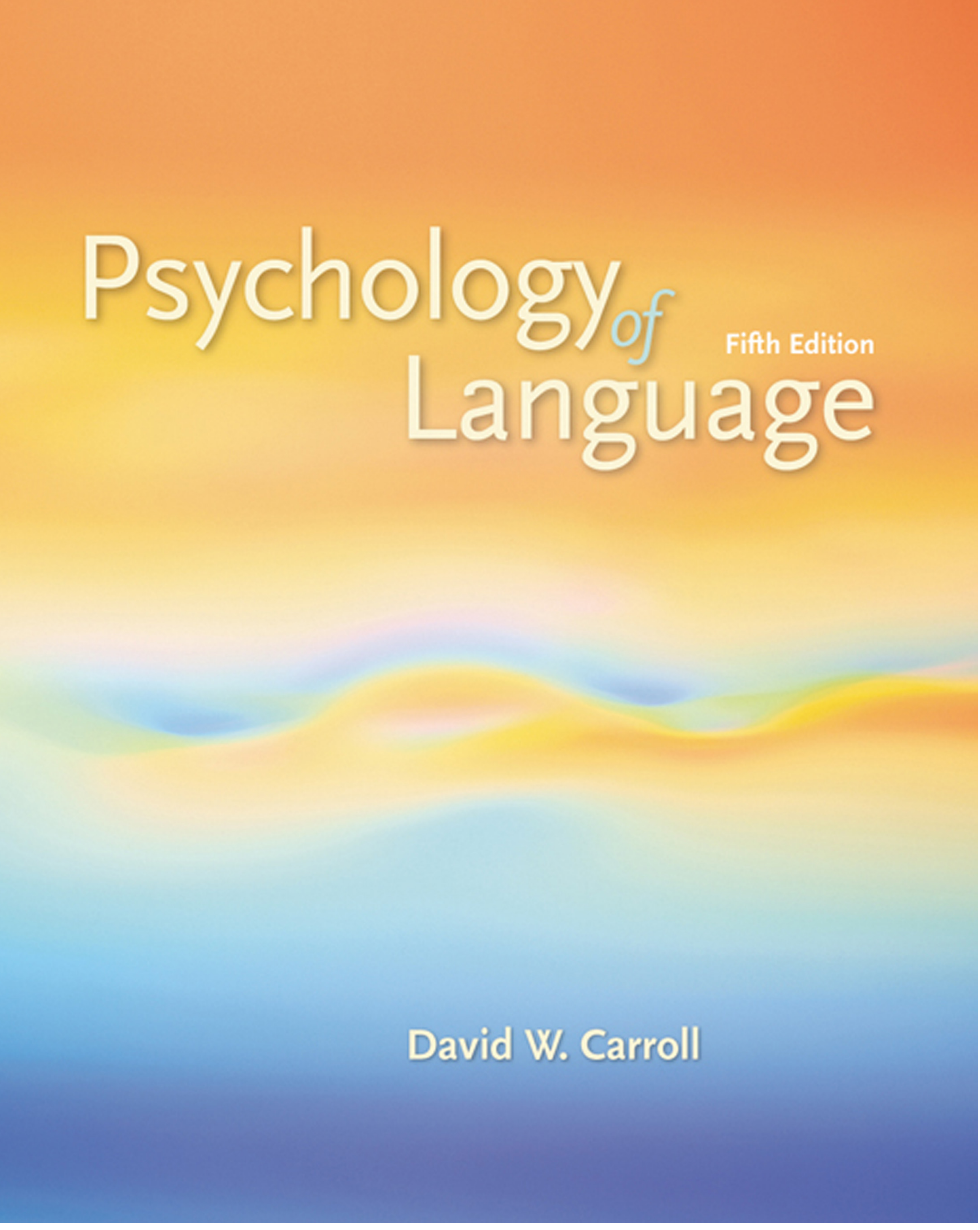

Psychology of Language

Fifth Edition

David W. Carroll

Psychology of Language

FIFTH EDITION

DAVID W. CARROLL
University of Wisconsin–Superior

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For my mother, Mary M. Carroll,
and in memory of my father, Patrick E. Carroll

David W. Carroll received a B.A. in psychology and philosophy from the University of California at Davis (1972) and an M.A. (1973) and Ph.D. (1976) in experimental and developmental psychology from Michigan State University. He has taught at the University of Wisconsin–Superior since 1976. He is currently a Professor of Psychology and previously served as chair of the psychology program. Dr. Carroll teaches courses in introductory psychology, psychology of language, cognitive psychology, and child development, and he conducts research on discourse comprehension, critical thinking, and the teaching of psychology. He is a member of the Society for Text and Discourse, the Division of Experimental Psychology, the American Psychological Society, the Society for General Psychology, and the Society for Teaching of Psychology.

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Preface

Some of the most fascinating questions about human behavior deal with language. Are we born with a propensity for acquiring language, or is this a skill that is nurtured by one's environment? What causes slips of the tongue? How does brain damage influence language functioning? Do individuals who speak different languages think differently? To pursue answers to these and many other questions, we must cut across some of the traditional boundaries of psychology. We will need to study children as well as adults and examine language both in the laboratory and in natural settings. Ultimately, as we pull all of these different strands together, we come to appreciate language as a whole and the central role it plays in human affairs.

It has been over 20 years since the first edition of this book was published. However, my goals for the book remain essentially the same. I want to present the principles of psycholinguistics in a manner that is accessible to undergraduates. Although the field can be technical at times, when presented clearly, it can be very engaging to students. In addition, I want to discuss fundamental psycholinguistic issues in a balanced way. I have presented controversial issues from a variety of perspectives and invited the reader to think through the competing claims.

The organization of the book is similar to earlier editions. Part 1 (General Issues) contains three chapters. Chapter 1 describes the scope of psycholinguistics along with a short history of the field. Chapter 2 discusses basic grammatical concepts such as phonemes, distinctive features, and morphology. The chapter also includes the grammatical features of American Sign Language, a topic that is discussed throughout the book. The chapter closes with a preliminary discussion of some controversial issues in linguistic theory, such as the psychological reality of grammar and whether language is innate. Chapter 3 focuses on basic concepts of information processing and how they may apply to language. The overriding goal of Part 1 is to introduce the notion of a cognitive approach to language processes, an approach that emphasizes the interrelationships among language, memory, and cognition.

This approach is then applied to various aspects of language processing. Part 2 (Language Comprehension) includes chapters on perception, the lexicon, sentence processing, and discourse processing. Chapter 4 discusses speech perception and reading, including research on nonalphabetic orthographies. Chapter 5 presents current knowledge on the organization of the internal lexicon, and it examines how we access words during comprehension. Chapter 6 discusses sentence comprehension, including parsing, figurative language, and memory for sentences. Chapter 7 emphasizes levels of discourse representation and how they function individually as well as in concert with one another.

Part 3 (Language Production and Conversational Interaction) contains one chapter on language production and one on conversation. Chapter 8 discusses speech errors and various explanations for them, as well as the process of implementing speech plans. Chapter 9 describes the tasks involved in conversational interaction and discusses how interaction varies with different conversational settings and participants.

Part 4 (Language Acquisition) contains three chapters. Chapter 10 discusses infants' use of gestures prior to language and the child's initial steps in language acquisition, including first words and the emerging ability to form multiword utterances. Chapter 11 discusses language acquisition in the late preschool and school years, with an emphasis on metalinguistic awareness and reading. Chapter 11 also considers bilingualism and second-language acquisition in children. Chapter 12 examines and appraises different theories of language acquisition.

Finally, Part 5 (Language in Perspective) includes Chapter 13 on biological foundations and Chapter 14 on language, culture, and cognition, with particular emphasis on the Whorf hypothesis. These last two chapters are somewhat broader in scope than most of the earlier ones and help put basic psycholinguistic processes (comprehension, production, and acquisition of language) into biological and cultural perspective.

For those familiar with earlier editions of the book, there are a number of changes in this edition. Chapter 3 is completely rewritten, reflecting contemporary research in working memory and episodic memory, and their relevance for language processing. Chapter 4 now includes a comparison of the dual-route and connectionist models of reading. Chapters 6 and 8 have new sections on the role of working memory in language comprehension and production, respectively. In fact, Chapter 8 has been substantially revised to incorporate newer research on covert monitoring, the lexical bias effect, and the "tip of the finger" effect in ASL. The treatment of bilingualism in Chapter 11 has been updated. Chapter 12 now includes a discussion of twin and adoption studies. Chapters 13 and 14 have updated discussions of fMRI studies of language processing and the effects of color on cognition, respectively.

This edition also follows the style of the earlier editions. Psycholinguistic terms are printed in boldface. When a linguistic example is of sentence length or longer, I have generally used the convention of numbering the example and setting it apart from the text. For shorter examples, italics are used. Quotation marks are employed when a term is used in an unusual or ironic manner.

This edition includes a number of pedagogical features that will be helpful to students. Chapters begin with a list of about four to six main points that the student should expect to learn. Interim summaries occur after each major section of the chapter, so that readers may assess their learning before going on. Each chapter concludes with two sets of questions. Review Questions are directly related to the material in the chapter, and students should be able to answer them if they have read the chapter carefully. Thought Questions are intended to stimulate thinking about the material in the chapter. Although the answers to these questions cannot be found directly in the chapter—indeed, most have no single "correct" answer—the material presented provides a basis for beginning to examine these questions. Finally, the book includes a glossary.

An instructor's manual, prepared by Lydia Volaitis of Northeastern University, is available for instructors who have adopted the book for classroom use. The manual includes multiple-choice questions and suggested classroom activities, readings, and Web sites for each chapter.

Additional resources for this book, including chapter-by-chapter glossaries, flashcards, and Web links, can be found at http://www.thomsonedu.com/psychology/dcarroll.

Once again, I would be delighted to hear from students or professors who are using this book. You can reach me at the University of Wisconsin–Superior, Superior, WI 54880, or by e-mail (dcarroll@uwsuper.edu).

I am pleased to acknowledge the assistance of many people in the preparation of this edition. First, I have benefited from the advice of a first-rate group of reviewers. They include Sara Gilliam, New Mexico State University; Richard Hurtig, University of Iowa; Michael Palij, New York University; Sandra Rietz, Montana State University–Billings; and William Sturgill, Rockhurst University.

I also want to thank Alice S. Horning of Oakland University and her students for their helpful comments on the fourth edition of this text.

The staff at Thomson Wadsworth was once again most helpful. I would like to thank Marti Paul, Christina Ganim, Gina Kessler, Karol Jurado, and Erik Evans. I would also like to thank Ravi Lakhina, Santosh Vasudevan, Laura Larson, and Richard Camp for their contributions to the finished product.

Finally, I want to thank my wife, Deb, who has endured my periodic absences, both physical and mental, during all five editions with patience, support, and love.

PART I

⁂

General Issues

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1 Introduction: Themes of Psycholinguistics
2 Linguistic Principles
3 Psychological Mechanisms

1

Introduction: Themes of Psycholinguistics

> Language in general is important not only because it distinguishes human beings from all other animals on the earth but because, directly or indirectly, it makes possible the elaborate organization of civilized society . . . and language in general is interesting because, although everyone knows and uses a specific language, few people understand what they know. Becoming self-consciously aware of what is known unself-consciously carries a special brand of excitement.
>
> —GEORGE A. MILLER (1991, p. 2)

- **Introduction**
- **The Scope of Psycholinguistics**
  - *Language Processes and Linguistic Knowledge*
  - *Four Language Examples*
  - *Summary*
- **The Historical Context**
  - *Early Psycholinguistics*
  - *Behaviorism and Verbal Behavior*
  - *Later Psycholinguistics*
  - *Current Directions*
  - *Summary*
- **Review Questions**
- **Thought Questions**

MAIN POINTS

- Psycholinguistics is the study of how individuals comprehend, produce, and acquire language.
- The study of psycholinguistics is part of the field of cognitive science. Cognitive science reflects the insights of psychology, linguistics, and, to a lesser extent, fields such as artificial intelligence, neuroscience, and philosophy.
- Psycholinguistics stresses the knowledge of language and the cognitive processes involved in ordinary language use.
- Psycholinguists are also interested in the social rules involved in language use and the brain mechanisms associated with language.
- Contemporary interest in psycholinguistics began in the 1950s, although important precursors existed earlier in the 20th century.

