 2017; Maccoby & Hagen, 1965). This involves tuning out distracting stimulations when performing a particular task. For example, second-grade children find it hard to concentrate on a task while music is playing (Higgins & Turnure, 1984). Sixth-grade children are not so bothered by music in performing the same task.

How is attention understood during early and middle childhood?

Sustained attention
The ability to direct one's attention and focus to a specific stimulus

Selective attention
A cognitive ability to tune out distracting stimulation while performing a task

Multitasking
The ability to distribute one's attentional resources over multiple tasks

In contrast to selective attention, there is also divided attention, more commonly referred to as multitasking. **Multitasking** is defined as the ability to distribute one's "attentional resources over multiple tasks" (Scholey et al., 2014, p. 435). Multitasking is cognitively more demanding than focusing attention on one task. Research has shown that the ability to multitask grows each year between the ages of 7 and 12 (Yang et al., 2017). The development of memory and the ability to plan support the development of multitasking. Practicing allows children to improve their ability to plan, which also helps improve multitasking.

9.3b *Memory*

As autobiographical memory improves significantly between the ages of 3 and 7, so to do other aspects of memory. Memory skills improve considerably during early childhood, partly because of the increasing efficiency of the cerebral cortex in storing information. Young children also show improvements in the strategies they use to place such information into their memory (Chance & Fischman, 1987; Galotti, 2017; Schneider & Bjorklund, 1998; Siegler & Alibali, 2004).

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Rehearsal allows us to remember how to complete tasks and activities more efficiently.

Two strategies are used increasingly and more efficiently by young children to help them place information into their memories. First, they strive to master **classification and categorization skills** to facilitate learning and the use of memory in information-processing. In recalling words, for example, young children may associate words that rhyme ("sun-fun" and "fat-hat") (Rossi & Wittrock, 1971; Schneider & Bjorklund, 1998; Siegler & Alibali, 2004). Second, young children learn by **rehearsal**—by doing or saying something repeatedly. For example, when 3-year-olds are directed to remember where something is hidden, they look more intently, touch the area, and point to it repeatedly (Wellman, Ritter, & Flavell, 1975). Naming objects repeatedly may also assist in the process of memory formation. Parents may quiz a child about what she sees, help her to name it, and ask the child to recall it later (Rosinski, Pellegrini, & Siegel, 1977). Preschoolers especially rely on this method of learning when they receive approval for remembering. They become aware that rehearsal improves their ability to use recall (Fabricius & Cavalier, 1989).

The use of memory to process information has been intensively studied among children. Memory is critical to cognition. Recall allows individuals to compare information newly received with information gained from past experiences.

How do information and experiences become memories that you can remember for a long time? Researchers know that storage of information in the brain's memory occurs in three phases. First, information is temporarily stored in the **sensory memory** (or sensory register) as it is received from the external world (Galotti, 2017; Hoving, Spencer, Robb, & Schulte, 1978; Siegler & Alibali, 2004). This storage is only for a very brief time, often for less than a second. This form of memory functions at adult levels by the age of 5. If the information in sensory memory is attended to, then the information is passed into **short-term memory (STM)** storage. If the information is not rehearsed or otherwise elaborated upon in STM, then it is forgotten within 15–30 seconds. STM steadily improves from infancy throughout childhood. It reaches adult levels during adolescence (Bauer & Starr, n.d.). If the information in STM is elaborated upon and integrated with other knowledge, it may then be processed into **long-term memory (LTM)**, where it may remain indefinitely.

Classification and categorization skills
The ability to use salient features to place objects or constructs into distinct groups

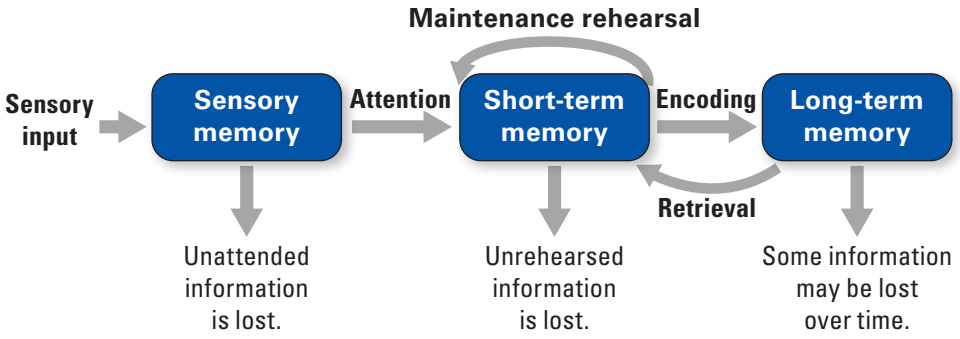
Rehearsal
Practicing something over and over again

