Young infants can detect an off-key note in familiar and unfamiliar scales, whereas older infants and adults can do so only in familiar scales.

Mauser, D., Lewis, T.L., Brent, H.F., & Levin, A.V. (1999). Rapid improvement in the acuity of infants after visual input. Science, 286, 108-110. Describes the development of visual acuity in infants who were born with cataracts that prevented visual input. After surgery to remove the cataracts, infants were fitted with contact lenses, and their visual acuity began to change within hours.


6

LANGUAGE DEVELOPMENT

Where you going?
I'm going.
Shoe fixed.
Talk to mommy.
Shoe fixed.
See Antho.
Anthony.
Good night.
See morrow morning. (Weir, 1962)

The preceding monologue was obtained from a tape recording of a 2½-year-old talking in his crib before going to sleep. The child’s statements exemplify several key properties of language development. First, they communicate meaning. It is easy to understand most of what is being said, even though the phrases are not the ones that older individuals would use. Second, the statements are cryptic. When children first learn to speak, they include only the essentials. They omit many of the prepositions, articles, adverbs, and adjectives that lend precision, color, and grammatical structure to the language of older individuals. Third, the language is internally motivated. No one else was in the room during Anthony’s monologue. Nonetheless, he found talking sufficiently enjoyable that he spoke anyway.
Children's acquisition of language raises several fundamental questions. Perhaps the most basic parallels one alluded to in the previous chapter on perceptual development: How do children make sense of the blooming, buzzing confusion of speech sounds? Simply dividing the flow of sound into distinct words is quite demanding; no computer program yet devised can do it very well. Comprehending other people's statements requires an additional skill: understanding not only the meanings expressed directly but also unspoken implications. Speaking correctly requires yet further skills: enunciating the individual sounds, ordering words within sentences, and organizing sentences in ways that communicate coherent thoughts.

In response to these demands, children engage in a variety of mental activities that enable them to comprehend and produce speech. Their well-developed auditory perception system, described in the previous chapter, helps them to divide speech into individual words. Children's accurate perception of other people's speech and their early-developing ability to imitate help them learn to pronounce words correctly. They pay attention to and remember the order of words that they hear in particular phrases, while also searching for generally applicable grammatical rules.

Above all, children attend to meanings, both the meanings they wish to convey and the meanings other people are trying to get across. Emphasizing meaning is an intelligent approach to language acquisition. Language is a tool for adapting to the social world. Sentences that express intended meanings will further that adaptation, even given serious shortcomings in pronunciation and grammar. Sentences that do not express intended meanings will not be adaptive, even if grammar and pronunciation are perfect.

In addition to children's own efforts to learn language, parents, siblings, other adults, and other children also promote language learning. They vary their intonations in ways that attract infants' and toddlers' attention; they speak in short, simple sentences that are easy to comprehend; and they focus on objects and events that are present in the immediate environment. Culture, history is also on the language learner's side. Languages were constructed by human beings and have evolved so that children can learn them. The result is that despite the immense complexity of language, almost all children learn their native tongue quickly and painlessly.

Organization of the chapter. The chapter begins by introducing two general questions regarding language development. First, is language learning special, in the sense that it differs from other, more general forms of learning? Second, what is the biological basis for language? These general questions set the stage for the discussion of language development in the remainder of the chapter.

The remainder of the chapter is divided into four main sections, corresponding to the four main aspects of language: phonology, meaning, grammar, and communication. Phonology concerns the structure and sequencing of speech sounds. Meaning emphasizes the correspondences between particular words and phrases, on the one hand, and particular objects, properties of objects, events, and ideas on the other. Grammar focuses on the system of rules through which people form sentences. Communication involves the ways that phonology, syntax, and semantics are used to convey messages to other people and to understand what they have in mind.

Children's developing knowledge of each of these aspects of language is reflected both in their ability to comprehend language, and in their ability to produce it. In general, comprehension precedes production for all aspects of language, and often by a substantial margin. For example, infants can recognize phonological contrasts in their native language before they can produce such contrasts, and infants comprehend many words before they can produce any words.

The four aspects of language first assume prominent roles at different points in children's language learning. Knowledge of phonology begins to develop soon after birth, as infants become increasingly able to recognize and produce the sounds characteristic of their language. Meaning becomes an important issue later in the first year. Many infants demonstrate understanding of a few simple words by 6 months of age (Tincoff & Jusczyk, 1999), and they produce their first words around their first birthday. During the second year, grammar becomes an important focus. By the middle of the second year, most children demonstrate some understanding of the differences among various syntactic constructions, and soon after this age most children begin to string together phrases of two or more words. Finally, communication is complexly related to all the other aspects of language, and it could reasonably be placed at any point in the ordering. Because it can best be understood in the context of the other aspects of language, however, we examine it after them. The chapter's organization is outlined in Table 6.1.
General Issues Regarding Language Development

**Is Language Special?**

There is no question that the vast majority of children learn language rapidly and well, but there is enormous disagreement about why they are able to do so. The great linguist Noam Chomsky (e.g., 1972) proposed one answer: that people possess a "language organ" that allows them to acquire language especially easily. Chomsky argued that without such a language organ, it would be impossible for children to learn a system as complex as language on the basis of the language input that they receive, because the rules of grammar are too complicated and the input too inconsistent. Furthermore, Chomsky believed that it would be impossible for general learning mechanisms (such as imitation and reinforcement) to yield knowledge about language of the sort that learners display—namely, abstract knowledge that allows them to formulate utterances that they have never encountered before. In Chomsky's view, only a special mechanism such as a language organ could account for how young children so quickly and easily learn such a complicated and abstract system on the basis of such impoverished input. Chomsky proposed that the language organ embodies innate knowledge of aspects of grammar that apply across all the world's languages, known as "universal grammar." This innate knowledge would allow children to recognize which of a few possible types of grammar their native language uses and thus to learn it quickly, despite its complexity.

Other researchers agree with the general claim that language is special, but disagree with the specific claim that the capacity to learn language is represented as a language organ that contains innate knowledge of a universal grammar. For example, MacWhinney (2002) noted that the capacity to learn language has evolved over a period of six million years. During this period, evolution has occurred, not only in the brain structures specifically relevant to language learning, but also in more general cognitive capacities and in the social structure of primate groups, which led to a need for more refined systems of communication. Thus, in MacWhinney's view, language learning is special, not because universal grammar is innate, but because language learning emerges from a unique and complex interplay of neural, cognitive, and social factors that have gradually evolved over historical time.

Several types of evidence support the general claim that language learning is special, in the sense that it differs from other, more general forms of learning. One way in which language acquisition is special is its universality. It occurs, and occurs quickly, across a wide range of environments. Children learn in cultures in which adults converse with children on topics of special interest to the children, in cultures in which adults refuse to discuss such topics, and in cultures in which they discourage young children from talking to them at all (Snow, 1986). Acquisition of most other complex cognitive skills is more dependent on favorable circumstances and direct instruction.

Another special characteristic of language acquisition is its self-motivating properties. Some children are interested in trucks, others in birds, still others in dinosaurs. In contrast, almost all children are sufficiently interested in language to master a very complex system in a relatively short time. Part of this is due to a desire to communicate. This desire is so characteristic of human beings that it is tempting to think it must apply to other animals as well. However, humans seem to be the only animals who are interested in communicating information that is of no direct importance for survival. No other animal communicates in the wild with anything like the frequency that every typically developing 3-year-old does. Even chimpanzees who have learned to communicate quite well through sign language rarely communicate just for the sake of communicating (Tomasello et al., 1995).

People's interest in language goes beyond communicating; we also try to speak grammatically, even when ungrammatical statements would communicate just as well. Beginning language users often ask questions such as Anthony's "Where you going?" Other people understand such statements, respond appropriately to them, and rarely correct them. Yet children soon abandon such immature forms in favor of grammatically correct ones. This motivation cannot be attributed to a general desire to imitate adults and other children, as young children's special tastes in clothing, music, and food indicate. Instead, the desire to learn language, like the desire to be near other people and to understand the world around us, seems to be a basic part of people's makeup.

A third way in which language is special is evident in its relation to disorders that affect thinking in general, such as Down Syndrome and Williams Syndrome (Bellugi, Lichtenberger, Jones, Lai, & St. George, 2000; Harris, Bellugi, Bates, Jones, & Loebell, 1995; Maratsos & Lewis, 1995; Ricci, Caselli, Gagliardi, Tonucci, & Volterra, 2002). Children with both syndromes tend to have IQs that are much lower than normal, usually between 50 and 70. However, the language skills of children with Williams Syndrome tend to be much better than those of children with Down Syndrome. Children with Williams Syndrome score higher than would be expected from their IQs on many tests of vocabulary and complex syntax. In fact, some adolescents and adults with Williams Syndrome speak well enough that they are mistaken for typical adults. This almost never happens for individuals with Down Syndrome. Thus, while language and thought are complex interdependent, the patterns of performance of children with these syndromes suggest that they also are distinct.

Although the many lines of evidence support Chomsky's view that language learning is special in certain ways, his specific claim that the specific knowledge of a universal grammar has fared less well. One problem is that evidence for the existence of universal grammar is weak. Comparisons of the grammars of the world's languages reveal tremendous diversity (Slobin, 1986).
Even simple grammatical distinctions, such as that between "a" and "the," are made in remarkably varied ways. In English, "a" and "the" are separate words, though both words are placed before the noun. In Hungarian, the distinction can be signaled through the order of the verb and the direct object. In some African languages, tone patterns are used to make the distinction. In Chinese, Japanese, Polish, and Russian, the distinction is inferred purely from context. Given this diversity, it seems unlikely that language learning involves simply recognizing which of a few possible types of grammar is being heard. Instead, language learning seems to require both general learning abilities and abilities specific to language acquisition (Maratsos, 1998).

**WHAT IS THE BIOLOGICAL BASIS OF LANGUAGE?**

The view that language acquisition differs from other kinds of learning suggests that there is likely to be a biological basis for language. Two concepts are especially important in thinking about this issue. One is localization, the idea that the brain activity that underlies a specific cognitive function is concentrated in a particular part of the brain. The other is plasticity, the idea that brain functioning changes in response to experience.

First consider evidence regarding localization of language. Language has a distinct anatomical base. For the large majority of people, the dominant area in language processing is in the middle of the left hemisphere of the brain, in particular in Broca's Area and Wernicke's Area (Figure 6.1). Studies of patients with brain lesions (damaged or removed parts of the brain) indicate that damage to these areas harms language competence more than comparable amounts of damage to corresponding areas of the right hemisphere. This is true of signed languages as well as spoken languages, indicating that the critical processing in this area is not limited to speech or to the auditory modality.

