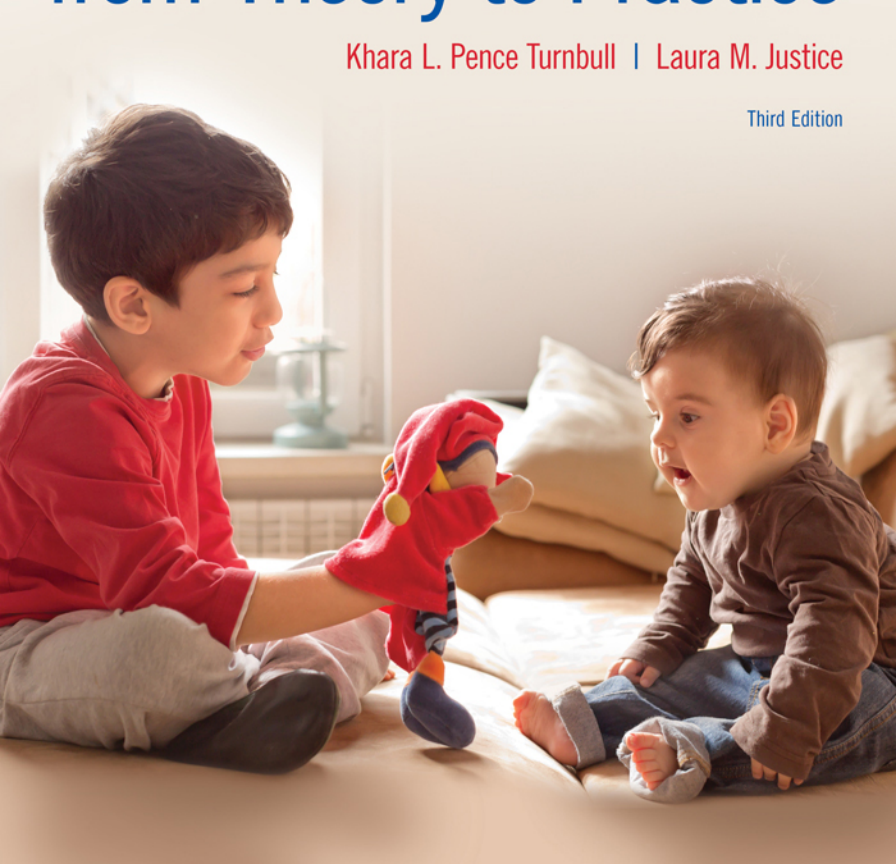
Language Development from Theory to Practice

Khara L. Pence Turnbull | Laura M. Justice

Third Edition



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THIRD EDITION

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Composition: Lumina
Printer/Binder: RR Donnelley/Owensville
Cover Printer: Phoenix Color/Hagerstown
Text Font: ITC Garamond Std

Library of Congress Cataloging-in-Publication Data

Names: Pence, Khara L. | Justice, Laura M., 1968-
Title: Language development from theory to practice / Khara L. Pence Turnbull, Charlottesville, Virginia ; Laura M. Justice, The Ohio State University.
Description: Third edition. | Upper Saddle River, New Jersey : Pearson Education, Inc., 2015. | Includes bibliographical references and index.
Identifiers: LCCN 2015028472| ISBN 9780134170428 (alk. paper) | ISBN 0134170423 (alk. paper)
Subjects: LCSH: Language acquisition.
Classification: LCC P118 .P396 2015 | DDC 401/.93--dc23 LC record available at http://lccn.loc.gov/2015028472

10 9 8 7 6 5 4 3 2 1

PEARSON

Bound Book ISBN 10: 0-13-417042-3
ISBN 13: 978-0-13-417042-8
E-text Package ISBN 10: 0-13-441208-7
ISBN 13: 978-0-13-441208-5
Pearson E-text ISBN 10: 0-13-417067-9
ISBN 13: 978-0-13-417067-1

To the very special and sweet guys in my life,
Doug, Ian, and Murray
—K.P.T.

To Ian, Addie, and Griffin, for their unwavering
support, love, and thoughtfulness
—L.J.

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Preface

The field of language development is an incredibly exciting area of study for college and university students in diverse disciplines, including allied health (e.g., speech–language pathology, audiology), liberal arts (e.g., linguistics, psychology), and education (e.g., elementary education, special education). For students in many preprofessional training programs, a basic course in language development is required at the undergraduate or graduate level. Yet, instructors teaching courses in language development commonly say that the language-development textbooks currently available do not address several important criteria:

- Integration of theory and practice, including discussion of how theories of language development influence state-of-the-art educational and clinical practices with children
- Discussion of individual differences in language development, including those of children who are developing language in diverse cultures or developing language atypically (e.g., children with disabilities)
- Descriptions of techniques that educators, clinicians, and researchers use to measure children's language achievements, including computer software
- Examination of language development from a multidisciplinary perspective, including its relevance to theory and practice in different disciplines

Language Development from Theory to Practice was designed to meet and exceed these criteria. This text provides a survey of key topics in language development, including research methods, theoretical perspectives, major language milestones from birth to adolescence and beyond, and language diversity and language disorders. The research base and the theoretical foundation this text provides are designed to prepare students for advanced study in subjects associated with language development, such as language disorders, psycholinguistics, instruction of English as a second or foreign language, and developmental psychology, among others. Although we do not adopt a single theoretical framework for how language phenomena are interpreted in the text, we attempt to summarize the various theoretical orientations that have guided research and practice in the relevant fields mentioned earlier.