Sensory memory
The first memory storage location where sensory information is stored in the brain before becoming short- or long-term memory

Short-term memory (STM)
An initial memory storage location in the brain where information remains for about 1 minute before being erased or placed into long-term memory; recall of information, events, and so on that are relatively recent

Long-term memory (LTM)
The final memory location in the brain where information is stored indefinitely; recall of events in the distant past

Figure 9–9 Basic Memory Processes



Source: Adapted from Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. Spence (Ed.), *The psychology of learning and motivation* (Vol. 2). Oxford, England: Academic Press.

It is well recognized that memory in general improves significantly through middle childhood (Galotti, 2017; Siegler & Alibali, 2004; Williams & Stith, 1980). Memory improvement probably occurs for several reasons, including improvements in attention span, brain development, maturation, and strategies for processing information (Galotti, 2017; Siegler & Alibali, 2004; Wingfield & Byrnes, 1981). In any case, it is known that children discover that verbal strategies assist them to process information into memory (Flavell, Beach, & Chinsky, 1966). Through trial-and-error, they find some strategies work better than others (Justice, 1985).

School-age children typically use repetition and rehearsal to place information into memory (Fabricius & Wellman, 1983; Galotti, 2017). They also use **chunking**, or grouping into one category items that share some attribute. For example, a long list of American presidents may be remembered by grouping all whose last names begin with *B, M,* and *R*. Various other mnemonic devices are used by school-age children to help in memory storage. Learning to spell words in English is a challenge. There are many tried-and-true rules to negotiate the spelling irregularities of English. For example, children find this rhyme very helpful for spelling certain words: "i" before "e" except after "c," or when sounded like "a" as in "neighbor" and "weigh."

Researchers have discovered that one reason school-age children become better at memory retrieval is because of improvements they experience in memory organization. One of the more notable organization methods is to develop **scripts**.

A script is formed out of a series of things that occur repeatedly. Frequently, these are routine events in one's daily life. For example, most people develop a repetitious way for brushing their teeth. Instead of intentionally selecting each step in the process every day, they form a "tooth-brushing script" and use it almost automatically. The steps in the process become unconscious—stored in long-term memory for repeated recall (Nelson & Gruendel, 1981; Slackman & Nelson, 1984).

Many scripts are developed during middle childhood because of children's improved memory and more extensive experiences. These range from the mundane, such as "getting-dressed scripts," to those that have social significance, such as "parenting scripts" and "spouse scripts." The latter scripts are formed through observation of adults in a family system and are not initiated by an individual until needed later in life. Because all scripts are based on learning, they may be modified and changed in any way at any point in the life span. Before changes can be made, however, a script must be dredged up from the unconscious (Harris & Harris, 1985; Hendrix, 1988; James & Jongeward, 1971).

Chunking
Grouping into one category items that share some attribute

Scripts
An organized series of acts committed to memory (e.g., getting dressed, brushing the teeth)

9.3c *Theory of Mind*

A **theory of mind (ToM)** is the ability to understand your own mental state, as well as the mental state of others (Dixon, 2003). "We use ToM to explain and predict our own and others' behavior based on mental states such as beliefs, knowledge, intentions, and desires" (Bernstein, 2018). **Mental state** refers to your thoughts, knowledge, beliefs, and desires. For example, you know that you do not believe in Santa Claus. However, you may know that your 3-year-old niece does believe in Santa Claus. Further, because you know about her beliefs, you may also be able to conjecture her thoughts about Christmas morning. However, a theory of mind takes time to develop.

Henry Wellman has completed a series of studies examining the development of ToM. He has also written numerous articles and chapters describing this phenomenon (e.g., Wellman, 1993; Wellman, 2014; Wellman, 2015; Wellman, Cross, & Watson, 2001; Wellman & Gelman, 1998; Wellman, Kushnir, Xu, & Brink, 2016; Wellman, Lopez-Duran, LaBounty, & Hamilton, 2008, etc.). ToM is dependent on the development of attention skills, language, and other executive function development (Derksen, Hunsche, Giroux, Connolly, & Bernstein, 2018). Around the age of 2, children begin to understand that people have wants and desires. By the third birthday, this understanding grows to include other mental states, such as thoughts and beliefs. At age 4 children really begin to understand the connection between mental states and behaviors. Children are unable to deceive others until they have a theory of mind. While most children fully understand that there is a relationships between mental states and behavior by the age of 4 or 5, children with quality relationships and interactions with older siblings and parents achieve it earlier.