In addition to language processing as a whole ordinarily being concentrated in the left hemisphere, particular linguistic functions tend to be located in particular parts of the left hemisphere. For example, studies of brain-damaged patients indicate that naming of colors involves at least three areas. Lesions to an area toward the back of the brain (in the lower occipital lobe) cause loss of color vision. Lesions to Wernicke's area (Figure 6.1) cause inability to say color names. Lesions to areas in between often leave intact the ability to see colors and to list the words used to label colors (for example, by saying "red, green, blue, brown..."), but they interfere with patients' ability to say which name goes with which color (Damasio & Damasio, 1989, 1992).

There is also evidence that words with specifically grammatical functions are processed at different locations in the brain than other words (Neville, 1995a; Neville, Mills, & Lawson, 1992). When people read a word whose main function is grammatical (such as "the"), the brain's electrical response reaches its peak about one-quarter of a second after the word is read, and the reaction is maximal toward the front of the temporal lobe in the left hemisphere. In contrast, when people read content words (such as "dog"), the electrical response reaches its peak after about one-third of a second, and the maximal response is seen toward the rear of both hemispheres. Furthermore, the electrical activity elicited by grammatical words depends on having mastered the grammar of the language. Among 8- to 13-year-olds and among deaf adults, those with greater grammatical knowledge tend to show the distinctive response to grammatical words, whereas those with less grammatical knowledge do not (Neville, 1995a).

The fact that grammatical words are processed primarily at the front of the left temporal lobe is evidence for the localization of particular linguistic functions.

Localizing linguistic functions in particular parts of the brain often proves tricky, however. Even the best accepted finding, the dominance of the left hemisphere in language use, has exceptions. For one-third of left handers, language processing occurs primarily in the right hemisphere (Kolb & Whishaw, 2003). The more specific the function, the more exceptions to the typical location in the brain.

There is evidence that the left hemisphere is already specialized for language activity in early infancy (Bertoncini, Morais, Bijeljac-Babic, & McAdams, 1989; Holowka & Petitto, 2002). However, damage to the left hemisphere early in development results in much less impairment in ability to understand and produce language than will similar damage later in development (Stiles, Bates, Thal, Trauner, & Reilly, 2002). Simply put, the brain's plasticity in the face of such damage decreases with age.

Evidence regarding this point comes from the experiences of infants born with brain abnormalities that cause life-threatening seizures. The only known way to correct these seizures is to remove the entire hemisphere that is causing the seizures, a surgical procedure known as a hemispherectomy. Usually, this procedure results in some degree of mental retardation (Huttenlocher, 1994), though at least one person who underwent a hemispherectomy attended and
Phonology

Development of Knowledge about the Sounds of Language

Infants know a great deal about the sounds of language long before they can pronounce their first word. As described in Chapter 5, from about 2 months of age, infants can distinguish among similar sounds, such as /b/ and /p/ or /k/ and /g/ (e.g., Eimas et al., 1971). Early on, infants are sensitive to many distinctions among sounds that are not used in their native language. However, late in the first year they begin to lose their sensitivity to distinctions that are not meaningfully different in their native language (e.g., Werker & Tees, 1984).

From a very early age, infants also recognize the sounds of their native language. Indeed, it seems likely that infants learn something about the sounds of their native language in utero, because infants as young as 2 days old prefer to listen to their native language rather than another language (Mehler et al., 1988; Moon, Cooper, & Fifer, 1993). Over the course of the first year, infants learn much more about the sounds of their native language (Aslin et al., 1998). For example, by 9 months infants prefer to listen to words made up of sound sequences that are used in their native language, rather than words made up of sound sequences that do not occur in their native language (Jusczyk, Fierderici, Wessels, Svenkerud, & Jusczyk, 1993).

Infants use their knowledge about the sounds of their native language to help them identify individual words within the stream of fluent speech. This skill is crucial to language learning, because most utterances do not contain pauses between words. By the second half of the first year, infants can use at least three aspects of the sound patterns of their native language as clues to word boundaries, as shown in studies using the head-turn preference procedure (described in Chapter 5). One clue is the predominant stress pattern of words in their native language (Jusczyk, Cutler, & Redarz, 1993). By 7 or 8 months, English-learning infants successfully segment words that begin with a stressed syllable (such as doctor or candle), which is a common pattern in English, but they tend to mis-segment words that begin with an unstressed syllable (such as guitar and surprise), which is an infrequent pattern in English (Jusczyk, Houston, & Newsome, 1999).

A second clue that infants use to segment words is transitional probabilities, which are the probabilities with which sounds follow one another in the language. For example, consider the phrase "pretty baby." In English, the syllable /pre/ is very likely to be followed by the syllable /ty/, because these syllables always occur together in the word /pretty/, which is a fairly common English word. However, the syllable /ty/ is quite unlikely to be followed by the syllable /be/ because the word /pretty/ is often paired with other words besides /baby/ (pretty dress, pretty eyes, etc.). The high probability with which /pre/ is followed by /ty/ suggests that /pre/ is likely to be a word, whereas the low probability with which /ty/ is followed by /be/ suggests that /ty/ is not likely to be a word. Studies using artificial language stimuli have shown that, by about 8 months, infants are capable of extracting such statistical information from a stream of fluent speech and using it to identify words (Saffran et al., 1996).

A third clue is phonotactic information, which involves constraints on the sequences of sounds that are allowable within individual words in the language. For example, the sequence /nt/ is found in many English words (such as and tent), but the sequence /tn/ is found in only a few. Therefore, the sound sequence /nt/ signals that the sounds are probably within a single word, but the sound sequence /tn/ signals that there is probably a boundary between words (as in "come to me"). Infants use such cues to segment words from fluent speech by nine months of age (Mattys & Jusczyk, 2001; Mattys, Jusczyk, Luce, & Morgan, 1999).

Taken together, these findings indicate that, even before they can produce any words, infants are surprisingly effective at tracking probabilistic features of
produce the sounds at will. The following list gives a general sense of the progression (Kent & Murolo, 1995):

1. **Crying**: Infants cry from the day they are born. The crying communicates that they would like something to be different. Many parents believe that they can infer what their infant would like merely from the sound of the crying. Given tape recordings of their infants’ cries, however, parents usually cannot tell what the infants want (Muller, Hollien, & Murray, 1974). Thus, parents must infer the cause of the crying from the context, rather than from the precise sound.

2. **Cooing**: Between 1 and 2 months, infants begin to make sounds other than cries. In particular, they coo by placing their tongue near the back of their mouth and rounding their lips. These coos resemble the uh sound that older individuals make in pronouncing the word “fun.”

3. **Simple articulation**: At around 3 months, infants substantially increase the number of consonant sounds they make.

4. **Babbling**: By 6 months of age, infants combine consonants and vowels, and thus produce syllables. These syllables are often repeated sequences, such as bahbahba. The intonations of the babbling increasingly resemble those of speech.

5. **Patterned speech**: Toward the end of the first year, infants increase their production of sounds that appear in their language and decrease their production of sounds that do not. Near their first birthday (give or take a few months), most say their first words.

A similar progression is observed in infants acquiring signed languages. Deaf babies cry, coo, and produce vocal babbling on about the same timetable as hearing babies. Both deaf and hearing infants who are exposed to sign languages also demonstrate manual babble, which consists of rhythmic, repeated motions of the hands (Petitto, Holowka, Sergio, & Ostry, 2001; Petitto & Marentette, 1991).

Manual babble is thought to serve a function in the acquisition of signed languages similar to that of vocal babble in the acquisition of spoken languages.

Although parents usually view their infants’ first word (or first sign) as a major milestone, the infants’ achievement is quite continuous with the development of babbling before that point. For infants acquiring signed languages, the sounds of infants’ babbling and of their first words tend to be similar. Summed across a set of 15 languages, the sounds b, p, m, d, and n are the most common sounds in infants’ babbling (Locke, 1983). This tendency makes understandable why in extremely diverse languages, words with these sounds, such as “papa,” “mama,” and “dada,” are names for parents and are among the first words that children learn (Table 6.3). Babies are making the sounds anyway; languages may as well take advantage of the fact.

As seen in Table 6.3, the consonants m and n are associated with meaning “mother” but not “father.” This pattern is typical; an examination of more than 1,000 terms drawn from the world’s languages showed that 55 percent of the terms for “mother” included nasal sounds such as m and n, but only 15 percent of the terms for “father” did (Jakobson, 1981). Jakobson proposed an intriguing explanation for the difference. The only phonemes that can be produced when the

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**TABLE 6.2 Placement of Tongue within Mouth for English Vowel Pronunciations**

<table>
<thead>
<tr>
<th>Front of Mouth</th>
<th>Middle of Mouth</th>
<th>Back of Mouth</th>
</tr>
</thead>
<tbody>
<tr>
<td>High in mouth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>meet</td>
<td>mitt</td>
<td>coed</td>
</tr>
<tr>
<td>Middle of mouth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mate</td>
<td>met</td>
<td>code</td>
</tr>
<tr>
<td>Low in mouth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td></td>
<td>cavew</td>
</tr>
</tbody>
</table>

---

**How people speak.** When people are silent, air passes freely through the windpipe, nose, and mouth in the process of breathing. We speak by impeding the airflow. The two fundamental classes of speech sounds—vowels and consonants—are produced by different types of impediments. With vowels, the only impediment to the airflow comes in the vocal cords. There is no further blocking by the tongue, teeth, or lips. Consonants, on the other hand, involve impediments by the tongue, teeth, and lips, as well as by the vocal cords. The difference can be seen in pronouncing a vowel such as the a in “hat” and then making a consonant sound such as the b in “ball.” With the vowel, we do not use our lips; with the consonant, we do. All languages include both vowels and consonants.

Different vowels are distinguished primarily by the placement of the tongue. As shown in Table 6.2, the vowel sound in “meet” is produced with the tip of the tongue high and quite far forward in the mouth. In making the vowel sound in “mat,” however, the tongue is much lower. (Because people usually are unaware of their tongue’s location within their mouth, it may be informative to use your fingers to determine its location when you make these sounds.)

