Fundamentals of Psycholinguistics

Eva M. Fernández and
Helen Smith Cairns

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*This book is dedicated to the students
in Introduction to Psycholinguistics at
Queens College: past, present, and future.*

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Prologue

For almost 40 years we (first Helen, then Eva) have been teaching 'Introduction to Psycholinguistics' to undergraduate students at Queens College of the City University of New York (CUNY). This book is dedicated to those students and others who come after them.

In 1999 Helen Cairns wrote *Psycholinguistics: An Introduction* (1999, now out of print), which was informed by years of figuring out which pedagogical strategies work and which don't when introducing students to the study of language acquisition and use. Both of us experienced great success teaching with that book, so we have adopted its focus and organization for *Fundamentals of Psycholinguistics*. The present volume offers updated content, given the empirical developments in the field of psycholinguistics in the past decade. We have also incorporated a new orientation triggered in part by our experience of teaching this material to the diverse student body at Queens College: we have woven multilingualism into the basic narrative.

We begin our story by asking what it means to know a language, a question whose answer necessarily includes an exploration of the biological underpinnings of language and its representation in the brain. We then explore the acquisition of language in children and adults. The book then focuses on the production and comprehension of sentences, describing the steps that intervene from the time an idea is born in the mind of a speaker to the moment it is understood in the mind of a hearer. We conclude with an overview of how language is used in discourse.

We have many people to thank for their assistance in the writing of this book. Danielle Descoteaux of Wiley-Blackwell has given us both enthusiastic support and helpful suggestions from the beginning of this project, and we received invaluable assistance from the editorial

and production team. A number of anonymous reviewers provided invaluable suggestions for improvement of the original manuscript. Dianne Bradley, Chuck Cairns, Dana McDaniel, Lucia Pozzan, and Irina Sekerina have provided guidance in a number of areas. We have also benefited from being part of the psycholinguistics community in and around the CUNY Graduate Center and Queens College.

We are fortunate to have students and colleagues with expertise in some of the languages we have used in examples throughout the book. For their help with these, we thank Yukiko Koizumi, Ping Li, Shukhan Ng, Irina Sekerina, Amit Shaked, Iglika Stoyneshka, and F. Scott Walters.

Our primary goal is not to provide our readers with a great many facts about language acquisition and use. As in all healthy empirical fields, data change with ongoing investigations. Instead, we hope to convey to our readers the amazing story of the unconscious processes that take place as humans use language.

Eva Fernández
Helen Cairns

1 Beginning Concepts

Psycholinguistics is an interdisciplinary field of study in which the goals are to understand how people acquire language, how people use language to speak and understand one another, and how language is represented and processed in the brain. Psycholinguistics is primarily a sub-discipline of psychology and linguistics, but it is also related to developmental psychology, cognitive psychology, neurolinguistics, and speech science. The purpose of this book is to introduce the reader to some of the central ideas, problems, and discoveries in contemporary

psycholinguistics. In this chapter, we explore key concepts about language that serve to distinguish it from related aspects of human behavior and cognition, and we identify the basic characteristics of language as a system. We also provide a brief account of how psycholinguistics emerged as a field of inquiry.

■   The Creativity of Human Language

A good place to begin is by thinking about some of the unique features of human language. Language is a system that allows people immense **creativity**. This is not the same creativity of people who write essays, fiction, or poetry. Instead, this is the linguistic creativity that is commonplace to every person who knows a language. The creativity of human language is different from the communication system of any other animal in a number of respects. For one, speakers of a language can create and understand novel sentences for an entire lifetime. Consider the fact that almost every sentence that a person hears every day is a brand new event not previously experienced, but which can be understood with little difficulty. Similarly, when speaking, people constantly produce novel sentences with no conscious effort. This is true for every person who speaks or has ever spoken a language. We can extend this observation to every person who uses a signed language to produce and comprehend novel sentences.

This remarkable ability to deal with novelty in language is possible because every language consists of a set of principles by which arbitrary elements (the sounds of speech, the gestures of sign language) are combined into words, which in turn are combined into sentences. Everyone who knows a language knows a relatively small number of principles, a small number of sounds put together to create words, and a large but finite vocabulary. This finite knowledge provides the person who knows a language with infinite creativity. The set of possible sentences for a given language is infinite. Everyone who has ever lived and known a particular language has produced and heard a miniscule subset of that infinite set. Knowledge of language confers upon every person the creativity to produce an infinite number of novel sentences. When that knowledge is shared with others in a given language community, speakers and hearers are able to produce and understand an indefinitely large number of novel sentences.