ToM allows for healthy relationships with peers (Derksen et al., 2018). Children with a good ToM are more likely to engage in prosocial behaviors than those with an underdeveloped ToM (Derksen et al.; Imuta, Henry, Slaughter, Selcuk, & Ruffman, 2016). Prosocial behavior includes behaviors such as helping, comforting, and cooperating. This is particularly evident by the age of 6 and beyond.

ToM influences social interactions beyond just prosocial behavior. A naturalistic study examined the influence of ToM on persuasion in children between the ages of 3 and 8 (Slaughter, Peterson, & Moore, 2013). As predicted, ToM influences one's ability to persuade peers to change their mind. Another study assessed ToM between the ages of 6 and 10 and perceived social competence by children's teachers (Devine, White, Ensor, & Hughes, 2016). ToM at the age of 6 predicted social competence at the age of 10. Hence, ToM influences many different aspects of social functioning.

Theory of mind
The ability to understand your own mental state, as well as the mental state of others

Mental state
Refers to thoughts, knowledge, beliefs, and desires

9.3d *Problem-Solving*

Problem-solving is another area that shows continued development across childhood into adolescence (DeLoache, Miller, & Pierroutsakos, 1998; Siegler & Alibali, 2004). Problem-solving involves developing a strategy to overcome an obstacle in order to achieve a goal. Problem-solving involves many aspects of cognitive processes, such as memory, reasoning, metacognition, and perception.

One key component to problem-solving is task analysis. **Task analysis** requires you to carefully examine the problem and consider what steps will be necessary in order to solve it (DeLoache, Miller, & Pierroutsakos, 1998; Siegler & Alibali, 2004). After task analysis, you must encode. **Encoding** allows you to develop an

Problem-solving
The development of strategies to overcome an obstacle in order to achieve a goal

Task analysis
The careful examination of a problem and consideration of what steps will be necessary in order to solve it

Encoding
Developing an internal, mental representation of the situation

internal, mental representation of the situation. Finally, your knowledge should be used to assist in addressing the problem and reconciling it.

There are developmental differences in problem-solving strategies and abilities (DeLoache, Miller, & Pierroutsakos, 1998; Siegler & Alibali, 2004). Rudimentary forms of problem-solving are evident in infancy. Across childhood, the ability to plan a strategy for solving a problem improves. As age increases, the ability to develop and achieve subgoals in assistance to solving the larger problem improves. The ability to choose or develop the most appropriate strategy also improves with age. Finally, with formal operational thought, sophisticated forms of reasoning emerge. Such reasoning allows for better problem-solving.

9.3e *Metacognition*

Knowing how to place information into one's memory and how to retrieve that information are new skills for preschoolers. Many researchers believe that children do not master this basic skill until they are older (Galotti, 2017; Siegler & Alibali, 2004; Wellman, 1985). It depends on **metacognition**, or the ability to be aware of, understand, and take note of changes in one's own cognitive processes. Metacognition includes knowing how to pay attention to things to remember them later; what interferes with making one's attention work properly to perform memory storage; and what works well to facilitate the use of one's memory. There is some controversy about whether young children are aware that they can use memory in information-processing. It is clear, however, that in early childhood, improvements occur in acquiring skills that help children control what they learn and remember (Brown, 1982; Siegler & Alibali, 2004).

There is a distinction between metacognition and metamemory. Again, metacognition is the awareness of the extent of one's knowledge. In middle childhood, many individuals improve in metamemory as well as metacognition. **Metamemory** is the awareness of the extent of what is in one's memory. The degree to which children can comprehend their particular capacity of knowledge and memory has important implications for their academic performance (Holt, 1964; National Research Council, 2000).

Metacognition
The ability to be aware of and understand the changes occurring in one's own cognitive processes

Metamemory
An awareness of the extent of one's memory

School-age children who have high levels of metacognition and metamemory may express more misunderstanding about concepts than others. This is because they are more aware of the extent of their knowledge than children who have lower levels of such awareness. Since they know what information they lack, they understand how to go about getting that information. These children are better students than others. Researchers are discovering ways to help school-age children develop better metacognition and metamemory skills (Cross & Paris, 1988; Galotti, 2017).

Pause & Process

- How does attention develop across childhood?
- How are memories formed?
- What is theory of mind and how does it develop?
- What is metacognition?
- Why may metacognitive abilities be important?

9.4 Language Development

Learning Objectives:

1. Understand language development during childhood.
2. Explain bilingualism, second language acquisition, and communicative disorders.

9.4a *Language Development during Childhood*

Language development during early childhood includes improvements and growth in a variety of areas of language. Let's look at these areas in-depth.