NEW TO THIS EDITION

The purpose of this third edition is to build on the strengths of the first and second editions by making a number of enhancements in response to suggestions from the field. We have retained a number of features from the second edition that were well received. One such feature, *Beyond the Book*, presents opportunities to connect the text to students' own future experiences with language. Another such feature, *Apply Your Knowledge*, presents problems that allow students to apply their knowledge in a similar way as on exams such as the Praxis. We have also made it a priority to improve students' learning opportunities in each chapter through the use of advance organizers, self-check quizzes, and video clips relevant to chapter content. We learned that students and educators would like to see more detailed coverage of topics (e.g., theory of mind, bilingualism) that students should find particularly

interesting. We have thus responded by expanding some topics and shortening others. We have also continued to strive to present material in an enjoyable and reader-friendly way. Finally, we received feedback that it would be helpful for students to have a general understanding of language development and language building blocks as well as language neuroanatomy and neurophysiology prior to introducing language-development theories, as language acquisition theories have risen from our understanding of language development and language neurology. We have responded by reorganizing the chapters to begin with an introduction to language development (Chapter 1), followed by language building blocks (Chapter 2), language neuroanatomy and neurophysiology (Chapter 3), and language-development science and theories (Chapter 4).

More specifically, the third edition of *Language Development from Theory to Practice* features the following changes to ensure that the material is current and comprehensive, while meeting the needs of students and educators:

- We have created *Learning Outcomes* for each chapter and linked each learning outcome to one main section within each chapter.
- We have also created a brief multiple-choice item within each chapter section called *Check Your Understanding*; this feature allows students to check their own responses and to receive immediate feedback before proceeding to the next section.
- We have also included a comprehensive *End of Chapter Quiz* with multiple-choice items assessing the chapter's learning outcomes. The *End of Chapter Quiz* allows students to check their own responses and receive immediate, detailed feedback.
- We have added a feature to each chapter called *Learn More About*. Each *Learn More About* margin note links to a video clip illustrating chapter content and provides a detailed description of the video. For example, videos of child language samples include a description of specific instances of language form, content, and use. As another example, videos of research paradigms include a description of the research stimuli and procedure.
- We have also provided more detailed coverage of topics that should be of interest to students. For example, we have expanded our discussion of areas such as language pragmatics, theory of mind, Spanish dialects used in the United States, and language disorders in children who are bilingual. With regard to language-development theories, we have expanded the categorization scheme (previously nurture-inspired theories and nature-inspired theories) to include a third category—interactionist theories, based on common categorization schemes in the language-development literature. We have also provided greater emphasis on the distinctions between the three categories of theories rather than the distinctions between the individual theories, and we have reduced the number of individual theories we discuss.
- Finally, in response to feedback, we have separated our discussion of *Language Diversity* and *Language Disorders in Children* into two separate chapters to allow a more thorough treatment of each of these topics.

ORGANIZATION OF THE TEXT

Language Development from Theory to Practice includes ten chapters. Chapters 1 through 4 provide a basis for understanding language development. Specifically, in Chapter 1, we define language and explain how it relates to the areas of speech, hearing, and communication. We also introduce the three domains of language—form, content, and use—and describe the features of language that make it so remarkable. Chapter 1 concludes with an introduction to language differences and language disorders. In Chapter 2, we introduce the building blocks of language: phonological, morphological, syntactic, semantic, and pragmatic development. Chapter 3 addresses the

neuroanatomy and neurophysiology of language. We describe the major structures of the brain, explain how the brain processes and produces language, and discuss sensitive periods in neuroanatomical and neurophysiological development. In Chapter 4, we describe the many reasons different people study language development. We introduce some major approaches to studying language development as well as some major language-development theories; we reference these approaches and theories subsequently in several places in the text. We conclude Chapter 4 by describing how theories of language development contribute to practice in several areas.

Chapters 5 through 8 provide a developmental account of language acquisition for four age groups (infancy—Chapter 5; toddlerhood—Chapter 6; preschool age—Chapter 7; and school age and beyond—Chapter 8). More specifically, in each of these four chapters, we describe the major language-development milestones children achieve during the period in question; examine achievements in language form, content, and use; explain some of the intra- and inter-individual differences in language development; and discuss methods researchers and clinicians use to measure language development.

