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Somehow, in the span of just a few years, newborn infants who neither speak nor understand any language become young children who comment, question, and express their ideas in the language of their community. This change does not occur all at once. First, newborns' cries give way to coos and babbles. Then, infants who coo and babble start to show signs of comprehension such as turning when they hear their name. Infants then become toddlers who say "bye-bye" and "all gone" and start to label the people and objects in their environment. As their vocabularies continue to grow, children start to combine words. Children's first word combinations, such as all gone juice and read me, are short and are missing parts found in adults' sentences. Gradually children's immature sentences are replaced by longer and more adultlike sentences. As children learn to talk, their comprehension abilities also develop, typically in advance of their productive speech. As children master language, they also become masters at using language to serve their needs. One-year-olds who can only point and fuss to request something become 2-year-olds who say "please"; later they become 4-year-olds capable of the linguistic and communicative sophistication of the child who excused himself from a boring experiment by saying, "My mother says I have to go home now" (Keller-Cohen, January 1978, personal communication).

This book is about these changes. It is about the what and when of language development—what changes take place and when they occur in the course of language development. It is also about the how and why. How do children learn to talk, and why is the development of language a universal feature of human development? In the following chapters, we will delve into these topics in detail. In this first chapter, we begin with an overview of the field we are about to study.

LANGUAGE AND THE SCIENTIFIC STUDY OF LANGUAGE DEVELOPMENT

A definition of language

Language is the systematic and conventional use of sounds (or signs or written symbols) for the purpose of communication or self-expression (Crystal, 1995). This definition is short and simple and, although true, it is misleading. It is difficult to capture the complexity of language in a short definition. The child who learns a language achieves the ability to recognize and produce a set of sounds and learns how these sounds can and cannot be combined into possible words. The child who learns English, for example, comes to know approximately 44 different consonants and vowels (Crystal, 1995) and that pling is a possible word but gnilp is not. By adulthood, the child who learns a language knows a vocabulary of tens of thousands of words. This vocabulary knowledge includes knowledge of each word's meaning and its possibil-
ities for combination with other words. Adult speakers of English know, for example, that *give* and *donate* are synonyms, that *John gave a book to the library* and *John donated a book to the library* are perfectly fine sentences, that *John gave the library a book* is also fine, but that *John donated the library a book* is not. The child who learns a language also comes to know the multiple ways in which pieces of the language can and cannot be systematically combined to form words and sentences. *John kissed Mary* and *Mary kissed John* are both fine sentences, albeit with different meanings; *kissed* is made up of *kiss* + *ed*, and *Mary* + *ed* *John kiss just does not work*. The child who learns a language also comes to know how to combine sentences into larger units of discourse—to tell a story or have a conversation. As they learn a language, children learn to use that language to communicate in socially appropriate ways. They acquire the means to share their thoughts and feelings with others and the skill to do so differently with their peers and their grandparents. In a literate society, children also learn to use language in its written form. They master both a complex set of correspondences between written symbols and meanings and a literate style of language use.

Children develop these different sorts of language knowledge concurrently, and there are many mutual influences between developments in these different domains. It is useful, nonetheless, for researchers and for students of language development to make distinctions among the subcomponents of language. The sounds and sound system of a language constitute a language’s phonology. The words and associated knowledge are the lexicon. The system for combining units of meaning (words and parts of words such as *ed*) is morphology; the system for combining words into sentences is syntax. The knowledge that underlies successful and appropriate language use includes knowledge of pragmatics and sociolinguistics. Knowledge of reading and writing is referred to as literacy. We will define these components of linguistic knowledge further in later chapters. Readers with some background in language development or linguistics may be surprised not to find semantic development listed here. Semantics is the study of meaning, and certainly learning a language is learning a system for expressing meaning. Much of what is usually subsumed under the heading of semantic development is word meaning, which is discussed in this text in Chapter 4 on lexical development. The meanings expressed in word combinations are discussed in Chapter 5 on the development of language structure.

A chronological overview of language development

In the chapters to follow, we will describe the course of language development in some detail and ask how children accomplish this remarkable feat. Here, as both overview and preview, we describe language development in broad outline. Figure 1.1 presents the major milestones of language develop-
Relevance of their communicative acts increases: also becoming more communicative. Both the frequency and conversational logical representations undergo changes. During this second year, children are not sound quite adulllike, both articulation abilities and underlying phon- and are producing word combinations (Penson & al., 1994). Their words do and by the end of the year they have a productive vocabulary of 300 words and by the end of the year they begin this year by producing their first word. of vocabulary. Children typically begin this year by producing their first word.

During the second year, the most obvious development is in the domain of language development, the even the grammatical properties of their language. However, these seemingly linguistic abilities are learning about the sounds and even the grammatical properties of their language. We know from experimental studies, the productive speech begins before 1 year. For most children, there is very little change in the sounds they produce and in the communicative functions of their language. For each language component, if you scan all four mean on separate time lines for each language component.
During the third year of life, the most obvious development is children's increasing mastery of the grammar of their language. Typically, children start this year producing two- and three-word affirmative, declarative sentences that lack grammatical endings, such as plural markers and past tense markers, on nouns and verbs. By the end of the third year, children are producing full sentences, including questions and negated forms with most grammatical devices in place. Vocabulary continues to grow, articulation of sounds improves, and children begin to develop an awareness of the phonological properties of their language—as evidenced, for example, in their appreciation of rhymes. Children's conversational skills increase, and they begin to introduce short accounts of past events into their conversations.

The period from 3 to 4 is largely one of refining and further developing the skills that are already in place. The most obvious new development occurs in the area of grammar, where children start to produce complex, multiclause sentences. Because there is nothing completely missing from the linguistic competence of most 4-year-old children, it is commonly said that language acquisition is completed during the first 4 years of life. Although there is some truth to that statement, language skills continue to grow in every domain after the age of 4. Articulation, vocabulary, sentence structure, and communicative skills all develop. There are also major transitions involved as children move from a home to a school environment and learn new ways of using language; literacy development is further associated with changes in language knowledge. We will return to each of these developments in future chapters.

Reasons for the scientific study of language development

**Language development as a basic research topic.** A child who has acquired language has acquired an incredibly complex and powerful system. If we understood how children accomplish this task, we would know something substantial about how the human mind works. The modern field of language development emerged in the 1950s when it became clear that language acquisition would serve as a test for rival theories of how change in human behavior occurs (Gardner, 1985; Pinker, 1984). In the 1950s, two psychological theories were pitted against each other: behaviorism and cognitivism. According to **behaviorism**, change in behavior occurs in response to the consequences of prior behavior. Most readers are familiar with clear examples supporting this view. For instance, rats who initially do not press levers come to press levers after receiving food pellets for producing behaviors that increasingly approximate lever pressing. Radical behaviorism holds that all behavior can be accounted for in this way. A central tenet of behaviorism is the belief that it is not necessary to discern what goes on in the mind of the rat in order to explain the change in the rat's behavior; behavior can be fully accounted for in terms of things external to the mind.
Cognitivism asserts the opposite—that we cannot understand behavior without understanding what is going on inside the mind of the organism producing the behavior. From approximately 1930 to the early 1950s, behaviorism dominated American psychology. But in the 1950s, a "cognitive revolution" began (Gardner, 1985). Over the next 2 decades, behaviorism came to be seen as inadequate, and the focus of the search for explanations of human behavior shifted to internal mental processes. Studies of language played a crucial role in the cognitive revolution. The ability to speak and understand language is incredibly complex, and children acquire that ability without receiving positive reinforcement for successive approximations to grammatical sentences. Simple theories that may well explain why rats push levers, why dogs salivate at the sight of the people who feed them, and why humans get tense when they sit in the dentist's chair cannot explain how children learn to talk. When cognitivism displaced behaviorism, theoretical dispute concerning how to understand human behavior did not end. In fact, a new interdisciplinary field called cognitive science emerged from the cognitive revolution.