INTRODUCTION

This book is about how people use language. Few things play as central a role in our everyday lives as language. It is our most important tool in communicating our thoughts and feelings to each other. Infants cry and laugh, and their facial expressions surely give their parents some notion of the kinds of emotions they are experiencing, but it is not until children are able to articulate speech that we gain much understanding of their private thoughts.

As we grow, language comes to serve other functions as well. Most young people develop jargon that is more meaningful to those of the same age than to older or younger individuals. Such specialized language serves to bind us more closely with our peers while at the same time excluding those who are not our peers. Language becomes a badge of sorts, a means of identifying whether a person is within a social group. Similar processes are at work in gender and social class differences in language use.

Over time, for many of us language becomes not merely a means to an end but an end in itself. We come to love words and word play. So we turn to writing poetry or short stories. Or to playing word games, such as anagrams and crossword puzzles. Or to reading novels on a lazy summer afternoon. A tool that is vital for communicating our basic needs and wants has also become a source of leisurely pleasure.

The diversity of how we use language is daunting for psychologists who wish to study language. How can something so widespread and far-reaching as language be examined psychologically? An important consideration is that although language is intrinsically a social phenomenon, psychology is principally the study of individuals. The psychology of language deals with the mental processes that are involved in language use. Three sets of processes are of primary interest: language comprehension (how we perceive and understand speech and written language), language production (how we construct an utterance, from idea to completed sentence), and language acquisition (how children acquire language).

The psychological study of language is called **psycholinguistics**. This book explores the principles of this field along with selected applications. This introductory chapter deals with two questions: What is psycholinguistics? and How has this field evolved over the last century?

THE SCOPE OF PSYCHOLINGUISTICS

Psycholinguistics is part of the emerging field of study called **cognitive science**. Cognitive science is an interdisciplinary venture that draws upon the insights of psychologists, linguists, computer scientists, neuroscientists, and philosophers to study the mind and mental processes (Stillings et al., 1995). Some of the topics that have been studied by cognitive scientists include problem solving, memory, imagery, and language. Anyone who is seriously interested in any of these topics must be prepared to cross disciplinary lines, for the topics do not belong to any one field of study but rather are treated in distinctive and yet complementary ways by various disciplines.

As the name implies, psycholinguistics is principally an integration of the fields of psychology and linguistics. **Linguistics** is the branch of science that studies the origin, structure, and use of language. Like most interdisciplinary fields, however, psycholinguistics has a rich heritage that includes contributions from diverse intellectual traditions. These contrasting approaches have often led to controversies in how to best think of or study language processes. We will consider many of these issues in the pages to come. For now, let us begin our survey of psycholinguistics by examining some of its central themes.

Language Processes and Linguistic Knowledge

At its heart, psycholinguistic work consists of two questions. One is, What knowledge of language is needed for us to use language? In a sense, we must know a language to use it, but we are not always fully aware of this knowledge. A distinction may be drawn between **tacit knowledge** and **explicit knowledge**. Tacit knowledge refers to the knowledge of how to perform various acts, whereas explicit knowledge refers to the knowledge of the processes or mechanisms used in these acts. We sometimes know how to do something without knowing how we do it. For instance, a baseball pitcher might know how to throw a baseball 90 miles an hour but might have little or no explicit knowledge of the muscle groups that are involved in this act. Similarly, we may distinguish between knowing how to speak and knowing what processes are involved in producing speech. Generally speaking, much of our linguistic knowledge is tacit rather than explicit. Reading this book will make you more aware of various things you know about language, thereby transforming some of your tacit knowledge into explicit knowledge.

Four broad areas of language knowledge may be distinguished. **Semantics** deals with the meanings of sentences and words. **Syntax** involves the grammatical arrangement of words within the sentence. **Phonology** concerns the system of sounds in a language. **Pragmatics** entails the social rules involved in language use. It is not ordinarily productive to ask people explicitly what they know about these aspects of language. We infer linguistic knowledge from observable behavior.

The other primary psycholinguistic question is, What cognitive processes are involved in the ordinary use of language? By "ordinary use of language," I mean such things as understanding a lecture, reading a book, writing a letter, and holding a conversation. By "cognitive processes," I mean processes such as perception, memory, and thinking. Although we do few things as often or as easily as speaking and listening, we will find that considerable cognitive processing is going on during those activities.

Four Language Examples

The interplay of linguistic knowledge and language processes is a continuing theme through this book. Because these concepts play a central role in psycholinguistic work, the following two chapters explore the knowledge and process questions in greater depth. Chapter 2 discusses linguistic insights into our tacit knowledge, and Chapter 3 considers psychological mechanisms of information processing and how these processes may be used in language processing. For now, it will be helpful to consider various examples of language and language processes. The following examples are intended to illustrate how the aforementioned themes apply to specific situations as well as to convey some of the scope of psycholinguistic research.

Garden Path Sentences What happens when we comprehend a sentence? We get a hint of what is involved when the process breaks down. For example, consider sentence (1):

(1) The novice accepted the deal before he had a chance to check his finances, which put him in a state of conflict when he realized he had a straight flush. (Adapted from Foss & Jenkins, 1973)

Sentences such as this are sometimes called **garden path sentences** because the subjective impression is one of following a garden path to a predictable destination until it is obvious that you were mistaken in your original interpretation and thus are forced to "backtrack" and reinterpret the sentence. That is, in terms of knowledge, we have stored in our memory at least two different meanings of the word *deal*. One is related to a business transaction, and the other, relevant in this case, pertains to card games. This knowledge of the two meanings of *deal* is part of our semantic knowledge of the language. Another part of our semantic knowledge is knowledge of the relationships among words, such as *deal* and *finances*. From a process standpoint, we appear to select the one that is most appropriate, and we have little or no conscious awareness of the alternative (or how else would we have the garden path experience?). That is, we are able, by some process, to focus our attention on what we believe is the relevant meaning of *deal*. Studies of ambiguity are examined in Chapters 5 and 6; we will find that there is more to garden path sentences than what we are immediately aware of. The point for now is that in the course of comprehending language we are making decisions—we are doing mental work.

Indirect Requests Consider now a sentence such as (2):

(2) Can you open the door?

Literally, this sentence asks whether we have the ability to open the door, but everybody assumes that the speaker is asking us to open the door in an indirect manner. Why is the request phrased indirectly? Part of the reason is that we have learned certain rules about the use of language in social settings, including rules of politeness. A request is, by definition, an attempt to change another person's behavior. This can be perceived as intrusive or threatening at times, so we soften it with indirect speech. An indirect request is more polite than a direct command such as sentence (3):

(3) Open the door!

We know this, as it is part of our pragmatic knowledge of our language. Some of us know it better than others, to be sure (studies discussed in Chapter 9 indicate that women and girls are more likely to use indirect speech than are men and boys).

From a processing standpoint, a speaker takes this pragmatic knowledge into account when producing a statement such as sentence (2) in a social situation. That is, the speaker utters the sentence with the understanding that it will be taken as a request. The listener presumably shares this aspect of pragmatic knowledge and interprets the sentence as a request rather than in a literal manner, although the exact processes by which the listener arrives at the nonliteral meaning are not fully clear (see Chapter 6).

Indirect requests are an aspect of language that forces us to consider language in a social context. The study of the relationships between language and social behavior is called **sociolinguistics**. Sociolinguists remind us that language activities always take place in a social world. Sociologists and anthropologists study how language varies with social groupings, how it influences social interaction, and how it is used as an instrument of culture (as in the transmission of cultural traditions). All of these aspects are well beyond those of the psychologist, who is principally interested in the behavior of individuals. Yet even when studying individuals, it is necessary to recognize the social dimension of language.

Language in Aphasia Although our primary focus is on language processes in normal individuals, we can learn a great deal about language by studying individuals with impaired language functioning. An **aphasia** is a language disorder due to brain damage. One type of aphasia, called **Wernicke's aphasia**, involves a breakdown in semantics. For example, consider excerpt (4):

(4) Before I was in the one here, I was over in the other one. My sister had the department in the other one. (Geschwind, 1972, p. 78)

The semantic relationships between words in this excerpt are seriously disrupted, suggesting that the patient's semantic knowledge has been impaired by the brain damage. In contrast, phonological knowledge was spared; the speech, although devoid of meaning, was articulated smoothly and with appropriate pausing and intonation. It also displays appropriate syntactic structure, which is typical in Wernicke's aphasia.

The study of the relationship between the brain and language is called **neurolinguistics**, which is discussed more fully in Chapter 13. Although the details of the links between brain structures and language elude us, what is presently known is both fascinating and instructive. Depending on the exact location of the injury, its severity, and many other factors, an individual who has sustained a brain injury may display a wide variety of reactions. One person may have normal comprehension but be deficient in language production. Another may have no loss of ability with sentence structure but have greater than normal problems finding words. Still other individuals may be unimpaired in comprehension and production but be unable to repeat exactly what they have heard and understood. In normal individuals with intact brains, various facets of language—sentence structure, meaning, sounds—appear to form a smoothly coordinated system of communication; however, in brain-damaged individuals, this system is revealed to be a combination of separate parts, for the deficits in such persons are often selective rather than total. Thus, brain injuries enable us to analyze an apparently unified program of language abilities into its separate components and raise questions about how such abilities become integrated in the normal adult in the first place.

Language in Children An area of considerable concern to psycholinguists is language acquisition. As difficult as it is to infer linguistic knowledge in adults, the problem is even more intractable with children. An example may help here. Imagine a young child, about 1 year old, interacting with her mother. Typically, children around this age produce one word at a time. When the mother leaves the room and then returns with the child's favorite doll, the child says *doll,* not *mother.* Later, when the mother is helping her with lunch, the child points at the milk and says *more.* Still later, when the child is struggling with her shoes and the mother asks her what she is doing, the simple response is *off.* What can we conclude from these observations?

For starters, the child might know, at least in a tacit manner, some of the rules of language to use words appropriately. We could infer that she uses *more* not as an isolated word or imitation but as a request that the mother bring the milk closer. *Doll* is less clear; the child might be making a comment on her environment by labeling a thing she finds interesting, or she may be requesting the doll. How do we determine what she is trying to say? One way is to see what happens if the mother does nothing. If the word were meant as a request, the child will probably become more insistent, perhaps by repeatedly pointing at the doll and saying *doll*; whereas if the word were meant as a comment, the child's behavior should end with mother's mere acknowledgment of the object. Thus, the child may have learned certain pragmatic rules to guide her choice of words.

You may complain that this is reading a good deal, perhaps too much, into a single word. Granted, the inferences made about this stage of development are terribly difficult. Yet, although there is disagreement over exactly how much knowledge to attribute to young children, it appears that children know more than they say. Children somewhat older than the one in the example commonly express themselves with two words at a time, as in *baby gone,* by eliminating the **closed-class** or **function** words (prepositions, conjunctions, and so on) in favor of **open-class** or **content** words (nouns, verbs, adjectives). This pattern suggests that children have an intuitive understanding of these two grammatical classes, which is part of their syntactic knowledge.

An analysis of children's comprehension and production abilities cannot be divorced from the social context in which the child masters language. Parents may set up situations in which one word is sufficient for communication. With the adult's query *What are you doing with your shoe?* as the base, the child's simple, economical *off* is instantly comprehensible. Parents do other things as well, such as simplifying their speech to children and teaching specific words. Is the orderly pattern of development observed in child language the result of an orderly biological program or of an orderly social environment? This issue is addressed in Chapter 12.

Summary

Psycholinguistics is part of an interdisciplinary field known as cognitive science. Two primary psycholinguistic questions are, What mental processes are involved in language use? and What linguistic knowledge is involved in language use? These questions reemerge in different forms in studies of adult language comprehension and production, the social use of language, language use in aphasia, and language in children.