In Chapter 9 we explore language differences. We detail the connection between language and culture, explain how languages evolve and change, describe bilingualism and second language acquisition, and explain some theories of second language acquisition and their implications for practice.

Finally, in Chapter 10, we examine language disorders in childhood. We define the term *language disorder*, explain who identifies and treats children with language disorders, discuss the major types of language disorders, and describe how practitioners treat language disorders.

KEY FEATURES OF THE TEXT

Each chapter bridges language-development theory and practice by providing students with a theoretical and scientific foundation to the study of language development. We emphasize the relevance of the material to students' current and future experiences in clinical, educational, and research settings.

Multicultural Considerations

Current perspectives emphasize the importance of taking into account multicultural considerations in understanding language development. This text promotes students' awareness of the way in which culture interacts with language development for children from diverse backgrounds within and beyond the many types of communities in the United States.

Research Foundations

Current initiatives in the educational, social science, and health communities emphasize the use of evidence-based practices. Such practices emphasize the importance of research results to making educational and clinical decisions. In keeping with this premise, we emphasize the research foundations of the study of language development, and use the most current empirical findings to describe children's language achievements.

Multidisciplinary Focus

The study of language development is constantly evolving and being influenced by many diverse disciplines; this multidimensional and multidisciplinary foundation attracts many students to the study of language development. We introduce exciting innovations in theory and practice from many diverse areas of research.

Easy-to-Read Format

Language Development from Theory to Practice is presented in a way that promotes student learning. First, the chapters are infused with figures, tables, and photographs to contextualize abstract and complex information. Second, important terms are highlighted for easy learning and reference. Third, discussion questions are integrated throughout to provide opportunities to pause and consider important information. All these features create opportunities for students to actively engage with the material in the text.

Pedagogical Elements

The text includes many pedagogical elements:

- Learning outcomes to organize each chapter
- Discussion questions interspersed throughout each chapter
- Video clips relevant to chapter material
- Chapter summaries
- Self-check, multiple-choice quizzes
- Activities that allow students to engage with language *Beyond the Book*
- Boxed inserts:
  - *Developmental Timeline*: We present milestones for language development, observable features of these milestones, and approximate ages for the milestones.
  - *Language Diversity and Differences*: We introduce cultural differences in language development and describe the observable features of these differences. We also discuss educational and clinical implications with regard to cultural differences.
  - *Research Paradigms*: We provide descriptions of various research paradigms used to inform our understanding of language development.
  - *Theory to Practice*: We discuss some implications of different theoretical perspectives for educational and clinical practice.

ACKNOWLEDGMENTS

We extend our thanks to our family members, friends, and colleagues who supported us throughout this revision. Among these persons are the Pence family, the Powell family, the Turnbull family, and the Justice and Mykel families. We are indebted to them for their interest in and support of this text.

We are grateful to a number of experts who reviewed this manuscript: Eileen Abrahamsen, Old Dominion University; Karin M. Boerger, University of Colorado–Boulder; Julie Dalmasso, Western Illinois University; Martin Fujiki, Brigham Young University; and Shannon Hall-Mills, Florida State University.

Brief Contents

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Language Development

An Introduction

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LEARNING OUTCOMES

After completion of this chapter, the reader will be able to:

1. Define the term *language*.
2. Describe how language relates to speech, hearing, and communication.
3. Describe the major domains of language.
4. Identify several remarkable features of language.
5. Discuss the distinction between language differences and language disorders.

Hundreds of scientists worldwide study the remarkable phenomenon of children's language acquisition. Each year, these scholars publish the results of numerous studies on children's language development in scientific journals, pursuing answers to such questions as:

- Does the language a child is learning (e.g., Chinese vs. English) influence the rate of language development?
- How do caregivers' interactions with their child affect the timing of their child's first word?
- Do children who show early delays in language development typically catch up with their peers?
- Do children learning a signed language develop language similarly to children learning a spoken language?
- Why do children with autism have such difficulties developing language skills?

These questions provide the student of language development a glimpse into many of the interesting topics language scientists focus on in their work around the world. These questions also suggest how important language research is to informing the everyday practices and activities of parents, teachers, psychologists, and other professionals invested in helping children achieve their fullest language development potential. That these questions have yet to be fully answered, shows that the study of language development is a constantly evolving and complex area of science in which practitioners have many more questions than answers.

In this chapter, we provide a general introduction to the study of language development and consider five major topics. In the first section, we answer the question "What is language?", and present a definition of *language* that we build on throughout this text. In the second section, we discuss differences among speech, hearing, and communication—three aspects of human development and behavior that are closely related but are nonetheless distinct capacities. In the third section, we address the five major domains of language, a topic we introduce here and discuss more fully in Chapter 2. In the fourth section, we examine several remarkable features of language, and in the fifth section, we describe differences in and disorders of language development—two topics we explore more comprehensively in Chapters 9 and 10.

WHAT IS LANGUAGE?