Private Speech

One characteristic of language acquisition in early childhood is the use of **private speech**. Piaget (1926) first noted this as a language form in early childhood. He observed that young children frequently talk even when no one is listening to them. He believed that this shows egocentrism in young children—their inability to see things from another's viewpoint. Piaget believed that this type of speech pattern became replaced by other means of self-expression as children developed.

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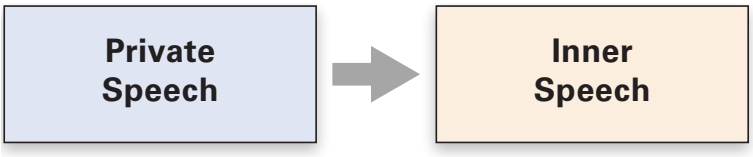
Private speech can be observed when children think "out loud" as they engage in solitary play or work through situations and learn problem-solving strategies.

Another interpretation of private speech was suggested by Vygotsky (1962). As discussed earlier in the chapter, rather than being an indication of egocentrism, private speech, in Vygotsky's view, is used by preschoolers to

Private speech
A speech form prevalent in early childhood in which children talk to themselves or continue to talk even when no one is listening to what they are saying

direct their actions, make plans, and maintain a psychological focus on the present. Private speech is an almost universal phenomenon (Alderson-Day & Fernyhough, 2015). It typically emerges between the ages of 2 and 3, as language skills develop. It is frequently observed between the ages of 3 and 8, peaking at the age of 5. It begins as task-irrelevant speech, but develops into task-relevant speech, helping guide thoughts and behavior. It can be observed when children think "out loud" as they engage in solitary play or work through situations and learn problem-solving strategies (Alderson-Day & Fernyhough, 2015; Crain, 2017; Harris, 1990; Manning, 1990). Rather than disappearing, as Piaget suggested, Vygotsky theorized that private speech becomes merely unspoken or sometimes subconscious thought—in modern times this is referred to as inner speech, which we will define and explain next (Alderson-Day & Fernyhough, 2015; Berk, 1986; Crain, 2017; Frauenglass & Diaz, 1985; Kohlberg, Yaeger, & Hjertholm, 1968). Towards the end of the period of private speech, one can observe children inaudibly mumbling to themselves, giving clues that the transition from private to inner speech is occurring.

Figure 9–10 Private Speech Transitions to Inner Speech



Inner speech is defined as "the subjective experience of language in the absence of overt and audible articulation" (Alderson-Day & Fernyhough, 2015, p. 931). In various studies, it has been referred to as verbal thinking, covert speech, silent speech, covert self-talk, inner speaking, internal dialogue, and internal monologue. It can be conceptualized as an inner conversation with our self. Much like private speech, inner speech is critical for self-regulation of thinking and behaving across the life span.

Vocabulary

Vocabulary continues to expand rapidly during early childhood (Siegler & Alibali, 2004). The average 3-year-old has a vocabulary of 896 words. By the age of 4, vocabulary size increases to an average of 1,540 words. Another jump is seen in vocabulary by the age of 5, with an average vocabulary of 2,072 words. Words acquired during this time become more complex with more of the derivatives and inflections acquired (Piper, 2003).

Grammar

Young children learning English as their primary language experience many challenges because English has a rather difficult grammar. Parts of speech, as well as the rules for forming correct sentence structures, must be learned. This involves comprehending, at an elementary level, such rules as: (1) the subject precedes the verb; (2) verbs have different tenses to reflect past, present, and future action; (3) words have different forms in the possessive case; and (4) verbs change form with plural subjects. However, there are many exceptions to these basic rules and they take years to master. Young children are able to place the subject before a verb

and the object after it (Clark, 1982). This is the grammatical structure commonly used in English. Infant usage such as "Baby go sleep" is refined into "I'm sleepy, and I want to take a nap." There is limited use of possessive words such as "my" and "mine" at age 3, and understanding of the possessive case increases during this period. Verb tenses are learned. Negatives are learned as well. For example, a 2-year-old would say when told it is bedtime, "No go!" while a 4-year-old might say, "I don't wanna go night-night!" Prepositions are difficult and may not be mastered at this time.

Preschoolers often resort to inventing words when forming sentences (Clark, 1982; Piper, 2003). Although they lack the vast vocabulary and cognitive abilities of older individuals, young children strongly desire to communicate so they create words according to their limited knowledge of grammatical structure. For example, they will add an "s" to a verb, as in, "I gots to use the potty," and an "er" to a noun for a doer, as in "My mom is a good cooker." This type of error is known as overgeneralizing the rules of grammar. Speech in early childhood is abundant with mistakes, but trial-and-error is the means by which young children learn the complexities of language.