Cognitive scientists now agree that it is necessary to understand how the mind works in order to explain human behavior, but they do not agree on how the mind works. The study of language acquisition still plays a central role in the debate over how to characterize human cognition, for the same reason that language acquisition played a central role in the cognitive revolution. That is, it is so difficult to explain how language acquisition is possible that accounting for language acquisition is a test not likely to be passed by inaccurate cognitive theories. Language acquisition is the New York City of the field of cognitive science: if you can make it there, you can make it anywhere.

Language development as an applied research topic. The goal for many researchers who study language development is perhaps less grandiose than discovering how the mind works, but it is more immediate. Success in modern industrialized society depends on having good verbal skills, and acquiring the verbal skills society requires is problematic for some children. For example, some minority children and some children from lower socioeconomic strata enter school with language skills that differ from those that mainstream, middle-class teachers expect, and they experience difficulty in school as a result. Thus, one area of research in language development focuses on understanding the nature of cultural differences in language use and on how teaching practices can be designed to best serve children with a variety of styles of language use. Acquiring adequate language skills is also problematic for children who have a variety of other conditions, including mental retardation, hearing impairment, or brain injury. Some children have difficulty acquiring language in the apparent absence of any other sort of impairment. A substantial body of research focuses on trying to understand the nature of the
problems that underlie such children's difficulty and on finding techniques for helping these children acquire language skills.

For many children, language acquisition involves acquiring more than one language. In some cases, the language that children learn at home is not the language of their school, and thus they must learn a new language when they enter school. In other cases, children are exposed to and learn two or more languages from birth; in still other cases, children immigrate or are adopted into a new country with a new language. The social realities of many children's multilingual experience both raise interesting questions about how children achieve competence in more than one language and pose challenges for school systems charged with educating children from such backgrounds.

The areas of basic and applied research in the study of language development are not wholly separate. There are important points of contact. For example, basic research on the process of normal language development is used to develop interventions to help children who have difficulty acquiring language (Warren & Reichle, 1992), and research on the processes involved in reading has provided the basis for successful reading interventions (Bus & van Ijzendoorn, 1999; Ehri et al., 2001). Sometimes work on language disorders also informs basic research. For example, evidence that children with autism acquire language structure even though they have severe communicative deficiencies suggests that learning language involves more than learning how to fulfill a need to communicate (Tager-Flusberg, 1994). There are also important points of contact among the various disciplines that study language development. For example, anthropologists' descriptions of cultures in which no one talks to babies is relevant to the work of developmental psychologists who study how mother–infant interactions contribute to language development (Lieven, 1994).

THE HISTORY OF THE STUDY OF LANGUAGE DEVELOPMENT

Although the modern study of language acquisition began in the 1960s, the linguistic capacity of children has been a source of fascination since ancient times. One can find examples in history of many of the motives that prompt current investigations of children's language.

Big questions and studies of special cases

The language in the brain. The first recorded language acquisition experiment was conducted by the ancient Egyptian king Psammetichus and described by the Greek historian Herodotus in the fourth century BC. The issue at hand concerned who among the peoples of the world represented the original human race. To resolve the issue, King Psammetichus ordered that two infants be raised in isolation by shepherds, who were never to speak in the
children's presence. The idea behind this experiment was that the babies would start to speak on their own, and whatever language they spoke would be the language of the "original" people. According to Herodotus's account, one of the children said something like "becos" at the age of 2. Becos, as it turned out, was the Phrygian word for bread. In the face of this evidence, King Psammetichus abandoned his claim that the Egyptians were the oldest race of humans and concluded that they were second oldest, after the Phrygians.

Although the assumptions underlying that experiment seem slightly comical now, and the method of the experiment is certainly unethical, the idea of asking about the language the brain creates when it is not given an existing language to learn has not been discarded. Susan Goldin-Meadow has studied the gestural communication systems invented by children born deaf to hearing parents (Feldman, Goldin-Meadow, & Gleitman, 1978; Goldin-Meadow, 1997; Goldin-Meadow, 2003). Because the children's parents do not know any sign language (and have been instructed not to learn or use any sign language in these cases, in accordance with the oralist method of instruction for the deaf), these deaf children are just as isolated from a language model as were the infants in King Psammetichus's experiment. Children in these circumstances invent "signs" and combine them in two- and three-sign sequences, suggesting that putting symbols together to communicate is something that naturally emerges in the course of human development. In Chapter 7, we will come back to the specifics of these findings and what they suggest.

"Wild children" and the nature of humankind. Occasionally there are children who are not only linguistic isolates but also social isolates, and these unfortunate children afford science the opportunity to ask an even broader question: What is the intrinsic nature of humankind? This question was hotly debated in the eighteenth century. On the one hand, there had been a long tradition of argument by philosophers such as Descartes (1662) that human nature (including having an immortal soul) was an innate endowment. On the other hand, the philosopher John Locke (1690) had argued that at birth the human mind was like a sheet of blank paper and that humans become what they become as a result of society's influence. What was needed to settle this question was a human raised outside of society. Such a human appeared in the winter of 1800.

That winter was an unusually cold one, and in January a young boy who had been living wild in the woods near Aveyron, France, approached a tanner's workshop on the edge of the forest (Lane, 1976). The child appeared to be about 12 years old. He was naked; he occasionally ran on all fours; he ate roots, acorns, and raw vegetables—but only after sniffing them first; and although he was capable of making sounds, he had no language. This "wild child" became the object of intense scientific interest because he provided an opportunity to examine the nature of the human species in its natural state. The young boy's muteness was problematic for theories of innate knowledge
for two reasons: (1) Language was held to be one of the defining characteristics of humanity; and (2) his muteness made him a difficult subject to interview to determine whether he had an innate idea of God (Lane, 1976). However, the boy’s muteness provided good support for the opposing idea that “man depends on society for all that he is and can be” (Lane, 1976, p. 5).

The wild boy of Aveyron, as he came to be called, was placed with young Dr. Jean-Marc Itard for training at the National Institute for Deaf-Mutes in Paris. The scientific community watched to see whether society could provide this child with the human characteristic of language. Although Dr. Itard was able to teach the boy some socially appropriate behaviors, the boy never learned more than a few words, and to this day we cannot be certain why. Perhaps the child was impaired from birth, perhaps the training methods employed were not the best, and perhaps the boy was too old to acquire language by the time his training began (Lane, 1976). Although the success that Itard achieved was quite limited, this scientific enterprise yielded practical dividends. Dr. Itard went on to use the training methods he had devised for the wild boy of Aveyron in teaching the deaf, and some of the techniques for teaching letters that Itard invented are used in Montessori classrooms today (Lane, 1976).

Over the course of history, there have been other “wild children” who were discovered mute at an age when children in normal environments have learned to talk (see Brown, 1958; Curtiss, 1989; Gleitman & Gleitman, 1991). The most famous modern case is that of a girl named “Genie,” who became known to the public in 1970. She was 13 years old and had been kept locked in a room by her mentally ill father since the age of approximately 18 months. Her language remediation was somewhat more successful than the boy of Aveyron’s, but Genie never acquired normal language (Curtiss, 1977; Rymer, 1993). To some, such cases suggest that there may be a critical period for some aspects of language acquisition, such that language acquisition begun after childhood is never quite as successful as language acquisition begun earlier. This is also a topic to which we will return in later chapters.

Baby biographies

Another approach to investigating “the nature of humankind” is simply to observe what emerges in the course of normal development. In this vein, several investigators in the late 1800s and early 1900s kept diaries of their own children’s development. The most famous of these “baby biographers” was Charles Darwin (better known for his theory of evolution), whose description of his son’s communicative development (Darwin, 1877) follows the course illustrated in the child’s speech excerpts presented in the chapter opening. Darwin’s son said “da” at 5 months, and, before he was 1 year old, the young Darwin understood intonations, gestures, several words, and short sentences. At 1 year, the child communicated with gestures and invented his first word, mum, to mean food. Other well-known diaries include Clara and Wilhelm
Stern's *Die Kindersprache* (Stern & Stern, 1907) and Werner Leopold's (1939–1949) four-volume account of his daughter Hildegard's acquisition of English and German.