Language Defined

You probably have an intuitive sense of what language is because it is a human behavior you have acquired to a sophisticated level and use regularly for various purposes. In fact, you are using your language abilities as you read and analyze the content of this chapter. However, if you take a moment to define language more explicitly, you may find the task challenging. If you were to ask 10 classmates for a definition of language, each would likely respond differently. The same outcome would probably occur if you questioned 10 language researchers.

You are also most likely aware that language is a basic and essential human behavior that develops early in life. You probably recognize that language involves words and sentences and both expression (language production) and comprehension (language understanding). In addition, you know language is a process of the brain that helps people communicate their thoughts to other individuals, although you may be somewhat unclear about how language differs from speech and communication.

However, to be as specific as possible about what language is and is not, let's look at the official definition of the term *language* the American Speech-Language-Hearing Association (1982) uses:

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The relationship between a word and its referent is arbitrary. English speakers use the word happy to represent an internal feeling of happiness, but any word would do.

Language is a "complex and dynamic system of conventional symbols that is used in various modes for thought and communication."

Next, we delineate in more detail the specific characteristics of language identified in this definition:

1. *Language Is a System of Symbols*. The first characteristic of language warranting discussion is that it is a code, consisting of a system of symbols called morphemes**.** Morphemes are the smallest units of language that carry meaning; we combine them to create words. Some words consist of a single morpheme (e.g., *school*), but many words comprise two or more morphemes, such as *schools* (two morphemes—*school* + *-s*) and *preschools* (three morphemes—*pre-* + *school* + *-s*). These symbols can exist in spoken or written format, a point we'll return to shortly.

The term *code* refers to the translation of one type of information into another type of information; this involves the use of symbols. For humans to develop the capacity to use language thousands of years ago, perhaps the most important prerequisite was the human ability to use symbols, such as representing a specific concept with a specific sound (Christianson & Kirby, 2003). In language, we create words by using morphemes to represent myriad aspects of the world around our language community. For instance, as English speakers, we can represent an internal feeling of happiness by using the single word *happy*. When we use the word *happy* in a conversation with other people to describe our feelings, we use the word to translate our feelings. Although we can share feelings and ideas through other means—such as gesture, facial expression, and posture—words are much more specific and provide a uniquely powerful tool for communicating.

One important characteristic of language code is that the relationship between a word and its referent (the aspect of the world to which the word refers) is arbitrary. For example, although English speakers recognize that *happy* refers to a specific feeling, any other word (e.g., *sprit*, *nopic*, or *grendy*) would do. Likewise, one way English speakers can denote plurality is to attach the morpheme *-s* to words (e.g., *pens*, *dogs*). Because the relationship between the plural morpheme *-s* and its plural marking is arbitrary, English speakers could denote plurality in various other ways. In contrast, the code we use to organize words into sentences is not arbitrary; rather, we must follow specific rules for organizing thoughts into words and sentences, as we discuss next.

2. *The System of Language Is Conventional*. The second characteristic of language is that the system of symbols is conventional, so the members of a community or culture can share it. The term *conventional* means users of a language abide by accepted rules. For instance, speakers of English agree to use the word *dog* (and related words and synonyms, such as *pup*, *puppy*, and *canine*) to refer to those companionable creatures, rather than other potential words, such as *boop* or *ming*. Speakers of Spanish use a different word to refer to this concept (*perro*), as do users of American Sign Language. Adhering to specific conventions allows all members of a language community to use language with one another as a tool for expression. A *language community* is a group of people who use a common language. In fact, somewhere in the history of the human species, a single language probably emerged within a social community of about 100 hominids (Cartwright, 2000). Some experts contend that language emerged within this community as a type of grooming behavior, essentially an efficient way to share socially useful information (Christiansen & Kirby, 2003). Accordingly, the numerous languages of the world emerged from this single community of language users.

Language communities emerge for many reasons. Some form as a result of geographic circumstances, as in the case of Ukrainian, the language people speak in Ukraine, a country in the western region of the former Soviet Union. Alternatively, a language community may emerge for sociological reasons, as in the case of Hebrew, which many persons of Jewish faith share, or American Sign Language, which persons in the U.S. Deaf community use. A language community can organize for economic reasons as well. For instance, the World Trade Organization (WTO), a global group that coordinates and regulates trade among 161 countries (as of April, 2015), conducts its activities in English, French, and Spanish.

3. *The Language System Is Dynamic*. The third characteristic of language is that it is dynamic. This means language is in a state of activity and change, both within an individual who is acquiring language and within a community that uses a certain language. Let's consider first the case of the individual. As we discuss throughout this book, the acquisition of language begins at birth, or even before birth, in utero, and is in a state of change across the lifespan. Even as adults, our language skills are dynamic. As one example, we might seek to learn a second language. As another example, as we age, some aspects of our language skill decline. We might, for example, have increased difficulty finding the names for things (Capuron et al., 2011), which is a normal part of aging.