The developmental course of producing sounds. How does the ability to produce sounds develop? Infants often have difficulty producing the particular sounds they want to make. With development comes increasing ability to

---
<table>
<thead>
<tr>
<th>Language</th>
<th>Mother</th>
<th>Father</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>mama</td>
<td>dada</td>
</tr>
<tr>
<td>German</td>
<td>mama</td>
<td>papa</td>
</tr>
<tr>
<td>Hebrew</td>
<td>eema</td>
<td>abra</td>
</tr>
<tr>
<td>Hungarian</td>
<td>anya</td>
<td>apa</td>
</tr>
<tr>
<td>Navajo</td>
<td>ama</td>
<td>ataa</td>
</tr>
<tr>
<td>Northern Chinese</td>
<td>mma</td>
<td>baba</td>
</tr>
<tr>
<td>Russian</td>
<td>mma</td>
<td>papa</td>
</tr>
<tr>
<td>Spanish</td>
<td>mma</td>
<td>papa</td>
</tr>
<tr>
<td>Southern Chinese</td>
<td>umma</td>
<td>baba</td>
</tr>
<tr>
<td>Taiwanese</td>
<td>amma</td>
<td>abra</td>
</tr>
</tbody>
</table>

Lips are pressed to the breast as nasal sounds, such as *m* and *n*. Later, infants may reproduce these sounds at the mere sight of food, to express an interest in eating, or to ask for some other change. Thus, words including *m* and *n* are especially convenient for naming the person who most often provides food and fulfills desires, the baby's mother. The use of such easy-to-make sounds to name mothers is a particularly nice example of cultures adapting to children's natures in ways gratifying to parent and child alike.

Cultures also accommodate to the phonological limitations of slightly older children by not using difficult-to-pronounce words for the objects toddlers most want to talk about (people, animals, vehicles). For example, although *str* sequences are fairly common in English (for example, "strong," "strap," "straight"), few are present in the names of objects that particularly interest young children.

Despite these accommodations of languages to infants' and toddlers' capabilities, achieving phonological competence requires a great deal of practice. The importance of such practice was illustrated in a case in which a birth defect required a cognitively typical infant to have a tube in her mouth between ages 5 and 20 months (Locke & Pearson, 1990). During this time, the infant heard a typical amount of speech, but the tube prevented her from making almost all sounds. When the tube was removed at 21 months, she immediately greatly increased the number of sounds she made, but very few were well-formed syllables. Her speech more closely resembled that of deaf children of the same age (Oller & Eilers, 1988) than that of hearing children. Only after a few months of being able to produce sounds freely did she acquire normal phonological abilities for her age.

Most children do not have full phonological proficiency until roughly school age. Some of the problems that toddlers and preschoolers experience come from their failing to produce the sound they intend. Their pronunciation is inconsistent, in the sense that they sometimes mispronounce words that at other times they pronounce correctly. Another part of the problem stems from certain sounds simply being difficult to make. Producing sounds such as *sh*, *th*, *s*, and *r* requires precise coordination of the vocal cords, tongue, teeth, and lips. Coping with other cognitive demands exacerbates the difficulty; mispronunciations increase when children try to produce grammatically complex sentences (Panagos & Prelock, 1982).

Young children cope with such challenges by choosing their words carefully. When toddlers with vocabularies as small as 25 to 75 words know more than one term for a given meaning, they tend to select the term that is easier to pronounce (Leonard, 1995; Menn & Stoel-Gammon, 1995). Conversely, once they become able to produce a sound pattern, they increase their use of terms that make use of that phonological pattern (Vihman, 1992).

Young children seem to be quite conscious of their pronunciation difficulties. For example, in one experiment, a 3-year-old was presented with a number of sentences ("I smell a 'kunk'") and asked whether that was the way he would say it or the way his father would. On all 30 trials, the boy was correct in identifying the person who would use that pronunciation (Kuczaj, 1983). Such knowledge is an early example of metalinguistic awareness—awareness of what you know, and don't know, about language. As a concrete example of this metalinguistic awareness, consider the following conversation between a psycholinguist and his 2½-year-old son:

**Father:** Say "jump."
**Son:** Dup.
  F: No. "jump."
  S: Dup.
  F: No. "jummp."
  S: Only Daddy can say "Dup!" (Smith, 1973, p. 10)

### Meaning

Learning the meaning of even a single word is far from simple. For example, if a parent points to a dog and says, "That's a dog," the lesson is unclear. Should the child conclude that the word "dog" means animal, collar, mammal, four-legged object, furry object, tail, ears, or any number of other possibilities? For words that are not object labels, such as verbs, the situation is even more complicated. Consider, for example, the verb "give." Whenever someone gives something, another person gets something. Consequently, whenever the word "give" is used, the word "get" could also apply to the situation. Given this inherent ambiguity in any given event, how does a child who knows neither "give" nor "get" ever zero in on the correct meaning for each word? To make matters worse, children hear words in the context of rapidly spoken sentences addressed to other people and
referring to objects and events that are not even present. Yet somehow they figure out the words’ meanings. The question is how they do so. In this section, we first describe the relatively slow course of children’s learning of words and word meanings up to about 18 months of age, and then the much faster acquisition that occurs thereafter.

**EARLY WORDS AND WORD MEANINGS**

**Understanding words.** When do infants begin to link sound patterns with meanings? Some evidence suggests that, for words that are highly familiar, even 6-month-olds can do so. Tincoff and Jusczyk (1999) examined infants’ comprehension of the labels “mommy” and “daddy” using a preferential-looking procedure. They videotaped each participant’s parents, and then played both videos side by side, along with an audiotape of a synthesized child’s voice saying either “mommy” or “daddy” (or whatever labels the participant’s parents used to refer to themselves). Across trials, 6-month-old infants looked longer at the parent who was being named than at the parent who was not being named. However, they did not show this pattern when the videos presented unfamiliar men and women. Thus, by 6 months infants link the words “mommy” and “daddy” to the appropriate individuals. These findings suggest that infants may begin to form their lexicons (sets of known words) by linking names to significant individuals in their social sphere.

A few months later, infants begin to link labels more widely to objects in their environment. When 9-month-old infants hear a label paired with an object, they are more likely to attend to other objects from the same category than to other objects from a different category (Balaban & Waxman, 1997), suggesting that they understand the meanings of the object labels. At about this same age, infants also begin to respond appropriately to commands, such as “get the ball” (Benedict, 1979). Thus, word comprehension appears to be well under way by 9 months of age—considerably before most infants produce any recognizable words.

**Producing first words.** The similarity between infants’ babbling and their early words makes it difficult to identify just when they produce their first word. Parents often discern words months before even sympathetic friends and relatives can. It is unclear whether the discrepancy reflects parental hopes and pride or whether the parents are simply more skilled in understanding their children. In any case, most uninvolved observers place the typical age of the eagerly awaited first word between 10 and 13 months, though deviations in both directions are common.

By 18 months, a productive vocabulary of three to one hundred words is typical. These words seem to many observers to have a characteristically childlike flavor. One-year-olds use words like “ball,” “doggie,” and “more”; they almost never use words like “stove,” “animal,” and “less.” In general, they refer to objects and actions that interest them, that are relatively concrete, and that they want.

Children throughout the world refer to the same types of objects with their earliest terms. They talk about people: “dada,” “mama.” They talk about vehicles: “car,” “truck,” “train.” They also talk about food, clothing, and household implements, such as keys and clocks. Table 6.4 lists the most common words of children in the United States. The first words spoken by children in Italy and other countries are highly similar (Caselli et al., 1995). This similarity is not limited to spoken languages; the first 50 signs produced by children acquiring American Sign Language are comparable, including such terms as “mommy,” “daddy,” “cookie,” “baby,” “shoes,” “milk,” “dog,” “bye,” and “ball” (Bonvillian, Orlandy, & Novack, 1983).

These examples suggest that nouns are prevalent in children’s early lexicons. Indeed, some researchers have claimed that young children have a “noun bias,” such that they learn nouns more readily than verbs (Gentner, 1982). In support of this idea, studies of children acquiring English and Italian have documented that a high proportion of children’s early words are nouns (Caselli et al., 1995). However, other research suggests that the noun bias may not be universal (Bloom, Tinker, & Margulis, 1993). Verbs are as frequent as nouns in the early lexicons of children acquiring Korean (Choi & Gopnik, 1995) and verbs actually outnumber nouns in the early lexicons of children acquiring Mandarin Chinese (Tardif, 1996). It appears that differences in caregivers’ speech to children may be responsible for some of these cross-language differences. Compared to English-speaking caregivers, Mandarin-speaking and Korean-speaking caregivers use more verbs in their speech to children (Choi, 2000; Choi & Gopnik, 1995; Tardif, Gelman, & Xu, 1999; Tardif, Shtatz, & Naigles, 1997). Thus, the content of children’s early vocabularies appears to depend in part on the language input they receive.

**One-word phrases.** In children’s first half year of speech (roughly 12–18 months), they usually speak in single words. The demands of producing even a single word tax their cognitive resources, as evidenced by their frequently reducing multisyllabic words to a single syllable (saying “go” for “plane”) and by their frequently pausing between syllables within a word (Echols, 1993; Johnson, Lewis, & Hogan, 1995). Thus, the cognitive demands of production appear to limit the meanings that toddlers can express.

Toddlers partially compensate for these limitations by choosing single words that convey larger meanings. These single words are often called holophrases, because they express the meaning of an entire phrase. When 1-year-olds say “ball,” the word seems to imply an entire thought such as “Give me the ball.”” “That is a ball,” or “The dog took the ball.” Both context and the particular words toddlers choose make these one-word statements understandable. For example, children in the one-word stage who want a banana usually say “banana” rather than “want” (Greenfield & Smith, 1976). Because of the many things the child could want, and the relatively few aspects of bananas about which the child could be commenting, “banana” is the more informative term. However, when offered
a banana they do not want, 1-year-olds generally say "no" rather than "banana," presumably because saying "banana" could be misinterpreted.

Overextensions, underextensions, and overlaps. The fact that young children use a word does not guarantee that they intend the same meaning that older individuals do. Clear deviations from standard meanings are quite common up to about 2 years of age, and more subtle ones continue for years thereafter.

Children’s deviations from standard meanings fall into three categories: overextensions, underextensions, and overlaps. Anglin (1986) observed each of these in the speech of his oldest daughter, Emmy. Overextensions involve using a word to refer not only to the standard referents but to others as well. For example, Emmy used the term “doggy” not just to refer to dogs but also to refer to lambs, cats, wolves, and cows. Underextensions involve limiting the use of a word to a subset of its standard referents. For example, Emmy used “bottle” to refer only to her plastic drinking bottles; she would not use it with other bottles, such as Coke bottles. Overlaps involve overextending a term in some ways and underextending it in others. Emmy underextended the term “brella” by refusing to apply it to a folded umbrella, but simultaneously overextended it to kites and to a leaf used to keep off rain by a monkey in her storybook.