THE HISTORICAL CONTEXT

In this section we consider some historical developments in the study of psycholinguistics. I have not attempted to be comprehensive here. The history of psycholinguistics has been treated in detail elsewhere (see, for example, Blumenthal, 1970, 1987; Cutler, Klein, & Levinson, 2005; Kess, 1991; McCauley, 1987; Miller, 2003; Reber, 1987); if you are interested, you are advised to consult these sources. My discussion here is simply meant to put succeeding chapters in a little bit of historical perspective.

Blumenthal (1987) has observed that the interdisciplinary field of psycholinguistics flourished twice: once around the turn of the last century, principally in

Europe, and once in the middle of the 20th century, principally in the United States. In both instances, it was a somewhat asymmetrical marriage of disciplines. In the early decades of the 20th century, linguists turned to psychologists for insights into how human beings use language. In the later period, psychologists turned to linguists for insights into the nature of language. In between these two periods, behaviorism dominated both fields, each of which practiced a form of benign neglect toward one another. We will look at the events of each of these periods, and I will add some observations on the current directions in the field.

Early Psycholinguistics

From the development of the first psychological laboratory, at the University of Leipzig in Germany in 1879, until the early 1900s, psychology was defined as the science of mental life. A major figure in early scientific psychology was Wilhelm Wundt (1832–1920), a man trained in physiology who believed that it was possible to investigate mental events such as sensations, feelings, and images by using procedures as rigorous as those used in the natural sciences. Moreover, Wundt believed that the study of language could provide important insights into the nature of the mind. Blumenthal (1970) refers to Wundt as the master psycholinguist because Wundt wrote extensively about many different aspects of language. His concerns included grammar, phonology, language comprehension, child language acquisition, sign language, reading, and other topics of contemporary concern.

One of Wundt's contributions to the psychology of language was developing a theory of language production. He regarded the sentence, not the word, as the primary unit of language and saw the production of speech as the transformation of a complete thought process into sequentially organized speech segments (comprehension was thought to be basically the same process in reverse). Wundt described speech production in the following terms:

> When I construct a sentence, an isolated concept does not first enter consciousness causing me to utter a sound to represent it. That it cannot be this way is shown by the phenomenon of phonetic induction which occurs when a vocal element on the verge of being expressed is already affecting the form of a sound being spoken at the moment. And similarly, an articulation that has just occurred influences the succeeding sound. . . . The sentence . . . is not an image running with precision through consciousness where each single word or single sound appears only momentarily while the preceding and following elements are lost from consciousness. Rather, it stands as a whole at the cognitive level while it is being spoken. If this should ever not be the case, we would irrevocably lose the thread of speech. (Wundt, 1912, cited in Blumenthal, 1970, p. 21)

These two notions—the view that speech production is a word-by-word process as opposed to the view that it begins with a whole sentence—continue to be of interest to language researchers. This distinction is a precursor of a contemporary distinction between bottom-up and top-down processing, two concepts that will be introduced and discussed in Chapter 3.

Some significant developments were also being made in measuring various language processes. An example comes from the 1908 work of Edmund Huey (1968), who examined reading from the perspective of human perceptual abilities. Huey, who regarded the achievement of reading as "the most remarkable specific performance that civilization has learned in all its history" (p. 6), employed the **eye–voice span** (the lag between eye position and voice when reading aloud, about six or seven words) and the **tachistoscope** (a machine that presents visual stimuli for very brief periods of time) in his studies. Interest in eye movement and tachistoscopic data remains very strong to this day.

Behaviorism and Verbal Behavior

In the first few decades of the 20th century in the United States, there was mounting opposition to the focus on mental life as a goal for psychology. By the 1920s, **behaviorism** took over the mainstream of experimental psychology. Behaviorists favored the study of objective behavior, often in laboratory animals, as opposed to the study of mental processes. Moreover, behaviorists had a strong commitment to the role of experience in shaping behavior. Emphasis was placed on the role of environmental contingencies (such as reinforcement and punishment) and on models present in the immediate environment.

From the 1920s to the 1950s, psychologists expressed relatively little interest in language. Behaviorists preferred instead to speak of "verbal behavior." The behavior of speaking correctly was, it was assumed, the consequence of being raised in an environment in which correct language models were present and in which children's speech errors were corrected. The manner in which parents shape their children's utterances was described by the behaviorist B. F. Skinner (1957) in his book *Verbal Behavior*:

> In teaching the young child to talk, the formal specifications upon which reinforcement is contingent are at first greatly relaxed. Any response which vaguely resembles the standard behavior of the community is reinforced. When these begin to appear more frequently, a closer approximation is insisted upon. In this manner, very complex verbal forms may be reached. (pp. 29–30)

Although this analysis seems straightforward or even obvious, we will find in Chapter 12 that the role of adult speech in child language acquisition is both more controversial and more complex than is suggested in this excerpt.

Another major topic of research was meaning. A number of behavioristic accounts of meaning were developed, most of which emphasized associations among words. Noble and McNeely (1957) constructed an index of the "meaningfulness" of individual words by measuring the number of associations a person could produce in a designated period of time. Later studies showed that high-meaningfulness words such as *kitchen* were more easily learned in a variety of tasks than low-meaningfulness words such as *icon* (Underwood, 1966). It was also about this time that Osgood and his associates developed the **semantic differential**, a tool for measuring the associative meanings of words by asking people to rate words on dimensions such as good/bad and strong/weak (Osgood, Suci, & Tanenbaum, 1957).

Similar developments were occurring within linguistics. Linguists of this period tended to emphasize behavioristic treatments of language, in which reference to mental states or processes was meticulously avoided. However, despite the similarities between the two fields, little interdisciplinary interest or activity took place. One striking example of this is the work of linguist Leonard Bloomfield. Bloomfield was once a student of Wundt's and published a book in 1914 that emphasized many Wundtian themes. However, his more widely known 1933 text took a more behaviorist view. In his preface to the later book, Bloomfield tried to distance himself not only from Wundt but from psychology as a whole:

> In 1914 I based this phase of the exposition on the psychologic system of Wilhelm Wundt, which was then widely accepted. Since that time there has been much upheaval in psychology; we have learned, at any rate, what one of our masters suspected thirty years ago, namely that we can pursue the study of language without reference to any one psychological doctrine, and that to do so safeguards our results and makes them more significant to workers in related fields. (Bloomfield, 1933, p. vii)

Thus, despite the inherent interconnections between the fields, psychology and linguistics "divorced" for a period of several decades.

Later Psycholinguistics

By the early 1950s, psychologists and linguists became interested in talking to one another. Tanenhaus (1988) describes the events in the following way:

> In 1951 the Social Science Research Council sponsored a conference that brought together several leading psychologists and linguists. . . . The proceedings of the conference outlined a psycholinguistic research agenda that reflected a consensus among participants that the methodological and theoretical tools developed by psychologists could be used to explore and explain the linguistic structures that were being uncovered by linguists. (p. 4)

A second, larger conference occurred two years later and included anthropologists and communications engineers as well as psychologists and linguists. It was out of these exchanges that the term *psycholinguistics* first came into use (Osgood & Sebeok, 1965). Not everyone was fond of the term. One of the participants at the first conference, Roger Brown, complained that a "psycholinguist" sounded more like a deranged polyglot than a psychologist interested in language (Brown, 1958), but the name stuck.

The second period of interdisciplinary psycholinguistics really took hold in the late 1950s, beginning with the emergence of the linguist Noam Chomsky.

Chomsky is generally regarded as the most influential figure in 20th-century linguistics, and Newmeyer (1986) has characterized the Chomskyan influence within linguistics as a revolution. Chomsky has also played a powerful role in how psychologists perceived language because he argued that the behaviorists' accounts of language were inadequate (Chomsky, 1957, 1959).

Let us look at some of his arguments. One theory advanced by behaviorists is called the **associative chain theory**, which states that a sentence consists of a chain of associations between individual words in a sentence. Put another way, each word in a sentence serves as a stimulus for the next word, and thus the entire sentence is produced left to right (at least for European languages). Lashley (1951) had earlier argued against such a view, claiming that there is something more to the structure of a sentence than the associations between adjacent words.

Chomsky (1957) advanced this notion further. Consider the following sentences:

(5) Colorless green ideas sleep furiously.
(6) Furiously sleep ideas green colorless.
(7) George picked up the baby.
(8) George picked the baby up.

Chomsky suggested that associations between words could not possibly explain the existence of sentences such as (5). Even though the associations between these words are almost nonexistent, the sentence is syntactically acceptable. But, if the words are presented backward, as in sentence (6), it is not a sentence at all. Now consider sentences (7) and (8). It is part of our intuitive knowledge of the language that these sentences are synonymous, but this simple fact poses problems for the associative chain theory. Clearly, there is a relationship between *pick* and *up* in these sentences, but the relationship is more complex in (8) than in (7), because the words are separated. To comprehend the sentence, we must somehow know that these words are part of a linguistic unit, or constituent. Linguists call separate units, like those in sentence (8), **discontinuous constituents**, and their existence suggests that there are long-range dependencies among words in a sentence. Again, a theory that stresses a simple association between adjacent words is inadequate.

Chomsky has also argued that language acquisition cannot be explained in terms of children's language experience. His primary argument is called the **poverty of stimulus argument** (Chomsky, 1980). This argument states that there is not enough information in the language samples given to children to fully account for the richness and complexity of children's language. Sentences (9) through (12) (from Caplan & Chomsky, 1980) illustrate the point:

(9) John believes he is incompetent.
(10) John believes him to be incompetent.
(11) John wants him to win.
(12) John wants Bill to see him.

Our knowledge of the language tells us that the *he* in sentence (9) and the *him* in sentence (12) could refer to John, though they need not. In contrast, the *him* in sentences (10) and (11) cannot refer to John. It is doubtful that anyone's parents systematically distinguished between the *him* in sentences (10) and (11) versus the *him* in sentence (12). In fact, most people would not know how to explain such a difference. Still, we recognize the difference and, moreover, can make a great number of other linguistic discriminations about much more complex aspects of language that we are similarly unable to explain in an explicit manner. Chomsky's argument is this: The language children acquire is intricate and subtle, and the sample of speech given to them during the course of language development is anything but. Therefore, although parents may assist the child's language development in some ways and influence the rate of development somewhat, the pattern of development is based not on parental speech but on innate language knowledge.

The Chomskyan revolution had a powerful effect on psychological thinking about language. In the late 1960s, Chomsky (1968) noted that "the study of language may very well, as was traditionally supposed, provide a remarkably favorable perspective for the study of human mental processes" (p. 98) and that linguistics could be profitably viewed as a branch of cognitive psychology. That is, linguists were examining the kinds of linguistic knowledge needed for ordinary language use and realized that this knowledge must be used, in some way, by those who use the language. As Slobin (1971) puts it, a person who has learned a language has formed something that is "psychologically equivalent" (p. 3) to a grammar. Thus, psychologists became very interested in linguistics in general and in Chomsky's transformational grammar in particular (see Chapter 2).

The psychologist George Miller created an important bridge between psychology and linguistics by introducing psychologists to Chomsky's ideas and their psychological implications. Miller collaborated with Chomsky on several articles and papers in the early 1960s (for example, Miller & Chomsky, 1963) and was at the forefront of research during this period to determine the psychological reality of linguistic rules (see, for instance, Miller & Isard, 1963).

Language development became an especially popular topic for investigators during this period. Several **longitudinal investigations** of child language, in which a sample of a child's speech is collected at several points over a period of years, emerged in the early 1960s (Braine, 1963; Miller & Ervin, 1964), and various "grammars" for child language were written, modeled after adult grammars but differing in the specific rules (Bloom, 1970; Brown, 1973a). The major questions for language acquisition researchers were posed in the following way: What set of rules governs the child's developing grammar, and when does this set develop?

Theoretical analyses of language development emphasized the role of innate factors. Together with Chomsky, the most influential person in this regard was Eric Lenneberg, whose 1967 book *Biological Foundations of Language* pulled together evidence from aphasia, studies of delayed language development (for example, mental retardation), and the available neurophysiological information into an elegant argument for the role of innate factors in language development.

