PHONETIC SCIENCE FOR CLINICAL PRACTICE

SECOND EDITION

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FOREWORD

Let's face it: Phonetics is a difficult and potentially tedious course, for both the instructor and the students. Although it may seem like a shallow and trivial topic—something one could learn from the key at the bottom of a dictionary page—there are multiple complexities that challenge many students who are accustomed to doing well easily in all their classes. Concepts from anatomy and physiology are needed to describe the articulators and their speech production functions. Concepts from physics are needed to explain the acoustics of speech sounds and prosody and how these are manifested in sound waves and spectrograms. Concepts from linguistics, including sociolinguistics, are needed to account for variable pronunciations of phonemes in different phonetic contexts and by different groups of speakers as well as phonemic differences across languages. And, at the same time, students must develop a so-called "good ear" for detecting subtle nuances among speech sounds. Somehow, the professor of phonetics must maintain the interest and motivation of groups of undergraduates while leading them through the interrelationships among all of these disparate aspects of our field.

Why should we bother? Because an understanding of all these aspects of speech and of their interrelationships is key to the assessment and treatment of speech sound disorders, which account for the majority of speech-language services provided to preschoolers as well as many older children and adults. To provide successful, high-quality, evidence-based services, speech-language pathologists (SLPs) must be more than competent in understanding and using phonetic concepts and skills. This mission is made all the more difficult by the growing diversity in English-speaking countries as well as our discipline's growing recognition of the importance of the home language. No longer is it sufficient for the SLP to recognize and understand the phonemes and allophones of English. Our caseloads are becoming increasingly linguistically diverse, so we also must be able to tease apart not only the influences of disparate dialects but languages as well, including the additional impacts of being bilingual.

Having just reviewed my phonetics student course evaluations for the past semester—one of a large number of sets of phonetics course evaluations I have reviewed over the past three decades—I am keenly aware that many students find all of this overwhelming, as it is typically presented in current phonetics texts. In this book and workbook, Kathy Jakielski and Christina E. Gildersleeve-Neumann have taken a different approach to presenting this information that will make the material both easier to digest and more engaging to our students. They present articulatory phonetics first—the anatomical and physiological foundations for consonants, vowels, and diacritics—as the basis for a chapter dedicated to each of these. Chapters on prosody and then acoustics come next. Only once students have a solid foundation in these more basic concepts about speech do the authors focus on concepts from phonology—phonemes, allophones, and so forth. Finally, they close with a lively review of the many respects in which languages differ from each other phonetically. Thus, students will be able to process and master the various components of the field of phonetics one by one. As the reader progresses through the book, the material from the earlier chapters is reviewed and related to the new concepts. As a result, there are many opportunities to revisit ideas from more basic aspects of phonetics and to integrate them into more complex concepts for a deeper understanding of the whole. This organization should be far less intimidating and far more reinforcing for students.

Another innovation in this book is that each chapter includes frequent "Did You Get It?" reviews, which encourage the student to answer a small number of short answer or multiple-choice questions that reinforce the material just covered. These,

in addition to the excellent, varied exercises in the accompanying workbook and also the mnemonic flashcards that are included, give the students many engaging opportunities to interact with the material and thus to master it at a far deeper level than they would by merely reading the text.

The organization of the material is definitely not the only innovative aspect of this book-workbook set. Most motivating for the students are the "Applied Science" sections that begin and end each chapter. Some are fascinating phonetic puzzles that will increase the students' curiosity about the topic of the chapter from the get-go. Others are clinical mini-case studies that raise interesting questions, the answers to which depend upon the material in that chapter. These are not trivial; they involve key clinical issues, such as identifying covert contrasts (Chapter 4), detecting production-based versus perception-based speech errors (Chapter 6), and differentiating the impacts of bilingualism from speech disorder (Chapters 7, 8, and 9). Despite the basic level of understanding that the undergraduate readers will have, the authors have managed to include accessible real-life clinical conundrums with "Aha!" solutions, based upon the recently learned material, revealed at the end of the chapter.

The clinical case studies are only one of the means by which Jakielski and Gildersleeve-Neumann introduce intriguing information about languages other than English into the text. Throughout the book, especially in Chapter 9, they provide fascinating phonetic details not only about Spanish, German, and Chinese but also about Guarani, Navajo, Quichua, Xhosa, Tlingit, and Taa, to mention just a few. Students completing a course taught with this textbook should have a much wider appreciation of phonetics as a human trait, well beyond the speech sounds of English.