The language a community uses is also very dynamic. When the first edition of this book was published, in 2008, there was no such word as *selfie* (or *selfie stick*, for that matter). Sometime during the last eight years, this word entered the English language and is now in our vocabulary. In any language, words come and go and other changes happen as well, as we discuss more thoroughly in Chapter 9.

4. *Language Is a Tool for Human Communication*. The final and perhaps most important characteristic of language requiring discussion is that it exists as a tool for communication. Communication is the process of sharing information, such as thoughts, feelings, and ideas, among two or more persons. Although other species are able to communicate, such as dogs, primates, birds, dolphins, and ants, the innate and specialized capacity of humans to use language as a tool to communicate is what makes the human species unique. For instance, although some primates may communicate alarms to one another using calls, these alarm calls seem to be general and do not symbolically represent a given predator (e.g., eagle) (Christiansen & Kirby, 2003). Experts therefore argue that "language is the most distinctive feature that distinguishes humans from other animals" (Wang & Minett, 2005, p. 263). Language itself is what supports the highly complex communication enjoyed by the human species, such as your ability to comprehend and learn from the complex matter contained within this text.

Learn More About 1.1

As you watch the video titled "What Is Language?" consider the different features of language and how language differs from other systems of communication. https://www.youtube.com/watch?v=GenkKxTk7bw

Language as a Module of Human Cognition

Beyond its role in supporting human communication, language is a cognitive tool that helps humans to develop the "picture of the world that we use for thinking" (Bickerton, 1995). This "picture of the world" includes not only symbolic representations of linguistic concepts (e.g., *big*, *fly*, *crazy*) that are organized in a vast network, but also the formal syntactic or grammatical rules that organize these concepts into orderly, surface-level representations. According to this proposition, first and foremost, language is a representational tool people use for thinking, and, second, this tool permits people to communicate their thoughts to other individuals.

Language probably emerged in the human species for the latter reason: to provide an efficient and effective means for communication within a community. In other words, language emerged as a cultural and social evolution, rather than a biological evolution: Our need and interest to communicate with others gave rise to the complexity of language over time (Christiansen & Kirby, 2003). Some experts suggest that language emerged in the human species because of increases in the size of human communities (e.g., from about 50 members in a group to more than 100 members), and therefore increases in the complexity of social dynamics (Dunbar & Aiello, 1993). With time, the neural circuitry of the human brain responded to the adaptive advantage of using language not only as a social tool but also as an inner representational tool, emerging as a specialized part of the human mind (Christiansen & Kirby, 2003).

The human brain uses language as a representational tool to store information and to carry out many cognitive processes such as reasoning, hypothesizing, memorizing, planning, and problem solving. These processes are sometimes called *higher-level* language skills to differentiate them from more basic-level language abilities. When applied to mathematical and scientific tasks, these higher-level abilities may be called *mathematical reasoning* and *scientific reasoning*; however, it is important to acknowledge the role of language in mathematical and scientific reasoning tasks. For instance, suppose you are asked to complete the following mathematical reasoning task:

> The average cost of a smart phone in the United States in 2015 is about $250. Assuming the prices of consumer goods decline about 3% per year, how much, on average, would a smart phone cost in 2020?

You would have difficultly generating an answer without using language as a tool. Although some persons may contend that they think in images and not in words, certain thoughts—such as "My trust in you has been shattered forever by your unfaithfulness"—are impossible to view as images and require language to be invoked as a representational tool (Bickerton, 1995, p. 22).

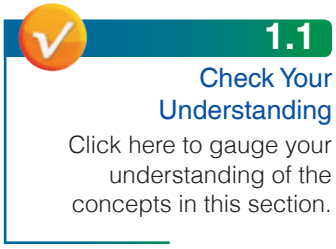
Too many people in the world are without food. We need a solution to the global food-shortage problem. Try to reason through a solution to this problem without using language. Is it possible? Can an individual engage in complex reasoning without language?

As we consider the definition of language, particularly its relation to cognition, we need to explore the concept of *modularity*. We introduce this concept here, and discuss it more thoroughly in Chapter 4. Modularity is a cognitive science theory about how the human mind is organized within the structures of the brain (Braisby & Gellatly, 2012). Questions about modularity concern whether the human brain contains a set of highly specific modules—regions of the brain developed to process specific types of information—or whether the human brain is itself a generalized module in which all parts work together to process information. A module is a specialized problem-solving device in the brain that responds to information of a restricted type. Because of the specificity of such modules, they are termed domain specific, meaning they can process only very specific types of information, such as depth perception within the visual system. Some cognitive theorists contend that the brain consists of very large domain-general modules, which carry out very general tasks like memory and reasoning, as well as domain-specific modules that execute very specific types of tasks.

