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WHAT IS PSYCHOLINGUISTICS?

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Photo 1.1 Many spiritual practices involve experiencing long periods of silence, which can be difficult to sustain. What is the longest you have gone without talking?



Consider your typical day. How many of your activities involve language? During our waking hours, it is rare for an hour to go by without our hearing or producing some form of language. We listen to conversations, television programs or songs. We send emails and text messages. We read websites and textbooks. When we are reading silently or thinking about a problem, we sometimes experience **inner speech**, which is the voice in our mind that articulates the words on the page or our thoughts. For most of us, we are completely without language for only brief periods in our daily lives. The aim of this book is to introduce you to the academic discipline of **psycholinguistics**, which focuses on the study of human language with an emphasis on how it is acquired, produced, and comprehended. The related field of **linguistics** is the scientific study of language as a formal system of rules just as mathematicians study mathematics as a formal system. Psycholinguistics is considered a subspecialization within **cognitive psychology**, which focuses on understanding human cognition and decision-making. Cognitive psychology and psycholinguistics are included in the broad interdisciplinary field of **cognitive science**, which aims to understand the nature of intelligence, both artificial intelligence and intelligence in humans and other animals (Sobel & Li, 2013). The disciplines that are included under the interdisciplinary umbrella of cognitive science include psychology, linguistics, anthropology, philosophy, computer science, and neuroscience. Because one of the challenges for those creating examples of artificial intelligence is achieving naturalistic communication with humans, research in psycholinguistics will be increasingly important as the field of artificial intelligence expands.

Throughout this book, we will examine how language works and what cutting-edge scientific research is revealing about how we process language. In this chapter, we will begin by asking “why study language?” As you will see, the answer is that understanding how language works can solve real-world problems and improve the daily lives of large numbers of people. In the second section, we will review the historical roots of psycholinguistics and how 20th-century events played a central role in launching psycholinguistics as its own discipline.

By understanding how perspectives on psycholinguistics became of interest in the past and how those perspectives evolved over time, we can understand better contemporary research. In the last section, we will explore five hot topics in psycholinguistic research, which have intrigued scholars in the past and continue to motivate new research projects. As you progress through the textbook, you will find that these themes will be revisited numerous times.

Why Study Language?

Only through a detailed understanding of human language can important real-world problems be solved. In this section, we will consider three areas in which psycholinguistic research has already led to important conclusions and promises to make future major advances: the diagnosis and treatment of language delays and disorders; improving how people communicate with one another; and developing procedures that reduce miscommunication and other human errors in critical communications in workplaces.

Diagnosing and Treating Language Disorders

There are numerous language and speech-related disorders, many of which currently have no cure. Those experiencing a language disorder, including children whose language development is delayed, should seek an assessment by a **speech-language pathologist**, who is trained in assessing speech disorders and providing treatment. Because speech-language pathologists are specialists, patients and their families are typically referred to them by others, such as school personnel when the patient is a child or by a doctor. Speech-language pathologists receive specialized training in graduate programs in the science of disorders and the clinical practice involved in the treatment of disorders. In many countries, speech-language pathologists are licensed professionals who are required to obtain continuing education, which allows them to stay up to date on new developments in the field. The number of career opportunities related to assessing and treating speech and language disorders is expected to grow in the coming decades (Bureau of Labor Statistics, 2015). One reason for the growth is due to the aging of the global population. As the average age of the population increases, more people will be living with language impairments caused by accidents, brain injury resulting from strokes, and other age-related diseases (e.g., Parkinson's disease and Alzheimer's dementia). With future research, there is the promise that effective treatments and/or cures may be discovered. Language disorders are explored in depth in Chapter 14. Chapter 8 discusses how children develop language skills. Some children experience delays in language development and are routinely referred for an assessment by a speech-language pathologist.

Before we move on, Table 1.1 lists some Latin abbreviations you will encounter in this textbook and other academic publications.

Facilitating Communication

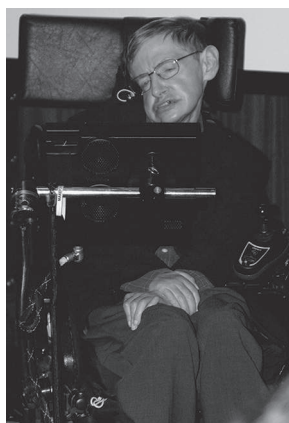
Many people experience difficulties communicating due to injuries, diseases, and/or disorders. Increasingly, technology is being developed to make communicating possible for some and easier for others. Such technologies are referred to as

Table 1.1 Frequently Used Latin Abbreviations and Their Meanings

| Abbreviation | Unabbreviated Latin | Meaning | Example |
|--------------|-----------------------|----------------------------|---------------------|
| AD | <i>Anno Domini</i> | in the year of our Lord | |
| BC | before Christ | before Christ | |
| c. | <i>circa</i> | around | |
| cf. | <i>confer</i> | for comparison | |
| e.g. | <i>exempli gratia</i> | for example | I love candy (e.g., |
| et al. | <i>et alii</i> | and others | |
| etc. | etcetera | and so on | |
| i.e. | <i>id est</i> | that is or in other words | |
| ibid. | <i>ibidem</i> | in the same place (source) | |
| vs. | <i>versus</i> | against | |
| viz. | <i>videlicet</i> | that is to say | |

Source: U.S. Government Printing Office (2008)

Photo 1.2 Professor Stephen Hawking relied on augmentative communication. Have you heard him speak with the help of the computer?



augmentative and alternative communication

(Beukelman et al., 2012). Perhaps, you have seen Stephen Hawking (1942–2018), the famous physicist who lost his physical ability to speak due to his long battle with amyotrophic lateral sclerosis. The technology he used to speak is an example of augmentative and alternative communication. Individuals who can use their hands may spell out words or select pictures that the computer will transform into synthesized speech. Some devices monitor users’ eye movements, enabling them to spell out words or select pictures by directing their gaze toward a visual display. Tablet computers

equipped with voice synthesizing software have enabled more people to increase their ability to communicate with other. Some individuals with autism spectrum disorder experience great difficulty in producing speech; consequently, some rarely speak at all. Tablet computers have provided them with the ability to express their thoughts to others more easily than ever before (CBS News, 2014).

Communication is also facilitated by technology that can translate one language into another. When we travel to other countries or host visitors to our country, we may need a translator to facilitate communication. Increasingly, there are software applications on websites and available for cell phones that can translate text or spoken sentences into another language. The translations are most accurate for single words and relatively simple phrases, especially those used most frequently (e.g., *Where is the restroom?*). If you have used such products, you might have concluded that the technology still has a lot of room for improvement, as the translations for full sentences often do not match the translation that would be provided by a native speaker of the language.

Communication is also facilitated through the teaching of foreign languages. Research is needed to find rapid and effective methods to teach foreign languages. Imagine that you received a dream job offer. The job has a

great salary and excellent opportunities for future promotions. Your background and skill set fit perfectly with the job description. There's only one problem. The job requires you to be bilingual in a language you have never studied. You'd be willing to learn the language. But how long would that take? Unfortunately, research suggests that the time needed to become fluent in a second language varies widely, depending on the individual, as well as the language being learned and the person's first language. Chapter 10 explores the various methods of teaching second languages and discusses what the research says about which methods produce the most desirable outcomes.

Language in the Workplace

Because language is an ever-present part of our lives, numerous products that people use every day are designed with careful consideration of how they will be used. The particular size of text displayed on the screen is carefully tested. The color of the background screen and the color of the letters of text are also important. The field of **human factors** aims to design optimal products through understanding how people use the products and analyzing any errors or problems they may have when using the products. Consider the amount of planning and testing that has gone into the design of highway signs to ensure that the letters can be easily comprehended at varying rates of speed in time for drivers to use the information and make any needed lane changes. Research in human factors has focused on areas in which human error may lead to the loss of life; for example, the work of pilots and air traffic controllers, not only regarding how information is displayed to them, but also in how they communicate (Wickens, 2002). Optimal communication is needed to avoid errors of the type that lead to accidents, including plane crashes (Estival et al., 2016).

Hospitals are a second type of workplace in which human factors research can lead to improvements in comprehension and communication (Mitchell et al., 2014). Healthcare providers (e.g., doctors and nurses) pass on medical information about patients to one another. Some of the information may be in hardcopy form and other information may be in an electronic format or orally transmitted. Other examples of healthcare communication include that which occurs between healthcare providers and patients. Healthcare providers provide critical information to patients about how they should care for their health by taking medicines, avoiding specific activities, foods, or over the counter medicines. How well do patients understand and remember the information they are told when they are with their doctor or nurse? When healthcare providers ask questions of patients, do patients understand the purpose of the questions and provide complete and accurate answers? Some questions may involve areas that are so personal that patients may be too embarrassed to answer honestly. Research may be able to help healthcare providers to find ways of asking personal questions that lead patients to feeling less embarrassed, which would lead to more informative and more accurate responses.