Don't be misled by the comfortable conversational style in which this book is written. These two authors "know their stuff"; both have many years of hands-on experience in clinical phonetics as well as in teaching this subject. The information in the book, for all of the aspects of phonetics that are covered, is solid as well as accessible.

[dɪg ɪn ænd ɛn.d͡ʒɔɪ]!

—Shelley L. Velleman, PhD, CCC-SLP
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PREFACE

The idea for this textbook originated in 1998, when one of us turned to the other and said, "One day, we are writing our own phonetics textbook." That statement was born out of our frustration of not finding an introductory phonetics textbook that maintained the powerful science material that underlies phonetics, while weaving the application of it into the speech and hearing sciences. As clinical and research speech-language pathologists ourselves, we experience daily how understanding the science that underlies the artful tool of phonetic transcription increases our success in the classroom, clinic, and lab. So, when Plural Publishing approached us about co-authoring an introductory phonetics textbook, it appeared that it was time to give substance to an idea that began 25 years ago. This second edition incorporates updates based on feedback we have received from our readers. We have added an introduction to transcribing typically-developing and disordered speech, along with audio and video speech samples. We now also offer two online quizzes. The first quiz is designed for phonetics students to assess their own transcription readiness in five skill areas, along with a set of tutorials for students to complete if they need practice in any of the five skill areas. The second quiz is designed for instructors of undergraduate or graduate speech sound disorders courses to administer to students at the beginning of the semester to assess their phonetics knowledge and skills. Students are directed to where in the textbook they can find the information assessed in the quiz, so that they can review any information the instructor requires.

Each of us has been teaching phonetics to students majoring in speech-language pathology and audiology for over 25 years and practicing as clinical and research speech-language pathologists for even longer. *Phonetic Science for Clinical Practice* mirrors the courses we have crafted over those 2½ decades, containing the information that speech-language pathologists and audiologists need to build a foundation in phonetic science, as well as to become accurate phonetic transcribers. Knowing how to transcribe is a practical skill. But knowing how to think like a phonetician is arming oneself with practical knowledge.

You would not be holding this book in your hands if not for the support we have received throughout our long careers. Our list of people to acknowledge is extensive. We first thank our academic mentors, including Barbara Davis, Peter MacNeilage, Björn Lindblom, Leo Engler, and Julie Ries. Their passion for teaching phonetic science was contagious. We thank the hundreds of students we have taught; their desire to dive into the inquiry of phonetics continually keeps us on our toes to remain current. This book also is the result of the support we have received during the actual writing process. Our many anonymous reviewers read early and late drafts, giving their valuable time to provide welcome feedback along the way. We gave every comment consideration, and we hope that our reviewers see their efforts to improve this book reflected on the pages that follow. Our non-anonymous reviewers also played a significant role in the development of this book, including Shelley Velleman and Andy McMillin. Many of our current and past students served as reviewers and contributors. Jordan Siegel added to the mix of talented reviewers, and the creative mind of Summer Zeimetz brought our ideas

to life with all her figures and drawings. Given that this entire project spanned several years, it required the unwavering support of our families. To Jonathan, Simona, and Elijah, and David and Byron, we say thank you for believing in us, cheering us on, and making countless sacrifices.

HOW TO USE THIS BOOK

What follows are our suggestions for maximizing your learning while using this textbook. Your learning will be enhanced if you engage in the material as you read each chapter, so we hope that you take advantage of the methods we have included to help increase your active engagement.

Learning Objectives
Each chapter begins with a list of learning objectives. Before you begin reading the chapter, go over the objectives so you know the topics that will be covered. After you have finished reading the chapter, we recommend that you return to the list of learning objectives as a means of testing yourself on the major concepts.

Applied Science
Each chapter also begins with a question designed to motivate your thinking about the topics that will be discussed in that chapter—prior to learning about the topics. We employ this strategy to draw you into the topics, asking you to pause to consider possible answers to the question before you jump into the reading. We also include "Applied Science" questions to connect your learning to clinical scenarios. We encourage you to think about the clinical question while you read the chapter.

Applied Science: Revisited
We return to the "Applied Science" clinical question at the end of each chapter. All of the questions ultimately can be answered by applying the phonetic science concepts covered in that chapter, so we walk you through each step of solving the problem. By answering the questions, you will have learned how to apply the concepts in the chapter to solve a real-life clinical problem.

Did You Get It?
Throughout each chapter, you will find many "Did You Get It?" mini-quizzes for checking your comprehension of the material just presented. If you cannot answer a question, then you know that you missed an important concept and should reread that section until you can answer the question. Once you have answered each question in a "Did You Get It?" quiz, you will find the answers at the end of each chapter. If you answered any questions incorrectly, then reread the material until you comprehend it.