9.4b *Language Development During Middle and Late Childhood*

While children are competent communicators with language in early childhood, language skills continue to develop during the school years (Piper, 2003). During the school years, children achieve **metalinguistic-awareness**. Metalinguistic-awareness (or metalinguistic ability) is defined as "the capacity to use language to analyze, study, and understand language" (Hulit & Howard, 1997, p. 247).

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During middle childhood, language learning often focuses on mastering the intricacies and rules of the language.

During middle childhood, vocabulary continues to grow, though at a slower rate than in early childhood (Hulit & Howard, 1997). Understanding slight variations between words and word choice skills improve. The meaning and definitions of words grow during this time. Children also improve in their ability to understand and use *figurative language forms*, such as similes, proverbs, idioms, and metaphors.

Language learning during middle childhood often focuses on mastering the intricacies and rules of the language. Syntax and morphology understanding and use continue to develop (Hulit & Howard, 1997). Early in middle childhood, children are still working to master the exceptions to the general rules of language. For example, they may still occasionally say "childs" instead of "children" or "gooses" instead of "geese." They also begin to learn about rules regarding double negatives in sentences and parts of speech. Language skills reach adult-like levels by the end of middle childhood.

Metalinguistic-awareness

The capacity to use language to analyze, study, and understand language

9.4c *Variations in Communication*

In the United States, the majority of individuals grow up knowing only one language. Serious exposure or instruction in a second language does not occur for many individuals until middle school or high school. Further, most individuals learn their native language with little or no difficulties. In this section of the chapter, we will learn about bilingualism and communication disorders—two areas that are not the norm, but far from rare.

9.4d *Bilingualism*

The ability to speak more than one language is a cognitive advantage (Piper, 2003). The earlier a child learns a second language, the easier it is for him or her to master it. When a child is raised in a home where two languages are spoken, some confusion may occur between the two languages during early childhood. However, this confusion typically subsides by the end of early childhood. Interestingly, a child raised in a bilingual home will eventually favor one language over the other. It is rare to find balanced bilingualism. Which language dominates is typically determined by which language is dominant in the surrounding environment.

9.4e *Second-Language Acquisition*

Most children who are bilingual early in childhood learn the second language in the home. However, many elementary schools offer courses in a second language, which is referred to as **school bilingualism** (Piper, 2003). School bilingualism differs from home bilingualism in several ways. For example, language in the home is practical, context-based, and sequential. Language learning in schools is considered "formal, abstract language that is largely decontextualized, logical, and expository" (Piper, 2003, p. 132). Hence, it is more difficult to become bilingual in the school than in the home.

Second-language acquisition is best prior to middle childhood. Research has shown that immigrants to the United States master English grammar as well as natives if they arrive before the age of 7 (Siegler & Alibali, 2004). Children who arrive between the ages of 8 and 11 show slight decrements in grammar ability. The downward trend in grammar ability in a second language continues as age increases. By the age of 15, grammar ability shows significant negative impacts in comparison to the younger children's mastery.

School bilingualism
The offering of courses in a secondary language in the elementary schools

9.4f *Communicative Disorders*

Communicative disorders can range from mild to severe and make either learning or using the language difficult (Piper, 2003). Three of the most common communicative disorders in children involve voice, fluency, and articulation of particular sounds.

Communicative disorders
Any disorder that impairs one's ability to communicate

Voice disorders are persistent difficulties with the quality of voice (Piper, 2003). They may simply be a nuisance (such as a nasal tone or breathiness) or may make speech unintelligible. **Fluency disorders** disrupt the ability to speak continuously or at a normal rate. Stuttering is one example of a fluency disorder. **Articulation disorders** range from difficulty with specific sounds to severe impairment in the phonological system. Lisping is one example of a mild articulation disorder.

The cause of these communicative disorders varies (Piper, 2003). Sometimes they are due to anatomical abnormalities. Other times they are due to brain injuries. In many cases, however, the cause is unknown. In general, the sooner a communicative disorder is identified and intervention begins, the better the chance of communicative improvement.

Pause & Process

- What is the difference between home bilingualism and school bilingualism?
- What are communicative disorders?

9.5 Learning and Knowledge

Learning Objectives:

1. Understand academic skill development across childhood.

Early Childhood

Early childhood is a time when children expand their knowledge of the world and develop an attitude of accomplishment. Changes in these years are the foundation for many future learning experiences. This stage is an exciting time when a child learns to explore the environment in many ways.