Communication is also critically important for **first responders** (e.g., firefighters, police officers, and emergency medical personnel), as well as the individuals whose job it is to handle the emergency calls from individuals in distress. Under conditions of high stress and/or high emotion, miscommunication may increase, which may have dire consequences (Pun et al., 2017; Ulmer et al., 2011). Emergency vehicles may be dispatched to incorrect locations (Cloherty, 2017). Callers and dispatchers

may fail to convey critical information to one another. Responding personnel may fail to communicate with one another, such as regarding the planned course of action at the scene of the emergency. As communication technology advances, more research will be needed to identify common pitfalls and best practices and develop effective training techniques to reduce miscommunication.

In this section, we reviewed three areas where research on language can solve real-world problems. There are many more. In the coming week, as you go about your weekly routine, see if you can think of ways in which research on language could solve problems you encounter.



Time out for Review

Key Terms

Augmentative and alternative communication
Cognitive psychology
Cognitive science

First responders
Human factors
Inner speech
Linguistics

Psycholinguistics
Speech-language pathologist

Review Questions

- 1 What is cognitive science? How is it related to the fields of psycholinguistics and linguistics?
- 2 What are some of the real-world problems that research on language may help solve?

The Historical Roots of Psycholinguistics

As a formal field of study, psycholinguistics is a young discipline. In fact, the term “psycholinguistics” is not yet 100 years old. It was first used in 1936 by Kantor ([1936] 1952) in his book *An Objective Psychology of Grammar*. Later, in 1946, a student of Kantor’s used the term in an article in a prominent psychology journal (Pronko, 1946). In 1951, the term was used at Cornell University, at the first conference on the psychology of language (Osgood & Sebeok, 1954). Yet, despite the relatively short history of the term, an interest in language and some understanding about the nature of language can be found throughout the historical record. Table 1.2 lists a few important firsts in human communication. With innovations in communications technology occurring rapidly this century, we can likely look forward to even more changes in how people communicate with one another in daily life. How many of the social networking platforms and search engines listed in Table 1.2 do you use?

In this section, we will review how scholars through the ages approached the study of language. These scholars include those who lived thousands of years ago and those whose work occurred in the 19th and 20th centuries. Some of the earliest insights into language are still relevant today. We start our discussion with contributions from the ancient world and the proliferation of

Table 1.2 Important Firsts in Human Communication

| | |
|-----------|-------------------------------------|
| 193000 BC | Earliest (estimated) human language |
| 3000 BC | Earliest example of writing |
| 1450 | First printing press |
| 1590 | First play written by Shakespeare |
| 1829 | First patent for a typewriter |
| 1832 | First telegraph transmission |
| 1876 | First telephone call |
| 1897 | First radio transmissions |
| 1913 | First television transmissions |
| 1971 | First email sent |
| 1975 | First personal computer sold |
| 1990 | First PowerPoint software |
| 1997 | First Google searches |
| 2005 | First YouTube video |
| 2006 | First Tweet |
| 2010 | First Instagram post |
| 2011 | First Snapchat post |

the printing of documents in the 1400s. We continue our discussion with the work of the scholars from the 19th century who aimed to understand language and human behavior in terms of its structure. The term **structuralism** describes this approach to language and the mind (Benjamin, 2007). We end in the 20th century with discussions of how language was studied by psychologists and events leading up to the cognitive revolution, which set in motion the events leading up to psycholinguistics becoming its own field of study.

Language and the Mind in the Ancient World

The historical record is, by definition, those events for which there is a written record, preserved in a book, piece of paper, or, in some cases, stone walls or tablets. Historians are able to understand the past because so many cultures have long traditions of producing and preserving written documents. The use of writing has been estimated to date back 5,400 years (Powell, 2009). For cultures with a long history of writing, there is a more complete historical record. Even today, there are many cultures with no written form of their spoken language (Simons & Fennig, 2017). The oldest known samples of writing are from Mesopotamia around 3500 BC (Bottéro, 1992). The modern countries that correspond to this region include Iraq, Iran, Syria, and Turkey. Writing appears to have been developed in different regions of the world independently. In China, the oldest known writing dates back to 1200 BC (Boltz, 1986). In Mexico, excavations have yielded samples dating back to 650 BC (Pohl et al., 2002). The invention of writing appears to have grown out of a need to record the exchange of goods (i.e., commercial transactions) (Bottéro, 1992). When the exchanges people were making became larger and impossible to remember accurately, written documentation was the solution to the problem of forgetting.

The English language has a long history as a written language. A recent discovery at the ruins of a church in England revealed the oldest example of

English writing, dated around 600 BC (*The Telegraph*, 2010). Chapter 11 explains how English's long history as a written language may have contributed to its confusing system of spelling. Because of contact with other languages through the centuries, many words in English have been borrowed. Most dictionaries will provide information about the **etymology** (history of the word) in the entry for the word. For example, the word *zombie* has its origins in West Africa. The words *lemon* and *candy* were borrowed from Arabic. The words *moose*, *opossum*, and *raccoon* were borrowed from Native American languages. In one analysis of English words in the Merriam Webster Dictionary, approximately 75 percent of words originated in other languages (Tilque, 2000).

When scholars examine the historical record, there is clear evidence that people in ancient societies were taking note of the mysteries of language, particularly those related to medical conditions. Some of the oldest written documents recorded information that would be beneficial for doctors to know. One such document is the Edwin Smith Papyrus, an Egyptian document from the 16th century BC containing descriptions relevant to a wide variety of medical conditions and treatments (Minagar et al., 2003). The papyrus describes a person with an injury that could correspond to aphasia, which is any disruption of language due to a brain injury:

One having a wound in his temple, penetrating to the bone, (and) perforating his temporal bone; while he discharges blood from both his nostrils, he suffers with stiffness in his neck, (and) he is speechless. An ailment not to be treated. (Minagar et al., 2003)

The papyrus provides clear evidence that even so long ago, there was an understanding that brain injury could lead to a problem using language. Today, the term **aphasia** refers to any disruption of language due to an injury to the brain. It is quite likely that as long as there have been people talking to other people, there have been individuals interested in thinking about how people use language and how language works.

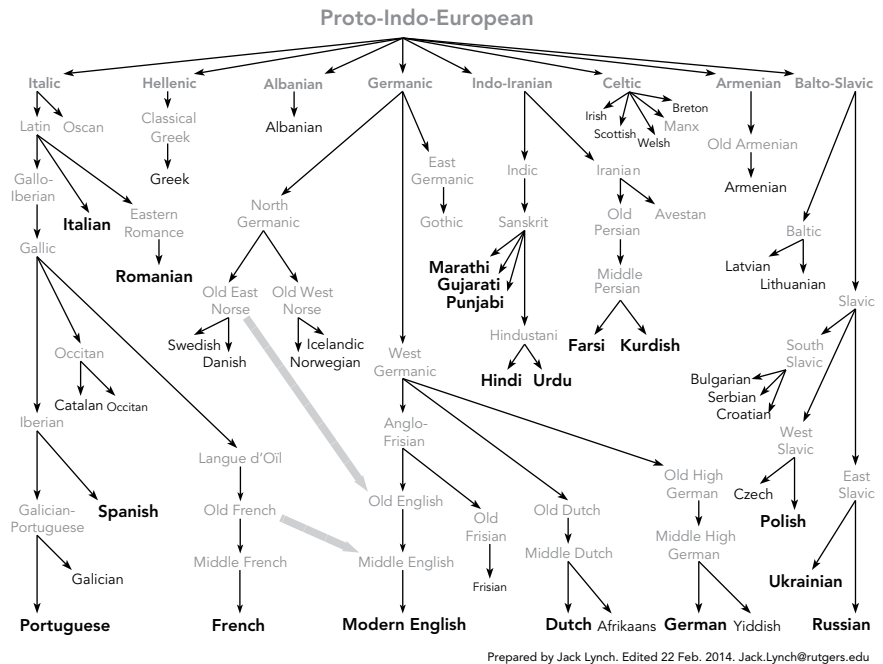
The scholars of Ancient Greece are widely recognized as having made major contributions in advancing thinking on a variety of topics, including philosophy and the mind. Language was also a topic that intrigued the Greek philosophers, including Plato, the most famous, who is believed to have lived around 400 BC (Nails, 2006). Although none of Plato's writings have survived, his teachings have survived in the writing of his student Socrates. Plato's theory of language is found in Socrates' *Cratylus* (Partee, 1972). Plato viewed language as not only distinct from knowledge, but also thought. Words were viewed as imprecisely representing reality. Plato's description of abstract symbolism is best illustrated by his allegory of the cave. With the allegory, Plato explains that words are not names for the physical objects that are visible in the world; rather, they are names for our understanding of the object in the world, which is invisible. In the allegory, a group of people have been held captive in a cave since childhood. They have been chained so that they cannot move. Even their necks are chained so that they cannot move their heads from side to side. Behind them a fire burns, creating light in the cave. On the wall in front of them, they can see shadows created by the firelight and the movement of people carrying objects walking in the space behind them, between where they are chained and the fire. Because the captives cannot