With respect to language, some language theorists argue that the human brain contains a large number of language-specific modules, tightly clustered and highly interconnected, each of which processes specific types of linguistic information (see Curtiss, 2012). Such theorists contend that during human evolution, the neural circuitry of the brain became highly specialized in several regions to handle the task of developing and using language (Cartwright, 2000). In fact, researchers have long known that specific regions of the brain are associated with specific language abilities. For instance, people who sustain damage to certain areas of the left frontal lobe, such as during a stroke, often exhibit difficulty with basic grammar. These people may omit grammatical markers and speak with a "telegraphic" quality (e.g., "Tommy go store now"), which suggests this region of the brain governs aspects of grammar (Shapiro & Caramazza, 2003). The results of brain-imaging studies of the workings of undamaged brains also indicate that various regions of the brain correspond to highly specific aspects of language (Okada et al., 2013), a concept we elaborate on in Chapter 3.

Studies of children with language impairment (a group we discuss more thoroughly in Chapter 10) also provide some support for the notion of language modularity. Typically developing in all areas except for language, children with a condition called *specific language impairment* (SLI) exhibit problems in very precise aspects of grammar, such as marking verb tense. Verb tense marking includes, for instance, inflecting verbs with *–ed* to create the past tense, as in "Juan brushed his teeth." At ages 4 and 5 years, children with SLI have significant problems with past-tense marking (typically omitting it; Clahsen, Rothweiler, Sterner, & Chilla, 2014), even when other aspects of language development are proceeding normally. Across any number of languages, including English, German, and Swedish, this is a prominent marker of children with SLI (e.g., Clahsen et al., 2014). That verb structures are so clearly impaired in children with SLI suggests that, perhaps, there is a particular module of the brain that processes verb structures and that this is the site of disturbance in cases of SLI.

The concept of language modularity is not without its critics. Some theorists argue that language emerges in response to an individual's culture rather than in response to any specific internal architecture. Others argue that language is processed by a general neural network that operates on all aspects of language and that the hypothesized language modules lack "neurological reality" (Bickerton, 1995, p. 76). Bickerton, in a well-reasoned critique of modularity theory as it applies to language, showed that the results of research on disordered language due to developmental disability (e.g., cognitive impairment) and brain injury have failed to support the modularity concept. For instance, Bickerton reviewed studies of persons with damage to a specific area of the brain purportedly linked to grammar problems, noting that these individuals showed diverse patterns of syntactic impairment. Because the same module was likely damaged in these individuals, the expectation would be little variability in their impairment. At the same time, it is also important to recognize that, even if language processes are modular, this does not mean language functions specific to a given module (or area of the brain) cannot be subsumed by another area of the brain when injury occurs. We'll discuss the notion of brain plasticity in Chapter 3. Undoubtedly, researchers in the next several decades will better elucidate how language is represented in the neural architecture of the brain.



HOW DOES LANGUAGE RELATE TO SPEECH, HEARING, AND COMMUNICATION?

Language, speech, hearing, and communication together represent basic and interrelated human abilities. Although simple forms of communication such as gesturing do not necessarily require language, speech, and hearing, more advanced forms of communication—particularly speaking and listening—require them.

DISCUSSION POINT

Speech, *hearing*, *communication*, and *language* are distinct processes, although people often use the terms interchangeably. Before reading further, consider your definition for each, focusing on what differentiates the four processes.

Often, the terms *language*, *speech*, *hearing*, and *communication* are used synonymously, but in fact they describe substantially different processes. We previously defined *language* as the rule-governed, code-based tool a person uses to represent thoughts and ideas. Once individuals formulate thoughts and ideas, they can communicate them to other people using speech or a manual sign system; otherwise, individuals can choose to keep thoughts and ideas to themselves (inner language) or can write them down (written language).

Speech describes the neuromuscular process by which humans turn language into a sound signal and transmit it through the air (or another medium such as a telephone line) to a receiver. Hearing is the sensory system that allows speech to enter into and be processed by the human brain. We described communication previously as the process of sharing information among individuals. Communication in the form of a spoken conversation between two persons involves language, hearing, and speech; in contrast, communication between two persons in an Internet chat room involves only language.

Speech

Speech is the voluntary neuromuscular behavior that allows humans to express language and is essential for spoken communication. In spoken communication, after people formulate ideas in the brain using language, they must then transmit the message by using speech. Speech involves the precise activation of muscles in four systems: respiration, phonation, resonation, and articulation. These four systems represent the remarkable coordination of a breath of air as it is inspired into and then expired from the lungs to travel up through the trachea, or windpipe (respiration). Within the trachea, the breath of air moves through the vocal cords, which are set into vibration to create one's voice (phonation). Then the breath of air proceeds into the oral and nasal cavities, where it resonates (resonation). Finally, the breath of air is manipulated by the oral articulators—including the tongue, teeth, lips, and jaw (articulation)—to emerge as a series of speech sounds that are combined into words, phrases, and sentences. Figure 1.1 illustrates these four systems.