Diary studies are not entirely a thing of the past. Child language researchers often have children of their own, and some researchers have kept detailed records of their children's language development. Some of the data we will refer to in later chapters come from such diaries (for example, Bowerman, 1985, 1990; Dromi, 1987; Halliday, 1975; Mervis, Mervis, Johnson, & Bertrand, 1992; Robinson & Mervis, 1998; Sachs, 1983; Tomasello, 1992b). In addition, researchers have sometimes trained mothers to keep diaries so that the early language development of several children could be studied (for example, Bloom, 1993b; Gopnik & Meltzoff, 1987; Harris, Barrett, Jones, & Brookes, 1988; Nelson, 1973).

**Normative studies**

In the period between the end of World War I and the 1950s, the goal of most research on language acquisition was to establish norms (Ingram, 1989). Toward that end, several large-scale studies were undertaken to provide data on when children articulate different sounds, the size of children's vocabularies at different ages, and the length of their sentences at different ages. Consonant with the behaviorist orientation of the times, the goal was not to ask theoretical questions about either the nature of humankind or the nature of language development but simply to describe what could be observed. These older studies are still valuable as descriptions of normative development (for example, McCarthy, 1930; Templin, 1957), and as new instruments for assessing children's language are developed, new normative studies continue to be conducted (e.g., Fenson et al., 1994).

**The Chomskyan revolution**

In the 1960s, the study of children's language development changed radically. The catalyst for this change was the 1957 publication of a slim volume entitled *Syntactic Structures*, written by Noam Chomsky, then a young linguist at the Massachusetts Institute of Technology. That piece, along with Chomsky's subsequent prolific work, revolutionized the field of linguistics and, within a few years, the study of language development. Before Chomsky's work, linguists concentrated on describing the regularities of languages. Linguists could study their own language or, better yet, a little-known language, but the job was the same: to find the patterns in what speakers do. Chomsky caused a revolution by saying that what speakers do is not as interesting as the mental grammar that underlies what speakers do. Since Chomsky's writings, the work of linguists consists of trying to describe what is in the minds of speakers that explains how speakers do what they do.
That new goal of linguistics raised a question about children. If adults have a mental grammar that explains what they do when they talk, then children must have a mental grammar that explains what they do. Children's speech is different from adults’ speech; therefore, children's mental grammars must be different. What are children's grammars like, and how do children eventually achieve adult grammars?

In 1962 Professor Roger Brown and his students at Harvard University began to study the grammatical development of two children given the pseudonyms Adam and Eve (Brown, 1973). Somewhat later a third child, Sarah, was added to the study. Every week for Sarah, and every 2 weeks for Adam and Eve, graduate students visited these children in their homes and tape-recorded their spontaneous speech. Transcripts of the children’s speech were then analyzed with the goal of describing the grammatical knowledge that underlay the speech they produced. That project, begun by Brown, along with just a few other projects (Bloom, 1970; Braine, 1963; Miller & Ervin, 1964) marks the beginning of the Chomskyan era of studying children’s language. The graduate students who met with Roger Brown to discuss the analyses of Adam’s, Eve’s, and Sarah’s language—along with a few notable others who were not at Harvard that year—became the first generation of child language researchers. We will discuss some of these pioneering projects when we discuss grammatical development in Chapter 5.

Chomsky focused on grammar (the structure of language), and the first new wave of research on language development in the 1960s was on children’s grammatical development. Later, in part following theoretical trends in linguistics, child language researchers shifted their focus more toward semantics and the acquisition of word meanings. In the later 1970s, the domain of language development was further expanded. Again following developments in linguistics, language use was added to the field of inquiry, and child language researchers began to study pragmatic and sociolinguistic development. In the 1980s and 1990s, linguistics and language development returned to focus on syntax, but the other questions about the lexicon and pragmatics have not been abandoned (or solved). The study of phonology and phonological development has continued throughout this period, somewhat outside the center ring of linguistic debate. (For fuller accounts of the history of child language research, see Golinkoff & Gordon, 1983; and Ingram, 1989.) Currently, the study of language development is a multifaceted field that includes a variety of very different research enterprises.

The current study of language development

Current research on language development is guided by current views of what language is, and there are several such views. One can think of language development as a series of ongoing tasks: the child must learn to communicate in the way that the
Information from the environment → Language-learning mechanism → Language acquisition

**Figure 1.2** A model for studying the nature of the language-learning capacity

...adults in one's social or cultural group do so. Language, in this view, is a social behavior, and language acquisition is really **language socialization**. The goals of language socialization research are to describe children's language use and their underlying understandings of language as a vehicle for social interaction at different ages and to identify the factors that influence that developmental course. This work includes, for example, studies of gender differences and cultural differences in styles of language use, and studies of how children recount stories, negotiate conflicts, and tell jokes (e.g., Slobin, Gerhardt, Kyritzis, & Guo, 1996). We will pursue these lines of work more fully in Chapter 6.

Language is also a complex system that maps sounds (for oral language) to meanings. If one thinks of language development as the acquisition of this system, the research question is, how does the child do it? That is, what is the mental capacity that underlies the human ability to learn to talk? This question can be conceptualized in the following manner: The human capacity for language is a device residing in the human brain that takes as its input certain information from the environment and produces as its output the ability to speak and understand a language. (This model is presented in Figure 1.2.) Everything that is part of adults' knowledge of language (i.e., the output of the device) must either be in the input, be in the internal device, or somehow result from the way the device operates on the input it receives. Noam Chomsky (1965) termed this capacity the **Language Acquisition Device (LAD)**. Not everyone uses this terminology, because it is associated with a particular,
Chomskyan, approach to the field, but everyone who is interested in how children acquire the language system is, in essence, asking the question: What is the nature of the human language acquisition capacity?

Researchers do not start out completely neutral with respect to an answer to this question. (Scientists must always start out with some ideas of how things work; the work of scientists is testing those ideas.) Current research on language development can be usefully organized in terms of four different approaches that researchers take—each motivated by a different premise regarding the nature of the LAD and the language development it produces. They are the biological, the linguistic, the social, and the domain-general cognitive approaches. We introduce them briefly here so that they are familiar when they come up in more detailed discussions of particular domains of language development.

The biological approach starts with the premise that the human capacity for language is best understood as a biological phenomenon and language development is best understood as a biological process. This premise then leads to research that investigates the degree to which language and language development share the hallmark features of other biological processes. Research in this vein looks for universal features of language development, for a hereditary basis to language ability, for evidence of a biologically based timetable for development, and more. In addition, biologically motivated research leads to the study of the structures and processes in the brain that underlie language development.

The linguistic approach to the study of language acquisition focuses on describing the nature of the child's innate linguistic knowledge. That is, this approach works from the premise that the LAD must contain some knowledge of the structure of language in order for language acquisition to be possible. That innate knowledge cannot be specific to any particular language; thus, it is Universal Grammar (UG). The linguistic approach seeks to describe UG and how it interacts with language experience to produce linguistic knowledge as a result.

The social approach rejects the premise that innate linguistic knowledge is necessary. It starts from the premises that language is essentially a social phenomenon and language development a social process, and seeks to describe the social processes that produce language acquisition. Research in this vein focuses on social aspects of interaction as the experience relevant to language acquisition and on the social-cognitive abilities of the child as the relevant learning capacities.

Another approach that seeks to do without innate linguistic knowledge is the domain-general cognitive approach. This approach starts from the premise that language acquisition is a learning problem no different from any other and that children solve it in the same way that they solve other learning problems. Research in this vein seeks an account of how language might be
learned by the child's application of domain-general cognitive processes to the information available in input.