Another strong advocate of innate factors was David McNeill (1966, 1970), who proposed a theory of development based on the concept of language universals.

The revolution of the 1960s and early 1970s emphasized the role of linguistic theory in psycholinguistic research and the role of innate mechanisms in language acquisition. These themes continue to be influential, but there are indications that psychological interest in linguistic theory has waned. Reber (1987) examined the number of references to Chomsky in psycholinguistic studies and found that they rose sharply in the late 1960s, peaked in the mid-1970s, and then fell off by the early 1980s. Although it might be interesting to look at citations of other linguists, these data nonetheless appear to reflect the trend among psychologists to shy away from directly incorporating linguistic concepts into psychological research. Reber cites several reasons for these changes. One was that throughout the 1960s and 1970s linguistic theories underwent rapid and (to psychologists, at least) confusing changes (see Newmeyer, 1986). These changes made it difficult for psychologists to base their studies on any particular linguistic view, and some psychologists became wary of linguistics, preferring instead to develop a psychological view of language that was not tied to any specific linguistic theory. As Blumenthal (1987) has observed, there is a historical symmetry in these reactions—70 years ago, linguists such as Bloomfield pulled away from psychology for much the same reasons.

Reber (1987) also points out the growing realization that the two fields were quite distinct in their methodologies. A distinction may be drawn between two intellectual traditions, **rationalism** and **empiricism**. To some extent, this distinction is reminiscent of the familiar one between heredity and environment, or nature and nurture: Rationalists emphasize the role of innate factors in human behavior, whereas empiricists stress the role of experience in behavior. But there is another difference between the two traditions that deals with the mode of inquiry. Rationalists emphasize the use of argument, whereas empiricists favor the collection of data as a means for evaluating hypotheses. For the most part, linguists approach language in a rationalistic manner; psychologists, even those who are sympathetic with the notion of innate factors, favor the empirical method. As a consequence of these differences, ideas tend to be evaluated somewhat differently in the two fields (Pylyshyn, 1972, 1973; Watt, 1970). In retrospect, it may have been too unrealistic to expect that two disciplines with their own histories and methodologies would mesh very easily.

Current Directions

Where do things stand now? It is always more precarious to describe events that are currently in progress than those well in the past, but it is possible to discern several themes of psycholinguistic work over the last 15 to 20 years (Cutler, 2006). One is that although early psycholinguistics primarily focused on syntax, more recently there has been an upsurge in interest in phonology, semantics, and pragmatics. These developments have led to a more well-rounded field, with research that cuts across these different areas (for example, Eberhard, Cutting, & Bock, 2005).

Second, although early research in psycholinguistics focused on language comprehension, there has been a strong surge of interest in language production recently. It is tempting to think that comprehension and production are mirror images of one another. However, as we will see in Chapter 8, this view is misleading, as there are processes in production that are not merely the reverse of comprehension (Griffin & Ferreira, in press).

Third, the development of techniques that allow researchers to see visual images of the brain has stimulated considerable interest in the brain mechanisms associated with language. For more than a hundred years, the primary method used in neurolinguistics was the study of language in individuals with aphasia. We can now observe the functioning of normal brains during various language tasks. The results of these studies has greatly deepened our understanding of neurolinguistics.

Finally, psycholinguistics has matured to the point that we are beginning to see applications of psycholinguistic principles that are useful to society. At the same time, tangible progress has been made in applying psycholinguistic research to topics such as reading (Just & Carpenter, 1987), bilingualism (Bialystok, 2001), and language disorders (Tartter, 1998). These advances have been made possible by integrating the insights from different disciplines within cognitive science. For instance, Just and Carpenter's book on reading comprehension integrates linguistic theories of sentence structure, computer simulations of reading, and psychological experimentation on eye movements. These results give us reason to believe that interdisciplinary work on language, although it can produce tensions between different approaches, can ultimately be fruitful (see, especially, Miller, 1990).

Summary

The history of psycholinguistics can be divided into two periods of interdisciplinary activity separated by several decades of behaviorism. The first period was dominated by Wundt, who presented a cognitive view of language. The behaviorist position later held that verbal behavior can be explained in terms of environmental contingencies of reinforcement and punishment. This view was criticized by Chomsky, leading to a second wave of psycholinguistic activity. This period was characterized by an effort to incorporate linguistic theory in psychological research as well as by the view that innate linguistic mechanisms are necessary to explain child language acquisition. Psycholinguistics is presently a more diverse field of study that draws insights and methodologies not only from psychology and linguistics but also from adjacent fields of study.

REVIEW QUESTIONS

1. Identify the two major questions that psycholinguists are interested in.
2. Define semantics, syntax, phonology, and pragmatics.

3. Distinguish between tacit and explicit knowledge.
4. What is a garden path sentence?
5. What aspects of linguistic knowledge appear to be disrupted in Wernicke's aphasia, and what aspects are intact?
6. Summarize Wundt's theory of language production.
7. Why did behaviorists prefer to talk of verbal behavior instead of language?
8. When did the term psycholinguistics arise?
9. What arguments did Chomsky give against behaviorist views of language?
10. How does the field of psycholinguistics currently differ from the field of the 1960s?

THOUGHT QUESTIONS

1. In sentence (1), our misreading of *deal* forces us to backtrack and do a good deal of extra mental work at the end of the sentence. Why don't we simply entertain both meanings of an ambiguous word until we know which one is appropriate?
2. If you discovered someone who spoke a language that no one else could understand, how would you go about trying to understand what the person was trying to say?

2

Linguistic Principles

> "Then you should say what you mean," the March Hare went on. "I do," Alice hastily replied; "at least—at least I mean what I say—that's the same thing, you know." "Not the same thing a bit!" said the Hatter. "Why, you might just as well say that 'I see what I eat' is the same thing as 'I eat what I see'!"
>
> —LEWIS CARROLL (1865/1946, p. 98)

> "I don't want to talk grammar. I want to talk like a lady in a flower-shop."
>
> —ELIZA DOOLITTLE/BERNARD SHAW (1913/2000, p. 32)

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MAIN POINTS

- Linguists have attempted to identify those grammatical features that appear in all languages. Four pervasive properties are duality of patterning, morphology, phrase structure, and linguistic productivity.
- American Sign Language shares these linguistic properties with spoken languages. Sign language differs from spoken language in its iconicity and simultaneous structure.
- A language consists of an infinite set of sentences. A person who knows a language knows its grammar, which consists of a finite set of rules.
- Transformational grammar distinguishes between two levels of sentence structure: deep structure and surface structure. Phrase-structure rules generate deep structures, and transformational rules operate on deep structures to produce surface structures.
- Several controversies exist within grammatical theory, including whether grammatical rules are psychologically real, the role of syntax in grammar, and whether knowledge of language is innate.

INTRODUCTION

The focus of this book is on how people process language—how we comprehend and produce spoken and written language—and how these skills are acquired. To understand these language processes, we need to understand the major properties of language as well as the processing characteristics of the individuals who use it. Chapter 3 examines what is presently known about how humans generally process information. This chapter deals with the structure of language.

As we saw in Chapter 1, fluently speaking a language does not guarantee that one has any explicit knowledge of the language. For most of us, speaking is easy—it is an activity akin to breathing that we do without much thought or effort. We might then assume, erroneously, that anything so easy must be pretty simple. The study of language proves otherwise. As we learn how languages are organized, we realize how truly complex they are.

This chapter is organized into four sections. The first presents some basic grammatical concepts common to a number of linguistic theories. The second examines American Sign Language and considers whether the concepts introduced in the first section apply to a language in the visual modality. The third section discusses a historically significant theory of grammar called transformational grammar. Finally, we consider some unresolved controversies in the study of grammar.

BASIC GRAMMATICAL CONCEPTS

Languages differ in a host of ways. Some languages, like English, are rather strict about word order, as Alice learned in the opening quotation. The words in sentences (1) and (2) are the same; the only difference is the order in which the words are arranged. When we learn English, we must learn syntactic rules including those pertaining to word order. In English, the basic word order is subject-verb-object, or SVO.

(1) The boy chased the girl.

(2) The girl chased the boy.

Other languages use word order in different ways. In Japanese, the basic word order is subject-object-verb (SOV). A simple Japanese sentence (3) translates literally to *Taro to Hanako that book gave*, where *hon* means *book* and *yatta* means *gave*:

(3) Taroo ga Hanako ni sono hon o yatta. (Shibatani, 1987)

Still other languages, such as Russian, are much more flexible about word order. Thus, although it is possible to say *Viktor kisses Lena* in English-type SVO form (4), a number of other forms ([5]–[9]) are also possible (Comrie, 1987). In Russian, meaning is conveyed less by word order than by the affixes (suffixes and prefixes) that are attached to words and slightly modify their meaning. In English, we know that we can express a word in a variety of interrelated forms (such as *trip, tripped, tripping,* and so forth), but other languages have far greater numbers of such forms. The system of affixing is considerably more complex in Russian, and in most languages, than in English.

(4) Viktor celuet Lenu.

(5) Viktor Lenu celuet.

(6) Lenu Viktor celuet.

(7) Lenu celuet Viktor.

(8) celuet Viktor Lenu.

(9) celuet Lenu Viktor.

Turkish is similar to Russian in that it primarily uses affixes, rather than word order, to signal meaning but differs in other respects. Turkish is a language in which speakers can combine different elementary meanings into very long words. For example, *gel* means *come, gelemedim* means *I couldn't come,* and *gelemeyeceklermis* means something like *[It was mentioned that] Those people won't be able to come* in Turkish. Word order is very flexible.

Not only do languages differ in their general tendency to emphasize word order versus affixes, they also differ in the particular affixes they employ. For example, to say the sentence *The elephant ate the peanuts* in English, we must include tense—the fact that the event occurred in the past. In Mandarin Chinese, indicating when the event occurred is optional. In Russian, the verb would need to include not only tense but also whether the peanut-eater was male or female. In Turkish, speakers must specify whether the eating was witnessed or just hearsay (Boroditsky, 2003).

These and other linguistic differences might tempt us to conclude that languages differ so greatly that no common patterns can be found. Despite these differences, linguists who have investigated the world's languages have concluded that although languages differ in a number of ways, the differences are not random, and there are impressive underlying similarities. For example, Greenberg (1966) has discovered that every language contains declarative sentences that express subject, verb, and object. Moreover, all languages have a preferred word order, even though some languages allow more flexibility than others. The point is that underneath the impressive diversity we see patterns. The variations consist of different combinations of similar underlying elements.

If this is so, then we need to identify features that are found, in some form, in all human languages but are not present in animal communication systems. What follows is a short list of properties that are commonly agreed to be pervasive among the world's languages and are of significant psychological interest.

Duality of Patterning

A grammatical concept that is basic to the study of language is called **duality of patterning** (Hockett, 1966). At one level, there is a large number of meaningful elements, or words. At another level, there is a relatively small number of meaningless elements that are combined to form the words. In spoken languages, these meaningless elements are individual speech sounds. As Hockett notes, this form of duality does not appear to exist in animal communication.

Phones and Phonemes To explain this duality, we need to make a few distinctions. **Phones** are speech sounds. Two sounds are different phones if they differ in a physically specifiable way. For example, consider the *p* in the words *pill* and *spill.* There is a puff of air, known as **aspiration**, in *pill* that is not present in *spill.* You can tell the difference easily by placing a lighted match a few inches in front of your mouth as you pronounce the two sounds. Phones are indicated by brackets: The aspirated sound is symbolized as [p^h], the unaspirated as [p].

Phonemes are differences in sound that make a contribution to meaning; they are indicated by slashes. For example, the sounds /b/ and /d/ are considered to be different phonemes in English because they contribute to the difference in meaning between *big* and *dig*. Phonemes may be thought of as categories of phones; each phone is a physically distinct version of the phoneme, but none of the differences between phones makes a difference to meaning. Notice that these phonemic categories vary from language to language. In English, aspiration is not phonemic, although it is in Thai, which would represent the sounds as /p^h/ and /p/.