see anything behind them, they can only conclude that the shadows on the wall are actual things rather than merely the reflection of physical objects. The entire allegory of the cave is quite long with numerous insights about subjects other than language. The introduction of the cave, the captives, the fire and the shadows provides a useful illustration of how words, like the shadows on the cave wall, can be viewed as things, but they are distinct from the physical objects in the world to which they refer. Psycholinguists agree that for this reason, a word is a symbol or something that represents an entity and refers to it, but is distinct from the entity.

The use of the written word to refer to objects in the real world and states of mind saw a huge increase following the invention of the printing press in the 1400s. The first printing press was invented by German blacksmith Johannes Gutenberg around 1440, and for the first time ever, copies of one-of-a-kind ancient documents could be produced. The printing press had a profound effect on human history. The number of historical documents surviving to the modern day was vastly increased by the invention of the printing press. Furthermore, for the first time in human history, people outside the wealthy ruling class had access to the written word, and learning to read became a goal for more than just the few (Eisenstein, 2005). Over the next century, classical works that had previously only been available to a few highly educated individuals were available throughout Europe. The classical works were written in a variety of different languages, many of which had ceased to be spoken centuries before (e.g., Ancient Greek, Sumerian, Egyptian, Sanskrit, Aramaic). Accomplished scholars were able to read the ancient works in the language in which the documents were written. Scholars needed to be able to learn to read languages they did not speak and some languages that were no longer spoken by anyone (e.g., Latin, Sanskrit). Two of the most famous 19th-century language scholars were the Brothers Grimm who became well known for documenting folk stories, which have become some of Western culture's favorite children's tales, such as Snow White, Sleeping Beauty, and Cinderella (Zipes, 2002). Through their study of folk stories, they examined the historical changes in the German language and spread their understanding in a German dictionary entitled *Deutsches Wörterbuch*.

Following the invention of the printing press, major advances in understanding of how languages differed from one another occurred. Through the study of the ancient texts, scholars could begin to theorize why some languages had more in common than others. Scholars could also study documents from a single language over long periods of time, in some cases centuries, and document how the language changed over time. As the number of studies increased, researchers began to theorize about why some languages were more similar than others. They proposed the existence of a **language family**, which is a group of languages that share the same ancestor language from which the languages in the language family evolved over time through migration, separation of populations, and language change. For example, the modern Romance languages (i.e., Italian, French, Spanish, Portuguese, and Romanian) share the same ancestor language Latin. Using the written documents that have survived, linguists have been able to propose the changes that occurred over time to result in each of the Romance languages. Figure 1.1 shows a portion of the Indo-European language family, which includes English, German, and Dutch, but also some languages that may surprise you – Greek, Hindi, and Persian. Indo-European is a large language family (Beekes, 1995). Have you heard of any other language families?

Figure 1.1 Portion of the Indo-European Language Family
Credit: Professor Jack Lynch



Structuralist Approaches to Language and the Mind

In the 19th century, scholars from a variety of disciplines began to approach the topics of those disciplines by attempting to identify the relevant structures. In linguistics, a prominent structuralist was Ferdinand de Saussure (1857–1913), a Swiss philosopher. He studied Hittite, an extinct language last spoken around 1100 BC (Bryce, 1999), and the historical changes in the Indo-European language family (Beekes, 1995). Saussure’s observations and theories about language were published in 1916 in *Course in General Linguistics*, which was compiled by students Charles Bally and Albert Sechehaye from notes from his lectures. In this book, he compared language to chess. Language has words whose order in sentences is determined by a set of grammatical rules (Saussure, [1916] 1977). The words are similar to the pieces on a chess board. The grammatical rules of language are similar to the rules of chess, which constrain how each chess piece can be moved. The term **grammar** refers to the entire set of rules that describe how a language can be used. De Saussure pointed out that all human languages, regardless of how developed the society in which the language was spoken, are complex and rule-governed. His claim that there was no such thing as a *primitive language* contrasted sharply with the prevailing prejudices of the time, which targeted populations around the globe as being savages and subhuman.

In psychology, structuralism was the focus of the first experimental laboratory for the study of the human mind. Wilhelm Wundt (1832–1920) established the first psychology laboratory in 1879 in Leipzig, Germany. Wundt was a German researcher who studied medicine in college and later physiology, studying with Hermann von Helmholtz (1821–1894), an expert in physiology and physics. Under Helmholtz’s guidance, Wundt studied sensation and perception. Wundt aimed to identify the structures of the mind, which he identified as images, feelings, and thoughts. The primary methodology Wundt and his students used to study sensation and perception was **introspection**.

Participants in the experiments were trained to report verbally their experience of a particular sensation or perception. Wundt envisioned the process of introspection as including two parts: internal perception, which would likely correspond to registering the experience with the senses; and self-observation, which would likely correspond to the process of consciously trying to reflect on the internal perception (Danziger, 1980).

In his writings, Wundt ([1897] 1999) demonstrated an interest in language. He discussed multiple aspects of language, including the fact that language varies across cultures and that language is the primary means by which we can label our sensory and perceptual experiences. He noted the *poverty of language*, because, at times, there are not words to describe one's subjective feelings (Wundt, [1897] 1999, p. 7). He believed that understanding the nature of language could reveal the workings of the human mind (Blumenthal, 1970). He also proposed a theory of language production, in which he expressed his view that the sentence, rather than the word, is the fundamental unit of speech production:

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. (Wundt, 1912, cited in Blumenthal, 1970, p. 21)

Wundt trained dozens of the future leaders of psychology, many of whom went on to train dozens more future leaders. Many of those students of students also trained more students. This explains why psychology flourished in the early part of the 20th century. Thus, Wundt can be seen as one of the founding figures of modern psychology. His work is a testament to the impact that a single individual can have in the course of history. A small number of researchers trained by Wundt or Wundt's students ended up studying psycholinguistics and training their students to carry on similar work. Even today, many psycholinguists take pride in the fact that they can trace their academic family tree back to Wundt. They do this by identifying their own research advisor's advisor and that advisor's advisor, and so on. A great many academic family trees lead directly back to Wundt.

Behaviorism and Verbal Behavior

In the early part of the 20th century, the study of human behavior, including behavior related to language, moved away from the examination of mental experiences through introspection in favor of the examination of observable actions. In 1913, psychologist John B. Watson (1878–1958) published his article “Psychology as the behaviorist views it,” also known as the “behaviorist manifesto,” in which he argued that research should focus on observable behavior and its causes (Watson, 1913). Watson's focus on observable behavior contrasted sharply with Wundt and his students' methodology, which relied on subjective reports of sensations and perceptions (Benjamin, 2007). In what is now referred to as **behaviorism**, Watson argued that behaviors could be learned through a process called **classical conditioning**, which was the same process at work in the popular example of Pavlov's studies, in which a dog would salivate to the ringing of a bell alone, after having experienced several mealtimes in which a bowl of food was

presented at the same time as the bell. The salivating is the **conditioned response** that dogs *learned* to produce in the presence of the **conditioned stimulus** – the bell. Watson and others showed that learning through classical conditioning is powerful because the conditioned stimulus need not have any relationship with the conditioned response prior to the learning experience.