When and how humans first began to use speech is the subject of considerable popular, philosophical, and scientific debate; estimates range from 2 million years ago with *Homo erectus* to only 35,000 years ago with *Homo sapiens* (Cartwright, 2000; Wang & Minett, 2005). Anatomically modern humans (based on remains

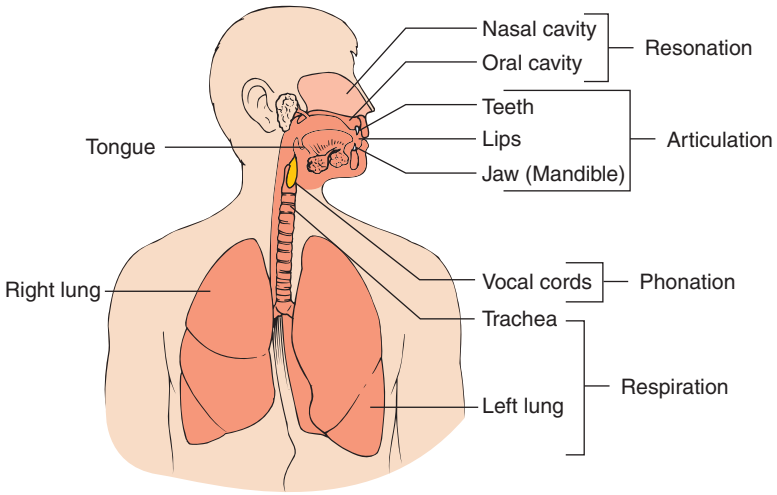


FIGURE 1.1

Systems involved with speech production.

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found in Ethiopia) existed about 160,000 years ago, and it is believed that speech and language emerged sometime between 160,000 and 50,000 years ago when the human species experienced a "cultural explosion" (Wang & Minett, 2005). Although this continues to be debated, it is likely that speech became the mode for language expression because of its advantages over other modalities, such as gesturing or grunting (Christiansen & Kirby, 2003). Whereas gesturing requires a direct line of sight, speech enables communication in the dark, around corners, and from relatively far distances; speech also allows one to communicate when the hands are occupied, as when one is carrying an infant or working manually. In addition, speech allows an individual to communicate with a larger number of persons, which became necessary as the group size of early humans increased from small bands of hunter-gatherers of a dozen or so individuals, to larger organized communities of more than 100 members (Cartwright, 2000). Finally, and possibly most important, speech provides the medium for sharing language.

Model of Speech Production

We provide here a relatively basic model of speech production to show how speech moves from the brain to the articulators. A model is a way to represent an unknown event on the basis of the best current evidence governing the event. Models of speech production provide a theoretical description of how an individual can move from a cognitive representation ("I forgot to bring paper . . . I'll have to borrow a piece … I see she has an extra one in her notebook") to a clearly articulated spoken product ("May I borrow a piece of paper?").

Figure 1.2 presents a basic model of speech production involving three stages. The first stage is a perceptual event: The speech production process is initiated with a mental, abstract representation of the speech stream to be produced. This abstract representation is the language code, which provides a *perceptual target* of what is to be produced by speech. At the perceptual level, the code is represented by the phoneme. A phoneme is the smallest unit of sound that can signal a difference in meaning; we combine phonemes to produce syllables and words. For instance, the word *mama* comprises four phonemes, whereas the word *my* comprises two. In written form, phonemic representations are usually bounded by slashes; thus, the four phonemes in *mama* are /m/ /a/ /m/ /a/, and the two phonemes in *my* are /m/ /aɪ/. Conventionally, phonemes are represented by the symbols of the International

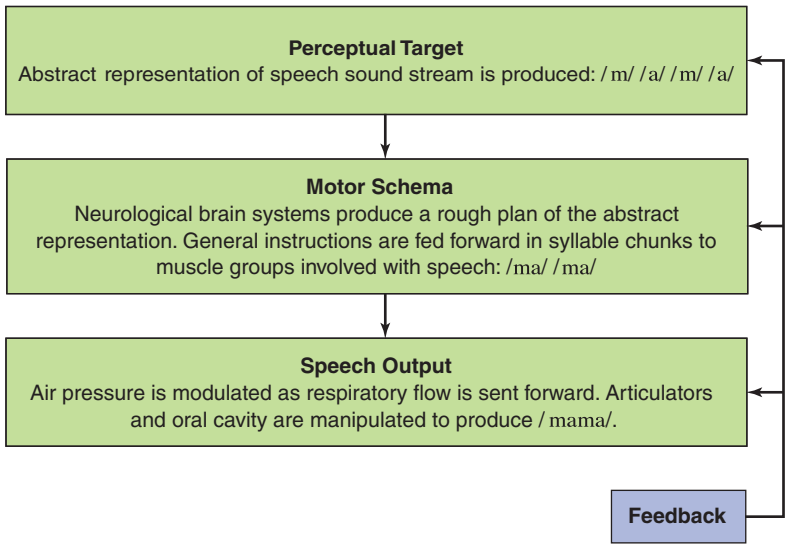

FIGURE 1.2
Model of speech production.