Distinctive Features We can understand these patterns better if we think of phonemes as combinations of discrete features. A **distinctive feature** is a characteristic of a speech sound whose presence or absence distinguishes the sound from other sounds. The phoneme /b/ is similar to the phoneme /p/ except that the vocal cords vibrate during the production of /b/ but not /p/. In distinctive feature theory, contrasts are binary with the presence of the feature indicated by + and its absence by –. The phoneme /b/ is said to be + **voicing**,whereas /p/

is − voicing. In a similar vein, /b/ is + bilabial, which means that the sound is articulated at the lips, and is + stop, meaning that the airflow from the lungs is completely stopped during production. Distinctive feature theory (Jakobson, Fant, & Halle, 1969) claims that these are independent units that are combined to form phonemes.

Let us turn to the question of how these small linguistic units are combined. The sequence of phonemes that may occur in any given language is constrained. Consider the sounds *port, plort,* and *pbort.* We easily recognize that the first one is a word, the second could be, and the third could not be, at least not in English. As a first approximation, we can state a phonological rule that explains these patterns in the following way:

(R1) /p/ cannot be followed by /b/ at the beginning of a word.

The problem with this rule is that it is stated too narrowly. A number of other sequences in the language, such as *pt, bg, td, kb,* and many others, are not allowed, either. We must look for a broader generalization.

The concept of distinctive features is helpful here, because *p, t, b, g, d,* and *k* are all + stop. This enables us to reformulate the rule more generally:

(R2) A word cannot begin with two stop consonants.

In the same vein, we may notice that aspiration is predictable in English. The pattern noted with *pill* and *spill* also applies to other voiceless stop consonants, such as *t* (*till/still*) and *k* (*kill/skill*). The aspirated sound occurs only at the beginning of the word; otherwise, the unaspirated sound is pronounced. The proper rule is

(R3) Voiceless stop consonants are aspirated when they occur at the beginning of a word.

Thus, distinctive features are useful in identifying how to formulate linguistic rules.

A study by Miller and Nicely (1955) demonstrated that these distinctive features have psychological validity. Miller and Nicely constructed a set of syllables that consisted of 1 of 16 consonants followed by the vowel [a]. The syllables were presented to subjects under difficult listening conditions, with "white noise" (a hissing sound) in the background. The white noise was at a consistent level of loudness, whereas the speech varied over seven levels of loudness. Subjects were asked to identify the sounds that they heard. They made more errors when the speech was softer. When errors were made, subjects tended to incorrectly hear a sound that was similar to the target sound in most features but differed in only one. For instance, if [b] was presented, subjects were more likely to err by identifying the sound as [d], which shares all features with [b] except + bilabial, than [f], which differs in a number of respects from the target.

Duality of patterning appears to be a universal property of language. Languages differ in their phonemes and in the rules by which the phonemes may be combined to form words. However, all languages have duality: a level at which there is a relatively small number of basic, meaningless elements and another level at which there is a large number of meaningful elements. And

TABLE 2.1 Major Grammatical Morphemes in English

Morpheme	Distinction(s)	Examples
Number	Singular, plural	Nouns: *ball, balls*
		Pronouns: *he/she*, *they*
		Verbs: *is*, *are*
Person	First, second, third	Pronouns: *I*, *you*, *he/she*
		Verbs: *I walk*, *you walk*, *he/she walks*
Tense	Present, past, future	Verbs: *I jump*, *I jumped*, *I will jump*
Aspect	Perfect, progressive	Verbs: *I have read the book*, *I am reading the book*

all languages have a systematic set of rules for combining the former into the latter.

Morphology

We have seen that the phonemes are combined to form words. Another important way in which we use words is to use different forms of the same word to convey different shades of meaning. The system of rules that governs this aspect of language is referred to as **morphology**.

The smallest meaningful unit in a language is referred to as a **morpheme**. Some words, such as *truck,* consist of only a single morpheme. Others consist of two or more morphemes; *bedroom* consists of the morphemes *bed* and *room*. We may also distinguish between **free morphemes**, which may stand alone, and **bound morphemes** (also called **grammatical morphemes**), which, although contributing to word meaning, are not words themselves. Some of the major grammatical morphemes in English are shown in Table 2.1. Notice that these categories intersect. For instance, the intersection of tense and aspect produces the present perfect (10), the past perfect (11), the present progressive (12), and the past progressive (13):

(10) I have read the book.
(11) I had read the book.
(12) I am reading the book.
(13) I was reading the book.

Although all languages have a morphological system, languages differ in the grammatical distinctions they make and in the way in which they make them. When we use English correctly, we are, at some level, paying attention to these properties. For instance, we must pay attention to the number of both pronouns and verbs because they must agree in number for a sentence to be grammatical in English. When choosing tense, we must decide when a given action took place. In Chapter 14, we will consider the idea that these subtle linguistic differences influence the thought patterns of the individuals who speak the language in such a way that speakers of different languages have distinct worldviews.

Phrase Structure

A third central concept in grammatical description is **phrase structure**. Intuitively, we know that sentences can be divided into groups of words, or constituents. Consider the simple declarative sentence (14):

(14) The young swimmer accepted the silver medal.

Think about how you might put these words into groups. The primary break in the sentence is between the noun phrase and the verb phrase—that is, between *swimmer* and *accepted.* This can be indicated by parentheses, as in sentence (15):

(15) (The young swimmer) (accepted the silver medal).

We can further subdivide the last group as follows:

(16) (The young swimmer) (accepted [the silver medal]).

The items in parentheses are the constituents of this simple declarative sentence. The first item is a noun phrase (NP), which consists of a determiner (*the*), an adjective (*young*), and a noun (*swimmer*). The second constituent is a verb phrase (VP), which consists of the verb (*accepted*) and then a second NP (*the silver medal*).

Another way to clarify the concept of constituent is to look at replacement patterns across sentences. For example, suppose we said, *The young swimmer accepted the silver medal.Then he smiled for the camera.* Notice that *he* replaces *the swimmer.* We can do the same for *accepted the silver medal.* For example, we could say, *The young swimmer accepted the silver medal, and the young ice skater did too.* Here *accepted the silver medal* is replaced by *did too.* The replacement test shows that a string of words is a constituent such as a NP or VP; NPs are replaced by NPs and VPs are replaced by VPs.

Phrase-structure rules are syntactic rules that specify the permissible sequences of constituents in a language. Each phrase-structure rule "rewrites" a constituent into one or more other constituents. By using a series of rules, we can derive a sentence from top to bottom (that is, from the largest to the smallest constituent).

A list of phrase-structure rules sufficient to generate this sentence is shown in Table 2.2. Phrase-structure rule 1 (PS 1), S → NP + VP, is read "A sentence may be rewritten as a NP and a VP." Another way of expressing what PS 1 means is to say that S consists of a NP and a VP. Rule PS 2 means that NPs are rewritten as determiner and noun, with optional adjectives indicated by parentheses placed between the article and the noun. We can now expand each of these items on the left side and ultimately work our way through the entire sentence. The final four rules, called **lexical insertion rules**, put words into the structure that has been built. The entire sequence of rules that produces the sentence is called a **derivation**. The step-by-step derivation of this sentence is shown in Table 2.3. The resulting phrase structure is shown in Figure 2.1.

TABLE 2.2 A Simple Set of Phrase-Structure Rules

PS 1 S (sentence)	→	NP + VP
PS 2 NP (noun phrase)	→	det + (adj) + N
PS 3 VP (verb phrase)	→	V + NP
PS 4 N (noun)	→	*swimmer, medal, horse*
PS 5 V (verb)	→	*accepted, returned*
PS 6 adj (adjective)	→	*young, silver, beautiful*
PS 7 det (determiner)	→	*a, the*

TABLE 2.3 Steps in the Derivation of *The young swimmer accepted the silver medal*

1. Rule PS 1	NP + VP
2. Rule PS 2	det + adj + N + VP
3. Rule PS 3	det + adj + N + V + NP
4. Rule PS 2	det + adj + N + V + det + adj + N
5. Rule PS 7	*the* + adj + N + V + *the* + adj + N
6. Rule PS 6	*the* + *young* + N + V + *the* + *silver* + N
7. Rule PS 4	*the* + *young* + *swimmer* + V + *the* + *silver* + *medal*
8. Rule PS 5	*the* + *young* + *swimmer* + *accepted* + *the* + *silver* + *medal*

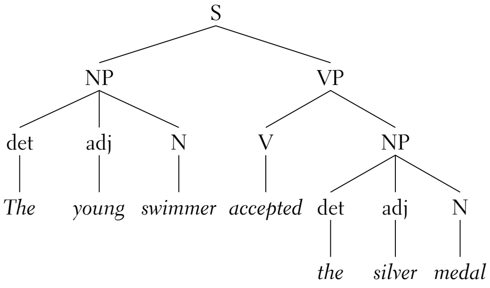

FIGURE 2.1 Tree diagram (phrase marker) for *The young swimmer accepted the silver medal.*

Phrase-structure rules provide a good account of one type of sentence ambiguity called **phrase-structure ambiguity.** This type of ambiguity is illustrated by sentences such as (17):

(17) They are eating apples.

In these sentences, the assignment of words to constituents is ambiguous, and more than one tree structure or phrase marker could be made for each case. In sentence (17), *eating* could be either a part of the verb or an adjective modifying apples. The two phrase markers for this sentence are shown in Figure 2.2.

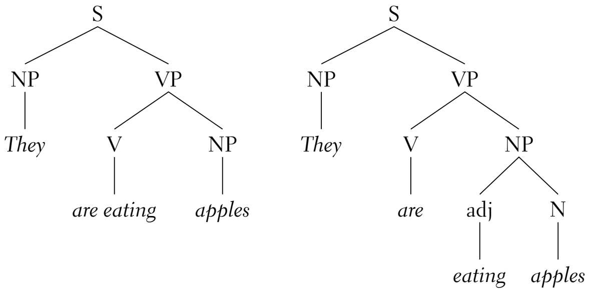

FIGURE 2.2
Tree diagrams for *They are eating apples.*

Linguistic Productivity

There is no limit to the number of sentences in a language. The vast percentage of sentences we utter are novel but grammatically acceptable arrangements of words (the main exceptions being clichés, proverbs, and the like). Our ability to create and comprehend novel utterances is called **linguistic productivity** (or **linguistic creativity**). This notion was discussed by Hockett (1966) but has been emphasized most strongly by Chomsky (1957, 1966, 1980). One way to get a sense of this concept is to take an ordinary sentence from conversation or from a written source and then look for the identical sentence from another source (you will be looking for quite a while).

Given that the human brain is obviously finite, the problem of explaining how we can master a language with an infinite set of sentences remains a vexing problem for psycholinguists. It is not possible, for instance, to store an infinite set of sentences somewhere in the brain for later use. Most current psycholinguistic accounts make the assumption that instead of storing sentences, we store rules for creating sentences. The number of rules needed is finite, but the rules can be combined to form an unlimited number of sentences.

An example will clarify the point (Lasnik, 1990). A way to construct longer and more complex sentences is to embed one sentence inside another. We have already seen that we can rewrite a VP into V + NP, but it is also possible to rewrite a VP as follows:

(PS 8) VP → V + S

That is, the material following the verb can be a complete sentence, as in (18):

(18) The child thinks the man left.

The phrase marker for sentence 18 is shown in Figure 2.3. Furthermore, we can continue the process and embed more and more sentences (for example, *The woman knows the child thinks the man left*) into the earlier ones, until the sentences become quite difficult to comprehend.

This process can be described through the use of phrase-structure rules. We can combine PS 1 and PS 8 to get PS 9:

(PS 9) S → NP + V + S

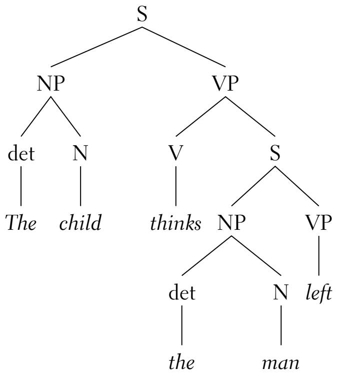

FIGURE 2.3 Tree diagram for *The child thinks the man left.*

Notice that S is on both sides of the arrow. A rule such as this, which refers to itself, is said to be a **recursive rule**. Recursion is closely related to language productivity for, as we have seen, there is no limit to the number of times we can embed one sentence into another. Recursion appears to be a resilient property of human language use. Goldin-Meadow (1982) has shown that children provided with very little exposure to language nonetheless create language that has this property (see Chapter 12).