Watson's approach to language was similar to his approach to any other human behavior. The focus was on the observable and what was internal was of little interest. In describing the emergence of language in the infant, Watson (1931, p. 225) states that “in the beginning [it is] a very simple type of behavior. It is really a manipulative habit.” Watson later came to be seen as one of the leading experts on child psychology due, in part, to his book *The Psychological Care of the Infant and the Child* (1928). However, due to the controversy surrounding one of his most famous studies with the infant Little Albert, history is not likely to remember him as the ideal scholar to provide advice on childrearing. Watson and his then graduate student Rosalie Raynor showed that an infant having no fear of a rat could learn to fear a rat through several trials in which a hammer was used to strike a pipe located behind the child's head each time the rat was presented (Watson & Raynor, 1920). The rat starts out just like the bell in Pavlov's studies, becoming the conditioned stimulus, causing a large fear response, including crying. The study is rightly criticized on ethical grounds, as Little Albert experienced psychological distress without experiencing any benefit from the study. Also, there were no recorded efforts to undo the conditioning experienced in the study, which could have ensured that Little Albert left the study as he entered it, showing no fear of rats. The study of Little Albert has led to a great deal of myth and mistakes in the recounting of the study (Harris, 2011). In recent years, attempts have been made to track down the identity of the infant who was so famously called Little Albert (Beck et al., 2009; Powell et al., 2014).

The behaviorist view of language is most closely associated with psychologist B. F. Skinner (1904–90), who published his book *Verbal Behavior* in 1957. He viewed language, as all other human behavior, as explainable through learning principles. Skinner was responsible for identifying and studying a new type of learning that he called **operant conditioning**. He proposed that the frequency of naturally occurring behaviors could be increased or decreased through actions that produced either positive or negative experiences for the organism. Any action that served to increase the frequency of a behavior was called a **reinforcement**. Any action that served to decrease the frequency of a behavior was called a **punishment**. For example, a parent whose toddler throws a tantrum in the toy store may be able to decrease the frequency of tantrums during shopping by scolding the toddler. The same parent may work to increase the frequency of good behavior during shopping by giving the toddler a small reward (i.e., stickers or candy) when the toddler has been well behaved throughout the shopping trip.

In *Verbal Behavior*, Skinner laid out a complex account of how a range of language behaviors come to be reinforced in the course of daily life. In the quote below, Skinner (1957, pp. 29–30) explains how, in his view, parents' interactions with children reinforce verbal behavior:

In teaching the young child to talk, the formal specifications upon which the 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 behaviors may be reached.

For a small number of utterances, his account works well. A mom shows her child a banana and carefully pronounces the word, and then waits for the child to say the word. Mom repeats the action, encouraging the child to pronounce the word. Mom's smiling and body language serve as a positive reinforcement each time the child produces sounds similar to the target. Soon, the child is on her way to saying the word when shown the fruit. Even in the workplace, adults may find themselves saying specific words or expressions in the context of specific triggers. You see your classmate or co-worker in the corridor in the morning. You say "Hi" and the person smiles, which is a nice experience for you. You are reinforced, and then you are more likely to say "Hi" again the next time you see the person. In fact, each morning you see the person, you find yourself saying "Hi" almost automatically. It is that ingrained. However, the bulk of human language use on a daily basis cannot be explained as easily as these examples.

Skinner's approach to language focused only on the observable behaviors related to language. In fact, within behaviorism, there were those who rejected the existence of mental processes (Carlson & Buskist, 1997). Skinner was one. In 1990, at a lecture at Harvard University shortly before his death, Skinner was asked by a student who had listened to his hour-long speech, as I did, whether he had changed his opinion about the nonexistence of mental processes. He asserted that he had not, that there was no need to appeal to mental processes to explain any behavior. The student seemed surprised by the answer. The room was silent for a minute, then the host informed us all that the question was the last of the day and we should all thank Professor Skinner, which we did with applause.

The Cognitive Revolution

Historians of science often report 1960 as the beginning of the cognitive revolution, although individuals who were alive during the middle of the 20th century would likely view the transition from behaviorism to the cognitive approach as more gradual (Benjamin, 2007). One of the events that many point to as a contributing factor in the shift away from behaviorism toward cognitive psychology was the 1959 review of Skinner's book that appeared in the journal *Language*. The now-famous book review was written by Noam Chomsky (1928–), a linguistics professor at MIT. In his review, Chomsky (1959) provided a description of language that enabled even those without much knowledge about language to understand that Skinner's approach was insufficient. Chomsky (1959, p. 57) pointed out that knowing a language involves knowing the rules of the language (the grammar) and the knowledge brings with it the ability to make fine-grained judgments about samples of the language: "One who has mastered the language [can] distinguish sentences from non-sentences ... understand new sentences (in part), [and] ... note certain ambiguities." He also pointed out that any sentence more than 10 words long is likely to be a sentence that has not been produced before and will not be produced in its exact form again. Knowing a language means that one can understand novel forms of the language (e.g., words and sentences).

Chomsky proposed the **nativist view of language**, claiming that people come into the world equipped biologically to learn language. He coined the

term **language acquisition device** (LAD) to describe the organ of the mind that enables infants to learn language so rapidly. The LAD was never intended to refer to a single location in the brain. In later writing, Chomsky used the term **universal grammar** to refer to the knowledge of language that is needed for children to be able to learn any human language to which they are exposed within the first few years of life (Chomsky, 1965, 1968, 1986). Chomsky's approach to language is referred to as the **generative approach**, because of the emphasis on the fact that knowing a language involves knowing the rules of the language and with the rules one can generate new forms. Table 1.3 lists the types of rules contained in any language's grammar. When learning a second language in a classroom, individuals must become consciously aware of the rules and how they apply. When learning a first language from birth, the acquisition of the rules occurs unconsciously. These rules will be discussed in later chapters.

Table 1.3 Types of Rules Contained in a Language's Grammar

| Type of rule | Relevant domain |
|---------------------|---------------------------------------|
| Syntactic rules | Word order |
| Phonological rules | Sound of words and phrases |
| Morphological rules | Word formation |
| Semantic rules | Meaning of words and sentences |
| Pragmatic rules | Social norms involved in language use |

As you will find, for each type of rule, there is much to be discovered about how the rule is learned and also how the rule is applied during the various examples of language use. For now, we can get started understanding each of the categories of rules. **Syntactic rules** involve the basic ordering of major elements in sentences, such as the subject (S), verb (V), and object (O). In English, Spanish, French, Italian, and many other languages, the basic word order is SVO, because in the typical sentence, the subject precedes the verb, which precedes the object. Japanese and Hindi are examples of languages with SOV word order, because in the typical sentence, the verb follows the object, which follows the subject. Across languages, all possible word orders are observed (Greenberg, 1966). Table 1.4 gives an example of each of the six possible word orders with a sample language and sample sentence.

Table 1.4 Six Possible Word Orders with Example Language and Sentence

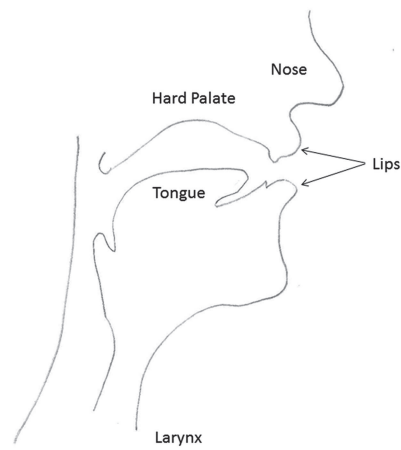
| Basic word order | Language | English equivalent |
|------------------|----------|--------------------|
| SVO | English | Kids love puppies. |
| SOV | Japanese | Kids puppies love. |
| VOS | Tzotzil | Love puppies kids. |
| VSO | Irish | Love kids puppies. |
| OSV | Xavante | Puppies kids love. |
| OVS | Huarijio | Puppies love kids. |

Source: Adapted from Tomlin (1986)

Phonological rules are involved in the sounds of the language. The smallest unit of sound in language is a **phoneme**. There are two categories of phonemes: **vowels** (a, e, i, o, and u) and **consonants** (/b/, /k/, /d/, /g/, and /k/). For vowels, the airflow during the production of the sound is not obstructed. For consonants, the airflow may be completely stopped (e.g., /b/, /p/, /d/, /t/, /k/ or /g/) or partially obstructed (e.g., /f/, /v/, /s/, and /z/). Languages vary in the number of phonemes they contain. Across all languages, there are 107 phonemes (International Phonetic Association, 1999). English has only 40 different phonemes (Roach, 2000). Some languages have far fewer phonemes than English. For example, Rotakas, a language spoken on the island of Bougainville near Australia, has 11 phonemes (Robinson, 2006). Phonological rules dictate how the phonemes in a language are arranged to form the words and how sounds should be realized within words and sentences. Because phonological rules for one's first language are learned unconsciously during childhood, you may find it difficult to identify the phonological rules you are using when you speak.