Overextensions are the most dramatic of these errors; almost everyone notices when a child calls a cat a “doggy.” Underextensions are less dramatic; in everyday situations, it is often impossible to know whether a child who does not say “doggy” upon seeing a dog underextends the term or simply does not feel like talking about the dog. This created an initial impression that overextensions were more common than underextensions. Testing 1- and 2-year-olds’ word meanings more directly (by showing them objects and asking “What’s this?” or “Is this a _____?”) has revealed a different picture, though. These studies have shown that underextensions actually are more common than overextensions (Kay & Anglin, 1982). Beginning language learners tend to be conservative in extending newly acquired words to novel referents (MacWhinney, 1989).

Form and function. What features play the largest roles in early word meanings? Two that appear to be especially important are forms and functions: the perceptual appearances of objects and the purposes that they serve. The role of form is evident in children’s overextension errors (Clark, 1973). For example, children throughout the world call round things, such as walnuts, stones, and oranges, “balls.” These objects share few functions with balls, but they do share a similar appearance. The importance of function in early word meanings is evident in the earliest words that children use (Nelson, 1973). These words tend to refer to things that children want (such as “more,” “up,” “cookie”), or objects or activities that interest them (“doggy,” “car,” “keys”).

Form, function, and other properties can dominate early word meanings, but no single one of them always does. Bowerman (1980) illustrated this point
TABLE 6.5  An Early Word and Its Referents

Eve, kick.

Prototype: kicking a ball with the foot so that it is propelled forward.

Features: (a) waving limb; (b) sudden sharp contact (especially between body parts and other object); (c) an object propelled.

Selected samples. Eighteenth month: (first use) as kicks a floor fan (Features a, b); looking at picture of a kitten with ball near its paw (all features, in anticipated event); watching moth fluttering on a table (a), watching a row of cartoon turtles on television doing can-can (a). Nineteenth month: just before throwing something (a, c); “kick bottle,” after pushing bottle with her feet, making it roll (all features). Twenty-first month: as makes ball roll by bumping it with front wheel or kiddicar (b, c); pushing teddy bear’s stomach against Christy’s chest (b), pushing her stomach against a mirror (b); pushing her chest against a sink (b), etc.


with observations of her daughters, Eve and Christy. Both overextended many of their early words. Typically, their overextensions were consistent with the particular instance from which they first learned the term. The overextensions emphasized a variety of notable features of the objects and actions they named, though form and function were the most common.

Table 6.5 presents a good example. Eve learned the term “kick” in the context of kicking a ball. She later overextended the term to describe activities with similar forms and functions, even though many of the events she referred to are not ordinarily labeled “kicks” in English. For example, she used kick to refer to sudden sharp contact between her arm and an object, to an object being propelled, and to the waving of a limb.

This example illustrates the demands of learning word meanings. When children hear an unfamiliar word, they cannot be sure which aspect of the situation it labels. Some words refer mainly to functions (such as “helps”), others to form (such as “big”), others to actions (such as “hits”). Interesting forms and functions increase the likelihood of children being sufficiently intrigued by an object or action to try to guess the right word for it and to use the word early on. Thus, both figure prominently in the meanings children assign to those words.

DEVELOPMENT BEYOND THE Earliest Words AND WORD MEANINGS

The course of vocabulary acquisition. Until about 18 months, word learning proceeds very slowly. At this point, however, there is a “vocabulary spurt” during which word learning accelerates. As shown in Table 6.6, average vocabulary size more than doubles between 18 and 21 months and again between 21 and 24 months. This rapid growth continues for years. Current estimates indicate that by first grade, a typical child understands at least 10,000 words, and by fifth grade 40,000 (Anglin, 1993). This means that from 1½ to 10 years, children add an average of more than 10 words per day to the set of words they understand. Increases in the number of words that children produce in their own speech occur at a similarly rapid rate (Droni, 1986; Goldfield & Reznick, 1990).

This torrent pace suggests that children must infer the meanings of new words from only a few exposures. Studies of children’s acquisition of word meanings support this conclusion. Despite the many possible meanings a word might have, 1-year-olds often can identify a new word’s meaning (or at least a good approximation) from fewer than 10 exposures to it (Woodward, Markman, & Fitzsimmons, 1994). Two- and 3-year-olds often can approximate the correct meaning after a single exposure (Carey, 1978; Heibeck & Markman, 1987). But how is such “fast mapping” between a word and its meaning possible, when, as pointed out earlier, even pointing to a dog and saying “This is a dog” allows so many interpretations? The philosopher Quine (1960) labeled this question “the riddle of induction.”

Different researchers have focused on different potential solutions to this riddle. Four broad classes of solutions have been proposed: (1) constraints on learning, (2) grammatical cues, (3) general cognitive processes, and (4) social cognitive skills.

Constraints on learning. Markman (1989, 1992) proposed that children solve the riddle of induction by never considering the vast majority of logically possible hypotheses about word meanings. Instead, they focus on the meanings that adults are most likely to have in mind. This does not mean that they are mind readers. Rather, Markman suggested, their hypotheses about word meanings are
constrained in ways that narrow the range of possibilities and that often lead to their first guesses being correct. She proposed that three constraints on the guesses are especially important: the whole-object constraint, the taxonomic constraint and the mutual-exclusivity constraint.

The whole-object constraint is the tendency to assume that a label for an object refers to the object as a whole, rather than to one of its parts or properties. Thus, when an adult points to a novel object and says, "This is my blicker," 2-year-olds assume that "blicker" is the name of the novel object, rather than its color or texture (Saja, Carey, & Spelke, 1991). Given the same situation, adults make the same assumption (Imai & Gentner, 1993).

When children are told, "This is an X," their guesses about what X means are particularly strongly influenced by the shape of the object being labeled. Both preschoolers and adults will use a newly introduced word to refer to objects that have the same shape as the original example but that differ in color, texture, material, or size (Baldwin, 1992; Landau, Smith, & Jones, 1992; Samuelson & Smith, 2000; Smith, Jones, & Landau, 1992). They are much less likely to use the new word to refer to objects that have different shapes but that are similar in color, texture, material, or size.

The mutual-exclusivity constraint is the tendency to assume that, if an object has a known name, then a novel word probably refers to a different object. Thus, when children encounter a novel word in a context in which it could refer to one of two objects, and they already know a name for one of them, their first guess is usually that the word refers to the other object. For example, if 3-year-olds who already know the word "spoon" but not the word "tongs" are shown a spoon and a tongs and are told, "Show me the gug," they generally choose the tongs (Golinkoff, Hirsh-Pasek, Lalavee, & Baduini, 1985; Markman & Wachtel, 1988). This constraint does not apply only to names of objects; preschoolers also assume that novel verbs refer to actions for which they do not know a term rather than to actions for which they do know a term (Clark, 1993; Golinkoff, Hirsh-Pasek, Mervis, Frawley, & Pavlis, 1995; Merriman, Marariza, & Jarvis, 1993).

The taxonomic constraint is the tendency to assume that when a new word is used to label an object, the word is also used to refer to other objects in the same class. For example, when children as young as 18 months are shown a picture of a dog chewing a bone and told, "This is a sud," they assume that "sud" refers to dogs as a class, rather than to the dog’s nose, body, or coat or to dogs chewing bones (Markman, 1989).

But how do children know whether "sud" means a general term such as "animal," a more specific term such as "dog," or a yet more specific term such as "German shepherd"? Part of the answer is that children tend to assume, unless given evidence to the contrary, that unfamiliar words involve a basic level of description, that is, a level that conveys the main perceptual and functional properties of the object without being extremely specific (Golinkoff, Shuff-Bailey, Olguin, & Ruan, 1995). Children would assume that "sud" means dog, because knowing that an object is a dog tells us its main characteristics without getting into detailed distinctions among types of dogs. This assumption works out well, because language addressed to young children includes many more basic-level terms, such as "dog," than more abstract or more specific ones (Anglin, 1977; Blevitt, 1983).

In some situations, these constraints conflict with one another. For example, in one experiment, children were shown a birthday cake, told that puppets call it a "fep," and then asked whether two other objects are also feps: a pie shaped differently from the birthday cake and a hat shaped like it. When faced with such conflicts between objects’ shape and their taxonomic class, 3-year-olds are more likely than 5-year-olds to choose the similarly shaped object as a fep, whereas 5-year-olds are more likely to choose the object from the same taxonomic class (Imai, Gentner, & Uchida, 1994; Merriman, Scott, & Marazita, 1993). As suggested by this example, appearance is particularly important in very young children’s guesses about word meanings. With age, belonging to the same category (such as sweets) and serving the same function (such as being good to eat) become more important.

Grammatical cues. Constraints on learning are not the only factors that help children solve the riddle of induction without much trial and error. Grammatical cues also contribute, at least by the time children are 2 or 3 years old. In the earliest study of this issue, Brown (1957) found that preschool children interpreted "a wug" to be an object, "some wug" to be an undifferentiated mass, and "wuggling" to be an activity. Two-year-olds also know that words introduced by saying "This is X" are usually proper names (e.g., "This is Robert") (Gelman & Taylor, 1984; Macnamara, 1982), and that when a word is introduced by saying "This is an X one" (as in, "This is a tasty one") X is an adjective that indicates a property of the object (Waxman & Markow, 1998).

Grammatical cues appear to be especially important in learning the meanings of verbs. Individual verbs differ in the syntactic structures in which they can occur. Some verbs are transitive, which means that they require a direct object. An example is the verb "hit": "Molly hit the ball" is grammatical, but "Molly hit" is not. Other verbs are intransitive, which means that they do not take a direct object. An example is the verb "fall": "Susie falls" is grammatical, but "Susie falls the ball" is not. The syntactic structures in which a given verb occurs reveal information about the verb’s meaning. For example, transitive verbs tend to involve actions that cause some effect, whereas intransitive verbs tend to involve non-causal actions. As another example, verbs that occur with prepositional phrases (for example, "Becky walked up the hill") tend to convey
motion. These systematic relationships between syntactic structures and verb meanings are evident in parents’ speech to young children (Naigles & Hoff-Ginsberg, 1995).

From an early age, children use such information to zero in on the meanings of verbs. Naigles (1990) presented 2-year-olds with a video clip of a duck and a bunny that portrayed either a causal action (the duck pushed down on the bunny’s head, causing the bunny to squat) or a non-causal action (the duck and the bunny waved their arms in circles). At the same time, children were presented with a novel verb embedded in either a transitive sentence (“The duck is gorping the bunny”) or an intransitive sentence (“The duck and the bunny are gorping”). Moments later, the children were shown the two video scenes simultaneously, and they were asked, “Where’s gorping?” Toddlers who had initially heard the verb in the transitive sentence looked longer at the causal action clip, but those who had initially heard the verb in the intransitive sentence looked longer at the non-causal action clip.