Linguistic productivity distinguishes human language from animal communication systems, which consist of a small number of discrete signals. In contrast, all human languages are open communication systems in which new words are coined as they are needed. Moreover, not only can we create new words, but we can, as we have seen with recursion, blend existing words in new combinations. These productive processes provide a measure of how complex and open ended our language faculty is.

Not all aspects of language are productive. Some aspects of language are not rule governed and so must be mastered by rote learning. One instance is the existence of strong verbs, which are verbs that are morphologically irregular. The most common in English are verbs that are irregular in the past tense, such as *went, fell,* and *ate*. Children trip over these forms early in their language development, preferring to overuse the past tense marker (for example, *goed*). Interestingly, most strong verbs are rather frequently used in the language, which is precisely what we would expect to see if children needed to learn each one in a rote manner.

Summary

Four basic grammatical concepts are duality of patterning, morphology, phrase structure, and linguistic productivity. Words are composed of phonemes, which, in turn, have distinctive features. In each instance, the smaller units are combined in a rule-governed manner to produce the larger units. Words consist of one or more units of meaning, or morphemes. The system of grammatical morphemes in a language provides speakers with a way of signaling subtle differences in meaning. Phrase-structure rules codify our intuitions about the groupings of words in a sentence. Some sentences are ambiguous and may be grouped in more than one way. Linguistic productivity refers to the fact that there is no limit to the number of sentences in a language. One type of phrase-structure rule, that of recursion, is responsible for some of this productivity.

INSIGHTS FROM SIGN LANGUAGE

We now consider some of the linguistic properties of **American Sign Language (ASL)**. Unlike speech, signs are expressed in visual or spatial form. This enables us to examine the extent to which the grammatical concepts we have just considered generalize to language in a visual modality.

American Sign Language is sharply distinguished from manual forms of English that translate English sounds into signs. The best known is fingerspelling, which, as the name implies, translates English words letter by letter into manual form. It is a secondary gestural system, derived from the English language. In contrast, ASL is independent of English and derived from French Sign Language (Frishberg, 1975). Although in the past ASL was regarded as mere pantomime or grammatically deficient in various ways, several decades of scholarly research on ASL have put these ideas to rest.

Even if we accept the notion that ASL is an autonomous language, we must ask what is its relation to spoken languages. We will begin to answer this question by considering some of the differences between signed (especially ASL) and spoken languages and then some of the similarities.

Differences Between Signed and Spoken Languages

Iconicity and Arbitrariness In English, as with most spoken languages, the principle of **arbitrariness** holds: No intrinsic relationship exists between the set of sounds and the object to which the sounds refer. For instance, there is no relation between the size of a word and the size of its referent; we have big words for small objects (for example, *caterpillar*) and small words for big objects (for example, *train*). According to Hockett (1966), this is a universal feature of human language.

American Sign Language, in contrast, possesses a high degree of **iconicity**: Many of the signs resemble the objects or activities to which they refer. For example, the sign for *attention* is to hold both hands parallel to one another in front of one's face and then move them away from one's body. This suggests the act of putting on blinders to keep out distractions. Another iconic sign is the sign for *judge,* which is to place one's hands in front of one's body and then repeatedly move one up as the other goes down. This resembles a balancing scale that weighs various thoughts (Klima & Bellugi, 1979).

Interestingly, different sign languages have developed in different parts of the world. Examination of ASL, Danish Sign Language, and Chinese Sign Language indicates that even though all have iconic signs, the signs differ from language to language in the actual details. For example, the sign for *tree* in ASL is to hold the forearm upright with the hand spread wide, which suggests a tree trunk and its branches. In Danish Sign Language, the hands outline the rounded top of the tree and then the shape of the trunk, whereas in Chinese Sign Language, the hands portray the trunk and then move upward (Klima & Bellugi, 1979). Thus, even though ASL is iconic, this property does not automatically determine the form of the signs. Each language represents the object iconically in different ways.

As a consequence, it is not necessarily easy for observers to guess the meaning of signs. In one study, hearing observers not familiar with signed languages were able to identify only about 10% of the signs that were presented (Klima & Bellugi, 1979). Subsequent studies reviewed by Pizzuto and Volterra (2000) found better performance in deaf signers unfamiliar with the particular sign language that was being signed but again poor performance in hearing observers. Thus, iconic signs are not necessarily transparent in meaning.

Frishberg (1975) has claimed that the degree of iconicity has declined in ASL over the past 200 years. An example of this is the sign for *home*. Originally, this was a combination of two other signs, one for *eat* and one for *sleep*. The sign for *eat* involves holding one's hand in a cup form near the mouth. The sign for *sleep* involves laying a flat hand against one's cheek and tilting the head. Just as each of these individual signs is iconic, so was the original sign for *home*: *eat* followed by *sleep*. Over time, the sign shortened and become more conventionalized, so that its present form is a hand in cup form touching two different locations on the cheek, which is not as transparent in meaning as the original signs. Thus, although many ASL signs are iconic, ASL has an increasing degree of arbitrariness. American Sign Language now has a dual system of reference—part iconic, part arbitrary.

Simultaneous and Sequential Structure A second difference between signed and spoken languages deals with the distinction between simultaneous and sequential structure. The structure of spoken languages is largely sequential in nature. We have rules that specify the correct order of phonemes within syllables, syllables within words, and words within sentences.

Sign language differs in that it is organized spatially more than temporally. The meaning of utterances is not specified primarily by the order of signs (although order does matter) but by the combination of features simultaneously present in the sign.

Similarities Between Signed and Spoken Languages

Duality of Patterning The three major parameters of signs are hand configuration, place of articulation, and movement (Stokoe, Casterline, & Croneberg, 1976). Stokoe and colleagues have identified 19 different values of hand configuration, or handshapes. These include an open palm, a closed fist, and a partially closed fist with the index finger pointing. Place of articulation, which has

12 values, deals with whether the sign is made at the upper brow, the cheek, the upper arm, and so on. Movement refers to whether the hands are moving upward, downward, sideways, toward or away from the signer, in rotary fashion, and so on, and includes 24 values. Although these values are meaningless in themselves, they are combined in various ways to form ASL signs. Thus, ASL has duality of patterning.

Figure 2.4 shows a series of minimal contrasts involving these three parameters. The top row shows three signs that differ only in hand configuration (that is, the signs are identical in place of articulation and movement). The second and third rows show minimal contrasts for place and movement, respectively. Notice how a change in a single parameter value can change the entire meaning of a sign.

It is also possible to analyze parameter values into distinctive features. Two such features for handshapes are index, which refers to whether the index finger is extended, and *compact,* which refers to whether the hand is closed into a fist. Among the signs in the top line of Figure 2.4, *candy* is + index, − compact; *apple* is + index and + compact; and *jealous* is − index and − compact. To determine whether signers' perceptions of ASL are related to features such as these, Lane, Boyes-Braem, and Bellugi (1976) presented deaf individuals with a series of signs under conditions of high visual noise (a video monitor with a lot of "snow"). The participants were asked to recognize the signs on the monitor. The researchers found that the large majority of recognition errors involved pairs of signs that differed in only one feature. That is, signs with similar patterns of distinctive features were psychologically similar to one another.

Morphology American Sign Language has a rich morphological system that signals various grammatical distinctions. For instance, the distinction between first and second person is marked on a sign such as ask. When the utterance is in the first person (*ask me*), the movement of the sign is toward the signer, whereas when it is in the second person (*ask you*), the movement is away from the signer and toward the addressee. In addition to person, ASL marks number, aspect, and reciprocity (Poizner, Klima, & Bellugi, 1987).

Reciprocity deals with the distinction between *they pinched them* and *they pinched each other*—that is, whether there is a subject that is the agent of the action and an object that is its recipient or whether there is mutual interchange between subject and object. In English, this distinction is made with pronouns. In ASL, there is a reciprocity morpheme on the verb so that *pinched each other* is conveyed by movement back and forth across the signer's body. Again, in all of these instances the marking of these distinctions is sequential in English and simultaneous in ASL.

Linguistic Productivity The property of embedding one sign into another also occurs in ASL (Poizner et al., 1987). Figure 2.5a shows the basic or uninflected sign for *give.* Figure 2.5b shows the durational form of the sign, which means "to give on a continuous basis"; part c shows the exhaustive form, which means "to give to each." It is then possible to combine both of these meanings into a single

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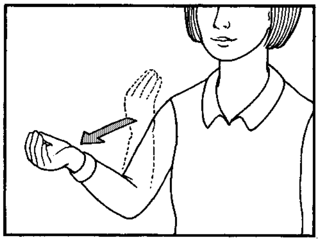
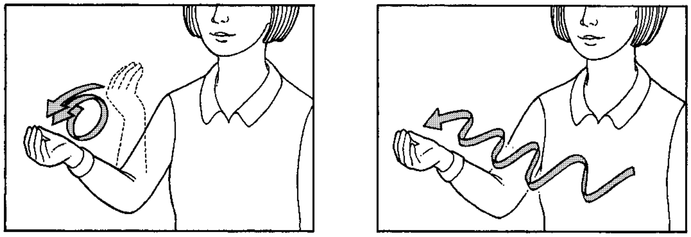
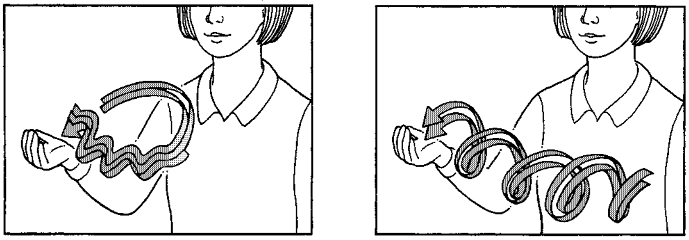


(a) GIVE (uninflected)



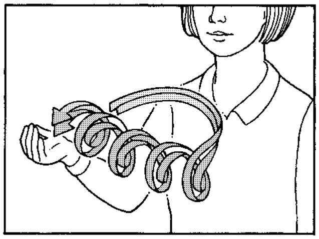
(b) GIVE [durational]
(give continuously)

(c) GIVE [exhaustive]
(give to each)



(d) GIVE [[exhaustive] durational]
(give to each, that action
recurring over time)

(e) GIVE [[durational] exhaustive]
(give continuously to each in turn)



(f) GIVE [[[durational] exhaustive] durational]
(give continuously to each in turn,
that action recurring over time)

FIGURE 2.5 Recursive nesting of morphological processes in ASL. (a) The uninflected sign *give*. (b, c) *Give* under single inflections. (d) One combination of inflections (exhaustive in durational). (e) Another combination of inflections (durational in exhaustive). (f) Recursive application of rules (durational in exhaustive in durational). (Based on *What the Hands Reveal about the Brain*, by H. Poivner, E. S. Klima, and U. Bellugi, MIT Press, 1987.)

sign by embedding one into the other, as shown in parts d and e. Notice that these last two differ, just as *The woman knows the child thinks the man left* differs from *The child thinks the woman knows the man left.*

Phrase Structure As we have seen, English marks grammatical categories, such as subject and verb, via word order. American Sign Language sometimes does this as well; for example, with transitive verbs (verbs that require a direct object, such as *give, kiss,* and *tell*), the order in which the constituents are signed is subject-verb-object (SVO) (Poizner et al., 1987). Thus, ASL makes some use of temporal order.

American Sign Language also uses spatial processes to convey syntactic distinctions. For example, ASL marks nouns with a given location in space that is initially arbitrary but retained in subsequent references to the noun. Other nouns are given other unique locations. A sentence with the same signs in the same order will have different meanings if there are different spatial indices (Poizner et al., 1987). This system actually reduces some of the ambiguity in language. For example, consider the following sentence:

(19) He said he hit him, and then he fell down.