Bolded Text
There are bolded words throughout the textbook to indicate that a new term was just introduced. Definitions of these words can be found in the Glossary at the end of the book.

Audio Files
Whenever you see a sound, syllable, word, or phrase highlighted in green text, you can find an accompanying audio file on the textbook's companion website. Listening to the file, you can hear exactly how it is pronounced.

Interest Piqued?
At the end of each chapter, you will find a section called "Interest Piqued?" There you will find a list of suggested print and online materials that illustrate or expand the materials covered in the chapter. Check out the suggested materials to help further your understanding of the topics.

Companion Website
Take some time to go to the PluralPlus companion website for the textbook. You will find an assortment of materials designed to support your learning. Materials include links to the "Interest Piqued?" resources, flashcards of the Glossary terms for each chapter, flashcards of the mnemonic resources, audio files of highlighted text, student note-taking slides for each chapter, an online Phonetic Transcription Readiness Quiz for students to take at the end

of Chapter 1, tutorials to review the five skills fundamental to phonetic transcription readiness, and 12 pediatric video case studies. See the inside front cover for instructions on how to access the website.

Companion Workbook

Nothing aids learning like practice! We published *Phonetic Science for Clinical Practice: A Transcription and Application Workbook, Second Edition* to provide you with abundant opportunities to apply the knowledge and practice the skills you will learn by reading this textbook. You will find that the workbook parallels the structure of the textbook chapters and topics, making it easy for you to follow along. From our decades of experience teaching beginning phonetics students, application of concepts and more transcription practice are what students request.

1

INTRODUCTION TO PHONETIC SCIENCE

Learning Objectives

By reading this chapter, you will learn

1. the scientific fields of phonetics and phonology
2. the concepts of phonemes, phones, and allophones
3. the difference between orthographic and phonetic symbols
4. about the International Phonetic Alphabet and its applications
5. the continuum of different styles of speech, including speech registers
6. skills underlying phonetic transcription
7. the phonotactic structure of words
8. the concept and types of word stress

Applied Science

A mother calls a local speech-language pathologist (SLP) to request an evaluation of her four-year-old son whose speech "is immature for his age and sometimes difficult to understand." The mother explains that even though she cannot always understand his speech, "he talks in sentences and understands what is said to him." When asked to describe her son's speech, the mother reports that "he can't pronounce all of his 't' and 's' words." The SLP arranges to test the little boy's speech.

Give examples of words you think the child cannot correctly pronounce. Make a list of words the SLP could use to test the child's speech. How will you unambiguously record the child's pronunciations?

The Study of Speech: Phonetics and Phonology

Phonetics is the study of speech sounds. **Speech sounds** are the consonant and vowel sounds that make up the words in a spoken language. Scientists who study this fascinating field are called **phoneticians**. Phoneticians are interested in the physical properties of speech sounds. Some phoneticians are interested in the production aspects of speech sounds, determining exactly how humans produce sounds, while others are interested in how humans recognize sounds as speech. Others still are interested in understanding how our brains process speech, and others in how speakers combine sounds to make words in their language. There are different branches of phonetics and within each domain of inquiry phoneticians focus a specific lens on production, recognition, perception, or use. We will introduce you to five of the branches of phonetics: articulatory, acoustic, auditory, linguistic, and clinical.

Articulatory phonetics is focused on the actual movements needed to produce speech sounds. When we talk about how and where in the vocal tract the "s" sound, for example, is produced, we are practicing articulatory phonetics. **Acoustic phonetics** is the study of the actual auditory signal generated when speech sounds are produced. For example, when we examine a speech waveform to compare the loudness of the "s" sound with other sounds, we are practicing acoustic phonetics. **Auditory phonetics** is the study of how humans hear, perceive, and categorize speech sounds. When we study the age at which infants can tell the difference between the "s" and "f" sounds, we are practicing auditory phonetics. **Linguistic phonetics** is focused on understanding the articulatory, acoustic, and auditory characteristics of speech sounds in different languages. When we study how these physical characteristics influence how the "s" sound is used in words, we are practicing linguistic phonetics. Finally, **clinical phonetics** is the study and practical application of phonetics to solving real-life problems affecting the diagnosis and treatment of individuals who exhibit speech sound errors. When we attempt to determine the most effective intervention for "s" sound errors, we are practicing clinical phonetics. Clinical and research speech-language pathologists and audiologists as well as speech and hearing scientists utilize phonetics to better understand the nature of speech sound disorders and differences.