In a related study (Fisher, Hall, Rakowitz, & Gleitman, 1994), 3- and 4-year-old participants watched videotaped vignettes of various actions that could be construed as either transitive (the rabbit pushes the elephant) or intransitive (the elephant falls). As children watched the vignettes, a puppet described the actions in “puppet talk,” using sentences such as “The rabbit is ziking the elephant” or “The elephant is ziking.” The children’s task was to translate the “puppet talk” into English. As would be expected if children were heeding the grammatical cues, children’s interpretation of the “puppet talk” verbs depended on the sentence frames in which they were presented. When children heard the word “ziking” in a transitive sentence frame, they interpreted it to mean pushing, but when they heard it in an intransitive sentence frame, they interpreted it to mean falling.

How do young children know how syntactic structures and meanings correspond? One likely possibility is that they learn these correspondences through detecting regularities in the language input that they receive. It appears that language input provides children with a rich database over which to draw inferences about the relations between syntactic cues and word meanings. These inferences then guide the course of vocabulary acquisition.

**General cognitive processes.** Whereas the grammatical cues perspective emphasizes characteristics of the language input as a source of development of early word learning, the general cognitive processes perspective emphasizes characteristics of the language learner. According to this perspective, basic processes of perceiving, attending, and remembering are themselves sufficient to enable children to rapidly and effectively learn new words (Bloom, 2000; Samuelson & Smith, 1996, 2000b; Smith, Jones, Landau, & Gershkoff-Stowe, 2002). Importantly, these processes are domain general in the sense that they are applicable to learning many different kinds of information, and not only to language. This is a key dimension of contrast with the constraints perspective, which holds that what enables children to learn so many words so quickly are constraints that are specialized for language learning.

Markson and Bloom (1997) provided compelling evidence that general learning and memory processes can allow rapid word learning. In their experiment, 3- and 4-year-old children played a game in which they used six novel objects. During the game, children were told that one of the objects was called a “koba,” and that another of the objects had been given to the experimenter by her uncle. Later, children were presented with an array of objects and asked to find both the koba and the object that the experimenter had received from her uncle. As expected, most children learned which object was the koba, and they retained this new label over a one-week and a one-month delay. More surprisingly, however, children were equally good at learning and remembering which object was given to the experimenter by her uncle. The fact that learning was comparable for the novel word and the novel fact suggests that general cognitive processes, rather than processes specialized for language, produced the learning.

General cognitive processes may also be responsible for the development of constraints on word meanings. To address this possibility, Smith et al. (2002) conducted a training study with 17-month-old children, who were young enough at the outset of the study that they did not yet generalize novel words based on object shape. In a series of seven weekly sessions, children in the trained group were taught names for objects that had one of four shapes (see Figure 6.2). Each training session involved repeatedly labeling instances of the

**FIGURE 6.2** The four categories of objects used by Smith, Jones, Landau, and Gershkoff-Stowe (2002). Instances of each category had the same shape, but differed in other attributes such as texture and color. Copyright 2002, Blackwell Publishers. Reprinted with permission.
category with a novel word ("look, a zup!") as well as presenting a contrasting case (an object of a different shape) that was not a member of the category ("oh, that's not a zup!"). Children in the untrained group did not participate in the training session.

In the final week of the study, children in both groups were presented with entirely new objects and new words, and they were tested to determine whether they generalized the new words to other objects on the basis of shape. Children in the trained group did so, whereas children in the untrained group did not. Thus, children who were taught about shape-based categories during the training session used shape to infer word meaning, and they also generalized the importance of shape to new words. These data suggest that basic cognitive processes, such as attention and generalization, may be the source of patterns seen in early word learning, such as the "shape bias."

Even more striking was the effect of training on children's vocabularies, which were measured with a parent checklist at the beginning and end of the study. Children in the trained group showed a dramatic increase in the number of object names in their productive vocabularies over the course of the study, much greater than the increase shown by children in the untrained group. These data suggest that learning to attend to the shape of objects actually brought on the vocabulary spurt for these children! In more natural settings, children may initially learn a few words for shape-based categories (such as ball, cup, shoe, etc.) and then generalize over these instances to infer that shape is an important property for determining which words label which objects.

Social cues and social cognitive knowledge. Another possible source of children's ability to solve the riddle of induction lies in the social world. A great deal of language learning takes place in social interactions, including situations that involve joint attention between child and adult, scripted activities such as book reading, and routines and games such as peek-a-boo (e.g., Bruner, 1983). Both children and adults contribute to these social interactions. For example, infants attend to objects that interest them, and adults often label the objects to which children are attending (Masur, 1982). As children's language skill grows, they begin to communicate about the things they have in mind, and most adults are highly responsive to these early efforts to communicate (Bloom, 1998; Bloom, Margulis, Tinker, & Fujita, 1996). Such social interactions provide a context in which children can learn about language and language use. Furthermore, as children's knowledge about other people grows, they can capitalize on this knowledge in language learning.

By their second year, infants realize that language generally refers to what the speaker is attending to, even if it is not what they themselves are attending to. To demonstrate that infants have this understanding, Baldwin (1991, 1993a) created a situation in which an adult was looking at one novel object and an 18-month-old at another, when the adult said, "A modi!" The children responded by shifting their attention to the object that the adult was looking at.

When later asked to get the modi, the toddlers were more likely to choose the toy that the adult had been looking at when she used the term earlier than the toy that they themselves had been looking at. Understanding of other people's intentions also aids toddlers' language learning. For example, if an adult appears to perform a novel action accidentally while saying a word, toddlers do not associate the action with the word, whereas they do associate the word with the action if the adult appears to perform the same action intentionally (Tomasello & Barton, 1994). Thus, understanding of communication, and of the social world more generally, influences children's learning of word meanings.

The social world facilitates children's word learning in other ways as well. Adults sometimes give corrective feedback when they use words incorrectly (Bohannon & Stanowicz, 1988). Children also recognize that adults can serve as repositories of information about word meanings, as the following question from a 4-year-old girl attests:

Mom, mud is when it rains on the dirt and it gets icky, and dirt is when it's dry, right? (Makis, personal communication, 2002)

Thus, through social interaction, corrective feedback, and answering questions, adults create conditions that facilitate language learning. By establishing joint attention, differentiating between intentional and unintentional actions, and asking questions, children contribute to this social learning process as well.

Beyond the riddle of induction. The preceding sections have described cues and abilities that children use to solve the "riddle of induction" as they attempt to infer the meanings of words they hear. Children appear to rely on some combination of constraints, grammatical cues, domain-general cognitive processes, and social information to zero in on the meanings of words. However, solving the riddle of induction is not the only challenge that children face in learning about word meanings. Another challenge is finding a way to express meanings for which they do not know any appropriate words.

To address this challenge, children often invent novel ways to express desired meanings that are not in their vocabulary. For example, Park (1995) cited such examples, saying, "There comes the rat-man" and a 25-month-old saying, "Mommy just fixed this spear-page." The "rat-man" was a colleague of her father's who worked with rats in a psychology laboratory; the "spear-page" was a torn picture of a jungle tribe holding spears that her mother had taped together. Clark also cited the example of a 28-month-old saying, "You're the sworder and I'm the gunner."

As these examples suggest, children's innovative uses of language are far from random. They reflect rules for forming new words, such as combining words or other components that are meaningful in their own right and that, when put together, have an unambiguous meaning. Such linguistic creativity allows children to express meanings that are well beyond what their limited vocabularies would otherwise allow.
Grammar

All human languages have grammars, that is, rules for forming sentences. Young children are motivated to learn these grammars, even when they can communicate well without learning them, and even though they are rarely corrected for grammatical errors (Brown & Hanlon, 1970). Children’s interest in learning grammar differentiates people from apes who, even when taught to express meanings through symbols, show no interest in learning the grammars of the languages they are taught.

Children’s ability to learn such complex systems at young ages has led some researchers to propose that there is a “critical period” in early development during which the brain is especially receptive to learning grammar. Below, we consider grammatical development in the first two years, then grammatical development at later ages, and then several explanations of how children learn grammar.

Early Grammatical Development

Perceptual bases of grammar learning. Even newborn infants seem to have some sensitivity to grammatical information. Shi, Werker, Morgan (1999) examined whether newborns are sensitive to the distinction between grammatical words, such as the, in, and its, and content words, such as play, chair, and ball. Words in these two categories play different roles in language: content words (such as nouns, verbs, adjectives, and adverbs) carry meaning, whereas grammatical words (such as articles, prepositions, and auxiliaries) play a structural role. Words in these two categories also differ in their perceptual characteristics. For example, grammatical words have shorter vowel durations and simpler syllable structure.

To test whether newborns could discriminate content words and grammatical words, Shi and colleagues presented 1- to 3-day-old infants with a list of either grammatical or content words. During a habituation phase, infants sucked on a special pacifier that recorded their sucking rate. When infants’ interest in the word list declined sufficiently that their sucking rate reached a pre-specified criterion, a new list of words was presented. For some infants, the new list was made up of words from the same category that they had heard during habituation (either grammatical or content words); for other infants, the new list was made up of words from the other category. Infants for whom the category switched between the habituation phase and the test phase showed greater interest in the new list, as measured by greater increases in sucking rates, than did infants for whom the category stayed the same. Thus, newborns can discriminate between grammatical and content words based on perceptual characteristics of those words. A follow-up study showed that by six months, children prefer to listen to content words rather than grammatical ones (Shi & Werker, 2001). These findings suggest that languages mark certain grammatical distinctions in ways that are perceptually salient to young infants; such marking may facilitate learning of grammar.

Sentences. Sentences are the basic unit of grammar. They are more than simple strings of words. Instead, they are cohesive units that express meaning and that follow conventions regarding word order, intonation, and stress. So basic are they that Anisfeld (1984) commented, “In a real sense, sounds and words exist to be used in sentences” (p. 113).

From a remarkably early age, infants are able to detect regularities across sentences in word order. To investigate this ability, Gomez and Gerken (1999) used an artificial language consisting of eight nonsense words that were presented in “sentences” that were constructed according to a set of arbitrary word-order rules. Infants were exposed to a set of sentences from this artificial language that were “grammatical” in the sense that they conformed to the word-order rules. After listening to the grammatical sentences for only two minutes, 12-month-old infants could discriminate between novel grammatical sentences...
(ones that had not been in the exposure set) and sentences that were “ungrammatical” in the sense that they violated the word-order rules. Other research has shown that infants as young as 7 months can abstract patterns such as the “ABA” pattern in “sentences” like ga li ga and li na li (Marcus, 2000; Marcus, Vijayan, Bandi Rao, & Vishton, 1999). Infants who had been habituated to an artificial language with an ABA pattern subsequently listened longer to novel sentences with an ABB pattern (such as wo fe fe) than to novel sentences with an ABA pattern (such as wo fe wo). Infants who had been habituated to a language with an ABB pattern showed the reverse preference. These findings suggest that infants readily acquire grammatical information that is abstract and rulelike.