This sentence is ambiguous in English, but because each pronoun has its own spatial index, it has a clear interpretation in ASL.

Significance of Sign Language

This introductory survey of ASL reveals some clear differences between ASL and spoken languages as well as some underlying similarities. This combination of properties makes it especially significant for several aspects of psycholinguistics. I will simply note here several issues that we shall consider in the coming chapters.

One is the topic of language production. Although speech is produced using the same channel as we use for breathing, ASL is independent of breathing. Sign production can occur entirely in parallel with, and unimpeded by, respiratory activity. Because some of the pauses we make during speech are for respiratory purposes and others are for cognitive and linguistic purposes, we might expect some interesting differences in the way signed and spoken languages are produced (see Chapter 8).

Another area of research that has benefited from the study of sign language is language acquisition. Because most deaf children have hearing parents who do not know ASL, many deaf children, unfortunately, are not exposed to a consistent language model in their early years. This provides some clues for understanding the role of the environment in language development (see Chapters 10 and 12).

Finally, the link between language and the brain could well be different in speech versus sign. It is commonplace these days to hear of differences between the two hemispheres of the brain, with the left being regarded as more verbal and the right as more skilled at spatial tasks. What then might be the neurological arrangement of a spatial language? (See Chapter 13.)

Summary

American Sign Language has its own set of grammatical rules and is a language that is independent of English. Our preliminary look at ASL indicates some striking similarities in its grammatical organization, suggesting that some of the basic concepts we have been discussing might be universal. At the same time, there are significant differences between ASL and English, and we will examine these further. Because the similarities and differences between ASL and spoken languages are so intriguing, we will return periodically to the study of ASL throughout this book.

TRANSFORMATIONAL GRAMMAR

Transformational grammar was an influential theory of grammar formulated by Chomsky in the late 1950s (Chomsky, 1957, 1965). The theory inspired a considerable amount of psycholinguistic work in the 1960s and early 1970s. The significance of this linguistic and psycholinguistic work remains controversial. In this section, I will outline some of the major features of transformational grammar. An evaluation of the theory will be postponed until the last section of the chapter.

Language and Grammar

Before discussing transformational grammar, we need to understand the relationship between grammar and language a little more precisely. The term *grammar* tends to elicit negative reactions, as the excerpt from Eliza Doolittle (from Shaw's *Pygmalion*) at the beginning of the chapter illustrates. But, as we shall see, the concept of grammar within linguistic theory has little to do with learning how to speak properly or having one's speech scrutinized by those concerned with the idea of "proper grammar." Rather, from a linguistic perspective, a grammar is a description of a person's linguistic knowledge.

Definition of Language Let us try to be a little more precise. Within linguistic theory, a **language** can be defined as an infinite set of well-formed sentences. As we have seen, there is no limit to the number of sentences in a language. A **grammar** is a formal device with a finite set of rules that generates the sentences in the language. This notion of generation is similar to the notion of deduction in mathematics or logic: We can deduce the sentences in a language by using the rules of the grammar. Grammars thus are theories of language, composed of more specific hypotheses about the structure or organization of some part of the language.

Evaluation of Grammars If a grammar is a theory of language, how do we evaluate how good a theory it is? Chomsky (see Greene, 1972, for a lucid discussion) has suggested three criteria. First, the grammar must specify what is and what is not an acceptable sequence in the language. This criterion, referred to as **observational adequacy**, applies at several levels of language. We know at the phonological level that *pbort* is not an acceptable sequence. Similarly, at the syntactic level we want the grammar to have rules that generate grammatical sentences without also generating strings of words we would regard as ungrammatical. A grammar is observationally adequate if it generates all of the acceptable sequences in a language and none of the unacceptable sequences.

The second criterion is that the grammar must specify the relationships between various sequences in the language, a criterion known as **descriptive adequacy**. It is not enough for the grammar to mark a sequence as permissible; it must also explain how it relates to other sentences that are similar in meaning, opposite in meaning, and so on. If, for example, two sentences are similar in meaning but differ in syntax, the grammar should be able to explain this fact.

The third criterion is called **explanatory adequacy**. Chomsky points out that it is theoretically possible for a number of grammars, all based on different principles, to attain these two forms of adequacy. How, then, does the linguist determine which of the descriptively adequate grammars is the best? Chomsky's answer pertains to language acquisition in children. He suggests that the child learning a language is presented with samples of the language and must determine the grammar from these samples. Chomsky notes, however, that even though the incoming data may be consistent with any number of grammars, children choose one particular grammar. This implies that certain innate language constraints enable the child to deduce the correct grammar. These innate language mechanisms would presumably be related to linguistic universals common to all languages. Thus, the final level of adequacy goes beyond the ability to describe patterns in a particular language; instead, it involves the ability to explain the role of linguistic universals in language acquisition.

These criteria have played a significant role in the development and evaluation of linguistic theories. In fact, Chomsky (1957) initially developed transformational grammar because of the descriptive inadequacy of a grammar based on phrase-structure rules. Let us now turn our attention to transformational grammar.

Deep and Surface Structure

A crucial insight into language is that sentences have more than one level of structure. In transformational grammar, this insight is captured in the distinction between deep structure and surface structure. These are both tree structures, differing in emphasis. **Deep structure** is the underlying structure of a sentence that conveys the meaning of a sentence. **Surface structure** refers to the superficial arrangement of constituents and reflects the order in which the words are pronounced. Three arguments can be made for the usefulness of this distinction. First, consider sentence (20):

(20) Flying planes can be dangerous.

This sentence is ambiguous, but not in the sense that the constituents may be grouped in more than one way, as in sentence (17). Here the ambiguity comes from the (optional) deletion of certain elements of the sentence (or, more precisely, the deep structure of the sentence). The sentence may be paraphrased roughly as *The act of flying planes can be dangerous* or *Planes that are flying can be dangerous*. This type of ambiguity, called **deep-structure ambiguity**, comes from a single surface structure that is derived from two distinct deep structures. It cannot be explained by phrase-structure rules.

A second reason for the distinction is that some pairs of sentences are similar in their phrase structure but not in their underlying structure. Consider, for example, sentences (21) and (22):

(21) John is easy to please.

(22) John is eager to please.

These sentences are apparently similar, but their paraphrases reveal their dissimilarity. We can explain this by observing that John is the object of the deep structure in (21) and the deep-structure subject in (22).

Third, other pairs are quite distinct in their surface arrangement but similar in their deep structure, such as the following sentences in **active** (23) and **passive** voice (24):

(23) Arlene played the tuba.

(24) The tuba was played by Arlene.

In this case, the active and passive sentences are considered two manifestations of the same deep structure.

Another way of putting these points is to say that a grammar that includes only one level of structure is not descriptively adequate. To fully capture these grammatical relationships, we need to posit a second level of structure, which in turn brings into play a new set of rules called transformational rules.

Transformational Rules

Within transformational grammar, the entire derivation of a sentence is a two-part process. First, phrase-structure rules are used to generate the underlying tree structure we have referred to as the deep structure. Second, a sequence of **transformational rules** (sometimes simply called **transformations**) is applied to the deep structure and the intermediate structures (those between the deep and surface structure), ultimately generating the surface structure of the sentence. Unlike phrase-structure rules, which apply to only one constituent at a time, transformations apply to entire strings of constituents. They transform them by adding, deleting, or moving constituents.

Let us look at a few transformations and see how they work. One is called the **particle-movement transformation**. We know that the following two sentences mean the same thing:

(25) John phoned up the woman.

(26) John phoned the woman up.

The concern is with the placement of the particle *up;* in these sentences, the particle may occur either just before or just after the noun phrase. Accordingly, we might write two different phrase-structure rules for the two instances, the first conforming to

(PS 10) VP → V + (part) + NP

and the second to

(PS 11) VP → V + NP + (part)

The problem with this approach is that it lacks descriptive adequacy—it does not reveal the similarity of the two sentences. In this approach, the two sentences are derived from different phrase-structure rules. An alternative approach is to assume that the two sentences have the same deep structure and to apply the particle-movement transformation to (25). The transformational rule looks like this:

(T1) V + part + NP → V + NP + part

Notice that the transformational rule simply moves the last two constituents of the verb phrase. Unlike phrase-structure rules that rewrite one constituent into a series of constituents, transformational rules begin with a series of constituents and transform them.

Consider now the following sentences:

(27) John phoned up the interesting woman.
(28) John phoned the interesting woman up.
(29) John phoned up the woman with the curly hair.
(30) John phoned the woman with the curly hair up.

Notice that in each case the particle is shifted around the entire NP—two words in (26), three in (28), and six in (30). The point is that the particle movement is defined in terms of constituents, not words. This condition gives transformational grammar tremendous power to apply to an infinite number of NPs. Instead of stating the rule in terms of the number of words, which will vary from sentence to sentence, we state it in terms of grammatical structures such as NPs. Because the movement is dependent on the grammatical structure, rules such as this are said to be **structure dependent**.

A second example is the **passive transformation**. Simplified somewhat, the rule is as follows:

(T2) NP 1 + V + NP 2 → NP 2 + be + V + –en + by + NP 1

This complex transformation, which might be involved in the derivation of sentences such as (24), contains several elementary operations. Let us begin with the active sentence (31) and then add the transformations needed to produce the passive sentence. First we invert subject and object, a transformation that produces sentence (32). (Sequences that are not grammatically acceptable are, by convention, marked with an asterisk.) Then we insert the preposition *by* in (33). Finally, we add a form of the **auxiliary verb** *be* to (34):

(31) Arlene played the tuba.
(32) *The tuba played Arlene.
(33) *The tuba played by Arlene.
(34) The tuba was played by Arlene.

One final property of transformational rules deserves mention. These rules may be blocked under certain circumstances. For example, the particle-movement transformation does not work with pronouns:

(35) John called them up.
(36) *John called up them.

These restrictions on transformations would be specified in the description of the rule. The rule would operate under specified conditions but would be blocked when these conditions did not apply.

Summary

Transformational grammar assumes that sentences have a deep structure and a surface structure. The deep structure is derived by a series of phrase-structure rules, and the surface structure is derived from the deep structure by a series of transformational rules. Transformational grammar can explain certain aspects of language, such as deep-structure ambiguity, that cannot be accounted for entirely by phrase-structure rules.

ISSUES IN GRAMMATICAL THEORY

Much of what we have discussed to this point constitutes a consensus of current thinking about linguistic concepts. In addition, linguistics has a number of issues that are actively debated. We will discuss several of them in this section.

Psychological Reality of Grammar

As indicated earlier, much psycholinguistic research in the early and mid-1960s was based on transformational grammar. This research was guided by the belief that the structures and rules of transformational grammar were psychologically real; that is, that they were a part of how people comprehend and produce language.

One assumption that was made was that the surface structure was the starting point for comprehension and that the deep structure was the end point; the roles were assumed to be reversed for production. If so, then it would be reasonable to assume that the distance between surface and deep structure (as measured by the number of transformations in a sentence's derivation) would be an accurate index of the psychological complexity of the sentence. This view was called the **derivational theory of complexity**, or DTC.

Early studies were encouraging. A variety of studies showed that negative sentences such as

(37) The sun is not shining.

were more difficult to comprehend than the corresponding affirmative form such as

(38) The sun is shining.

But these sentences differ in meaning as well as transformational complexity, so this point is hardly conclusive. Later studies directly contradicted DTC. Sentence (39) is, for example, transformationally more complex than (40):

(39) The boy was bitten.

(40) The boy was bitten by the wolf.

In transformational theory, (39) requires a transformation that deletes the phrase *by the wolf,* so DTC would predict it would be more difficult to comprehend than (40). However, neither intuition nor experiment has revealed any relationship to processing difficulty. Similarly, there is no psychological difference between sentences that have undergone particle-movement transformation and those that have not. These studies have been reviewed extensively elsewhere (Cairns & Cairns, 1976; Fodor, Bever, & Garrett, 1974; Slobin, 1971).