In American English, the flap rule is an example. The pronunciation of the phoneme /t/ depends on what other sounds in the word surround it. When /t/ is surrounded by vowels, as in *water*, the /t/ is produced with a flap of the tongue against the ridge just behind the front upper teeth. The result is more of a /d/ sound rather than a /t/ sound. In contrast, when a consonant occurs before the /t/, then the /t/ is pronounced as a /t/, as in *renter* or *wilted*. The /t/ in *renter* and *wilted* is produced with front teeth closed. When the word *water* is produced, the flap sound is produced when the tongue lightly touches the alveolar ridge, which is a part of the mouth located just behind the upper teeth. In Figure 1.2, the regions of the mouth are labeled.

Figure 1.2 Locations in the Mouth
During speaking, the parts of the mouth and throat work together to produce speech. Can you name the speech sounds in English that are produced with the lips closed?



Morphological rules specify how new words can be formed through the combination of **root words** (also called stems), prefixes, and suffixes. The smallest unit of meaning in a language is referred to as a **morpheme**. In English, many words consist of a single morpheme, such as *chair*, *berry*, and *camel*. Some words do contain more than one morpheme when prefixes or suffixes are added to other morphemes, such as *antisocial* and *hopeful*. Table 1.5 lists some common prefixes and suffixes in English and some sample words in which they appear. As you will learn in Chapter 8, between the second and fourth years of life, English-speaking children learn how to use many of the most common prefixes and suffixes in the language. The Classic Research box reviews the research demonstrating that young children learn to apply morphological rules by age three.

Semantic rules are those involved in the meaning of words and sentences. One of Chomsky's most famous example sentences is *Green ideas sleep furiously* (Chomsky, 1957). With this example, Chomsky pointed out the separateness of syntax and meaning. The sentence is certainly nonsensical in meaning but well

Table 1.5 Common English Prefixes and Suffixes with Example Words

| Prefixes | Example words |
|----------|---|
| Mis- | misunderstand, misinterpret, misstep, misspell |
| Un- | undo, uncover, unfold, unroll |
| Re- | reapply, rewrite, repossess, reword, resend |
| Anti- | antisocial, antihero, antimatter, antivenom |
| Inter- | interaction, intermediate, interracial, interdental |
| Suffixes | |
| -ish | childish, selfish, sheepish, devilish, clownish |
| -ness | happiness, closeness, kindness, promptness |
| -ly | slowly, sweetly, angrily, patiently, wildly |
| -er | lover, writer, fighter, dancer, caller |
| -ful | tearful, helpful, mindful, cheerful |

formed when it comes to syntactic structure. When speakers of the same language interpret the meanings of sentences, they end up with similar interpretations. The consistency in interpretation is amazing considering all the possibilities for individual variation. For example, when confronted with a sentence such as: “Tanya had already eaten lunch,” listeners will understand that Tanya had eaten something edible (e.g., salad, burger, etc.), rather than something inedible (e.g., shoe, hat, etc.) (Searchinger et al., 2005). Speakers of the same language can also determine that sentences with different structures have the same meaning. For example, the sentences *The cow kicked the horse* and *The horse was kicked by the cow* mean the same thing, although the arrangement of the words in the sentences differ. The first sentence is an **active sentence**, where, by definition, the subject of the sentence is the agent or doer of the action. The second sentence is



Classic Research

The Wug Test

Imagine that you are shown a picture of a small bird and are told that it is called a *wug*, and then you are shown a picture with two birds with the statement: “Now there are two of them. There are two ____.” What would you say? Jean Berko (1958) carried out this task with children around the age of three years and found that they came up with the correct answer – *wugs*. In a second condition, children saw a picture of a person performing an action with an object and then were asked to fill in the blank: *This man is ricking. Yesterday, he ____*. The study elegantly showed that children can produce grammatically well-formed words they had never experienced before. The children were demonstrating the principle of productivity (see Chapter 2). They used the rules of grammar they had already acquired to create new words. By using non-words in the conditions (i.e., *wug* and *rick*), Berko (1958) ensured that children could not rely on past experiences when interpreting the words or in producing the plural noun form or past tense verb form. A strict behaviorist account of language development, such as Skinner’s (1957), cannot easily explain these results. It is interesting to note that the results were published one year before the publication of Chomsky’s review of Skinner’s (1957) *Verbal Behavior*.

a **passive sentence**, where, by definition, the subject of the sentence is the patient or the entity that is changed during the action.

Pragmatic rules pertain to the social rules of language. For languages, such as English, some may argue that knowledge about the social rules of language are not part of the grammar at all. However, there are other languages in which social aspects of the language involve syntactical, morphological, and/or phonological variations depending on the social status of a person with whom one is speaking. For example, in Japanese, when speaking with an elder, different forms of verbs and sometimes different vocabulary are used (Matsumoto, 1997). The highest level of polite language in Japanese is called *teineigo*. When speaking using *teineigo*, the suffix -*desu* is added to most nouns and -*masu* to most verbs. Other suffixes are added to objects in sentences. A second example comes from an indigenous language in Australia, Yanyuwa, in which separate dialects are spoken by men and women in the community (Kirton, 1988). In the two dialects, the root words are the same, but men and women produce the root words with different suffixes (Bradley, 1988). All children initially learn the dialect of the mother, but when boys enter puberty, they begin speaking the men's dialect. The rite of passage from boyhood to manhood involves a change in how one speaks to others.

Chomsky's insights about language include the distinction between the knowledge of language, which he called **language competence**, and the use of language, which he called **language performance** (Chomsky, 1986). He argued that errors may occur during the use of language that do not stem from inaccurate information in the knowledge of language. One common type of error is a tip-of-the-tongue (ToT) state. When we speak, we want to produce a word that is well known to us, but we temporarily cannot think of the word. We might even say, "Oh, it's on the tip of my tongue." Later on, the word we were searching for may come to mind. When we experience ToT, our knowledge of the particular word or our language competence is fine. The problem is with our language performance. Chapter 4 explores the types of errors that occur during speaking and what they tell us about how speech is planned.

Over the past 75 years or so, the field of psycholinguistics has grown, attracting researchers with a wide array of interests. Researchers who have chosen the study of language for their educational projects or for their career typically focus on a relatively narrow topic. Some researchers investigate the psychological processes involved in written language comprehension (reading), specifically whether readers can generate expectations about the words or types of phrases that may occur later in a sentence. Other researchers focus on auditory language comprehension (listening). Still others study issues in language production (speaking, writing, signing when using a signed language), language acquisition (child language development or second language acquisition), or language disorders. While researchers in these subfields may use different methodologies, there is an emphasis on measurement: how quickly tasks involving language stimuli can be carried out and the accuracy of judgments. For example, for those who study reading comprehension, experiments typically involve the measurement of reading time and accuracy in comprehension questions. For those who study language production, experiments often involve measuring the time taken to begin speaking following the presentation of a word or signal and the percentage of the time that the participant pronounced the stimulus correctly.

One of the biggest challenges in studying language scientifically is time, specifically because our production and comprehension of language occurs rapidly. Most of the time, it occurs so rapidly that when we try to reflect on how we do it, we have little to report. Have you ever tried to record how much time passes between your feeling that you have something to say and the exact moment when you are saying the words? For the next sentence on this page, take note of how much time seems to pass between your reading the line and your sense that you understand what the line means. The cognitive processes involved in language production and comprehension occur exceedingly fast, so fast that they seem to take no time at all. These difficulties in studying the cognitive processes involved in language are one of the reasons psycholinguistics is so fascinating. The Research DIY box outlines an experiment you can carry out with your friends and family. The topic is the Stroop effect (Stroop, 1935), which provides an excellent illustration of how rapidly occurring mental processes can affect our ability to carry out a relatively simple task (i.e., simply name the color of the letters making up a word). Just as a researcher would prepare to conduct a study, first obtain and construct the necessary materials and practice following the instructions without participants, taking note of how long the task takes. When you are ready to test your first real participant, contact those who may be willing to help you out, and schedule each for a session.



Research DIY

The Stroop Effect

The Stroop effect acquired its name from John Ridley Stroop, an American psychologist who described the effect in an article published in 1935 (Stroop, 1935). Stroop wasn't the first person to discuss the effect though. The German researcher Erich Rudolf Jaensch had published a description of the effect in 1929 (Jaensch, 1929), and the earliest work to describe the effect was James McKeen Cattell's (1886) dissertation. Cattell, an American, studied under Wilhelm Wundt in Leipzig.