Even before children begin to produce sentences on their own, their understanding of other people’s statements in everyday contexts reflects knowledge of some of the grammatical conventions of their native language (Hirsh-Pasek & Golinkoff, 1996). For example, at ages when children are mainly producing one-word phrases, they already show some understanding of the difference between sentences. In one set of studies, 17-month-olds were simultaneously shown two films that differed only in who was doing what to whom. Big Bird was washing Cookie Monster in one film, and Cookie Monster was washing Big Bird in another. When asked questions such as “Where is Big Bird washing Cookie Monster?” the toddlers usually looked at the film where that action was occurring. This pattern suggests that the 17-month-olds believed that the character mentioned first in the sentence probably was doing the action, which corresponds to the usual grammatical pattern in English.

Turning to children’s own speech, their earliest two-word phrases seem somewhat between pairings of individual words and true sentences. The two words in each phrase tend to express related meanings, but they are not very cohesive and are often separated by long pauses. Sometimes, they are referred to as sequences (of words), to distinguish them from true sentences. Thus, one 20-month-old boy produced such phrases as “train/bump,” “cow/moo,” and “beep/beep/trucks” (Anisfeld, 1984); the slashes indicate pauses between words. These expressions seemed to indicate meanings comparable to those of simple sentences (“The train bumped.” “Cows say moo.” “Trucks beep.”). However, they lacked the intonational patterns and cohesion of sentences.

Along with these sequences, children begin to produce true sentences. At first, the sentences are rare, but within a few months, they become dominant. The cognitive effort needed to construct them is evident in the halting way in which young children talk. Braine (1971) estimated that 30 to 40 percent of 24- to 30-month-olds’ statements are “replacement sequences,” in which children build on earlier statements until they succeed in producing the desired form and meaning. Thus, Braine described a 25-month-old saying, “Want more. Some more. Want some more.” and a 26-month-old saying, “Stand up. Cat stand up. Cat stand up table.”

Early in language learning, grammatical knowledge is often interwoven with knowledge of meanings (Corrigan, 1988; Corrigan & Odyta-Weis, 1985). Children from different language backgrounds emphasize the same meaningful relations in their two-word phrases: agent-action ("Mommy hit"), possessor—possessed ("Adam checker"), attribute-object ("big car"), recurrence ("more juice"), and disappearance ("juice allgone") (Anisfeld, 1984; Bloom, 1990; Braine, 1976). Within each relation, children order words in a regular fashion. Thus, when describing an object that has disappeared, a child who said "juice allgone" would rarely if ever say "allgone juice" or "allgone milk." However, the consistency of the word ordering is specific to the meaning being expressed. At first, children are very conservative about generalizing from the islands of grammatical competence that they have established. For example, Kuczaj (1986) observed that one of his two children initially used "are" only in declarative sentences starting with "these" or "those" ("Those are good toys."). His other child at first used "is" only at the end of sentences ("There they is."). This reluctance to extend newly acquired grammatical forms to novel contexts parallels children’s conservatism about extending newly acquired word meanings to new referents and their avoidance of words that they have trouble pronouncing.

Later Grammatical Development

Once children produce true sentences, they begin to acquire many of the grammatical conventions used in adult language. For example, English-speaking children learn to indicate that an event happened in the past by appending ed to the verb. They learn to indicate that more than one individual was involved in an event by appending s or es to the noun. They learn to use "am," "is," and "are" in the full range of circumstances to which they apply. Acquisition of two grammatical conventions, those used to form past tenses and to ask questions, illustrate grammatical development particularly clearly.

**Past tense forms.** In English, the past tense forms of most verbs are produced by adding "ed" to the infinitive (such as adding "ed" to "help" to produce "helped"). However, the past tense forms of a number of particularly common verbs are exceptions to this rule, for example, "came," "went," "hit," and "ate." Indicating that events occurred in the past thus requires mastering both the rule and the exceptions.

Children appear to begin learning the past tense by treating each word as a separate case. This leads to their first past tense verbs being correct repetitions of forms they have heard, both regular (such as "jumped") and irregular (such as "ran"). However, once they have learned a fairly large number of verbs (roughly 60 to 70 in most cases), and abstracted the "ed" pattern, they impose it not only in cases where it fits but also in cases where it does not (Marchman & Bates, 1994).
This tendency helps them to infer the correct past tense form for the many regular verbs whose past tense forms they never heard, but it also leads to overregularized forms such as “runned” and “eeted.” These overregularized forms are not the only ones that they produce at any given time. The same child who says “runned” in one sentence may say “ran” in the next, and may occasionally say “ranned” as well (Marcus et al., 1992). However, the overregularizations persist for a long time, being produced occasionally by most children from around age 2 into the school years (Marcus et al., 1992). They also cannot be dismissed as accidents. When 5- and 6-year-olds are asked to judge whether particular forms are “ok” or “silly,” most indicate that both “ate” and “ated” are ok, though most judge “eated” to be silly (Kuczaj, 1978). Not until age 7 do they judge only the correct past tense form to be correct.

Questions. Soon after children begin to use two-word phrases, they start to learn a common, but surprisingly complex, set of grammatical forms: those involved in asking questions. Quite often, the first question they ask is “What day?” (Reich, 1986). This is soon followed by questions involving “where” (“Where Mommy boot?”), yes-no questions (“Go now?”), and questions involving doing (“What Billy doing?”).

Plainly, it is a long way from these abbreviated questions to full grammatical ones. It takes several years of experience before children consistently ask questions grammatically. For example, consider the process of learning to ask who questions. Initially, English-learning children often maintain the basic subject-verb-object order that is typical of English and just attach a “wh” term to a sentence that they have just heard (de Villiers, 1995). A child who was told “Billy hates Mary” might ask “Why Billy hates Mary?” Later, children realize that auxiliary verbs such as “does” must be added. Sometimes they produce forms with the auxiliary verb in the wrong place (“Why Billy does hate Mary?”). Other times, they produce forms with the auxiliary verb in the right place but with the s not removed from the verb (“Why does Billy hate Mary?”). Yet other times, the same child will produce the correct form. Not until roughly age 5 do children ask such questions consistently correctly. Their persistence in learning this complicated set of forms again illustrates their high motivation to speak grammatically.

Critical periods in grammar learning. Why are such grammatical forms learned when they are, rather than earlier or later? Lenneberg (1967) raised one intriguing possibility: that the time between 18 months and puberty is a critical period, during which the brain is especially receptive to learning grammar.

Initial explanations of grammatical acquisition seemed to contradict Lenneberg’s hypothesis. For example, comparisons of adults and preschoolers who were completing their first year of living in Holland indicated that the adults’ mastery of Dutch grammar was superior (Snow & Hoefnagel-Hohle, 1978). However, studies that have focused on the end point of grammatical acquisition, rather than knowledge after one or a few years of exposure to the language, suggest that learners who start young ultimately reach higher levels of proficiency. Johnson and Newport (1989) examined knowledge of English grammar among Korean and Chinese immigrants who had come to the United States when they were between 3 and 39 years old and who had lived in the United States for between 3 and 26 years. Because age of arrival and number of years in the United States were only moderately correlated in the group they studied, the investigators could separate the influences of the age at which the immigrants began to learn English from the amount of time they had spent learning it.

Age of arrival was closely related to ultimate level of grammatical mastery. In contrast, number of years in the United States had little relation to it. Immigrants who came before age 7 knew grammar as well as native-born adults; those who came between 8 and 10 knew it slightly less well; those who came between 11 and 15 knew it somewhat less well. Most striking, very few of those who came after age 15 mastered English grammar very well at all (Figure 6.3). Only one of the 22 people who arrived that late showed as much grammatical knowledge as the least knowledgeable of the 15 people who arrived before age 11. Further, among those who arrived after age 15, neither age at arrival nor number of years in the United States correlated highly with degree of mastery. Unlike the universal mastery of the basics of English grammar seen among native speakers, some adult learners mastered English grammar to a moderate degree, and others very poorly.

![FIGURE 6.3 Performance on a test of grammatical competence as a function of age of immigration from East Asia to United States (data from Johnson & Newport, 1989).](image-url)
Like Johnson and Newport's research, most studies of the critical period for grammar learning have focused on second language learning, because it would be unethical to withhold exposure to a first language from a developing child. However, there have been some rare cases of children who grew up with- out language input because of extreme neglect or abuse. One such child, Genie, was first discovered at age 13 years, 7 months, after having been confined to a small room from the age of 20 months. Genie made great strides in language acquisition after her discovery, but she was unable to acquire many of the more subtle aspects of grammar, such as the auxiliary verb system (for example, she consistently omitted "will" in sentences such as "I will go home") and passive constructions (she produced no sentences such as "The ball was hit by Molly") (Curtiss, 1977). These data are consistent with the idea that language input during a critical period is essential for acquiring at least some aspects of grammar. However, it is possible that Genie may have had other developmental or learning problems in addition to her lack of language exposure, so one cannot definitively conclude that her inability to acquire these grammatical structures is due to lack of input in the critical period.

One naturalistic situation in which children may grow up without language input in their early years is the case of deaf children of hearing parents. Some of these children are not exposed to fluent sign language until they enter school. Again, consistent with the critical period hypothesis, these "late learners" of sign language generally perform less well than individuals who learn sign language from birth on tests that require high grammatical competence, such as recall of complex sentences (Mayberry, 1993; Mayberry & Elchanan, 1991; Newport, 1990). Late learners of American Sign Language also perform more poorly than do native signers when they later learn English in written form (Mayberry, Lock, & Kazmi, 2002).

These findings clearly support the idea that grammar learning is superior early in development. However, other studies have raised a number of questions. Some studies have shown that at least some adults who learn English as a sec- ond language do acquire grammatical proficiency comparable to that of native speakers (Bialystok & Hakuta, 1994; White & Genesee, 1992). Other studies sug- gest that, contrary to the critical period hypothesis, the decrease with age in the ability to learn a second language is gradual rather than sudden (Hakuta, Bialystok, & Wiley, 2003). Thus, the critical period debate is far from settled.

**EXPLANATIONS OF GRAMMATICAL DEVELOPMENT**

Currently, there is no generally accepted theory of grammatical development. However, several accounts seem to tell parts of the story.

**Basic child grammar.** Spe Goodenough (1986) proposed that children impose a basic child grammar on whatever language input they receive. This view is a first cousin of the constraints approach to word meaning and a second cousin of Piaget's general concept of assimilation. Within Slobin's view, children expect that certain meanings are sufficiently important that they should be reflected in grammar. They also expect that particular meanings should be expressed in par- ticular places within phrases. When meanings that children believe are impor- tant are marked by the grammar of the language where children believe they should be, children learn the grammatical conventions quickly. When the gram- matical markings are in different places, or when children do not expect the meaning to be important at all, they learn more slowly.