A second important kind of creativity humans possess is that we can use language to communicate anything we can think of. No other animal communication system affords its users such an unlimited range

of topics. Many mammals have complex sets of calls and cries, but they can communicate only certain kinds of information, such as whether danger is coming from the ground or the air, who is ready to mate, where food is located, and so forth. The philosopher Bertrand Russell once said, "No matter how eloquently a dog may bark, he cannot tell you his parents were poor but honest" (Gleason and Ratner 1993: 9). Language is so flexible that it not only allows people to say anything they can think of; it also allows people to use language for a vast array of purposes. Language is used to communicate, to interact socially, to entertain, and to inform. All cultural institutions – schools, communities, governments – depend upon language to function. Written and audio-recorded language allows people to communicate and convey information – as well as interact and entertain – across vast spans of space and time. It is probably the case that human dominance of the planet has been possible because of the power of human language as a medium for transmitting knowledge (Dennett 2009).

■ Language as Distinct from Speech, Thought, and Communication

Language is the primary communication system for the human species. In ordinary circumstances it is used to convey thoughts through speech. It is a special system, however, that functions independently of speech, thought, and communication. Because one of the main themes of this book is to identify the unique aspects of the human linguistic system, it might be helpful to distinguish between language and the other systems with which it usually interacts: speech, thought, and communication.

Before we discuss those other systems, let us emphasize that here and throughout this book our discussion of human language includes the signed languages of the deaf, unless explicitly noted. Sign languages are just as structured as any spoken language and are just as capable of conveying an unlimited range of topics (as discussed in the previous section). Sign languages also operate under principles distinct from thought and communication. What differs between signed and spoken languages is the transmission mode: gestural for the former and articulatory-phonetic (speech) for the latter.

Speech ought not to be confused with language, though speech is indeed the most frequent mode for transmitting linguistic information. Other modes for transmission include the gestures used in sign language and the graphic representations used in writing. Later in this

chapter (and later in the book), we will address the differences between the signal (speech, signs, written symbols) and the abstract information carried by that signal, and we will demonstrate that producing or perceiving a speech signal is possible and efficient because of knowledge of language. For now, consider the "linguistic" abilities of parrots and computers. Both can produce speech that might sound very human-like (promising new technologies are also able to create gestural sequences, using computer-animated figures, in sign language). But animal or computer-generated speech (or signing) differs from true human language production in one crucial respect: it is not based on knowledge of language as a finite system that yields an infinite set of possible sentences. Notice in particular that parrot and computer speech will fail to be creative in the senses described above.

Another mode for transmitting linguistic information is **writing**, but writing is markedly different from both speaking and signing. Writing systems are invented by people who already use language, so the central difference is that writing is a cultural artifact, while speaking and signing are biological; we will examine this point in more detail in Chapter 3. Writing is always dependent on spoken language, though the connection differs from language to language. In some languages, like English, the written symbols – also called **graphemes** – are linked to the language's sound system (consonants, vowels); in other languages, like Chinese, the symbols represent words. Writing has had a very different historical trajectory than speech: humans have been using spoken language to communicate for tens of thousands of years, while writing is a relatively new development, with the earliest examples dating back to only about 5,000 years ago. Children learn to speak spontaneously and without explicit instruction, yet require hours and hours of teaching and practice when they are learning to read and write. While all human communities have some form of spoken (or gestural) language, in the majority of the world's languages a writing system has not been invented. It is important to remember that languages without a writing system are no less complex than their counterparts with standardized writing systems. The complexity and sophistication of all human languages is independent of whether speakers have developed a way to write the languages down.

It is tempting to confuse **thought** and language, because we verbalize our thoughts using language. The distinction between language and thought (or general intelligence) becomes clear when one considers the many kinds of individuals who can think but cannot communicate through language. Among these kinds of individuals are infants and people who suffer from neurological pathologies that have

impaired their language ability. Moreover, many animals can think but cannot communicate using language. In the language pathologies, we observe pronounced mismatches between level of intellectual development and linguistic ability. Specific language impairment (SLI) is not a rare disorder in children without any neurological or motor pathology. In children with SLI, language development lags far behind that of their peers. While there are numerous cognitive deficits associated with children with SLI, their non-verbal intelligence is within normal range and their cognitive deficits are not sufficient to account for their language disorder (Leonard 1998). The flip side of SLI is Williams Syndrome, a genetically based disorder causing severe retardation. Children with Williams Syndrome are deficient in many other aspects of cognition. While some aspects of their language are impaired (Jacobson and Cairns 2009), these children have surprisingly good language skills, in both vocabulary and in the ability to form grammatical sentences (Lenhoff et al. 1997). Pathologies such as SLI and Williams Syndrome, that demonstrate a dissociation of language and general intelligence, are of interest because they demonstrate the independence of language and thought.