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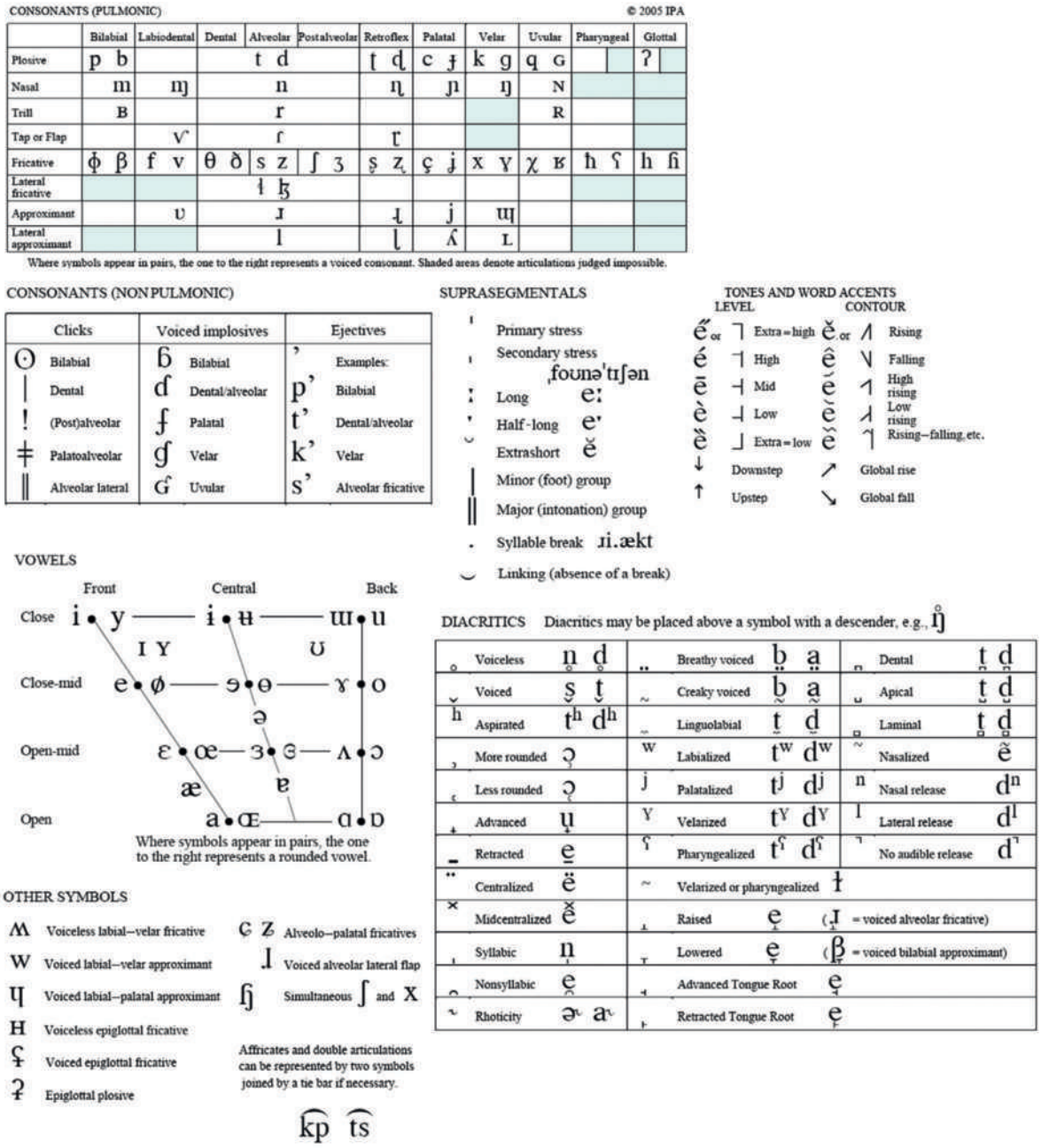

FIGURE 1.3

International Phonetic Alphabet.

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Phonetic Alphabet (IPA), which is an international set of symbols that represents all of the phonemes of the world's languages. Figure 1.3 provides a reproduction of the IPA simply for illustrative purposes. (Shortly, we'll focus on the smaller subset of phonemes used in General American English; for a preview, turn to Table 1.2.)

The second stage of speech production is development of a *motor schema* to represent the perceptual language–based representation. This is a rough motor plan based on the abstract representation of the perceptual target. The rough plan organizes the phonemes into syllable chunks; for instance, for an infant who wants to call her mother, *mama* is represented as two syllables to be executed: /ma/ /ma/. The rough plan is sent forward to the major muscle groups involved with speech production. This stimulates the production of speech, or *speech output* in the