Experiment

You will need 40 blank, unlined index cards and markers or pencils in the following colors: blue, red, green, black, and purple. Separate the cards into two groups of 20. Think of the groups as Set 1 and Set 2. For Set 1, create four cards for each of the color words, writing the word on the card using a marker of the same color (i.e., four cards on which the letters B L U E are written in blue). After all the cards are created, put the cards in quasi-random order. An easy way to do this is to put all the cards in a bag, close your eyes, and draw out the cards one by one, placing them in that order on a desk. This ordering of cards can be used for all participants. To preserve the order, secure the stack with a rubber band or clip. For Set 2, create four cards for each of the color words, but this time, write each color word in a color that is different from the color referred to by the color word (i.e., B L U E is written in red, green, black, and purple ink only). Create a random ordering of the cards as you did for Set 1 and secure the order. The instructions for the task are as follows:

In the following task, you will see a series of cards on which words have been written in different colors. I will show you the cards one at a time. When I turn over each card, name the color in which the word is written as quickly as you can. The word itself is not important for



Figure 1.3 The Stroop Effect
The classic Stroop task requires the participant to name the color in which each word is printed. Try naming the colors for the letter sequences opposite. Do two items seem easier to name?

the task, so you can ignore it. There are two sets of cards. After you complete both sets, I will ask you to comment on any differences you noticed in how you performed on the two sets.

During the task, show the participant the cards from Set 1 first followed by the cards from Set 2. After they complete Set 2, ask them: "Were you able to respond faster to the cards from Set 1 or the cards from Set 2?" If they indicate that they noticed a difference in how they responded to the two sets of cards, ask: "Why do you think this difference occurred?"

Participants may speculate that Set 2 seemed easier to respond to because it occurred after Set 1, and they would be correct. Practice effects are commonly observed in all behavioral studies. The more one carries out a task, the faster and more accurate one becomes. If your participants do not mention the possibility of the ordering of the two sets of cards, you can mention it. Then, have the volunteers perform the task again, and this time, have them complete the cards in Set 2 first followed by the cards in Set 1. In my experience, the effect is so strong that it does not disappear with this amount of practice. Your participants will likely report that the cards from Set 2 are harder than the cards from Set 1 (i.e., it takes longer to name the color of the ink and, sometimes, the participant may make errors, naming the word written on the card instead of the color of the ink).

Explanation

The popular explanation for the Stroop effect is that reading the word occurs so rapidly that even when the instructions of the task do not require participants to read the word, they cannot avoid it (MacLeod, 1991). The topic of visual word processing is examined in Chapter 5. Once the word is read, it is in their mind and when the word is different from the word they get ready to name as the color of the ink, there is confusion. This leads to more time being taken to name the color and sometimes to the wrong color being named. For more information about the Stroop effect, reviews of numerous Stroop studies can be found in Jensen & Rohwer (1966) and MacLeod (1991, 1992).

In this section, we reviewed thousands of years of history related to the study of language and the mind. Table 1.6 provides a timeline of the major approaches to language, the relevant historical figures, and the years they lived. Since the 1960s, research in psycholinguistics has been strongly influenced by Noam Chomsky's view that humans are born with innate knowledge of language, which enables children to acquire language quickly with little or no direct instruction by parents. In the rest of this chapter, we will review current hot topics in psycholinguistics, and the reasons researchers conduct research on language.

Table 1.6 Timeline of the Study of Language from the 19th Century to the Present

| Approach to language | Contributor | Years |
|--------------------------------------|-------------|--------------|
| Structuralism (linguistics) | De Saussure | 1857–1913 |
| Structuralism (psychology) | Wundt | 1832–1920 |
| Behaviorism (classical conditioning) | Watson | 1878–1958 |
| Behaviorism (operant conditioning) | Skinner | 1904–1990 |
| Generative approach | Chomsky | 1928–present |



Time out for Review

Key Terms

- | | | |
|------------------------|-----------------------------|-------------------|
| Active sentence | Language acquisition device | Pragmatic rules |
| Aphasia | Language competence | Punishment |
| Behaviorism | Language family | Reinforcement |
| Classical conditioning | Language performance | Semantic rules |
| Conditioned response | Morpheme | Structuralism |
| Conditioned stimulus | Morphological rules | Root words |
| Consonant | Nativist view of language | Syntactic rules |
| Etymology | Operant conditioning | Universal grammar |
| Generative approach | Passive sentence | Vowel |
| Grammar | Phoneme | |
| Introspection | Phonological rules | |

Review Questions

- 1 What was Plato's theory of language, specifically regarding words and their meaning?
- 2 Who was Ferdinand de Saussure? What did he mean when he said that language was similar to a game of chess?
- 3 Describe Wilhelm Wundt's role in the history of psychology and the study of language processing.
- 4 What was the behaviorist approach to language? In what way did B. F. Skinner attempt to use behaviorism to explain language?
- 5 What was the cognitive revolution? When did it occur? How did the study of psychology differ before and after the cognitive revolution?
- 6 Describe Noam Chomsky's view of how language is learned and used in daily life.
- 7 How do psycholinguists define grammar? Identify five types of rules that would be included in a language's grammar.

Hot Topics in Psycholinguistics

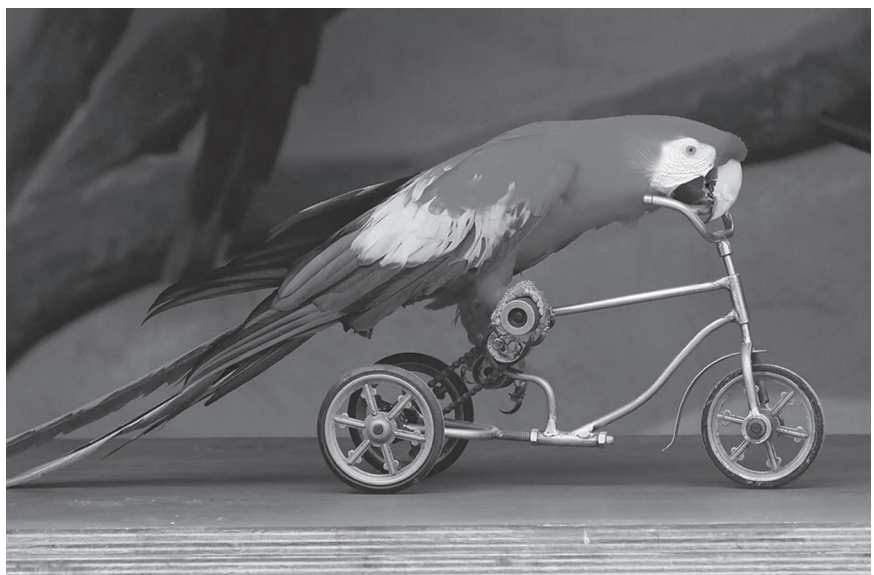
Some of the topics that researchers in psycholinguistics investigated in the 20th century continue to intrigue researchers today and motivate new studies. Some of these topics involve theoretical controversies, for which there are competing points of view, and the research findings that have been obtained so far are inconsistent and/or inconclusive. No single theoretical perspective provides a complete explanation. In subsequent chapters of this book, you will learn about five major areas of controversy. Is language special? How does the brain process language? What role do genes play in language? What roles do nature and nurture play in language and language processing? Does language influence thought? Areas of controversy present opportunities for future research. Will you be someone who conducts the study that settles one of the debates?

Is Language Special?

Noam Chomsky's view that language is innate to humans is a view that distinguishes language ability from other types of human abilities (Chomsky, 1965, 1968, 1986). In Chapter 2, we discuss how language differs from forms of communication by other species and also the attempts to teach a variety of other species language. Chomsky's view that language is part of the human biological endowment suggests that other species would not be able to acquire language, because those species' biology is different. On the other hand, the view of the behaviorists is that humans and animals can learn just about anything that a researcher would aim to train them to do. B. F. Skinner was famous for teaching pigeons to perform a wide variety of human behaviors, such as playing ping pong (Koren, 2013). Some researchers have argued that learning language is no different from learning any other human skill, such as learning algebra or learning to knit (Saffran, 2003; Saffran et al., 1996; Seidenberg & McClelland, 1989). They believe that the general neural mechanisms involved in learning all cognitive skills are also involved in

Photo 1.3 The principles of behaviorism provide the basis for modern animal training. Have you tried teaching a pet to perform a trick using positive reinforcement?

Credit: The Torch



learning language. Neural mechanisms, in their view, are able to capitalize on information about statistical co-occurrences in the language input, which can lead to knowledge structures and emergent processing routines, known as the **statistical learning approach**.