The thoughts that people have are distinct from the language (or languages) in which they encode them. Bilinguals can use either of their languages to transmit the thoughts they want to convey. It may be that one of the languages of a given bilingual will have a richer vocabulary for conveying certain thoughts, as in the person who prefers to speak about art in English and about soccer in Portuguese. Perhaps it is more convenient to convey information in one of the two languages; for example, memorizing word lists in one language will facilitate recall in that same language (Cabeza and Lennartson 2005). But neither of these phenomena alters the basic point: when required to, bilinguals are able to convey any thought in either of their languages, or in both. This observation can be extended to all human languages, of which there are close to 7,000 (Ladefoged, Ladefoged, and Everett 1997; Gordon 2005): any thought can be conveyed in any human language. A corollary of this is that any sentence in any human language can be translated into any other, even by ordinary bilinguals, as opposed to experienced translators or trained interpreters. It may take more than one sentence to do the job, and the translation may not be as elegant as the original, but all languages possess an ability to formulate equivalent meanings with precision. Thus, one can think of general intelligence as the system responsible for generating the "language of thought" (Fodor 1975), and this in turn is translated into speech by our linguistic system, which we describe in the following section and, in more detail, in Chapter 2.

Language is the primary communication system for human beings, but it is not the only way to communicate, so language can be distinguished from **communication** in general. Many forms of communication are not linguistic; these include non-verbal, mathematical, and aesthetic communication through music or the visual arts. Frequently, language is not used to communicate or transfer information; language can be used aesthetically (consider poetry or song lyrics) or as a means to negotiate social interactions (consider how *Yo, whassup!* might be the preferred greeting in some contexts but quite inappropriate in others). One of the wonderful things about language is that it can be studied in many different ways. Its social, cultural, and aesthetic characteristics can be analyzed independently of one another. In psycholinguistics, however, researchers are primarily concerned with the underlying structure of language as a biologically based characteristic of humans, derived from the human neurological organization and function; we come back to this topic in greater detail in Chapter 3. Human language is unique to human beings and its general structure is universal to our species. All and only humans have human language. These facts have profound implications for the way language is acquired by infants (see Chapter 4) and for the way that language is produced (Chapter 5) and perceived (Chapters 6, 7, and 8).

■ Some Characteristics of the Linguistic System

Language is a formal system for pairing signals with meanings (see Figure 1.1). This pairing can go either way. When people produce a sentence, they use language to encode the meaning that they wish to convey into a sequence of speech sounds. When people understand a spoken sentence, language allows them to reverse the process and decode a speaker's speech to recover the intended meaning. Obviously, these activities depend upon the speaker and hearer sharing a common language: both must have the same linguistic system for pairing sound and meaning.

The linguistic system that enables sound and meaning to be paired contains a complex and highly organized set of principles and rules. These rules are ultimately the source for the infinite creativity of language because they describe (or generate) any one of an infinite set of sentences. The set of rules that creates sentences in a language is a language's **grammar**, and the words of a language are its **lexicon**. Notice that this way of defining language is very specific about what it means to know a language. Knowing a language involves knowing its
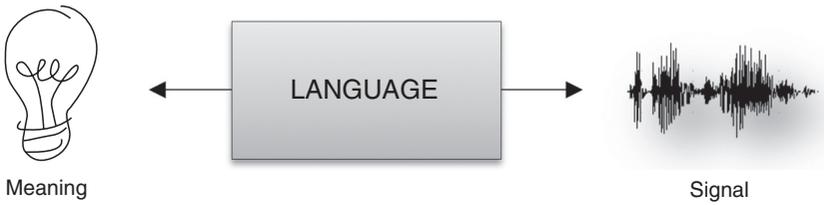
Figure 1.1   Language is a system that connects signals (the sound wave on the right, symbolizing speech) and meanings (the light bulb on the left, symbolizing an idea). In the figure, the signal is acoustic, a speech sound. The signal could take on other forms (it could be written, it could be gestural).

grammar and lexicon. Knowledge of such a system will give a speaker the ability to organize ideas into words and sentences, and sentences into sequences of sounds. This special kind of knowledge is called *tacit* (or *implicit*) *knowledge*, to distinguish it from explicit knowledge, such as your knowledge of a friend's telephone number. Tacit knowledge is represented in the brain and is put to use, in this case, in the production and comprehension of sentences, but is not consciously available to the individual who possesses it.