Use of negative terms illustrates Slobin's general idea. Negatives affect the meaning of the entire phrase they modify. When we say, "He didn't run to the store," the negative in "didn't" modifies the entire verb phrase "did run to the store." Children's errors indicate that they try to keep the negative outside of the phrase, even when the language they hear places it inside the phrase. In Turkish, correct sentences specify the verb, then indicate whether the meaning is negative, and then complete the verb phrase (as in "He run didn't to the store"). Turkish children often err, however, by moving "didn't" outside the verb phrase (as in "He didn't run to the store"). Thus, children's expectations can, for a time, override the language to which they are exposed, leading to grammatici- cal errors. More generally, the fit between children's expectations and the grammatical conventions of the language they hear influences how quickly they learn the grammar.

**Semantic bootstrapping.** Children's early sentences usually follow stan- dard orders of meanings such as agent-action-recipient (e.g., "Billy hit me"). Eventually, however, children also produce sentences that deviate from such standard sequences. For example, when a child says, "Going to school sure is fun," the grammatical subject ("going to school") is not an agent, the verb ("is") is not an action, and the grammatical object ("fun") is not a recipient of any ac- tion. As children's grammatical competence grows, they also recognize that a meaningless sentence can still be grammatically correct (for example, "Frequent exercise prevents restless windows."). A full account of grammatical under- standing must explain how people reach such abstract understanding of gram- mar and what role their initial understanding of meaning plays in the process. Pinker (1984) proposed that early learning of grammar is based on semantic bootstrapping. The key idea is that children first identify the most common catego- ries of meanings in the sentences they hear (for example, the person or thing that produces the action, the name of the action, and the person or thing affected by the action). They then use these meanings to form meaning-based categories and rules for ordering words in sentences. Finally, they use these meaning-based categories and rules to "pull themselves up" to purely grammatical categories and rules.

Such a learning process is possible because grammatical categories tend to be correlated with meanings. In English, names of persons or things usually
function as nouns, actions as verbs, and attributes of persons or things as adjectives. These relations provide a basis for early analysis of sentences. For example, from frequent exposure to sentences such as “Babar jumped on the bed,” children learn that in English, the agent who engaged in the action is typically named at the beginning of the sentence, that the action itself is typically in the middle, and that the recipient of the action is typically at the end. This provides a basis for the child to order words within sentences according to the agent-action-recipient framework.

These early sentence frames not only allow children to produce grammatical sentences; they also provide a basis for learning grammatical rules that are not based on meaning. Pinker hypothesized that grammatical categories such as noun, verb, subject, and predicate are innate to human beings. Children’s learning task is to identify how these grammatical categories function within their particular language. They do this by establishing correspondences between the meanings they initially represent and the innately known grammatical categories. For example, they map the grammatical category “agent” onto the meaning-based concept “agent” and the grammatical category “verb” onto the meaning-based category “action.” Once they code the language they hear in terms of these grammatical categories, they note regularities of ordering, phrasing, and intonation that allow them to extend the grammatical categories to cases where the grammatical subject is not an agent and the verb is not an action (such as “The house has three bedrooms” or “Going to school is fun”). In doing this, they create the purely grammatical categories that characterize mature grammatical competence.

Construction grammar. Another approach to understanding grammatical development, the construction grammar approach, denies the existence of innate grammatical categories like those hypothesized by Pinker and Chomsky. Instead, according to this view, early grammatical development involves learning specific linguistic items, or constructions. A construction is defined as a “complete and coherent verbal expression associated in a relatively routinized manner with a pro- completely and coherent communicative function” (Tomasetto & Brooks, 1999, p. 162). In essence, constructions are recurrent linguistic patterns. For example, “Where’s X?” is a simple construction that conveys the communicative function of seeking something. It has an abstract “slot” for a noun indicating the thing being sought ("Where’s Daddy?", “Where’s doggie?”, “Where’s bottle?”).

According to the construction grammar approach, early grammatical development involves learning constructions and beginning to use them productively (Tomasetto & Brooks, 1999). Beginning language learners readily substitute nouns for one another in constructions; however, verbs and other predicates must be learned one by one, each as a novel construction (Tomasetto, 2000). Thus, children’s early constructions often revolve around verbs or other predicate constructions, with open slots for nouns, such as “Eat X” or “See X.”

The systematic two-element combinations described by Braine (1976) (such as “all gone juice,” “all gone milk”) are examples of such constructions.

Before 2 to 3 years of age, children tend to use only one type of construction for each verb (Lieven, Pine, & Baldwin, 1997; Tomasello, 1992). For example, a child who uses the construction “Eat X” (“Eat apple,” “Eat cereal”) is unlikely to also use the construction “X eats” (“Mommy eats,” “Doggy eats”). Thus, learning one construction involving a particular verb does not immediately enable children to generate other constructions involving that same verb. Advocates of the construction grammar approach have taken this finding as evidence that children do not have an innate grammatical category of verb, because an innate category should allow them to quickly generalize to other new constructions (Tomasello, 2000).

With time, children extract commonalities among the individual, verb-based constructions, and in so doing they develop more abstract constructions, such as transitive sentences (“noun phrase – verb – noun phrase,” as in, “Molly hit the ball,” “Willie pushed the truck”) and locatives (“noun phrase – verb – noun phrase – location,” as in, “Amy put the cup on the table”). According to Tomasello (2000), this development occurs through processes of structure combination and analogy formation. Children begin to combine simple constructions into more complex ones; for example, the constructions “Eat X” and “X eats” may be combined into a larger construction such as “X eats X” (“Mommy eats cake”). Children also begin to notice structural similarities among various constructions and form analogies on the basis of these similarities. Eventually they extract the common structures in these analogically similar sets, and these common structures form the basis of more abstract constructions. For example, a child might notice the similarities between “X eats X,” “X pushes X,” and “X breaks X,” and on this basis, the child might abstract the more general construction “noun phrase – verb – noun phrase.”

Through these mechanisms, according to construction grammar theorists, children eventually develop general syntactic structures that are no longer based on individual items.

Connectionist accounts. As discussed in Chapter 3 (pp. 92–97), several connectionist models of development have focused on learning of grammar (e.g., Elman, 1993; MacWhinney & Chng, 1995; MacWhinney & Leinbach, 1991; Plunkett & Marchman, 1993). These models have demonstrated that computer simulations that encode features of phonology, meaning, and word order can learn complex grammatical systems such as English past tense forms and German gender and case markings.

Connectionist systems operate by detecting patterns of correlations in the language that is presented and using these correlational patterns to predict what grammatical form should be used in new situations. This type of mechanism may also be at work in children’s learning of grammar. All of the connectionist models learn grammar quite slowly, as a result of exposure to thousands and
thousands of instances. This fits children's learning of grammar quite well. As Maratsos (1998) has noted, grammatical systems are so complex that children's acquisition of them is by necessity more like a process of "grinding through," than like a process of testing a few hypotheses to see how the system works.

Evaluation. How can we evaluate these alternative accounts of children's acquisition of grammar? In many ways, they resemble the proverbial story of the blind men feeling different parts of the elephant. Each explanation incorporates part of the truth, but none the totality. Slobin's and Pinker's emphasis on the role of meaning in formation of early grammatical categories seems well founded. Pinker's semantic bootstrapping idea is an attractive transition mechanism. The notion that early performance is based on learning particular constructions is also intuitively appealing. The connectionist idea that grammatical competence is based on detection of complex patterns of correlations within the language also is clearly a large part of the story. Yet the views are sufficiently different that it is unclear how they could be integrated into a single theory. In sum, the task of explaining grammatical development continues to challenge the best minds in the field.

Communication

The ultimate purpose of language is communication. Such communication can be accomplished either through spoken language or through signed language. These modes of communication are considered in the following sections.

COMMUNICATION THROUGH SPOKEN LANGUAGE

Communication to and from infants. Rudimentary communication skills are present even in the first months after birth. Already by 3 or 4 months, infants act in ways that motivate adults to speak to them. They tend to be quiet when an adult talks to them and to vocalize more when the adult stops talking (Ginsburg & Kilbourne, 1988). In the first few months after birth, infants' and mothers' vocalizations frequently clash, in the sense of occurring simultaneously. By 3 or 4 months, however, the interactions evolve into a smooth turn-taking process, akin to that of the conversations of older children and adults. Infants of bilinguals also tend to reproduce the gestures and intonation patterns just produced (Masatake, 1992). The infants' turn taking and reproduction of intonational patterns encourages adults to talk more with them than if they remained silent or behaved in ways uncorrelated with what the adult was saying (Locke, 1995).

Adults, in turn, speak to infants in ways that encourage them to listen and respond. Just as infants imitate their mothers' intonational patterns, mothers

imitate the speech sounds that infants make. When mothers imitate their infants' speechlike sounds, but not other vocalizations, the infants' proportion of speechlike sounds increases (Bloom, Russell, & Wassonberg, 1987). As noted in the previous chapter, adults and older children in many cultures also use a form of speech known as infant-directed speech, or "motherese," in which they speak using high pitch, exaggerated intonations, short, simple sentences, and elongated vowels (as when saying "Wheeeee"). From an early age, infants prefer infant-directed speech to adult-directed speech (Cooper & Aslin, 1990). When caregivers use infant-directed speech, infants pay increased attention to what is being said and to the caregiver's activities more generally (Fernald, 1992).

Infant-directed speech is very common among the world's cultures, but it is not universal. For example, on the island of Java, parts of Guatemala, and parts of Western Samoa, parents rarely talk to babies (Ochs & Schieffelin, 1995; Pye, 1992; Smith-Hefner, 1988). When Kaluli adults in New Guinea saw Westerners speaking infant-directed speech to babies, they wondered how the babies ever learned to speak proper language (Schieffelin, 1990). In these societies, infants and toddlers learn language primarily by observing adults speaking. These cases cannot be dismissed as minor exceptions; 100 million people live on Java. The practices may not seem very conducive to language learning, but children still master the grammars of their native language quite efficiently (Ochs & Schieffelin, 1995).

Communication to and from toddlers and older children. When babies begin to produce words, they add new strategies for communicating. Some of these strategies are unique to beginning language users. For example, some toddlers repeat entire phrases with only minimal grammatical alterations (Billman & Shatz, 1981; Keenan, 1977). When one father asked his 2-year-old son, "Are you a great big boy?" he responded, "I are a great big boy." The early responses to wh questions that were described previously provide another example of such imitations. The imitations often are considerably longer than the child's typical sentences at that time. Thus, they may provide a stepping stone for constructing longer and more complex sentences than the child previously generated (Schlesinger, 1982).