There is another bit of terminology to introduce with respect to characterizing approaches to the study of language development. A distinction has been made between the learnability approach and the developmental approach (see, for example, Bloom, 1991). The **learnability approach** focuses on explaining the fact that language is acquired (i.e., that language is learnable). The **developmental approach** focuses on explaining the course of language development. These approaches are not mutually exclusive, and few researchers focus on one goal and ignore the other. Rather, different lines of research may differ in emphasis.

**MAJOR ISSUES IN THE FIELD OF LANGUAGE DEVELOPMENT**

Another way to organize current research and theory in the field of language development is in terms of the major issues that any account of language development must address. The major issues concern, among other things, the degree to which language is innate or learned from experience, the nature of the innate contributions and the learning processes, whether change over the course of development is continuous or discontinuous, and how the communicative functions of language are involved in the process of learning the language system. We elaborate these issues in the next sections.

"The title of my science project is 'My Little Brother: Nature or Nurture.'"

**Figure 1.3** Source: © The New Yorker Collection, 2003 Michael Shaw from cartoonbank.com. All rights reserved.
Nature or nurture?

Is the development of language in children the result of human's innate endowment (like the development of upright posture and bipedal locomotion), or is it the result of the circumstances in which children are nurtured (like the development of table manners or the ability to do calculus, both of which depend on particular experiences)? This is the nature-nurture debate, and it predates not only the modern study of language development but also the emergence of psychology as a discipline. This was the ongoing debate when the wild boy of Aveyron left the woods in 1800. The extreme experience-based position, known as empiricism, asserts that the mind at birth is like a blank slate; all knowledge and reason come from experience (Locke, 1690). The alternative view, known as nativism, asserts that knowledge cannot come from experience alone. The mind must have some preexisting structure in order to organize and interpret experience (Gleitman, 1995; see the works of Plato and Kant for the original arguments). This debate still rages among those who study language development.

The nativist view. For proponents of nativism as an explanation of language development, there are three salient "facts" about language development: (1) Children acquire language rapidly, (2) children acquire language effortlessly, and (3) children acquire language without direct instruction. Rapid, effortless, untutored development seems more like maturation than like learning in the usual sense of the term. As Chomsky (1993) put it,

Language learning is not really something that the child does; it is something that happens to the child placed in an appropriate environment, much as the child's body grows and matures in a predetermined way when provided with appropriate nutrition and environmental stimulation. (p. 519)

The modern-day descendant of the opposite, empiricist view is behaviorism. As mentioned earlier, behaviorism has not stood the test of time (or empirical evidence) as a theory of language acquisition. Behaviorist theories will be mentioned again in the following chapters, but primarily for historical completeness.

The interactionist view. In current debate, the alternative to nativism is not pure empiricism but rather interactionism (Braine, 1994). Like nativists, interactionists acknowledge that there must be some innate characteristics of the mind that allow it to develop language based on experience. But the interactionist position places a greater burden of accounting for language development on the nature of children's language-learning experiences than the nativist position does. Research on the nature of the language input children
receive and the relation of that input to the rate and course of development are relevant here (see, for example, Gallaway & Richards, 1994; Hoff-Ginsberg & Shatz, 1982; Morgan, 1990). The position known as **social interactionism** holds that a crucial aspect of language-learning experience is social interaction with another person. Interactionists contest the "facts" so salient to the nativists. As Catherine Snow has put it,

> We on the other side think that learning language is a long slog, which requires from the child a lot of work. And the child is working as hard as he can, fifteen, sixteen hours a day. We think it requires a relationship with an adult, and a whole set of cognitive abilities. (quoted in Rymer, 1993, p. 37)

Another term for this type of position is **constructivism**. Constructivism as a view of development was first argued with respect to cognitive development by Jean Piaget, and *constructivism* remains a term in current use. According to the constructivist view, language (or any form of knowledge) is constructed by the child using inborn mental equipment but operating on information provided by the environment. In 1975 Noam Chomsky and Jean Piaget debated their respective nativist and constructivist views of language development at the Abbaye de Royaumont near Paris. Nearly 200 years after the wild boy of Aveyron left his woods (and roughly 200 miles away), the debate about the essential nature of the human mind continued. In his foreword to the edited transcript of that debate, Howard Gardner (1980) summarized the two views:

Piaget saw the human child—and his mind—as an active, constructive agent that slowly inches forward in a perpetual bootstrap operation, Chomsky viewed the mind as a set of essentially preprogrammed units, each equipped from the first to realize its full complement of rules and needing only the most modest environmental trigger to exhibit its intellectual wares. (p. xxiii)

More recently, the term **emergentism** has been used to label the view that knowledge can arise from the interaction of that which is given by biology and that which is given by the environment (MacWhinney, 1999). This new term tends to be used in the context of new models of learning that are termed *connectionist, parallel distributed processing*, or *neural network models* (Bates & Goodman, 1999). The advent of these new learning models has given new life and new form to the old nature–nurture debate. As Bates and Goodman (1999) have put it, "the debate today in the field of language development is not about nature versus nurture, but about the 'nature of nature'" (p. 33). That is, granting that there must be some innate
characteristic of the human mind that allows language development, theorists still disagree about the nature of that which is innate.

The nature of nature

There are different ways that something can be innate (Elman et al., 1996). The most strongly nativist view holds that knowledge itself is innate. A weaker form of innateness holds that the computational procedures for learning are innate and that knowledge results from the way in which those procedures operate on input. According to the innate knowledge view with respect to language acquisition, children have inborn knowledge of the general form of language, and it is this inborn, specifically linguistic knowledge that allows children to figure out a whole language in only a few years. Thus, this theoretical position holds that the internal contribution to language is domain specific. Various contrasting views differ from this position both in putting more burden on the input and learning procedures and also in questioning the domain specificity of the internal (i.e., innate) contribution to language acquisition.

A language-specific module. Perhaps the first question to ask about the language-specific innateness view is, how could it be? To many, the notion that something as specific as knowledge of language is innate is bizarre. To others, postulating innateness amounts to giving up on explaining language development by turning the job over to the geneticists. However, the proposal that children have inborn knowledge of the general form of language may be more reasonable than it first appears. All languages of the world share many structural characteristics. These shared characteristics constitute the universal grammar of human language, of which each particular language is an example. (It's the different vocabularies that make languages other than our own incomprehensible.) Evolution seems to have equipped the human mind with other sorts of useful knowledge, such as the knowledge that the world is a three-dimensional place (our eyes alone cannot tell us this because our retinas are two-dimensional surfaces). Universal Grammar may similarly be an innate endowment. The view that the human ability to develop language is specific to language is part of a larger theory known as the modularity thesis (Fodor, 1983). According to this thesis, the innate human ability to develop language is a self-contained module in the mind, separate from other aspects of mental functioning. Chomsky (1991), in fact, referred to the human language capacity as a functionally separate “mental organ”: “The mind, then, is not a system of general intelligence. . . . Rather, the mind has distinct subsystems, such as the language faculty, a cognitive system . . . .” (pp. 50–51).

The issue of whether language acquisition is supported by a domain-specific mental module or by general cognitive processes is one question in a
larger ongoing debate in cognitive psychology. The debate concerns whether
cognition in general consists of the activity of a general-purpose set of
reasoning abilities applied to different tasks, or whether there are many cog-
nitive abilities that are specialized to handle different kinds of information
(Hirschfeld & Gelman, 1994). The modularity thesis asserts that the mind is a
bundle of many special-purpose modules—one for language, one for percep-
tion, one for understanding spatial location (map making)—and dismisses
the concept of a "general ability to learn" (Barkow, Cosmides, & Tooby, 1992;
Fodor, 1983; Pinker, 1994). Thus, the modularity issue is not specific to lan-
guage development. Rather, it is an issue in cognitive psychology in which
language plays a crucial, but not a singular, role. (For a discussion of modu-
larly and nonmodularity in other domains, see Barkow et al., 1992; Cosmides,
1989; and Karmiloff-Smith, 1992.)