■   The Distinction between Descriptive and Prescriptive Grammar

The term *grammar* means something different to linguists than what it means to language teachers. People who teach language are interested in teaching a standardized use of language, the form of a language that is accepted in academic and business circles. We can refer to this type of language as conforming to **prescriptive grammar**. Knowing how to adapt to the standard (*prescribed*) way of speaking or writing is very useful for people conducting a job interview or producing a formal piece of writing. People who study language, in contrast, are interested in what is called **descriptive grammar**, that is, the language system that underlies ordinary use. This is not an easy concept to grasp, so some examples are in order. Many people who speak English – especially young people or people talking in informal contexts – will say sentences like the following:

(1)   Me and Mary went to the movies.

(2)   Mary and me went to the movies.

These sentences are generated by a person's internalized grammar of English, which licenses those constructions, but which would not generate an **ungrammatical** sentence like the following:

(3)   *Me went to the movies.

(The asterisk, *, indicates that the sentence is badly formed.) The use of *me* in subject position is possible in English only with a compound subject (*me and Mary* or *Mary and me*), not with a singular one. A person who can say (1) and (2) but not (3) has a particular kind of grammar that a linguist would want to be able to describe.

English teachers are not interested in describing the properties of people's underlying grammars; they want instead to make sure that their students know that certain ways of saying things are not considered "correct English." The prescriptive rules of English grammar require that *I* be used in subject position, whether it is singular (*I went to the movies*) or compound (*Mary and I went to the movies*). (English teachers would further object to (1) because it is considered impolite to place oneself before others.) Similarly, students are told that they should say *It is I* and *This is she* rather than *It's me* or *This is her*. However, most people – including the occasional English teacher, in casual speech – say *It's me* and *This is her*. The grammar that people develop during language acquisition is the (colloquial) grammar of other members of their language community. In fact, when people are acquiring the bulk of their linguistic ability in their first language (or languages) – a process that lasts from birth until a child is around 5 or 6 years of age – they have not even heard of linguistic correctness. There can be many differences between the sentences generated by that colloquial grammar and those sentences dictated by prescriptive grammar. For example, many people will answer the telephone with *It's me* or *This is her*, rather than *It is I* or *This is she*. It is interesting to note that learning the prescribed rules of usage for a particular language is often a tedious and difficult process, and one that requires a great deal of conscious attention as well as explicit instruction, in contrast to the ease with which children acquire (implicitly and without instruction) the rules for the language or languages they acquire early on in life.

The issue of correctness also arises when one considers dialectal variation. English, like most languages, takes on many different forms; the language varies geographically, by class, and by ethnicity. People from different English-speaking countries, from different areas within these countries, and from different racial and ethnic

groups not only pronounce words differently, but also have profound and highly systematic lexical and syntactic differences from the transnational standard version of English, or from regional standards, like Standard American English or Standard British English. For instance, people from the south of the United States use the word *purse*, whereas people from the north use the word *pocketbook* to refer to the same thing. A feature of Southern American Vernacular English is "modal stacking," such that it is perfectly grammatical to say the sentence in (4), in which the two modal verbs *might* and *should* are stacked.

(4)   We might should pay our bills tonight.

Different dialects – their distinguishing properties, their origins, and their development over time – are of great interest to linguists. So-called "standard" English, spoken by people like network newscasters who have been trained to use it, is considered to be the ideal form of the language, but it is actually spoken by very few people. The fact is that most people speak some sort of non-standard variety of English, some coming closer than others to the idealized standard form. Linguists do not take a position on whether there should be a standard version of a language or on what form the prescriptive rules of the grammar should take. Yet language with prescriptive grammar guiding usage in formal contexts is a fact of life in modern society. Since business and professional communities ascribe to the ideal, most people would be well advised to become consciously aware of the differences between the colloquial version of English acquired naturally by children (the language that linguists are interested in describing) and the standardized form of the language that will get someone a good job or an A+ on an essay exam. It is a mistake, however, to believe that there is anything inherently better about the set of sentences acceptable based on the prescriptive grammar of a language compared to those sentences generated by the grammar acquired naturally and unconsciously. Unfortunately, non-standard varieties of English are generally stigmatized, even by the very people who speak those varieties (Preston 1998), and are often mistakenly seen as reflecting lack of intelligence or education. Yet all human languages have variations that extend across their speakers, so if one considers a naturally occurring linguistic characteristic to be good, any deviations from the linguistic norm are wonderful – or at the very least, normal. The point is that linguists are interested in describing people's grammars and dialects, and psycholinguists are interested in understanding how those

grammars are put to use in the production and comprehension of sentences. Psycholinguists are not concerned with correctness or standard forms.