As children develop, they become increasingly able to take their communication partners into account when they use language (Krauss & Glucksberg, 1969; Sonnenschein, 1986, 1988). For example, children as young as 2 years of age simplify their speech when speaking to younger children (Tomasello & Moore, 1977) and to deaf children (Schachter & Gelman, 1973) and to deaf children (Schachter & Gelman, 1973). Children also alter their communicative behavior depending on whether their listener can see them. Children as young as 3 use more verbally explicit speech when speaking to a blindfolded listener than when speaking to a listener who is not blindfolded (Maratsos, 1973), and kindergarteners use fewer gestures along with their speech when speaking to a listener who is sitting behind a curtain than when speaking to a listener face-to-face (Alibali & Don, 2001). Thus,
even very young children can modify their communicative behavior to fit their listeners' needs, and this ability improves with age and experience.

Although infants and toddlers bring a great deal to the task of communication, understanding some of the finer points requires direct parental effort. Learning of politeness conventions is one prominent example, as illustrated in the following conversation (cited in Ely & Gleason, 1995, p. 252):

**CHILD:** Mommy, I want more milk.

**MOTHER:** Is that the way to ask?

C: Please.

M: Please what?

C: Please gimme milk.

M: No.

C: Please gimme milk.

M: No.

C: Please . . .

M: Please may I have more milk?

C: Please may I have more milk?

COMMUNICATION THROUGH SIGNED LANGUAGE

Signed languages, such as American Sign Language (ASL) and Quebec Sign Language (Langue des Signs Quebecoise, or LSQ), are true languages in every sense of the word. They have lexicons that consist of thousands of signs and grammars that are as rich and complex as the grammar of any spoken language. There are hundreds of different signed languages that are used in Deaf communities throughout the world. Like spoken languages, each one is unique—users of one sign language generally cannot understand other sign languages.

Deaf children who acquire sign languages from birth, and hearing children who acquire spoken languages from birth, show closely parallel paths of language acquisition (Petitto, 1992, 1995). Both groups babble, produce one-word phrases, and produce two-word phrases at similar ages; they produce grammatical forms such as past tenses, negatives, and questions at similar ages; and they acquire similar meanings and similar communicative competence at similar ages. Older children in both groups use considerable amounts of nonliteral language, such as metaphor, simile, and invented words (Marschark & West, 1985; Marschark, West, Nall, & Everhart, 1986).

The similarities in children's acquisition of sign and speech led Petitto (1995) to suggest that the same language acquisition mechanism leads to learning of both spoken and signed language. She hypothesized that this mechanism recognizes input that is structured in the way that both spoken and signed language is, and that once the learning system recognizes relevant input, it stimulates motor activity (speech or manual activity) that responds to that structure, regardless of whether the structured input is seen or heard.

Stokoe (1960) described three dimensions that determine meaning within individual signs. One is the location at which a sign is made. The most common locations, in order of frequency, are the area in front of the body where the hands ordinarly move, the chin, the trunk, the cheek, the elbow, and the forehead. These also are the locations at which young children find it easiest to produce signs, one more instance of languages' having evolved to facilitate learning (Bonvillian, Orlinsky, & Novack, 1983). A second dimension that distinguishes signs is the shape or configuration of the hands. Several common handshapes are shown in Figure 6.4. The third dimension of variation among signs is the action or movement involved in making the sign. For example, the ASL sign for "candy" is produced by making a rotating movement with the index finger at the cheek. Of these three dimensions, location appears to be easiest for children to master, and handshape the most difficult. In a study of nine children (ages 5 to 18 months) acquiring ASL, Bonvillian and Siedlecki (2000) found that children were most accurate in producing the location of a target sign (over 80 percent correct), next most accurate at producing movement (about 60 percent correct), and least accurate at producing handshape (about 50 percent correct).

**FIGURE 6.4** Some hand shapes that are commonly used in American Sign Language.
Deaf children of hearing parents who are not exposed to signed languages in early childhood often invent simple gestural languages, called home sign systems, for communicating with their families. These children use their home sign systems to communicate information, make requests, tell stories, and talk about objects and events, both present and absent (Goldin-Meadow, 2003; Morford & Goldin-Meadow, 1997; Phillips, Goldin-Meadow, & Miller, 2001). Such children even use home sign to talk to themselves! Thus, home sign systems serve the same functions as do conventional languages. Based on their observations of a set of ten home signers, Goldin-Meadow and Morford (1985) commented, "Communication in humans is a resilient phenomenon; when prevented from coming out of the mouth, it emanates almost irreplaceably from the fingers." (p. 146).

One of the most striking aspects of home sign systems is that they have language-like structure at a variety of levels. Each child's home sign system can be characterized by a simple grammar that specifies how individual signs are combined into sentences (Goldin-Meadow, 1977; Goldin-Meadow & Mylander, 1984, 1998). For example, in most (but not all) children's home sign systems, when describing an action on an object, the object is named before the action ("apple eat"). Furthermore, like signs in conventional sign languages, individual signs within home sign systems are made up of components, such as handshape and motion, that combine in systematic ways to express meaning (Goldin-Meadow, Mylander, & Butcher, 1995). Thus, home sign systems are structured like conventional languages, both at the sentence level and at the level of individual signs. Moreover, it is clear that children create these language-like structures on their own, because the gestures used by the children's hearing parents do not display such structure (Goldin-Meadow & Mylander, 1983).

Despite their similarities, home sign systems also differ from true signed languages in important respects. Most important, home sign systems are less systematic and less grammatically complex than true signed languages are. Why might this be the case? Unlike signed languages, home sign systems are invented by individual children, rather than being passed down and refined from generation to generation. In addition, home sign systems tend to be shared by only a few individuals (with only one native speaker, the inventor), rather than by an entire linguistic community. These factors appear to be important in the evolution of full-fledged, conventional languages.

In Nicaragua in the late 1970s, a number of deaf home signers were brought together in the nation's first school for the deaf. As these children attempted to communicate with one another, the set of signs rapidly coalesced into a new, shared language. The new sign language that emerged in this situation was far more systematic and grammatically complex than any of the individual home sign systems upon which it was based, and it became even more complex as the next generation of young deaf children learned it as a native language (Keeg, Senghas, & Coppola, 1999; Morford & Keeg, 2000; Senghas & Coppola, 2001). This new language is called Lengua de Signos Nicaraguense (Nicaraguan Sign Language), and it is one of few instances of the birth of a new language that has been observed systematically.

Summary

The acquisition of language in the first few years of life is one of children's greatest achievements. They quickly learn phonology, meanings, and grammar, and they use this knowledge in the service of communication. Phonology refers to the production and comprehension of speech sounds. Meaning refers to relations between words and what they describe. Grammar involves the ordering of words into sentences, as well as the specification of tense and number. Communication is the way phonology, grammar, and meaning are used together to express desires and intentions, elicit reactions, and provide information.

Phonologies of all languages involve production of vowels and consonants. Impeding the usual flow of air is critical to both. However, they differ in the particular type of impediment that produces them. With vowels, the only impediments are produced by the vocal cords; with consonants, the tongue, teeth, and lips produce additional ones. Infants know a great deal about the phonology of their native language before they can produce any words. They are initially sensitive to many distinctions among sounds; however, late in the first year, they begin to lose their sensitivity to distinctions that are not meaningfully different in their language. Infants' ability to produce sounds develops in a regular sequence. First infants cry, then they coo, then they produce consonant sounds, then they babble, and then they produce words. Languages throughout the world take advantage of the types of syllables that babies babble most often by making these names of caregivers: mom, dad, and so on. The ease of understanding what beginning speakers say is improved both because they avoid words with difficult-to-make sounds and because languages tend to use relatively easy-to-pronounce words to name objects that young children wish to discuss. Later phonological development occurs in the ability to control the sounds that are made and in the clarity of pronunciation.

Throughout the world, children's first words express similar meanings. The words refer to people, animals, toys, vehicles, and other objects that interest children. The set of words is relatively concrete, and that the children want. Even when beginning language users say the same words as adults, they may not assign the same meanings to them. At first, children understand some meanings, overextend others, and develop some meanings that are underextended in some ways and overextended in others. The rate of acquisition of new words is at first gradual, but it speeds up greatly at about age 18 months. Some factors that may be
involved in this vocabulary spurt are constraints that narrow the range of possible word meanings, grammatical cues to word meaning, general cognitive processes such as learning and memory, and social experience. Children also use a variety of clever strategies to invent words for expressing meanings when they do not know any appropriate standard word.

Grammatical development begins in infancy, when children begin to distinguish grammatical from content words, and when they become sensitive to regularities in word order in the language that they hear. When children begin to produce two-word phrases, they need to order words within their utterances. At first, children base their ordering of words on the words’ meanings. The orders follow standard patterns such as agent-action and possessor-possessed object. After the two-word period, children learn to form a wide variety of grammatical constructions, many of them based on categories that have no clear correspondence to meanings. Among the factors that contribute to formation of purely grammatical categories and rules are children’s expectations about the forms grammars should take, bootstrapping from early meaning-based categories to later grammar-based ones, learning of constructions, and detection of regular patterns within the language.

Children communicate both through spoken language and through signed language. Long before infants say words, they motivate older people to talk to them by moving in synchrony with speech intonations and making sounds when the other person stops talking. Adults and older children motivate young children to listen by adopting the conversational style known as infant-directed speech, involving high pitch, exaggerated intonations, and simple sentences. Both deaf and hearing children who are exposed to signed languages use those languages to communicate, and deaf children who are not exposed to signed languages invent and use informal sign systems, called home sign systems, which have a simple, language-like structure. There are notable parallels in the order and timing of linguistic development between children who are learning spoken languages and children who are learning signed ones. These parallels suggest that there may be a general motivation to communicate and to find regular structures in communicative input, regardless of whether that input arrives through the eye or the ear.

**Recommended Readings**

**Bloom, P.** (2000). *How children learn the meanings of words*. Cambridge, MA: MIT Press. In this book, Bloom argues that word learning depends on general cognitive abilities, including the ability to infer others’ intentions and certain general learning and memory abilities.


**Senghas, A. & Coppola, M.** (2001). Children creating language: How Nicaraguan Sign Language acquired a spatial grammar. *Psychological Science, 12*, 323–328. A study of language creation in a group of deaf Nicaraguans who were not exposed to conventional sign language in early childhood. When this group came together in Nicaragua’s first school for the deaf, a new sign language was “born,” and this sign language has become more systematic with each successive generation of learners.