**Alternatives to language-specific innateness.** The view that language ac-
quision results from the maturation of innately specified knowledge has the
advantage of being a self-contained and, in principle, complete account. In
contrast, the alternatives include a collection of ideas that are more difficult to
summarize. Some early cognitive approaches to language development were
based on Piagetian theory and sought to explain changes in children's lan-
guage functioning in terms of stagelike developmental shifts in their nonlin-
guistic functioning. The shift from the sensorimotor intelligence of infancy to
the preoperational intelligence of the toddler years was a particular focus of
research (see, for example, Sinclair, 1969; and see Corrigan, 1979, for a re-
view). However, that sort of across-the-board relation between cognitive de-
velopment and language development was not supported by the evidence
(Corrigan, 1979).

Subsequently, several studies have proposed how **domain-general** cog-
nitive skills contribute to language acquisition. The kinds of cognitive skills
suggested as contributing to language acquisition include the capacity for
symbolic representation (Bates, Benigni, Bretherton, Camaioni, & Volterra,
1979), memory skills (Braine, 1988; Gathercole & Baddeley, 1990), skill in seg-
menting chunks of speech into their constituent parts (Bates, Bretherton, &
Snyder, 1988), and a variety of processes that might be grouped under the
heading of pattern analysis (Braine, 1988; Kelly & Martin, 1994; MacWhinney,
1987; Maratsos & Chalkley, 1980).

One kind of domain-general approach comes from the field of **connc-
tionism.** Connectionism is a way of modeling how knowledge is represented
in the brain, what thinking consists of, and how learning occurs. In very gen-
eral terms, a connectionist model consists of a set of processing elements,
called nodes, and the interconnections among those nodes. The nodes both
collect input from the world or from other nodes and send activation out to
other nodes. In a connectionist model, mental activity consists of activation
spreading in a network of connected nodes, and knowledge is represented in
the pattern of activation among the nodes (Elman, 2001). So, for example,
thinking of a dog is a different pattern of activation than thinking of a cat. The
former would involve activation of nodes pertaining to barking, among oth-
ers; the latter would involve activation of nodes pertaining to meowing,
among others. The particular pattern of activation that is present at any given
time is a function of the current stimulus and the learner’s past history of that
stimulus. In the past, dogs and barking occurred together and cats and me-
owing occurred together, forging connections between the dog and barking
nodes and the cat and meowing nodes.

Although connectionism is like behaviorism in that it depends heavily on
the nature of the learner’s experience and really only involves learning asso-
ciations between things that are experienced together, it is a far more power-
ful learning mechanism than behaviorism. In behaviorism, the learner is learn-
ing what to do under what circumstances. Connectionism is a mechanism for
extracting regularities from experience; that is, for acquiring knowledge that
is not directly given in any single experience. Connectionist proposals have
spurred new interest both in the nature of the input, because the regularities
must be there to be extracted, and in the nature of the learning mechanisms
available to the child. The next section reviews behavioral evidence regarding
the nature of the child’s learning mechanisms, which may also provide alter-
natives to language-specific innate knowledge as the explanation of language
acquisition.

What kind of learning mechanisms does the child have?

Babies as statistical learners. A 1996 article in the prestigious journal
Science described a study demonstrating that 8-month-old babies could learn
something about the patterns in language (Saffran, Aslin, & Newport, 1996).
The babies in this study listened for 2 minutes to a tape recording that pre-
sented four different “words” combined in random order in a single stream of
sound. The words were, for example, tupilu, gola, bidaku, and padoti; and
thus the babies heard something like tupilu-golabidakukapodotibidakugol-
abidaktu-tupilu. Next, the babies were presented with strings of the same
“words” again on some trials, and on other trials they were presented with
strings of “nonwords” made up of the same syllables combined in different or-
ders. The result was that the babies listened longer to the nonwords than to
the words. This finding is consistent with other research showing that babies
of this age prefer novel stimuli to familiar stimuli.

The question is, how did the babies know the difference? The answer has
to be that the babies noticed that in the first tape tu was always followed by
pi and pi was always followed by ro, but the ro was followed by three differ-
ent syllables, equally often. In the nonword tape, these transitional probabili-
ties were different, even though the particular syllables presented as words and nonwords were the same (see also Aslin, Saffran, & Newport, 1998). In other words, the babies were doing what is called statistical learning—counting the frequency with which one stimulus is followed by another. This finding demonstrated that babies were more powerful learners than had previously been thought. Related findings support the notion that although these mechanisms are recruited for language acquisition, they are not language specific, because they can operate on nonspeech stimuli as well: 8-month-olds can learn the patterns in sequences of tones (Saffran, Johnson, Aslin, & Newport, 1999). Other research has pursued the question of just what statistical learning might explain. It turns out, for example, that statistical regularities are sufficient to allow 9-month-olds to distinguish possible from impossible phonological sequences (like the difference between *pling* and *gnilp*) (Saffran & Thiessen, 2003). Another line of relevant work investigates the degree to which input contains co-occurrence patterns that could reveal grammatical categories and structures to a statistical learner (Mintz, Newport, & Bever, 2002; Saffran, 2001).

**Babies as rule learners.** Babies may be able to do more than mere statistical learning. In 1999 another article in *Science* claimed that 7-month-old infants were capable of learning rules (Marcus, Vijayan, Bandi Rao, & Vishton, 1999). The babies in this study also heard sequences of syllables for 2 minutes. For half the babies, the sequences followed an ABA pattern (e.g., *ga ti ga, li na li*), and for the other half, the sequences followed an ABB pattern (e.g., *ga ti ti, li na na*). Then the babies heard sequences of entirely new syllables that either matched the pattern they had heard or matched the other pattern. So, for example, the ABA sequence was *wo fe wo* and the ABB sequence was *wo fe fe*. When the babies were presented with the new syllable sequences, they were able to tell the difference between the pattern they had heard and the new pattern, even though they had never heard any of those sounds before.

This result demonstrated that babies can do more than learn the co-occurrence patterns among sounds they actually experience. Instead, babies can learn a pattern that must be described in terms of symbols (or variables) that stand for any sound. As Marcus and colleagues put it, the babies were learning algebraic rules, not just statistical regularities. The crucial difference is the fact that statistical regularities are regularities among stimuli actually experienced. In contrast, rules capture patterns among abstract variables that can refer to any stimuli, old or new. This issue has become central to the field of language acquisition. The mental ability to note co-occurrence patterns in input is essentially associative memory. Everyone agrees that children have associative memories and use them to acquire language. Learning vocabulary, for example, is almost entirely a process of rote memorization. The issue is
whether language acquisition also depends on another mental ability: the ability to learn rules (Pinker, 1999). The issue of whether such **rule learning** is a necessary part of the language acquisition process is intimately connected to another hot debate: whether linguistic knowledge can be characterized as knowing statistics or knowing rules.

**What kind of knowledge does the child acquire?**

Fundamental disagreement exists between two types of models of what it is to know a language and, therefore, how such knowledge can be acquired. According to traditional accounts in cognitive psychology, linguistic knowledge consists of a system of rules that operate over symbols. The symbols stand for abstract categories such as “Noun” and “Verb,” for example. These categories are also called variables, because the actual word that is the Noun or Verb can vary, but the rule applies just the same. Knowledge has to be represented this way because knowing a language involves knowing how to do things with words you have never heard before, so long as you know to what category the word belongs. For example, you know how to form the past tense of *blick* even though you have never heard *blick* used before. What you know, according to the symbolic account, is a rule of the form “past tense → Verb + *ed,*” and you can apply that rule to anything that you categorize as a Verb.