Emerging Academic Skills While some children learn foundation for academic skills at daycare or preschool, many others learn such skills from their parents or even older siblings. Early academic skills can also be acquired from educational programming (such as *Sesame Street*, *Between the Lions*, or *Sid the Science Kid*) or computer programs (such as mathisfun.com, ABCmouse.com, or specific software programs). Academic skill development is intertwined with cognitive development and language development (Piper, 2003).

Voice disorders
Persistent difficulties with the quality of voice

Fluency disorders
Disorders in which a person struggles to communicate smoothly

Articulation disorders
Disorders in which a person struggles to produce appropriate speech

Early Mathematic Skills Culture is very important in determining what mathematical skills are important and need to be learned (Ginsburg, Klein, & Starkey, 1998). Learning the number words and using them to count begins around age 2. For a while, adult (or older child) help is needed to count things with any accuracy. In fact, the average 3-year-old will make a counting mistake 33% of the time. A conceptual understanding of what counting means takes longer than simply memorizing the order of the number words.

Counting with conceptual understanding progresses so that by the age of 4 children have a general conceptual understanding of adding objects or subtracting objects in relation to a group (Ginsburg, Klein, & Starkey, 1998). This does not mean that the average 4-year-old can do addition and subtraction problems. Instead you can show them an original picture with three cows. You can then show them two other pictures: a picture that still has three cows, and a picture with only two cows. If you asked the child, "Which picture shows that one of the cows left?" he or she would be able to choose the picture with only two cows.

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Experiences, such as trips to science museums, increase children's learning and knowledge.

Most 3-year-olds do not display a strategy when asked a mathematical question (Ginsburg, Klein, & Starkey, 1998). However, across the preschool years, some rudimentary mathematical strategies emerge. An early strategy to emerge is counting. For example, when asked which of two pictures has more tomatoes, most 4-year-olds will use counting to answer the question. Another early strategy to emerge is learning to start counting from the larger of two addends. For example, consider the following word problem:

> Amy picks four apples from a tree. Then Amy picks three more apples from the tree. How many apples does she have altogether?

A younger child would start counting from one, all the way up to seven. However, an older preschool child would start with the four in mind, and count up three from there. Older preschool children also acquire finger-counting for addition and subtraction problems. Surprisingly, older preschool children have two strategies for division problems: consecutive and overlapping (Ginsburg, Klein, & Starkey, 1998). For example, consider the following word problem:

> Leonardo has five friends. He has 10 pencils that he would like to give to them, making sure that each has the same number of pencils. How many pencils will each friend receive?

This division problem could be solved by a young child using either a consecutive strategy or an overlapping strategy (Ginsburg, Klein, & Starkey, 1998). In the *overlapping strategy*, a child could draw five boxes representing the five friends. He or she would then place a tally mark in each box (representing a pencil) until they

counted up to 10. In this way, the child could learn that each friend would receive two pencils. The alternative would be the *consecutive strategy*. With this strategy, the child would distribute the pencils to each friend completely before moving on to the next friend. Early on, this strategy could involve a lot of trial-and-error while trying to figure out how to distribute the total number of pencils equally among the friends.

Early Language Arts Skills To be successful in our society, a child must learn to read and write. However, how do children come to learn that the strange shapes and lines they see on paper stand for letters? Further, how do they come to know that these letters represent specific sounds in their language? Finally, how do they come to know how to share their thoughts, memories, feelings, or imaginations with the written word? All of these skills typically begin in early childhood.

Phonics can be defined as a system "designed to help children use the correspondences between letters and sounds to learn to read and write" (Adams, Treiman, & Pressley, 1998). The first step in phonics is to teach that the letters of the alphabet stand for specific sounds. Some letters have only one sound (e.g., the letter "B"), while other letters have more than one sound (e.g., the letter "G"). Once children know the sounds that letters can make, they can begin sounding out words. Of course, they must learn the language-specific rules during the school-age years (e.g., when "le" is at the end of a two-syllable word, the consonant before the "le" joins it in forming the last syllable, like "candle"). While phonics is very important for reading development, context is also important in helping young readers decode words that are neither familiar, nor easily sounded-out. Additionally, some words must be taught that are neither phonetic nor easily learned through contextual clues. Many of these words, along with high-frequency words, are taught in preschool as "sight words."

Writing skills are limited in early childhood. Writing is both a cognitive and motor skill task. Simply holding the pencil (or crayon) and working the hand to make the desired marks on the paper uses much of the young child's cognitive resources. If a child has to write a story himself, it will be limited and sketchy. However, if a teacher or parent writes a story that the child dictates, the story will be filled with much more information and details.