As Berwick and Weinberg (1983) point out, however, these results do not necessarily mean that the linguistic theory of transformational grammar is faulty. It could be that the linguistic theory is correct but that some of the psychological assumptions guiding DTC are faulty.

More recent work has been more favorable to the hypothesis that linguistic theory has psychological reality. Consider this sentence:

(41) The dentist from the new medical center in town was invited by the actress to go to the party.

The use of the passive voice results in the movement of the NP that is the object of the verb (*dentist*) from the object position to the subject position. However, according to recent grammatical theory, it is assumed that the moved constituent leaves a trace at its earlier location. Thus, the presumed linguistic representation of (41) would be more like (42):

(42) The dentist from the new medical center in town was invited [trace] by the actress to go to the party.

If this proposal has psychological reality, then the hypothesis would be that comprehenders would be likely to reactivate the moved noun (dentist) when its trace was encountered. Osterhout and Swinney (1993) have provided evidence that comprehenders do this. Participants responded rapidly when words semantically related to the moved noun were presented in the trace position. It is as if they were thinking about *dentist,* which made it easier to respond to a semantically related word, such as *tooth.* Responses were slower either before or after the trace position.

A converging group of studies (see Zurif & Swinney, 1994) are suggesting that traces have psychological reality. I will leave the details for a later discussion (see Chapters 6 and 13). But, for now, the point is this: These studies have suggested that some psychologists may have overreacted to the problems with DTC. When we see a combination of the right linguistic theory and the right psychological experiment, better results are obtained.

The Centrality of Syntax

There have long been controversies within linguistics regarding the proper way to characterize linguistic knowledge. As we have seen, phrase-structure rules are insufficient in themselves to account for our linguistic capacities, and these insufficiencies led Chomsky to propose transformational grammar.

In the years since transformational grammar was formulated, it has gone through a number of changes. In the most recent version, Chomsky (1995) has eliminated many of the transformational rules in previous versions of the grammar and replaced them with broader rules, such as a rule that moves one constituent from one location to another. It was just this kind of rule on which the trace studies were based. Although newer versions of the theory differ in several respects from the original, at a deeper level they share the idea that syntactic structure is at the heart of our linguistic knowledge. However, this view has been controversial within linguistics. We will discuss two alternative linguistic theories.

One alternative approach is supplied by lexical theories of grammar. In lexical theories (for example, Bresnan, 1978), greater emphasis is placed on individual lexical items (words) than is given in more structural theories, such as transformational grammar. This view has been influential in recent years in diverse areas of psycholinguistics, including language comprehension, language production, and language development.

Let us go through an example to contrast structural and lexical views. In most grammars, the lexical entry for a word includes its meaning, its spelling, its pronunciation, and syntactic characteristics such as part of speech. In Bresnan's (1978, 2001) **lexical-functional grammar**, lexical entries also include the various forms of the word (for example, *kiss, kissed, kissing*) and the different kinds of sentences into which each form would fit. For verbs, this includes the arguments or semantic roles, such as the **agent** (the person doing the action) and the **patient** (the one to whom the action is done) that are associated with the verb, as well as the surface structure designation, such as subject or object, that goes with it. Consider sentences (43) and (44):

(43) Mary kissed John.

(44) John was kissed by Mary.

The lexical entry for *kiss* would indicate its underlying semantic structure as

kiss: (agent, patient)

That is, the verb requires both an agent and a patient (**John kissed* is not a grammatical sentence). In addition, the entry includes various forms of the word, including

kiss: agent = subject, patient = object

and

(be) kiss: agent = object; patient = subject

The first verb form, used in sentences in the active voice, assigns the agent role to the surface-structure subject and the patient to the surface object. The second form, used in passive sentences, assigns the patient to the subject and the agent to the object of the preposition *by.*

By storing this additional information in the lexical entry, the derivation of passive sentences becomes shorter than in traditional transformational grammar. When the surface structure includes a form of the verb kiss, that lexical entry is retrieved and fitted into the sentence. The grammatical information in the entry allows us to interpret the sentence semantically (that is, to interpret John as patient). The constituent structure of a passive sentence in lexical-functional grammar looks like a passive sentence, not like an active sentence, and no passive transformational rule is involved. The meaning relation between these two sentences is preserved through lexical rules that specify the relation between different forms of a word, not by transformational rules.

The major significance of lexical-functional grammar is the shunting of most of the explanatory burden onto the lexicon and away from transformational rules. This makes a good deal of psychological sense. Cognitively speaking, the retrieval of items from our mental dictionary is relatively easy. In contrast, working our way through a syntactic structure is more difficult. By storing syntactic information in the lexical entry in the mental dictionary, lexical theories simplify the process of comprehending sentences. This seems to provide a potentially more plausible explanation for the nearly effortless manner in which we comprehend sentences in our everyday life.

Bresnan's lexical-functional grammar has sometimes been called a **psychologically realistic grammar** because it takes psychological or processing considerations into account. Another linguist who considers the processing implications of linguistic structures is Ray Jackendoff (2002). Jackendoff accepts many of Chomsky's views, notably the belief that some of our language knowledge is innate (discussed later). But he rejects the Chomskyan view that syntax is at the core of our linguistic knowledge. More specifically, he rejects the notion that linguistic productivity (which he calls combinatoriality) is solely due to syntactic rules of the sort we have discussed already.

Jackendoff suggests that grammars have multiple sets of formation rules (syntax, semantics, phonology), and thus a complete account of grammar requires attention to the interfaces between these different systems. He suggests that these different systems operate in parallel, a view that many psychologists have independently advocated (see Chapter 3). The simultaneous use of different kinds of linguistic and even nonlinguistic information may simplify language processing, a point discussed in Chapter 6 and again in Chapter 8.

The appeal of this line of approach may be seen in sentences (45) and (46). Typically, both sentences would be uttered with stress on the syllable *par* and, up until the comma, the sentences are pronounced identically. Note in particular that it is impossible to determine word boundaries on phonological grounds alone. The pronunciations of *a parent* and *apparent* are ordinarily identical, so we need to use semantic information to identify the word boundaries. This suggests that we have a phonological processor and a semantic processor along with an interface that connects the two.

(45) It's only a parent, not a teacher.

(46) It's only apparent, not real.

One implication of Jackendoff's view of language is that it might be easier to understand the evolution of language. The evolution of language poses a problem for language theorists because it is not obvious how language could evolve through the process of natural selection. That is, it is difficult to see how language could emerge incrementally from simpler communication systems. The greater emphasis Jackendoff places on semantics suggests a way out of the dilemma, because it is generally assumed that other primates have the ability to understand meaning at least to some degree. Thus, if we begin with semantics instead of syntax, it may be (a little) easier to construct an understanding of how language may have evolved.

The relationship between grammar and evolution has recently been the subject of intense debate. Hauser, Chomsky, and Fitch (2002), in a provocative article, suggest that we should distinguish between what they term the "faculty of language in the broad sense" (FLB) and the "faculty of language in the narrow sense" (FLN). FLB includes systems that support the ability to acquire a language, such as memory and conceptual ability. In contrast, FLN only includes recursion and is the only uniquely human component of the faculty of language.

Hauser et al. suggest that this distinction may help explain how language evolved. In this view, FLB might have a long evolutionary history and thus there may be considerable similarities in memory, cognitive skills, and intentional behavior between humans and both other current species and our own evolutionary ancestors. However, FLN is seen as more recent in origin and exclusively human. The essence of FLN, the capacity for recursion, deals with the narrow but vital function of mapping meanings onto sound. Hauser et al. suggest that recursion arose first in other systems such as navigation, vision, and number, and then somehow linked up with the language system.

Pinker and Jackendoff (2005) criticize this view and suggest that there are many aspects of grammar that are not recursive, including phonology, morphology, and many properties of words. Moreover, Pinker and Jackendoff suggest that the Hauser et al. distinction is motivated primarily by Chomsky's recent approach to syntax, which also minimizes these (nonrecursive) aspects of language. In essence, by simplifying what is regarded as the essence of language, Chomsky has attempted to simplify the question of how it evolved.

The evolution of language is an important topic and deserves a fuller discussion than provided here. We will explore the evolution of language in greater detail in Chapter 13.

Is Language Innate?

Another issue that has prompted considerable debate is the question of whether some of our linguistic capacities are innate. As noted in Chapter 1, two views emerge here. Nativists assert that children are born with some linguistic knowledge, and empiricists instead claim that children acquire language from linguistic experience.

At one level, it is obvious that experience plays a major role in language acquisition. We all learn the language to which we are exposed, not some other language from across the globe.

Some evidence in support of the nativist view has come from children with limited linguistic experience. In certain situations in which children are not presented with any consistent linguistic model, they appear to have the capacity to invent some aspects of language. This has been seen in deaf children whose parents did not believe in or teach ASL (Goldin-Meadow, 1982). Despite the lack of either speech or sign, these deaf children invented a form of gestural language that was similar in some respects to ASL. They could not have acquired this system from their parents, because the children's facility with sign exceeded that of their parents. Bickerton (1983) presents similar conclusions based on studies of immigrants and their children.

What kinds of linguistic capacities might be inborn? Current thinking centers on the concept of parameters. A **parameter** is a grammatical feature that can be set to any of several values. For example, the **null-subject parameter** deals with whether a language permits constructions that have no subject. This parameter has two values: null subject (the language allows sentences without a subject) or subject (the language requires subjects for sentences to be grammatical). For example, sentence (47) is not grammatical in English, but it would be in Italian or Spanish. Thus, Italian is a null-subject language, and English is a subject language.

(47) want more apples

Parameter-setting theorists (Chomsky, 1981; Hyams, 1986), then, suggest that children are born with the parameters and with the values of the parameters. What they must learn, from experience, is which value is present in their native language.

A rough analogy is thinking of two restaurants. Restaurant A provides customers with a small array of choices within a few well-understood categories (that is, baked potato or fries or rice; French or Italian or ranch dressing).

Restaurant B provides customers with a large number of choices within an equally large number of categories. Most dinnergoers would find Restaurant B informationally overwhelming; in contrast, it would be far easier to learn what choices to make in Restaurant A. The analogy is not perfect: We have acquired the categories in Restaurant A from experience, whereas the language parameters are presumed to be innate. Nonetheless, there is a fundamental similarity. Parameter-setting theorists would suggest that without built-in categories (and values), a child would be lost in a sea of linguistic details and would not be able to acquire a language as well as most children do.

Parameter-setting models appear to offer a tidy solution to the question of how innate processes interact with a child's language experience. Some scholars believe that the parameter-setting account is too tidy and have pointed out flaws in the model (Bloom, 1990; Valian, 1990). Nonetheless, the approach has raised some important issues regarding the role of innate linguistic mechanisms in language acquisition. We will discuss these issues further in Chapter 12.

Summary

Several controversial issues in grammatical theory have been discussed. One is whether linguistic principles have psychological reality. Although research on transformational grammar in the 1960s suggested a negative answer, more recent research has reopened the question. A second issue is whether our grammatical knowledge is better described in structural or lexical terms. Finally, we have briefly considered whether our linguistic knowledge may be innate.

REVIEW QUESTIONS

1. What is aspiration, and how is it related to the distinction between phones and phonemes?
2. What is wrong with a rule that states that /p/ cannot be followed by /b/ at the beginning of a word?
3. How is duality of patterning represented in American Sign Language?
4. Why does ASL interest psychologists?
5. Define grammar and state its relation to language.
6. Distinguish between phrase-structure rules and transformational rules.
7. What is the current status of the derivational theory of complexity?
8. Describe how the study of traces relates to the issue of the psychological reality of grammar.
9. Distinguish between the faculty of language in the broad sense (FLB) and the faculty of language in the narrow sense (FLN).
10. In lexical-functional grammar, what is the advantage of storing syntactic information in the lexical entries of words?

THOUGHT QUESTIONS

1. Is productivity an attribute of human language, of the human mind generally, or of both?
2. The discussion of American Sign Language indicates that it is becoming progressively less iconic and more arbitrary. Speculate as to why this might be occurring.