■   The Universality of Human Language

Linguists tend to refer to human language as a single entity, despite the fact that there are many different versions spoken by the thousands of different language communities around the world. The fact is that all human languages are cut from the same mold: they are highly similar in their organization and in the abilities they confer on the people who know them. All human languages have a grammar and a lexicon, which together allow the creation of an infinite set of sentences to convey any possible thought. The fact that all humans have languages of similar organization and function strongly suggests that language is part of the human biological endowment, as the communication systems of animals are specific to their species. The **universality of human language** has profound consequences for the way psycholinguists analyze the human use of language.

At the same time, linguists are interested in understanding what is specific and what is universal, not only about knowledge of language but also about the mechanisms that put that knowledge of language to use. The majority of the world's population is bilingual or multilingual, and most of the world's children grow up in environments that expose them to multiple languages (Romaine 1995). These facts indicate that the mechanisms for representing and processing language can handle efficiently more than one linguistic code.

■   Implications for the Acquisition of Language

An important area of psycholinguistics is **language acquisition**. Just as every human culture has at least one language, children in every culture acquire the grammar and lexicon of the language or languages in their environment and develop the ability to employ that linguistic knowledge in the production and comprehension of speech. Children do this without effort and without being taught. Just as there are profound similarities among human languages, there are profound similarities in the way children everywhere acquire their native language or languages. Language acquisition is more similar to the acquisition of other skills that develop in early childhood, such as walking, than it

is to skills that are learned later in life, such as riding a bicycle or writing. If a person does not know how to ride a bicycle, one does not assume there is anything wrong with this person, only that the person has not been taught how to ride a bicycle. If a person is unable to talk or a child is unable to acquire language, then one assumes a basic pathology and seeks professional advice. The rapid, effortless, and natural acquisition of language by children is likely a result of the fact that language is a faculty of the human brain. As the brain develops, it organizes the language the child is exposed to in ways that are common to all humans.

This picture is complicated somewhat by second language acquisition after early childhood, because learning a language as a teenager or as an adult is perceived as being very difficult, especially compared to the ease with which we learned our first language. Indeed, learning a second language is a great deal of work, particularly when the learner lives in an environment in which the language is not spoken regularly. Certain aspects of a second language are quite difficult to master, pronunciation in particular. And when learning a second language, one's first language sometimes seems to get in the way. Yet (adult) second language learners go through similar developmental stages as do (child) first language learners. Furthermore, many people acquire high levels of competence in a second language without having been taught explicitly. Underlying these abilities, therefore, is a system for acquiring human language that is engaged fully during first language acquisition and again at least partially with exposure to a second language, at any time within the lifespan of an individual. To account for the perceived differences between first and second language acquisition, research has pointed to variable amounts of exposure – usually vastly more extensive for first language learners – as well as to factors that include the learner's psycho-social proximity to the target language culture. Also, some recent proposals link age effects in second language acquisition to the decline in memory abilities observed with aging (Birdsong 2005).

■ How Language Pairs Sound and Meaning

In any human language, the principles and rules of the grammar organize words from the lexicon into sentences used to convey meaning. Three kinds of rule systems make up a grammar. **Phonological rules** describe the sound patterns of the language; they are used to create individual words and are responsible for the rhythm and intonation

of speech. **Morphological rules** and **syntactic rules** are involved in creating the structural organization of words and sentences, that is, the relationships between words and phrases in sentences. (Chapter 2 describes the basic operations of these various rule systems, as well as the organization of the lexicon.) It is a fundamental concept in psycholinguistics that the meaning of a sentence is a function of the meaning of individual words and how those words are organized structurally. People are consciously aware of many elements of language – like consonants or vowels, syllables, and words – but they tend not to be aware of sentence structure. When one reads in the popular press that some subculture, like teenagers or video gamers, has a different "language," it usually turns out that this "language" differs from English only in that it has some special vocabulary items or some specialized pronunciation features. People are probably not as aware of sentence structure as they are of sounds and words, because sentence structure is abstract in a way that sounds and words are not. The acoustic signal of a recorded sentence has properties that reflect the consonants and vowels it carries (more on this phenomenon in Chapter 5). Also, though they are not usually pronounced in isolation, words are generally written with spaces around them in most of the world's writing systems. In contrast to sounds and words, syntactic structure is not represented in the spoken or written signal. At the same time, sentence structure is a central aspect of every sentence. Though it has no physical reality, sentence structure has psychological reality: it must be represented by the speaker and recovered by the hearer in order for the meaning of a sentence to be conveyed. In other words, the meaning of a sentence depends on the structural organization of the sentence's words.