There is another area of study that is particularly important to clinical and research speech-language pathologists—an area that is entwined with linguistic phonetics. This area of study is called phonology. **Phonology** is a distinct branch of linguistics, separate from, but related to, phonetics. Scientists who study phonology are called **phonologists**. Phonologists are interested in how speech sounds are mentally represented in the human brain. Whereas phoneticians study the spoken sound, phonologists study the thought of a sound. Phonologists study the sounds that hold meaning in a language as well as the rules for how those sounds can be combined into words. The rules are the phonological grammar of a language. When we determine, for example, that the consonant cluster "sf" cannot occur at the beginning of a word in a particular language, such as English, we are studying the phonology of that language. An overlap between phonetics and phonology occurs when there are articulatory and acoustic factors that motivate a specific phonological rule, resulting in a phonetic explanation for an observed phonological systematicity. Throughout this textbook, we will discuss the inquiry into these varied domains while weaving in examples of how to apply the information to clinical situations.

? 1–1. Did You Get It?

1. Name the branch of phonetics—articulatory, acoustic, auditory, or linguistic—that each example describes.

a. Determining if a puff of air is typically emitted during production of a "p" sound when in initial position of English words. _____

b. Determining if a puff of air that was produced during production of a "p" sound could be heard by a panel of listeners. _____

c. Determining if a puff of air was emitted during production of the "p" sound by examining a speech spectrogram (a visible representation of sound). _____

d. Determining if a puff of air was emitted during production of the "p" sound by placing your hand near the speaker's mouth to feel the airflow. _____

2. A phonetician studies the _____ of a language.

3. A phonologist studies the _____ of a language.

The Sounds of Speech: Phonemes, Phones, and Allophones

Speech sounds that establish meaning when used in words are called **phonemes**. Phonemes are not interchangeable in words because when a phoneme is changed, so is the meaning of the word. For example, the word *pat* holds specific meanings. *Pat* can refer to an action we perform with our hand to congratulate someone, the name of a friend, or a dab of butter. If we replaced "p" with "b" to make *bat*, a new word, with its own meanings, is formed. Being able to create meaningful words is what establishes "p" and "b" as phonemes in English. In Chapter 7, we will detail how phoneticians and phonologists determine which sounds are phonemes in languages.

In addition to phonemes, there are speech sounds called **phones** that do not change the meaning of words. Phones are the physical product of producing speech. When we want to say the word *go*, for example, the mental representation of *go* is a specific sequence of a consonant phoneme + a vowel phoneme. When we actually produce that consonant + vowel sequence, the phonemes move from being abstract thoughts to concrete sounds (i.e., phones) having measurable physical properties. For example, we can measure the loudness of the two phones or the tongue strength required to say them. Because of the dynamic nature of speech production, we never say the same sound the exact same way twice, and phoneticians love to study these intricate details of speech production within and across speakers and languages. In addition to careful listening and using acoustic methods, we also have tools for seeing sound production as it is being produced. Some of these tools include **cinefluoroscopy** (imaging using motion X-rays), ultrasound (imaging using sound waves), and **electropalatography** (an artificial mouth plate fitted with contacts that detects when the tongue touches the roof of the mouth).

Within a language, some of the differences in pronouncing sounds are systematic and predictable, and other differences are less predictable. For example, we can say the "t" sound in the word *pat* with a little burst of air at the end. Or, we can say the "t" sound without the burst of air. Even though the pronunciation of the word *pat* would sound different in the two productions, the meaning of the word *pat* remains the same. Nonetheless, those two variations of "t" are different phones: one with a burst of air and one without. They are two phones that represent the single phoneme "t." We call these production variations **allophones**. Therefore, the "t" with a strong burst of air and the "t" without a burst of air are considered allophones of the phoneme "t." The term allophone, like phone, refers to the actual spoken production of a phoneme. Therefore, every phoneme mentally represents a set of phones. In

Chapters 4, 7, and 8, we will provide detailed information about the production and usage of phonemes, phones, and allophones.

? 1–2. Did You Get It?

Match the following terms.