In contrast, according to connectionist views, linguistic processing in the adult does not require positing a symbolic rule system. Rather, processing is carried out by a network of elementary units (i.e., the nodes). The specifics of what results from processing depends on the input to the network and the nature of the connections among units in that network. By this account, learning consists of establishing and setting weights on the connections among units. As we just discussed, the process by which weights are set is fundamentally that of association (Plunkett, 1998). According to the connectionist view, you know how to form the past tense of *blick* by virtue of the strength of the associations you have formed between similar sounding verbs and their past tense forms (for example, *kick—kicked, lick—licked,* and so on).

Often, the kind of research that addresses the dispute between the symbol/rule approach and the connectionist approach consists of writing computer programs that instantiate a particular connectionist model. Researchers feed the computer the kind of language input children are likely to hear, and then see whether the computer can mimic the course of human language development. The most optimistic view of connectionism sees it as a possible alternative to the trade-off between finding the structure of language in the input or building the structure into the acquisition mechanism. Instead, structure emerges from the effect of input on the connectionist network (Plunkett, 1998). Connectionist models also seem closer to biology than symbolic models, because we know that the brain is a set of interconnected neurons. If cog-
nitive processing could be modeled in a system that is closer to the "wetware" of the brain (an analogy to a computer's hardware), we could eliminate the problem of determining how the brain represents symbols and rules. (For a more thorough introduction to connectionism see, for example, Bechtel & Abrahamsen, 1991; Elman, 2001; Martindale, 1991).

Both the claim that connectionism can eliminate the need for rules and symbols and the view that connectionist models bring us closer to understanding how the brain accomplishes language have been challenged. According to Marcus (1998), the connectionist models that work do so because they actually contain within them nodes that stand for variables. That is, they use the machinery of connectionism to implement a symbolic processor. Other sorts of connectionist models eliminate rules and symbols, but those, according to Marcus, do not work. In fact, Marcus (1998) has argued that any model that eliminates symbols and rules must ultimately fail to account for what people know when they know a language. The analogy between connectionist models and the brain has been criticized as illusory (Fodor, 1997). Nodes are not neurons, and no one knows how the neurons in the human brain represent what humans know. For that reason connectionism does not bring us closer to knowing how the brain represents human linguistic knowledge (Fodor, 1997).

To return to Saffran and colleagues' findings, the connectionist view would be that because the babies heard *tupiro, bidaku*, and so on over and over again, they formed very strong connections between *tu* and *pi* and between *pi* and *ro*, but weaker connections between *ro* and *bi* because *bi* did not follow *ro* as frequently. After 2 minutes of listening, the connections forged would activate *pi* and then *ro* after hearing *tu*, whereas only a weaker activation of any particular syllable would result from hearing *ro*. In other words, a learning mechanism that does nothing more than count the frequency with which things appear together can end up telling words from nonwords because the previously heard words result in a different level of activation in a network than nonwords. Although no one doubts that the mind can do this, some seriously doubt that a mind that could only do this could ever acquire language. The alternative argument is that to do language, the mind needs symbolic processes, like algebraic rules. In essence, then, two different proposals try to explain how the mind represents the patterns it learns from experience: as connections among the stimuli actually experienced or as rules that operate over abstract categories.

**Continuity or discontinuity in development**

It is obvious that children's language knowledge changes as they grow. The 1-year-old who knows five words becomes the 2-year-old who knows hundreds of words. If what 1-year-olds understand about their first five words is the same
sort of understanding that 2-year-olds have of their larger vocabularies, then vocabulary development is continuous—the change involves acquiring more of the same kind of thing as was there at the beginning. If, on the other hand, the 1-year-old has a very limited understanding of his first words—he says *bye-bye* and *night-night* as part of social rituals and says *up* only when he wants to be picked up—but the 2-year-old knows his words refer to objects and events in the world, then knowledge has changed in kind, not just in amount. Changes in kind are discontinuities in development. We will review this issue as it plays out in language development in the chapters on phonological, lexical, and morphosyntactic development. Like the nature–nurture issue, the issue regarding continuity is not unique to the study of language development. Researchers who study cognitive development ask whether children’s understandings of the world change qualitatively over the course of development. Readers who are familiar with the theory of Jean Piaget know one proposal regarding discontinuous or qualitative changes in development.

The relation between communication and language

Children use the language they learn to communicate. In fact, one might say that the value of language to the human species is the communicative power it affords. Although no one doubts that language is useful for communication, there are differing views on how important communication is to language and to language acquisition. The two extreme positions are (1) **formalism**, the view that the nature of language and its acquisition have nothing to do with the fact that language is used to communicate, and (2) **functionalism**, the view that both language itself and the process of language acquisition are shaped and supported by the communicative functions language serves.

**Formalist views.** A clear and strong statement of the formalist position comes from Chomsky (1991):

For unknown reasons, the human mind/brain developed the faculty of language, a computational-representation system. . . . [This system] can be used . . . in specific language functions such as communication; [but] language is *not intrinsically a system of communication* [italics added]. (pp. 50–51)

For the formalists, language is an autonomous, arbitrary system whose form is independent of its function. Another position asserts that language was shaped in the course of evolution by its communicative value, but that the nature of that form cannot be derived from the functions it serves (see Pinker & Bloom, 1990). From the point of view of language-learning children, this position asserts, as does the Chomskyan formalist view, that language is an external
system that has to be figured out—or provided innately—and the use to which that system is put provides no clues to how the system is structured.

**Functionalist views.** The contrary view is that language “is not an arbitrary and autonomous system” (Budwig, 1995) but rather a system shaped by the communicative functions it serves. And, one view holds, because the form of language reflects the communicative functions to which it is put, children are led to discover the form of language in using the system to communicate. As MacWhinney, Bates, and Klugl (1984) state, “The forms of natural languages are created, governed, constrained, acquired and used in the service of communicative functions” (p. 128).

A number of different functionalist views exist today, and some make stronger claims than others about the usefulness of communication to language acquisition. One claim is that the infant’s social capacities are the source out of which language emerges (Snow, 1999). The key to language acquisition, according to this view, is very young children’s understandings that other people are trying to communicate with them. A related claim states that the desire to communicate one’s thoughts and feelings to others is the motivation for language acquisition (Bloom, 1991). According to both these views, communication explains the why of language development, but not necessarily the how. A stronger claim comes from Tomasello and colleagues (e.g., Tomasello, 1992a, 2000, 2001; Carpenter, Nagell, & Tomasello, 1998), who argue that communication also provides the how of language development. According to Tomasello,

Children are not engaged in a reflective cognitive task in which they are attempting to make correct mappings of word to world based on adult input, but rather they are engaged in social interactions in which they are attempting to understand and interpret adult communicative intentions... children acquire linguistic symbols as a kind of by-product of social interaction with adults, in much the same way they learn many other cultural conventions. (2001, p. 135)

**METHODS OF RESEARCH IN LANGUAGE DEVELOPMENT**

**Cross-cultural and cross-linguistic research**

The modern study of language development began with investigations of the acquisition of English by middle-class American children. Initially this geographic focus was not seen as a terrible limitation because, the thinking went, the processes underlying language acquisition are universal, and thus discovering how children in Cambridge, Massachusetts, acquire language is the same
as discovering how all children acquire language. Currently the study of language acquisition by children who live in other cultures and the study of the acquisition of languages other than English are considered crucial to discovering the universal processes of language acquisition. Two insights provide the motivation for cross-cultural and cross-linguistic research. One is the recognition of individual differences in language development and of the possibility of more than one route to language acquisition. This is true of different children within a single culture, but it may be especially true when describing language acquisition in cultures that provide children with different kinds of language-learning environments (Lieven, 1994; Tardif, Gelman, & Xu, 1999). Thus, researchers no longer assume that if you’ve seen one child acquire language, you’ve seen them all.