The notion that language is special and may be handled differently by the brain than other types of processing is consistent with Jerry Fodor's view that the brain contains *genetically determined modules* having specific *neural structures*, which he referred to as "modules" (Fodor, 1983). Modules were viewed as *autonomous* (independent) from other modules. The term **modularity** describes this view of the brain. Fodor described the characteristics of modules of the mind. Each module was *domain-specific*, handling information of one type. For example, a module for visual processing would be located in a specific location of the brain, handle only information related to vision, and operate independently from modules handling other types of information (e.g., hearing, sense of touch, taste, smell, etc.). Although tremendous advances have been made in understanding what areas of the brain are involved in a variety of types of processing, there is a long way to go before researchers can track, millisecond by millisecond, how the flow of information occurs within and between regions of the brain. If such fine-grained detailed information can be obtained about how the brain processes information, it may then be possible to determine the extent to which regions of the brain function as modules in the sense Fodor (1983) suggested. In psycholinguistics, those researchers who view the brain as modular envision separate modules, each involved in a specialized type of language function (Frazier, 1990). The issue of modularity figures prominently in models of visual word recognition (Chapters 5 and 11), speech production (Chapter 4), sentence processing (Chapter 6), and discourse processing (Chapter 7).

How Does the Brain Process Language?

Since the mid-1800s, there has been clear evidence that specific locations in the brain play central roles in language. The studies of Pierre Paul Broca (1824–80) and Carl Wernicke (1848–1905) resulted in the identification of two areas of the brain carrying their names to this very day (Kolb & Wishaw, 2009). Broca and Wernicke, working separately, identified individuals with acquired language problems. After keeping careful notes about patients' problems with language and carrying out examinations of patients' brains following their deaths, they were able to link specific language deficits to damage found in a specific area of the brain. Broca identified an area located in the frontal region of the left hemisphere, which was linked to great difficulties in producing speech. Wernicke identified an area located in the left hemisphere in the back or posterior part of the hemisphere roughly behind the ear, which was linked to great difficulties in comprehending speech.

Over the past 130 years, a great deal has been learned about how the brain is involved in language processing. Researchers continue to search for additional locations in the brain that are involved in specific types of language processing. Major steps forward have been gained since the innovation of brain imaging technologies, which enable researchers to obtain information about which brain regions are most active as participants perform tasks involving language as well as other cognitive processing. Functional magnetic resonance imaging (fMRI) is an important brain imaging technology (Benjamin et al., 2017).

Photo 1.4 An EEG experiment may involve as many as 256 electrodes. Would you be willing to participate in an EEG study?



FMRI provides excellent information about the locations of the brain; however, an important limitation is that it does not provide fine-grained resolution regarding how the cognitive processing occurs in real time, millisecond by millisecond. Electroencephalography (EEG), another brain imaging technology, provides excellent information about the time course of processing, but poorer information about the location of processing within the brain. In an EEG study, electrical activity is recorded from electrodes placed on a participant's scalp. The recording of activity is usually linked to the presentation of a stimulus (i.e., a sound or visually presented word or picture). Research has shown that there are bursts of electrical activity produced by the brain during perceptual and cognitive processing, occurring as early as 100 milliseconds following the presentation of the stimulus (Toga & Mazziotta, 2000). In Chapter 12, we will discuss additional methods for investigating which areas of the brain are involved in language processing. Several of these methods are relatively new and enable researchers to investigate brain processing more easily than ever before. Research related to the brain and language will also be discussed in Chapters 13 and 14.

What Roles do Nature and Nurture Play in Language?

The terms “nature” and “nurture” have long been used to refer to the biological and environmental influences on development, respectively. Few, if any, scholars today believe that human behavior can be fully explained through explanations that are purely nature (biological) or purely nurture (environmental influences). Matt Ridley (2003, p. 6) makes this point in his book *Nature via Nurture*:

It is genes that allow the human mind to learn, to remember, to imitate, to imprint, to absorb culture and to express instincts. Genes are not puppet masters, nor blueprints. Nor are they just the carriers of heredity. They are active during life; they switch each other on and off; they respond to the environment.

The biological and environmental influences involved in language will be discussed in multiple chapters in this book. For example, in Chapter 8, you will learn more about the views of language development. On one hand, there is the behaviorist view of language promoted by Skinner, which emphasized nurture. On the other hand, there is the nativist view that you have learned about in this chapter, popularized by Chomsky, which emphasized the role of nature in language. Similar views about the innateness of language knowledge have been described by Stephen Pinker in his book *The Language Instinct* ([1994] 2007). Both Chomsky and Pinker point out the ease at which children acquire language and do so at relatively similar rates regardless of where they are born in the world and what language(s) they are learning. They also emphasize the fact that children learn language with little or no direct instruction from their caregivers.

Additional support for the view that language is an instinct rather than a skill acquired through conditioning came from the neuropsychologist Eric Lenneberg (1964, 1967), who argued that there is a period in development in which language is learned best – the **critical period hypothesis**. Lenneberg was not the first to suggest that humans had a critical period for language acquisition, as other animals had critical periods for learning species-typical behaviors; Penfield and Roberts ([1959] 2014) first proposed that humans have a critical period for learning language. The observation that there were critical periods in birds' development dates back to the 1870s when **imprinting** was first described (Spalding, 1873). Soon after hatching, a bird tends to follow whatever individual is present, even if that individual belongs to another species. Others have noted that there is a critical period for songbirds to acquire their species' tune (Nottebohm, 1969). If a songbird is not exposed to the song during the critical period, the song will not be fully mastered. In humans, cases of severely neglected children have been cited as examples of children failing to acquire a first language fully due to missing the critical period (Curtiss, 1977). Acquiring a second language is particularly difficult in adulthood, because the critical period for language learning has passed. Have you tried learning a second language? Was your experience of learning a second language evidence for or against the critical period hypothesis?

Among the evidence that supports the existence of a critical period for learning language are cases of children – known as **feral children** – who have experienced severe neglect, which prevented them from receiving regular language input from adults in their environment. A famous case from the 1970s was described in the documentary *Genie: The Secret of the Wild Child*. Genie (not her actual name) had been kept isolated in a room at her home and bound to a portable toilet most of the time. She was rescued when she was 13 years old and was unable to speak. She was examined by a variety of experts (e.g., doctors, psychologists, linguists, social workers). She became the focus of a multi-year study funded by the National Science Foundation, which aimed to determine whether Genie could learn language. Ultimately, the results showed that Genie's spoken language ability was extremely limited; however, she showed an aptitude for learning the signs of American Sign Language (ASL). She learned numerous signs, but was unable to fully master sentence structure (i.e., syntax) (Curtiss, 1977). The sequences of signs she produced did not conform to ASL grammar.

Previous cases of feral children discovered with little or no language ability seem to have fared similarly to Genie. For example, a boy who came to be called Victor was discovered in 1800 in Aveyron, France (Lane, 1975). He was estimated to be between 9 and 12 years when he was captured. He was taken in by a local doctor named Jean Marc Gaspard Itard, who attempted to teach him to communicate and to carry out the basic tasks of living and socializing with others (Lane, 1975). Victor made moderate progress learning household tasks (e.g., setting a table), but made little progress in learning to speak. He died in 1828. The story of Victor and his teacher Itard was dramatized in Truffaut's 1970 film *L'Enfant Sauvage (The Wild Child)*. In an unusual coincidence, the film was released the same year that Genie was found and became the focus of a research study on language development. The researchers who came together to study Genie's progress were aware of the film and the similarity between Genie's and Victor's stories (Garmon, 2007).

Unfortunately, there are new cases of severely neglected children described in newspaper articles around the world each year. None of the cases, alone, can definitely prove the critical period hypothesis true or false, because individual case studies involve too many uncontrolled variables to enable researchers to conclude that the lack of progress in language acquisition was due to the age at which language input was consistently available. For example, in the case of Genie, researchers debated the possibility that Genie suffered from some form of cognitive impairment from birth, which may have contributed to her language learning difficulty (Garmon, 2007). Researchers interested in testing the critical period hypothesis have looked beyond cases of feral children. In Chapter 10, you will learn about some of this research, which tests the prediction of the critical period hypothesis using information collected from adults who have learned second languages.

What Role do Genes Play in Language?