1. phonemes _____

2. phones _____

3. allophones _____

a. the sounds articulated when a child says *no*

b. the different ways the sound "s" can be articulated

c. the mental sound units that make up the word *chair*

The Written Representation of Speech: Orthographic and Phonetic Symbols

Orthographic Symbols: The Latin Alphabet

In English, there is not a one-to-one correspondence between alphabet graphemes (i.e., letters) and the sounds they represent. This makes it important to distinguish between how phonemes are written using orthographic alphabet graphemes and how those phonemes are produced as phones. For example, consider the written word *bow*. The written word *b-o-w* could mean the pretty decoration that you tie around a gift box, or it could mean the action of bending at the waist at the end of a fine performance. In the first example, the decoration that you tie around a gift box, the word *bow* is pronounced as a "b" sound plus a long "o" sound. In the second example, the word *bow* is pronounced as a "b" sound plus the sound you yell when you bang your knee on the corner of a table, "ow" (as in *ouch*). Simply reading the word *bow*, written by itself, you have no way of knowing to which *bow* the word refers; thus, you have no way of knowing which pronunciation to use. These two words are spelled the same way, yet they mean different things and they have different pronunciations. The alphabet letters used to spell them do not offer any help in knowing which pronunciation to utter. Orthographic spellings often do not help us with pronunciation. Words that are spelled the same way but have different meanings are called **homographs**, and some homographs are pronounced differently (as in the previous examples of *bow*), while others are pronounced the same (as in *bat*, which could refer to the animal, the club used to hit a ball, or the action of striking something).

There also are examples of two words that are spelled differently, yet pronounced the same way. These words are called **homophones**. Such is the case with the word that means the action of bending at the waist at the end of a fine performance, *bow*, and the word *bough* that means a tree branch. Both words are pronounced as a "b" sound plus an "ow" sound. But now another confusion using orthographic alphabet letters to represent sounds emerges. Can you identify it? Yes, there is no single way of using alphabet letters to represent the "ow" sound. We could use the alphabet letters "ow" (*owl*), "ough" (*bough*), "ou" (*foul*), or, in some dialects, "a" (*gal*). Confusions such as these are common in English.

Phonetic Symbols: The International Phonetic Alphabet

Phoneticians help us to understand that while spelling is focused on the orthographic graphemes used to write a word in a language, phonetics is focused on capturing how a word was pronounced, or articulated, by a speaker. To articulate speech is to produce it. When we read a dictionary, we can study the special pronunciation spellings that were developed to tell us how a word typically is pronounced. For example, in the Encarta Dictionary for North American English (Microsoft Corporation, 2009), the pronunciation of the word *example* is listed as "ig 'zæmpl." There also is a pronunciation key that serves as a guide for how to pronounce each of the letters. When examining the key, we find a variety of letters representing the pronunciation for each of the 50+ different speech sounds; therefore, not even the pronunciation key represents a one-to-one correspondence of one letter for one sound. And even if you were so inclined, you would not want to spend your time memorizing those letters and associated sounds because each dictionary has its own abstruse pronunciation key!

There is hope, however, for students who are interested in unambiguously capturing phonemes, phones, and allophones using written symbols. That hope comes in the way of the **International Phonetic Alphabet (IPA)**. The IPA is a set of symbols used to represent the speech sounds across the world's languages. Each symbol represents one, and only one, consonant or vowel. The IPA was developed in 1886 by a group of scholars interested in speech sound articulation who had formed an organization called the International Phonetic Association. The International Phonetic Association also is abbreviated as IPA. For clarity throughout this textbook, every time we refer to the International Phonetic Association we will write out the name of the organization, and every time we refer to the International Phonetic Alphabet, we will use the abbreviation IPA. The IPA periodically is updated, with the most recent version published in 2015. Even though the IPA represents sounds in all the world's languages, it is biased toward English and other Indo-European languages and largely uses symbols from the Latin alphabet; therefore, you will recognize many of the phonetic symbols. Most of the phonetic symbols we will use in this textbook will be from the IPA; however, we also will introduce a few other symbols that we believe better represent phonetics for clinical use in speech-language pathology and audiology.

One major benefit of learning the IPA is to be able to capture, using written symbols, how words in a language are pronounced. When determining how words are pronounced, we may be interested in knowing how a word is typically pronounced by speakers of the language and/or we may be interested in knowing how an individual actually articulates a word. The former is important to establish common pronunciations of words in a language, so that even speakers with different dialects within one language can be understood. The latter is important so that when an individual misarticulates (i.e., mispronounces) a word, there is an unambiguous way of writing down just how the person said a word.

We utilize the same basic symbol set, the IPA, to write phonemes, phones, and allophones. We designate phonemes, phones, and allophones, as such, by enclosing the letter symbols in between either virgules, / /, or brackets, [ ]. When we write using IPA symbols that represent a word, we place the symbols within **virgules**, which represents a phonemic transcription. For example, we could transcribe the mentally stored word *no* as /no/. When we write using IPA symbols that represent an actual production of a word, we place the symbols within **brackets**, which represents a phonetic transcription. For example, if we transcribed a child's correct articulation of the word *no*, we would transcribe it as [no]. In summary, a phoneme is enclosed in between virgules and a phone is enclosed in between brackets.