When a person sets out to learn a new language, something usually done in school, the task is frequently conceptualized as memorizing new vocabulary. Language learners quickly realize, though, that structure is just as important a feature of a new language as is its vocabulary. Indeed, bilinguals usually have a better sense of language structure than monolinguals, because they are accustomed to noticing that ambiguities in one language are not parallel in the other, for example, and that word-by-word translations usually do not work. All of this makes bilinguals more consciously aware of sentence structure than are monolinguals.

We can appreciate the importance of sentence structure by looking at examples within a single language. For instance, in English, the same set of words can convey different meanings if they are arranged in different ways. Consider the following:

(5)   The senators objected to the plans proposed by the generals.

(6)   The senators proposed the plans objected to by the generals.

The meaning of the sentence in (5) is quite different from that of (6), even though the only difference is the position of the words *objected to* and *proposed*. Although both sentences contain exactly the same words, the words are structurally related to each other differently; it is those differences in structure that account for the difference in meaning. The same ten words could be combined in such a way that they would have no structure and no meaning:

(7)   The to plans senators objected proposed the by generals the.

An unstructured collection of words does not convey meaning, and the same collection of words can mean different things depending upon their organization. A person who knew only a lexicon, without a principled system to combine the words into sentences, could get some ideas across, but would lack a system of sufficient precision to convey more than just some simple thoughts.

Another way to get a sense of how meaning depends upon sentence structure is to see how the same string of words in the same linear order can convey two different meanings, depending upon the abstract structure assigned to them. Consider the structurally ambiguous sentence in (8):

(8)   The man saw the boy with the binoculars.

The sentence can mean either that the man saw the boy by means of the binoculars or that the man saw a boy who had the binoculars. Thus, *with the binoculars* is associated either with the verb *saw* or with the noun *boy*.

Figure 1.2 illustrates the structural differences associated with each of the two meanings of (8), using tree diagrams to spell out the structural (hierarchical) relationships between the words for the two meanings of the sentence. In the top tree in Figure 1.2, *with the binoculars* is a prepositional phrase (PP) completely separate from the noun phrase (NP) that contains the noun *boy*. In contrast, in the bottom tree, the PP *with the binoculars* is grouped inside the NP that contains *boy*. The structures illustrated in Figure 1.2 reflect the difference in meaning that distinguishes the two interpretations of the sentence, namely, *with the binoculars* tells us the instrument used by the man to see the boy (top tree),