The second reason for cross-cultural and cross-linguistic research is the observation that different languages present children with different language-learning tasks. The human capacity to acquire language works equally well whether the task is to acquire English, Mandarin, Spanish, or Georgian (see, for example, Bowerman & Choi, 2001; Maratsos, 1998; Naigles & Terraza, 1998). If researchers study only the acquisition of English and construct a theory of language acquisition that accounts for the acquisition of English, their theory may not account for the acquisition of Georgian. And a theory of language acquisition that cannot account for the acquisition of all languages is obviously not the correct description of the human language-learning capacity. Currently cross-cultural and cross-linguistic work is very much in the mainstream of child language research.

Research designs

In their search for answers to the question of how children learn to talk, child language researchers use the same kinds of research designs that other scientists use. They engage in longitudinal and cross-sectional observational studies to describe developmental changes in children’s language, and they analyze those patterns of development for what they might reveal about the process underlying that development. They do correlational studies in which they look for relations between different aspects of language development or between language development and other aspects of development or experience. They do experiments in which they provide children with different kinds of exposure to language and then look for differences in what children have learned. Sometimes researchers use computer simulations to test whether a hypothesized model of language development could work in principle, and sometimes researchers do case studies of individuals whose unique circumstances or pattern of development promises to shed light on some issue. The focus of studies of children’s language development can be language production, language comprehension, or both. Researchers interested in com-
prehension have been very inventive in designing ways to get small children to reveal what they think a word or a sentence means. We will discuss the particulars of different methods in later chapters when the research is discussed. But one aspect of methodology in child language research is so often employed and so specific to this field that it is worth discussing by itself. The analysis of samples of spontaneous speech is the method Roger Brown used in his pioneering study of Adam, Eve, and Sarah, and it is a method that is still widely used today.

Assessment of productive language from speech samples

**Speech sample collection.** Child language researchers can often be identified by the equipment they carry. Videotape or audiotape records of spontaneous speech samples are the standard database for assessing children's language development. Typically, the researcher picks a setting in which children are likely to talk—a mealtime or toy play, for example—and then records interactions in that setting. The recording can be done in the children's homes or in a laboratory playroom. The children can be talking to the researcher or to someone more familiar to them (usually their mother). The purpose of collecting such speech samples is to find out the nature of the language children produce. Thus, the speech sample collected should be representative of everything the children say. Achieving representativeness can be difficult because speech may be different in different contexts (Bacchini, Kuiken, & Schoonen, 1995; Hoff-Ginsberg, 1991). Another concern is that the act of recording will alter children's speech in some way. This is probably more of a problem for recording the speech of adults than that of children, because children tend to be less self-conscious than adults; however, researchers typically spend some "warm-up" time with their subjects before turning on the tape recorder. One research project attempted to secure more representative speech samples by putting little vests with radio-controlled microphones on children (Wells, 1985). The children wore the vests all day, although the microphone was turned on only intermittently.

How much speech needs to be recorded to estimate characteristics of a child's language? How frequently does speech need to be recorded to capture developmental changes? Generally, a speech sample of approximately 100 utterances is considered large enough to yield reliable estimates of grammatical properties of children's speech. If the focus of interest is some characteristic of language use not present in every utterance, then of course the sample would need to be larger. There are also no established guidelines for how often children need to be recorded (Bloom, 1991). Researchers select different intervals using the existing literature to make their best guess at what interval will reveal the sorts of developmental changes they are studying.
Sometimes the research focuses on a particular type of language use, such as storytelling. In this case, more directive techniques of elicited production can be used. As we shall see in Chapter 6, an enormous body of research on children’s narrative development is based on studies using the same technique of asking children to tell a story using a book that has pictures but no words (Berman & Slobin, 1994).

**Speech sample transcription.** The invention of audiotape and videotape recorders made it possible to collect a record of everything a child says, which made a central kind of language development research possible. However, there is a downside to tape-recording speech samples: the tapes have to be transcribed. Child language researchers are sometimes envious when they see their colleagues in other fields say good-bye to study participants and then turn to the participants’ just-completed questionnaires to find numbers ready for analysis. When child language researchers say good-bye to the little participants in their studies, the task of data collection has only just begun.

The next step in data collection is transcription, which consists of writing down what was recorded. What makes that task difficult is that the children being recorded were not giving dictation but were engaging in conversation. In conversation, people do not speak in full sentences; they interrupt each other and even talk at the same time. Furthermore, especially if they are children, their pronunciation is less than clear, and their usage not quite adultlike. Creating a transcript that is a faithful record of what was on the tape is difficult and time-consuming. It requires training to be able to transcribe, and then it can take as long as 5 hours to transcribe each hour of recorded speech.

**Transcript coding and analysis.** After the speech has been transcribed, the researcher has to code the transcripts. Coding varies, depending on what the researcher is studying. For example, if the research is attempting to chart the development of verb usage, then coding the transcripts might involve identifying every verb in the children’s speech. If the purpose of the research is to study children’s conversational skill, then coding the transcripts might involve categorizing every utterance the child produces as related or unrelated to what was said before. Ultimately, for researchers to conduct the kinds of analyses that get reported in journal articles, the codes have to be turned into numbers. For example, a researcher might analyze changes in the number of different verbs in children’s spontaneous speech or changes in the proportion of children’s utterances that are related to prior speech.

When this sort of research started in the 1960s, transcripts were handwritten documents with columns for different codes. Graduate students in child language logged many hours over these transcripts, identifying verbs or whatever the research called for and adding numbers in the code columns. The advent of computer programs for analyzing child language transcripts has
considerably lightened that load. It still takes a human being to transcribe and code, but the transcription can be entered directly into a computer-based file, and the coding can be entered onto the transcript as well. Then, instead of the researcher counting all the codes, the computer can do it—and far more quickly and accurately. Probably the most widely used programs for transcript analysis are those associated with the Child Language Data Exchange System (CHILDES) (MacWhinney, 1991). Another is SALT (Systematic Analysis of Language Transcripts) (Miller & Chapman, 1985). SALT was developed specifically for researchers and clinicians in communicative disorders, but it is a flexible program that can be used for basic research as well. Another program, Logical International Phonetics Programs, or LIPP, allows the user to transcribe in the International Phonetic Alphabet and thus permits fine-grained phonetic analysis (Oller & Delgado, 1999).

CHILDES—A data archive

Another benefit made possible by computer-based transcripts is widespread data sharing. Although researchers have always been able to share data with colleagues by photocopying their transcripts, sharing is easier when the transcripts are in computer-based files and when (as a necessary side effect of computerized transcription) the transcripts are in a standardized format. The CHILDES project has taken the concept of data sharing even further by establishing an archive. In the early 1980s, the MacArthur Foundation funded a project, led by Brian MacWhinney and Catherine Snow, to establish an archive for transcripts of children's speech. Roger Brown contributed his transcripts of Adam, Eve, and Sarah, and other researchers contributed transcripts they had collected. Since then, other researchers have added their transcripts so that the CHILDES database now has more than 100 corpora (i.e., speech samples) representing more than 20 different languages, including both monolingual and bilingual children. Researchers whose questions can be addressed by looking at speech samples in the CHILDES archive can go straight to the coding phase of research. A full description of the archive and the corpora themselves are available at the CHILDES Web site, which can be accessed at www.psy.cmu.edu. The Web site also contains online tutorials and a bibliography of references in the field of child language.

Standardized tests and measures of language development

Sometimes researchers want to be able to describe a child's language in terms that compare that child's language to the language of other children of the same age. Child language researchers are typically interested in such measures primarily for the purpose of describing the children they are studying, much the way researchers in cognitive development sometimes want to describe their samples in terms of IQ or mental age. By far the biggest users of stan-
standardized measures are practitioners in communicative disorders, who use such measures for diagnosis and for treatment evaluation.