? 1–3. Did You Get It?

1. List an example of one consonant sound spelled with different graphemes in two different words. _____
2. List an example of one vowel sound spelled with different graphemes in two different words. _____
3. List a pair of homographs. _____
4. List a pair of homophones. _____
5. Would you transcribe the following words using virgules or brackets?
   a. *book*, as said by a child _____
   b. *book*, as the object itself _____
   c. the word *kitten* _____
   d. the spoken word *kitten* _____

The Registers of Speech

To paraphrase the renowned linguist Roman Jakobson, "*we speak to be heard to be understood.*" Driven by a desire to communicate, speakers will talk just clearly and loudly enough to be heard, so they have a chance of being understood. The styles in which speakers talk vary along a continuum of **speech registers**, or spoken level of familiarity. Registers vary from **frozen** (using unchanging archaic language, as in reciting the Pledge of Allegiance) to **formal** (one-way communication, as in giving a speech) to **consultative** (communicating with an authority figure, as in a student–professor conversation) to **casual** (speaking to peers) to **intimate** (speaking to close friends and family members). We change registers by changing the way we articulate sounds.

During any conversation, we may move back and forth across this continuum, using listener feedback and our own intentions to guide exactly how formally or informally we articulate our words. The same speaker produces the same speech sound differently—even in the same word—as speaking registers change.

The fact that the articulation of every phoneme varies so greatly within and across speakers presents many challenges to speech researchers, and they have given this phenomenon a name: the **invariance problem**. The invariance problem also captures the nature of speech sound variance as phonetic contexts change. For example, we might think that the long "i" vowel sound (pronounced as the word *eye*) is one invariant sound, but if we pay attention to how this vowel sounds when we speak aloud the words *I* and *bite*, we will hear that the two vowels sound slightly different. The difference is because the phonetic contexts are different: the vowels and/or consonants between the two words vary. For example, *I* has only a single vowel sound, so we say it has a single vowel (V) word shape, while *bite* contains three sounds, resulting in a consonant-vowel-consonant (CVC) word shape. We articulate the long "i" vowel sound—and every other speech sound—slightly differently based on the consonants and vowels coming before and after it. The result is a multitude of possible productions for every phoneme, and for every speaker.

Pronouncing words using very precise articulation—as you would when speaking in frozen and formal, and sometimes consultative, registers—is called **citation-form** speech. Citation form is overarticulated speech. It is speech on which a word's dictionary pronunciation form is based. We use citation-form speech when we need everyone to hear our words clearly and unambiguously. Citation form typically refers to single word productions; however, it also can be used on a single sound or syllable to ensure understanding, as in, "The vocal folds ab-duct during breathing and ad-duct to produce sound," or to emphasize a particular point, as in, "*No, you may not go.*" Citation-form speech is typically articulated slightly slower and is produced with greater effort and attention on the structures used to produce speech: the articulators, such as the tongue and lips. If we use citation-form speech for too long, our listeners might become fatigued hearing all our overarticulations. Dictionary forms of words are prescriptive by nature, telling a reader exactly how to pronounce any given word. As you will discover in later chapters, there are many reasons why an individual may articulate a word differently than its dictionary citation form specifies. It is important to understand that as clinical scientists we are more interested in descriptive phonetics than prescriptive rules. That is, we are more interested in how people speak than how they should speak, even while we compare their productions to the speech of other members of their linguistic community.

The most common form of speech production is **casual**. Casual speech is highly intelligible in most speaking contexts. Speech sounds are articulated clearly; however, we do not overarticulate sounds, thus decreasing the effort we expend producing speech. It is easy to listen to casual speech. Speech produced in a significantly relaxed style, such as when speaking intimately to very close friends and family, is characterized by omitting some sounds, syllables, and words (e.g., *Are you coming?* becomes *Comin'?*), mixing two sounds into one (e.g., *Don't you want to go*? becomes *Donchu wanna go?*), and substituting one sound for another (e.g., *I see you* becomes *I see ya*).