(a)


```
S = Sentence
NP = Noun Phrase
VP = Verb Phrase
PP = Prepositional Phrase
Det = Determiner
N = Noun
V = Verb
P = Preposition
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(b)
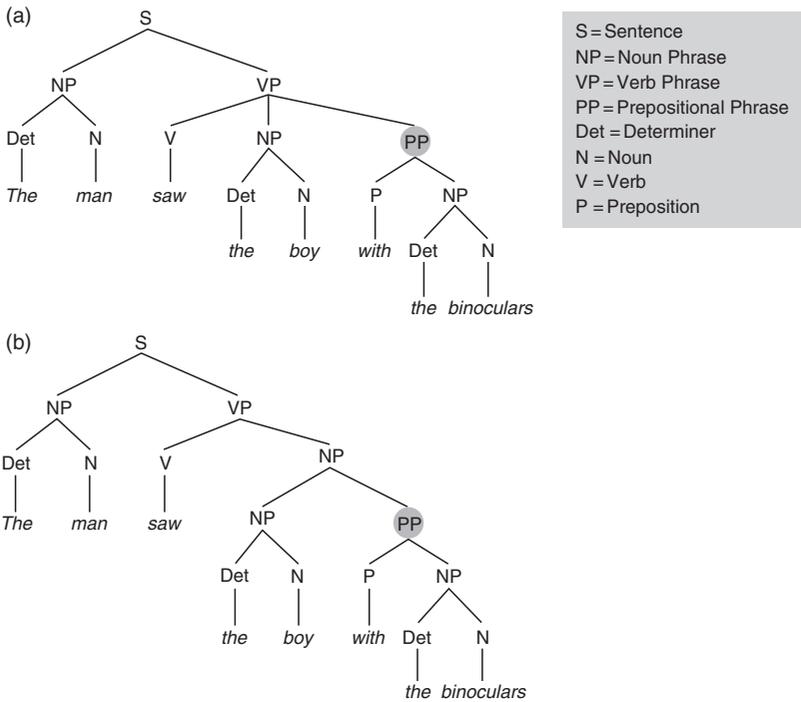
Figure 1.2   Abstract structures associated with the two meanings of the structurally ambiguous sentence *The man saw the boy with the binoculars*. Focus on the different location for the prepositional phrase (the shaded node labeled PP), *with the binoculars*, in each of the two structures.

or conveys information about which boy was seen, namely the one with binoculars (bottom tree). The crucial difference is that the node labeled PP (which dominates the prepositional phrase, *with the binoculars*) attaches directly to the VP node in the top tree, but to the NP node in the bottom tree.

The structures in Figure 1.2, like the ones that will appear elsewhere in this book, are not constructed with the type of detail a linguist would use. When linguists draw representations of the structures of a sentence, such theoretical objects take on a level of detail – like a drawing of a molecular structure by a biochemist – that goes well beyond our needs in this book. We will use simplified graphic representations, illustrating only the particular aspects of sentence structure that need to be focused on. The structural elements in Figure 1.2 will be described in more detail in Chapter 2.

■ Linguistic Competence and Linguistic Performance

A grammar and a lexicon are those components of language that allow sounds and meanings to be paired. When people know a language, they know its grammar and its lexicon. This knowledge is called **linguistic competence**. Linguistic competence is a technical term, different from the usual meaning of the word *competence*. Being competent at something usually means that a person has adequate abilities to perform an action with skill, but that is not what is meant by linguistic competence. Linguistic competence has no evaluative connotation; it simply refers to the knowledge of language that is in a person's brain (or mind), knowledge that provides a system for pairing sound and meaning. **Linguistic performance**, in contrast, is the use of such knowledge in the actual processing of sentences, by which we mean their production and comprehension. Typically, linguists are concerned with describing linguistic competence and psycholinguists are concerned with describing linguistic performance. Beyond basic sentence processing, psycholinguists are also concerned with the actual use of language. After a sentence is processed, it is stored in memory and combined with other sentences to form conversations and narratives. The description of how language is actually used is called **pragmatics**, a topic we address in Chapter 8. It is important to distinguish between the grammatical and pragmatic aspects of a particular linguistic event. For example, let us return to the structurally ambiguous sentence in (8). The sentence can have two distinct meanings, each of which is described by a different structural representation, like those shown in Figure 1.2. These two structures are made available by the grammar and conform to a number of syntactic rules. If this sentence is actually used by a speaker and understood by a hearer, only one of the two meanings will be the one intended by the speaker and only one of the two meanings (hopefully the same one!) will be recovered by the hearer. Which meaning is intended or recovered will be a purely pragmatic issue, determined by the situation, the participants in the conversation, the function of the communicative exchange, and so on. The grammar is completely indifferent to the speaker's intent or to the hearer's recovery of the message. The grammar simply provides structures that are available for the encoding of meaning in sentences. The actual use of those sentences in conversation is a function of encoding and decoding processes and pragmatics.
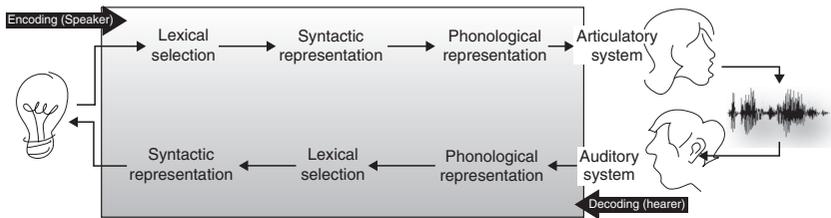
Figure 1.3   Steps involved in encoding by the speaker (left to right) and decoding by the hearer (right to left).

There are several actual processes that must take place when people use language to exchange ideas, processes for the **production** and **perception** of sentences. Figure 1.3 illustrates these operations, by expanding on the gray box of Figure 1.1. The speaker begins (top right of the figure) with an idea or a thought she wants to convey to the hearer. In order to do this, she first must translate her thought into a semantic representation (a representation of meaning) for a sentence in her language. Then she must select the words from her lexicon and use her grammar to construct the **syntactic representation** (representation of sentence **structure**) that will convey the meaning she has selected. The words must then be represented as sounds, that is, as a **phonological representation**, since they are eventually going to be pronounced. Finally, the phonological representation is sent to the motor areas of the speaker's brain and instructions are sent to the articulatory organs that are used to produce speech. The speech signal is the result of a precisely timed and exquisitely organized interaction of hundreds of muscles, including those of the jaw, lips, tongue, vocal folds, and respiratory system. Speech sounds reach the auditory system of the hearer, and he begins the process of reconstruction that is necessary to decode the speaker's message. First, he must reconstruct the phonological representation in order to recover the speaker's words and their meanings. Then, using the grammatical and lexical knowledge that he shares with the speaker, he must reconstruct the words' structural organization. He then has sufficient information to recover the basic meaning for the speaker's sentence that will ultimately lead to her idea or thought. (We have arbitrarily chosen to refer to the speaker as a woman, and to the hearer as a man. This is a convention we will follow throughout the book.)