Middle and Late Childhood

School-age children have many learning experiences, especially in the school system. Individuals are expected to acquire the basic skills our society considers essential for effective functioning during middle childhood. They are also expected to absorb much information about the world of people and things.

Some developmental researchers study the ways that children learn (Bransford, Brown, & Cocking, 2000; Brown et al., 1983). This involves trying to understand how a child's mind perceives and processes information from the external world. These researchers have amended Piagetian and learning theory according to what is known about how computers process and logically handle information.

Phonics
An approach to teaching reading and spelling based upon phonetics, or the sound of letters

Academic Skills In the previous section, we learned about some early academic skills acquired during the preschool years. Some mathematical strategies

developed in early childhood include counting, use of fingers in counting, counting on from the higher addend, and the use of overlapping and consecutive strategies in division. Some language arts skills in early childhood include the ability to identify letters of the alphabet, beginning phonics, and early writing.

Mathematical Skills You are probably not surprised that some basic academic skills are either acquired or further developed during middle childhood. Mathematics is one such area. School-age children are expected to master the basic operations of addition, subtraction, multiplication, and division. While variations on counting were the predominant strategy for early childhood, more sophisticated skills emerge during middle childhood (Ginsburg, Klein, & Starkey, 1998).

The math taught in school is **codified**. Codified can be defined as math that is written, systematically arranged, and guided by explicit rules (Ginsburg, Klein, & Starkey, 1998). Such math cannot be learned through exploratory learning; instead it must be taught by formal instruction (sometimes called direct instruction). Once again, what mathematical knowledge is taught depends upon the culture.

As we learned in the previous section, counting strategies continue to evolve so that the early school-age child consistently adds on from the larger addend (Ginsburg, Klein, & Starkey, 1998). However, through frequent drills, children eventually store basic number facts into long-term memory (e.g., they will learn that 8 – 5 = 3 without having to do the counting each time). Drills are often useful in learning addition, subtraction, multiplication, and division facts. They can also be useful in learning conversion facts (e.g., converting inches to centimeters). However, a conceptual understanding should be the foundation upon which to drill.

However, much of math is too complicated to be committed to memory via the drill method (Ginsburg, Klein, & Starkey, 1998). For these areas of math, algorithms and invented strategies can be useful. An **algorithm** has been "developed and codified over the course of centuries, [and] produces correct results. When used properly, the algorithm always works" (Ginsburg, Klein, & Starkey, 1998, p. 419). For example, A2 + B2 = C2 is an algorithm that will always work. Inventive strategies are different, however, from algorithms. **Inventive strategies** make use of one's knowledge and current strategies for help in answering novel problems. For example, a child may know that 5 + 5 = 10. When faced with the problem 5 + 6 = ?, she may choose to add 5 + 5 (which she knows the answer to) and count up 1, instead of counting up five from the number six. Exploiting the base 10 system is a very popular inventive strategy.

American children do poorly in these skills compared to children in other countries (Stigler, Lee, & Stevenson, 1987). Newer instruction methods are based on what we know about how children in the concrete operations stage of cognitive development learn (Resnick, 1989). They stress cognitive processes rather than memorization and calculation skills. By the end of this period, children should understand fractions, decimals, pre-geometry and pre-algebra knowledge, and conversion between the decimal and standard systems of measurement.

Codified
Math that is written

Algorithm
A developed procedure to produce correct results in a math problem

Inventive strategies
Making use of one's own knowledge and current strategies in answering a novel problem

Language Arts Skill Reading also shows great development during middle childhood. It involves integration of perceptual, attention, and memory skills. Teachers consider many factors in reading instruction: for example, letter size, readability of text material, and the child's knowledge base (Athey, 1983; National Research Council, 2000). Most children enter the first grade knowing the alphabet;

some may already know how to sound out words and read easy books. By the end of this period, children should be able to read most books with ease and fluency. When first learning to read, simply sounding out and identifying the words uses most of working memory. It takes time to be able to read and comprehend what one is reading. Reading instruction is based on teaching different reading skills, use of phonics, and different types of comprehension (Jones, 1986; National Research Council, 2000). Phonics is especially important for reading development. Also, the more a child is read to early in childhood and the more they read independently and with others during middle childhood, the earlier a child is able to read efficiently and for knowledge.

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Reading becomes more efficient during middle childhood.

Finally, writing develops by leaps and bounds during middle childhood. Writing also involves the integration of several cognitive skills. Like reading, it is used in many contexts of classroom learning. Classroom writing is less a communication device than a means of evaluating what children have learned. Early during the school-age years, children will often just list everything they have learned in response to an essay question with little organization or coherence. Across middle childhood, children learn to write with thesis statements, introductions, topic sentences, transitional sentences, summaries, coherence, and organization. Children also learn how to write informational reports, persuasive arguments, research reports, and other such formats during this time. Of course, these skills continue to be improved upon during adolescence and beyond.