With each passing week, we learn more about the science of genetics and the mysteries that are coded in DNA, which provides the blueprint for all lifeforms on earth, plant and animal (Kolb & Wishaw, 2009). The genetic material of humans is composed of 23 chromosomes, which involve approximately 25,000 genes. Between 1990 and 2003, the human genome project has aimed to understand what the genes do (Human Genome Project, n.d.).

Language researchers have demonstrated that specific genes play a role in some language disorders. For example, a mutation on chromosome 7 that regulates FoxP2, a protein, has been implicated as the cause of an inherited language disorder in which an individual has difficulty producing speech (Estruch et al., 2016; Fisher, 2006; Marcus & Fisher, 2003; Vargha-Khadem et al., 2005). Genes have also been identified as possible causes of inherited forms of reading disability or dyslexia (Gibson & Gruen, 2008) and stuttering (Kraft & Yairi, 2011).

Does Language Influence Thought?

The Greek historian Herodotus (484–425 BC) is credited as being the first to suggest that people who speak different languages may differ in other ways, such as their personality. He suggested that Greeks and Egyptians differed so much in personality because the languages used by the two groups were written in different directions (Fishman, 1980; Hunt & Agnoli, 1991). At that time, as now, Egyptian was written right to left and Greek was written left to right. Today, while no one believes that personality traits are shaped by the language one speaks, there is still debate regarding how one's language affects memory processing and perception.

Benjamin Whorf (1956) proposed that the language one speaks affects one's thinking. He and his mentor Edward Sapir promoted this view, referred to as the **Sapir-Whorf hypothesis**. Over the years, many versions of the view have been proposed. An extreme version of the view claimed that speakers of languages without specific words to describe certain objects in the world may not perceive those objects. For example, there are languages without a word for the color red. The extreme view of the Sapir-Whorf hypothesis would predict that such individuals may not be able to perceive the color red. This version of the view is

called **linguistic determinism**. Other discussions of the extreme view pertained to the Hopi language, which is spoken in Arizona and New Mexico. Whorf (1956) claimed that because Hopi had no formal way to represent time, speakers of the language are likely to perceive time differently than speakers of other languages in which time is formally represented in the tense system of verbs, such as in English. Whorf's experience with the languages he studied was primarily through written documents; consequently, he has been criticized for making bold claims about languages whose speakers he had little direct contact with (Deutscher, 2010; Pinker, [1994] 2007). Researchers continue to investigate the extent to which language affects thinking. The Language Spotlight box takes an in-depth look at the language Pirahã and recent work supporting the notion that speakers' cognitive processing may be influenced by the characteristics of the language they speak. The less extreme view claimed that the language spoken can influence the cognitive processing of the speaker, leading to some concepts being easier to process or remember. This version of the view is called **linguistic relativity** (Rollins, 1980). Scholars who have examined Whorf's writings have suggested that sometimes Whorf himself appeared to embrace this less extreme view.



Language Spotlight

Pirahã

If a language does not have many number words, will speakers of that language have difficulty solving problems involving numbers? One such language exists in a remote corner of the Amazon rainforest and provides us with the answer to this question. Pirahã is a language spoken by the Pirahã people, a hunter-gatherer tribe living along the Maici River in northwestern Brazil. Daniel Everett (2005, 2007), a Christian missionary from the USA, spent over 30 years living with the tribe, learning their language and cultural norms. The language has only 11 phonemes (8 consonants and 3 vowels), which allows it to be qualified as one of three known languages with the fewest number of phonemes (Everett, 2008). The other languages with only 11 phonemes are Hawaiian and Rotokas, a language spoken in Papua New Guinea.

Pirahã has a complex verb marking system with ways of adding morphemes to a verb stem to communicate whether an event was observed by the speaker (Gordon, 2004). In English, verbs take on suffixes to indicate past tense (i.e., -ed) or the present progression (i.e., -ing). In Pirahã, one suffix would be added to a verb to indicate that the event was not observed by the speaker and a different suffix would be added to the verb to indicate that the event had been observed by the speaker. One of the most researched features of the language is the fact that it contains very few words for numbers (Everett, 2005; Gordon, 2004). There is a word for *one*, which is *hoi* pronounced with a falling tone. To say *two*, one would say *hoi* with a rising tone. If one would like to say *many*, one would use the words *baagi* or *aibai*. There are no other words in the language to express quantity (i.e., number or amount). The lack of number words is not

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problematic in daily life as there is only limited trading with other groups. The tribe trades nuts, which they harvest from plants they grow (Colapinto, 2007). The culture is one in which individuals do not engage in the accumulation or storage of food (Colapinto, 2007). They go through periods of not eating as a cultural practice (Everett, 2008). When they want to eat, they find food in the forest where they live, such as fish and small game.

Many research studies have examined how speakers of Pirahã can perform memory tasks in which keeping track of quantity is necessary (Frank et al., 2008; Gordon, 2004). In Gordon's (2004) study, participants were shown an arrangement of objects, such as small batteries. After the objects were removed, the experimenter asked the participants to re-create the arrangement of objects. The results showed that participants performed well when there were a small number of objects, but inaccuracy increased as the number of objects increased. Gordon (2004) concluded that speakers of Pirahã used a strategy of estimating quantities rather than tracking the exact number of objects. In a more recent study, Frank et al. (2008) showed that when tasks required participants to remember large numbers of objects, performance was poor; however, when participants were asked to judge whether two arrangements contained the same number of objects while the arrangements remained in view, they performed better. In sum, the memory processing of speakers of Pirahã supports the weak version of the Whorfian hypothesis, referred to as linguistic relativity.



Time out for Review

Key Terms

Critical period hypothesis

Feral children

Imprinting

Linguistic determinism

Linguistic relativity

Modularity

Sapir-Whorf hypothesis

Statistical learning

approach

Review Questions

- 1 What is meant by the view *human language is special*? What is the opposing perspective about language?
- 2 What is the nature–nurture debate as it pertains to the psychology of language?
- 3 What is the critical period hypothesis? Provide an example of evidence that supports the existence of a critical period for language acquisition.
- 4 To what extent has the study of genetics produced findings relevant to psycholinguistics?
- 5 How do linguistic determinism and linguistic relativity differ?

Summary

Many aspects of daily life can be improved through the scientific studies of psycholinguistics, including the diagnosis and treatment of language disorders, facilitating communication between those with communication problems, and ensuring that critical communications in the workplace achieve desired outcomes. In contemporary research, there are points of particular interest that generate new research. These include: whether language is special, requiring explanations that are distinct from other abilities; how specific brain regions are involved in different types of language processing; the roles of nature and nurture in language acquisition and language processing; the relationship between language acquisition and processing to individual's genetic makeup; and the role of language on thought. The way in which these topics are approached by researchers is influenced by how the field has developed historically. Informal studies of psycholinguistics are likely to date back to the earliest period of human history, but the study of language began formally as a topic of interest to philosophers. In the 19th century, contributions by linguist Ferdinand de Saussure and psychologist Wilhelm Wundt set the stage for 20th-century advances in the field. In the late 1950s, the contrasting views of behaviorist B. F. Skinner and linguist Noam Chomsky gained international attention, highlighting nurture versus nature perspectives that continue to divide the field today. Skinner's extreme *nurture* position claims that all language behavior arises from prior learning experienced, and Chomsky's extreme *nature* position claims that the knowledge that enables rapid language acquisition is innate.

Recommended Books, Films, and Websites

- Curtiss, S. (1977). *Genie: A Psycholinguistic Study of a Modern-day "Wild Child."* New York: Academic Press.
- Garmon, L. (Producer) (2007). *Secret of the Wild Child* [DVD]. NOVA. Boston: WGBH Educational Foundation. Available from www.pbs.org.
- Labov, W., Ash, S. & Boberg, C. (2006). *The Atlas of North American English*. Berlin: Mouton de Gruyter.
- Lebrun, D. (Writer/Director/Producer) & Guthrie, R. (Producer) (2008). *Cracking the Maya Code* [Television series]. NOVA. Boston: WGBH Educational Foundation. Available from www.pbs.org.
- Levelt, W. (2013). *A History of Psycholinguistics*. Oxford: Oxford University Press.
- Pullum, G. K. (1991). *The Great Eskimo Vocabulary Hoax and Other Irreverent Essays on the Study of Language*. Chicago: University of Chicago Press.
- Searchinger, G., Male, M. & Wright, M. (Writers) (2005). *Human Language Series* [DVD]. United States: Equinox Films/Ways of Knowing Inc.
- Simons, G. F. & Fennig, C. D. (eds) (2017). *Ethnologue: Languages of the World* (18th edn). Dallas, TX: SIL International. Online version: www.ethnologue.com.