The linguist Björn Lindblom referred to over- and underarticulated styles of speech as **hyperspeech** and **hypospeech**, respectively. Lindblom hypothesized that variations in articulation are a speaker's adaptations not only to changes in speaking situations but also to the consonants and vowels that come before and after any particular sound, creating phonetic contexts that continually change from one syllable to the next (e.g., Lindblom, 1983, 1990). Lindblom explains this occurrence as **economy of articulation**, a factor in speech production that linguist Peter Ladefoged (2005) called the principle of ease of articulation. Researchers have conducted numerous studies over recent decades to identify factors related to the degree of articulatory effort put forth by speakers. In one of the first such studies, Philip Lieberman in 1963 discovered that speakers used less articulatory precision when saying words that could be considered predictable in a sentence, and that those words were less intelligible to naïve listeners hearing only the predictable words spoken. Contrastively, speakers used more articulatory pre-

cision when saying the unpredictable words, and those words were more intelligible to the naïve listeners. For example, in Lieberman's study, the word "nine" was considered to be predictable in the sentence, "*A stitch in time saves nine*," whereas the word "*nine*" was considered to be unpredictable in the sentence, "*The number you will hear is nine*." Another interesting study was conducted by Carol Fowler and Jonathan Housum in 1987. In their study, articulatory features of words produced the first time (called "*new words*") and a second time (called "*old words*") by speakers giving a monologue were compared. New words produced the first time were articulated approximately 40 ms to 70 ms more slowly on average than during their second production, and the new words were more intelligible to listeners who heard the words in isolation. These findings elucidate what we do unconsciously.

Remember, though, Jakobson's assertion that speakers not only want to be heard, they also want to be understood. Lindblom explained that speakers attempt to strike a balance between their own desire to make articulation as easy as possible and their listener's need for intelligible speech. Ladefoged referred to this additional factor as the **principle of sufficient perceptual separation**. Ladefoged observed that languages preserve auditory distinctions across speech sounds, allowing listeners to be able to distinguish one phoneme from another with minimal difficulty. "*Rose may be a rose may be a rose may be a rose*" (Stein, 1990), but when it comes to speech production, "*P is not a p sound is not a p sound is not a p sound*." Talking to be heard and then to be understood is achieved by a speaker successfully balancing the diverse forces presented by his or her own inclination toward articulatory ease and demands from various listeners, speaking environments, and phonetic contexts.

? 1–4. Did You Get It?

1. Practice saying each of the following sentences using a formal register, a casual register, and an intimate register.

a. Hi, how are you doing today?

b. Please, let me help you with that!

Seeing Letters, but Hearing Sounds

The IPA is a powerful tool that is used to capture actual speech production; however, to phonetically transcribe speech correctly, you must first learn to hear the speech sounds that actually were produced and largely ignore the orthographic spellings of words. Beginners of phonetic transcription often let written orthographic spelling guide their transcriptions, which frequently results in incorrect phonetic transcriptions. Think back to the problems we discussed earlier about the many difficulties of pronunciation and spelling using the orthographic alphabet. You want to begin to improve your listening skills right away so that you will be able to identify correctly the number of sounds—not letters—in words.

Let's revisit some of the words we looked at previously, beginning with *bow* (the decoration) and *bough* (a tree branch). Say each word aloud using citation-form speech. How many sounds did you hear in each word? The correct answer is that there are two sounds pronounced in each word, either "b" + long "o" or "b" + "ow." If you incorrectly answered that you heard three sounds, you probably said that you heard the consonant sound "w" at the end of each word. If that is the case, then you may have overarticulated your pronunciation of the vowel sound. Both the long "o" and "ow" vowel sounds require that you round your lips to make them, and that lip rounding can sound as though you are making a "w" sound when you are saying the vowel only, thus, only one sound.

We now will consider a different type of problem when determining the number of speech sounds articulated in a word: saying speech sounds that are not represented in the spelling of a word. For example, say the word *one* aloud. How many speech sounds do you hear? The correct answer is that there are three speech sounds in the articulation of *one*: "w" + vowel "uh" + "n." Even though the word *one* is spelled orthographically as vowel + consonant + vowel, it is pronounced as consonant + vowel + consonant.

It is helpful to practice counting the number of sounds in words. We will start with easy words. Remember to listen to how the words sound, not to how they are spelled.

A	B	C
in	fin	skin
egg	leg	dreg
am	bam	spam
us	bus	plus
op	top	crop

How many sounds did you hear in each of the words in each column? Hopefully, you heard two sounds in the words in Column A, three sounds in the words in Column B, and four sounds in the words in Column C. All the words in Column A begin with a vowel sound and end with a consonant sound. All the words in Column B begin with a consonant sound, have a vowel sound in the middle, and end with a consonant sound. Last, all the words in Column C begin with two consonant sounds, have a vowel sound in the middle, and end with a consonant sound.

Next, try segmenting intermediate-level words into individual sounds.