There are essentially two ways to assess how a child's language development compares with that of other same-age children. One is to collect a speech sample and code it using a coding system for which norms have been collected. For example, the mean length of a child's utterances (MLU) is a good index of a child's level of grammatical development, and data that provide norms for MLU have been collected (Leadholm & Miller, 1992; Miller & Chapman, 1981; see Chapter 5 for more on this topic). SALT will calculate MLU on an appropriately entered transcript and will indicate the child's level of grammatical development. Age-referenced norms for phonological features of children's speech are also available (Grunwell, 1981).

The second way of getting a norm-referenced measure of a child's language level is to employ one of the many existing standardized instruments. These instruments estimate the child's language proficiency either by asking caregivers to report their children's language comprehension or production or by having an examiner test the child. An example of a caregiver report instrument is the MacArthur Communicative Development Inventories (CDIs) (Fenson et al., 1994). There are two versions of the MacArthur CDI: one for infants between 8 and 16 months of age and one for 16- to 30-month-old toddlers. These inventories consist of checklists that caregivers fill out to report on the gestures, words, and word combinations that their children understand and produce. Data from nearly 2000 children have been collected using these inventories, providing a basis for evaluating an individual child's level of development. An example of an examiner-administered instrument is the Peabody Picture Vocabulary Test (PPVT), which is used to assess vocabulary knowledge in children from 3 years to adulthood. The examiner presents the child with a word (Can you find boat?) and asks the child to select from four pictures the one that corresponds to the word. An individual child's performance is compared to a larger reference group that provided norms for this test. There are also a wide variety of examiner-administered tests of school-aged children's oral language and reading proficiency.

SOURCES FOR RESEARCH ON LANGUAGE DEVELOPMENT

Journals

One way students new to language development can get an idea of the range of topics, issues, and research methods in the field is to scan journals that publish research on language development. The titles of the articles in these journals give an idea of the topics being studied. The list of journals that contain papers on language development is long and includes journals from a variety of disciplines. The major sources are listed in Box 1.1.
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<th>Box 1.1  Major journals that publish research on language development</th>
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Developmental psychology journals:
- *Child Development*
- *Developmental Psychology*
- *Infancy*
- *Journal of Experimental Child Psychology*
- *Merrill-Palmer Quarterly*

Cognitive psychology journals:
- *Cognition*
- *Cognitive Psychology*

Linguistics journals:
- *Discourse Processes*
- *Language*
- *Lingua*

Psycholinguistics journals:
- *Applied Psycholinguistics*
- *Journal of Psycholinguistic Research*

Language development journals:
- *First Language*
- *Journal of Child Language*
- *Language Acquisition*

Language disorders journals:
- *American Journal of Speech-Language Pathology*
- *Journal of Communication Disorders*
- *Journal of Multilingual Communication Disorders*
- *Journal of Speech, Language, and Hearing Research*
- *Language, Speech, and Hearing Services in Schools*
Neuroscience journals:

The Behavioral and Brain Sciences
Brain and Language
Developmental Neuropsychology
Cognitive Neuropsychology

Second-language learning journals:
Applied Linguistics
Language Learning
Second Language Research
Studies in Second Language Acquisition

Other specialized journals:
American Journal on Mental Retardation
Journal of Autism and Developmental Disorders
Bilingualism: Language and Cognition
The International Journal of Bilingualism

Indexes

If you already have a particular interest in some topic, or if you find an interesting topic by scanning the journals, you may want to find other articles on the same topic. Indexes can help you track down everything that has been written on a particular topic in language development. Just as the index in the back of this book allows you to find all the places in this book that a particular topic is mentioned, these indexes allow you to find all the places a particular topic is mentioned in the set of journals they scan. Psychological Abstracts is a service that covers more than 1300 different journals in psychology and related fields and provides an index to material in those sources. Since 1987, Psychological Abstracts has also covered books and book chapters. Linguistics and Language Behavior Abstracts provides an index to material in 1500 journals in language and language-related fields. Psychological Abstracts and Linguistics and Language Behavior Abstracts are available online; the online version of Psychological Abstracts is PsycInfo. To use these databases, all you have to do is type in the subject you are interested in (such as “lexical development” or “sign language”), and you will get a list of all the articles on that topic that appear in all the sources covered by that indexing service.
Summary

Language development is a multidisciplinary field that has as its central question, How is language acquired? Because language is highly complex yet universally acquired, the answer to this question has profound implications for understanding the essential nature of the human mind. Because language is a vehicle for social interaction and acquired in a social context, the answer to this question also may reveal how development is supported and shaped by the social environment. The study of language development also has practical importance for education, for the treatment of communicative disorders, and for second language instruction.

Acquiring a language includes learning the sounds and sound patterns of the language (phonological development), learning the vocabulary of the language (lexical development), learning the structure of the language (grammatical, or morphosyntactic, development), and learning how to use language to communicate (pragmatic and sociolingustic development). The study of language development has a long history because questions about how children's language emerges have long been considered central to larger philosophical and scientific debates. These debates have concerned the intrinsic nature of humankind and the role of experience in shaping human nature.

The modern study of language development began in the 1960s following the Chomskyan revolution in linguistics. Chomsky argued that the study of language is the study of the mind. In turn, the study of language development captured the interest of researchers interested in the study of the developing mind.

Language development is a field divided on several fault lines. Some major points of disagreement are (1) whether language is largely innate in the child or learned from experience, (2) whether the mechanism that underlies language acquisition is specific to language or consists of general-purpose cognitive abilities applied to the task of learning language, and (3) whether the communicative functions that language serves (for children and adults) account for language acquisition, contribute to the process of acquisition, or are merely a benefit of language acquisition that must itself be explained in other terms. Child language researchers also debate whether the most useful approach to understanding language development is to focus on children and ask how they acquire language (the developmental approach) or to focus on language and ask how it is acquired by children (the learnability approach).

Language development researchers use a variety of research methods and designs. Central to a great deal of research is the collection of speech samples from children for the purpose of characterizing the children's productive language. Collecting speech samples involves recording children as they talk, and transcribing and coding the recorded speech. Computer programs help in that process. For some purposes, researchers may not need to collect new speech samples if their question can be addressed by examining the speech samples contained in the CHILDES archive. For descriptive and assessment purposes, a variety of norm-referenced tests and measures of language development are available. Because language development is a multidisciplinary field, articles and chapters on language development appear in widely diverse sources. Most of these are indexed in one of two computer-accessible databases: PsycInfo or Linguistics and Language Behavior Abstracts.

Key Terms

- behaviorism
- cognitivism
- cognitive science
- nature-nurture
- empiricism
- nativism
interactionism
language input
social interactionism
constructivism
emergentism
domain-specific capacities
domain-general capacities
Universal Grammar
modularity
connectionism
statistical learning
rule learning
formalism
functionalism
developmental approach
learnability approach
speech samples
CHILDES
Psychological Abstracts/PsychInfo
Linguistics and Language Behavior Abstracts

**Review Questions**

1. Describe the role the study of language development plays in cognitive science and applied fields.

2. Learning a language involves learning in several separable domains. List and define these components of language knowledge.

3. What questions can be addressed by studying children who grow up without exposure to language?

4. What was the Chomskyan revolution, and why did it affect the study of language development?

5. Define and contrast the nativist and interactionist views of language development.

6. What is the modularity hypothesis with respect to language development? What is the alternative?

7. What is the crucial difference between statistical learning and rule learning as applied to language acquisition?

8. Define and contrast formalism and functionalism as theories of language development.

9. Define and contrast the developmental and learnability approaches to the study of language development.

10. What can be learned from studying language development in other cultures and other language groups that cannot be learned from studying the acquisition of one language in one culture?

11. Imagine you had to explain to your skeptical family (or roommate, or somebody) why you are taking a whole course just on language development. How would you justify spending this much time on such a narrow topic?