Exchanging ideas using speech is so commonplace that people never think about the complex cognitive processes that underlie that experience.

Like the complex processes underlying most of the activities of living – walking, breathing, sleeping – the activities involved in the production and perception of sentences are completely unconscious. It is not possible to introspect and experience a piece of the process, like the retrieval of words from the lexicon or the use of one's grammar to create a structural representation of a sentence. As we will see – particularly in Chapters 5, 6, and 7 – psycholinguists have developed experimental procedures that have led to an understanding of a great deal about these unconscious processes, which are quite remarkable in their speed and complexity.

In the **encoding** process, an abstract object – an idea – is translated into a physical object – a speech signal. When we say that an idea is abstract, we mean that it does not have an observable physical reality. Certainly, an idea must have a physical representation deep in the neurological connections of the brain, but it has no such physical representation for the hearer nor is that neurological representation measurable with ordinary instruments. Speech, on the other hand, is concrete; it is part of observable physical reality. Not only does it have an effect on the auditory system; it can also be recorded and its physical properties measured. When the hearer **decodes** the physical signal, he recovers the same abstract object – the idea – that was encoded by the speaker. Let us take this a step further by pointing out that, since the idea and the physical signal are not part of the linguistic system, neither is directly reflected in the (also abstract) representations built by the linguistic system during the encoding or decoding processes. (We come back to the nature of these abstract representations – the gray box of Figure 1.1 – in Chapter 2 and in Chapters 5, 6, and 7.) The linguistic system is the system that bridges the idea and the speech, allowing them to be related. The linguistic system represents sounds and words, and creates the structures that organize those sounds and words into sentences.

■ The Speech Signal and Linguistic Perception

The fact that the signal is the only physical link between speaker and hearer is a critical psycholinguistic point. The speech signal must contain enough information for the hearer to reconstruct the abstract structures that eventually convey the abstract ideas, and that reconstruction is essential to the decoding process. To fully appreciate the complexity of this task, it is necessary to understand the relationship between speech and the linguistic representations that it encodes.

| Linda | loves | the | melody |
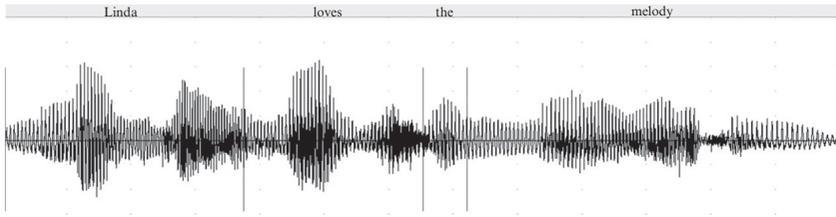
Figure 1.4 Waveform for the sentence *Linda loves the melody*, illustrating graphically the continuous nature of the speech signal. The superimposed vertical lines mark the approximate locations for word boundaries. The word boundaries are not particularly salient, and neither are the boundaries between the consonants and vowels that make up the words.

In fact, even the phonological representation of a sentence is far removed from the properties of the acoustic signal. The phonological representation can be thought of as an idealization of the physical speech sounds. The abstract representation is made up of discrete phonological units (consonants and vowels, syllables, and higher-order rhythmic units, like prosodic words and intonational phrases). The physical signal itself is very different, however. The portions that correspond to abstract phonological units overlap, and the words run together; this is illustrated in Figure 1.4, which shows that the waveform for an utterance is continuous. The speaker may be speaking rapidly and with an unfamiliar accent, with chewing gum in her mouth and with a radio playing in the background, all of which will affect the signal, making it measurably different from a signal for the same sentence produced slowly by a native speaker with no gum in her mouth and in a quiet room. The relationship between the continuous (and perhaps very noisy) physical signal the hearer receives and the neatly structured units of the idealized phonological representation he must reconstruct is not at all direct. A complex set of mental processing mechanisms must consult the hearer's grammar and lexicon in order to reconstruct a series of linguistic representations, resulting in the recovery of the speaker's meaning. Researchers think that those mental processes are executed by neurophysiological operations that are specialized for the perception of speech as a linguistic object.

In every modality people make the distinction between the actual stimulus (the physical signal) that impinges on our eyes or ears and the percept that the brain constructs when we interpret that stimulus.