A	B	C
edge	any	tread
la	blah	smock
who	you'd	glued
duh	none	ahead
off	cough	golf

How many sounds did you hear in each of the words in each column? Again, hopefully you heard two sounds in the words in Column A, three sounds in the words in Column B, and four sounds in the words in Column C. In Column A, *edge* and *off* begin with a vowel sound and end with a consonant sound, and *la*, *who*, and *duh* begin with a consonant sound and end with a vowel sound. In Column B, *any* is the only word that begins with a vowel sound, followed by a consonant and then a vowel sound. Also in Column B, *blah* begins with two consonant sounds and ends with a vowel sound, while *you'd*, *none*, and *cough* begin with a consonant sound, have a vowel sound in the middle, and end with a consonant sound. Last, the first three words in Column C begin with two consonant sounds, have a vowel sound in the middle, and end with a consonant sound; *ahead* alternates from vowel sound to consonant sound to vowel sound to consonant sound, and *golf*, which begins with a consonant sound, has a vowel sound in the middle, and ends with two consonant sounds, "l" + "f."

Last, try a few challenging words. Remember, try not to let the spelling trick you.

use

pew

taxi

special

column

shriek

friend

ghost

height

colleague

The following text shows the correct number of sounds in each word. Note that the sound made by the letter is listed, and specific vowel sounds are not listed because there are multiple ways to write vowel sounds using orthographic spelling.

use (noun)	= 3 sounds	"y" + vowel + "s"
use (verb)	= 3 sounds	"y" + vowel + "z"
pew	= 3 sounds	"p" + "y" + vowel
taxi	= 5 sounds	"t" + vowel + "k" + "s" + vowel
special	= 6 sounds	"s" + "p" + vowel + "sh" + vowel + "l"
column	= 5 sounds	"k" + vowel + "l" + vowel + "m"
shriek	= 4 sounds	"sh" + "r" + vowel + "k"
friend	= 5 sounds	"f" + "r" + vowel + "n" + "d"
ghost	= 4 sounds	"g" + vowel + "s" + "t"
height	= 3 sounds	"h" + vowel + "t"
colleague	= 5 sounds	"k" + vowel + "l" + vowel + "g"

? 1–5. Did You Get It?

1. How many consonant and vowel sounds do you hear in each of the following words?

a.	dog	_____	doggie	_____	doghouse	_____
b.	win	_____	window	_____	windowsill	_____
c.	in	_____	inside	_____	insideout	_____
d.	hon	_____	honey	_____	honeybee	_____
e.	bass	_____	basket	_____	basketball	_____

The Phonotactic Structure of Speech

Another skill that underlies the ability to master phonetic transcription is being able to specify the sound structure of syllables and words, that is, the shapes of syllables and words. Specifying the sound structure or permissible combination of sounds is called **phonotactics**. Every word has a phonotactic structure that is based on how it is actually produced, not on its spelling. The phonotactic structure of a word has an underlying value in a language and is constrained by the phonological rules of the language—concepts that we will discuss in detail in Chapters 7 and 8. Let's practice using the easy words of *in*, *fin*, and *skin*. We established that *in* has two sounds, *fin* has three, and *skin* has four. Because *in* begins with a vowel sound and ends with a consonant sound, its phonotactic structure is vowel (V) + consonant (C), abbreviated as VC. The phonotactic structure of *fin* is CVC and *skin* is CCVC. Now, we will try the challenging word *one*. Because we determined previously that *one* begins with a consonant sound, followed by a vowel, and followed by another consonant sound, its phonotactic structure is CVC. Phonotactic structure is defined for each language. For example, in English, we have a phonological rule that permits words to begin with "s" + "p" (as in *spot*), "s" + "t" (as in *steak*), and "s" + "k" (as in *skip*) but not with "s" + "b," "s" + "d," or "s" + "g." Contrastively, in Spanish, no words can begin with "s" + another consonant.

Consonants and Vowels by Position

When we talk about the consonant sounds that make up a particular word, we need to specify where in the word those sounds occur. Consonant sounds that occur at the beginning, middle, and end of words are said to be in **initial**, **medial**, and **final positions**, respectively. For example, in the word *hot*, "h" is word initial and "t" is word final; there is no

? 1–6. Did You Get It?

1. What is the phonotactic structure of each of the following words?

a.	dog	_____	doggie	_____	doghouse	_____
b.	win	_____	window	_____	windowsill	_____
c.	in	_____	inside	_____	inside-out	_____
d.	hon	_____	honey	_____	honeybee	_____
e.	bass	_____	basket	_____	basketball	_____