Explain how math and language arts skills develop in childhood

Summary

1. The preoperational stage of cognitive development is experienced during early childhood. Cognitive skills are focused on internalizing the environment by an increasing use of mental imagery. Thought during this time of the life span is characterized as inflexible, egocentric, and centered. Children make decisions based on appearances rather than on reality. Preschoolers also have difficulty understanding the principles of conservation and reversibility. Classification skills begin to emerge, as well as precausal thinking, in the later part of this stage. Young children are beginning to master learning skills and to develop strategies for using their memories.
2. School-age children enter a new stage of cognitive development called concrete operational. Before entering this stage at about age 7 or 8, they go through a transition period (the 5-to-7 shift) when their thinking is based on intuition. The concrete operations stage is characterized by limitation of thought to present physical realities and the increasing ability to use mental imagery in problem-solving. Several important cognitive changes take place during middle childhood: (1) classification skills improve because of decentering; (2) class inclusion, or how to consider a whole in relation to its parts, is learned; (3) reversible operations such as subtraction are accomplished; (4) most kinds of conservation problems are mastered; (5) seriation tasks, or the scaling of objects according to various dimensions are performed; (6) time is better understood; and (7) a cognitive style that is less bound by egocentrism is formed. Individuals in middle childhood use elementary logic to make inferences, but their reasoning is limited by cognitive conceit, or all-or-nothing thinking.
3. Vygotsky believed that cognitive development followed both a natural line and sociocultural line.
4. The use of tools and signs propel cognitive development through social interactions.
5. Information-processing skills increase during early childhood. Memory strategies improve and early academic skills emerge. The degree to which children have metacognitive skills in early childhood is still open to debate.
6. School-age children process information in ways that facilitate the learning experiences required by school systems. They demonstrate their improved abilities to process information in their use of attention and use of memory. School-age children become better at selective attention in gathering information from the environment. Their memory improves significantly and they are better able to recall information when performing cognitive tasks. School-age children use various methods and strategies for memory storage. Many different scripts are formed during this stage to facilitate routines. Other scripts are based on understanding social roles. School-age children show great improvements in metacognition and metamemory. Those who have higher levels of these kinds of awareness perform better in school.
7. Private speech is often observed in preschoolers, which will eventually become internalized as thought.
8. Language development includes the emergence of metalinguistic-awareness. Children also develop an awareness and use of figurative language. Additionally, conversational skills improve. Finally, children fine-tune their knowledge of morphology, syntax, and pragmatics during the school years.
9. Communicative disorders include voice disorders, fluency disorders, and articulation disorders.

Self-Quiz

1. What cognitive skills are difficult during the preoperational stage?
2. Explain the principles of conservation and reversibility.
3. What do preoperational children base their decisions on?
4. What are transductive reasoning and precausal thinking? What are the limitations of these types of thinking?
5. Describe concrete operational thought.
6. Compare and contrast preoperational thought and concrete operational thought.
7. How are tools and signs the same? How are they distinct?
8. What is scaffolding and how does it help close the gap in the zone of proximal development?
9. What is meant by attention?
10. Describe the process of speech becoming internalized.
11. How does language develop between early childhood and the end of childhood

Terms and Concepts

5-to-7 shift 228
Algorithm 250
Animism 226
Articulation disorders 247
Centering (or centration) 224
Chunking 240
Classification 226
Classification and categorization skills 239
Class inclusion 229
Codified 250
Cognitive conceit 230
Communicative disorders 246
Concrete operations 228
Conservation 225
Decentering 228
Egocentrism 223
Encoding 241
Fluency disorders 247
Horizontal decalage 229
Inner speech 234
Inventive strategies 250
Irreversibility 225
Long-term memory (LTM) 239
Mediated activity 233
Mental state 241
Metacognition 242
Metalinguistic-awareness 245
Metamemory 242
Multitasking 238
Natural line 232
Phonics 249
Precausal thinking 226
Preoperational 222
Private speech 243
Problem-solving 241
Psychological tool 233
Rehearsal 239
Reversibility 229
School bilingualism 246
Scripts 240
Selective attention 238
Sensory memory 239
Seriation 229
Short-term memory (STM) 239
Signs 233
Sociocultural line 232
Sustained attention 238
Task analysis 241
Theory of mind 241
Transductive reasoning 226
Voice disorders 247