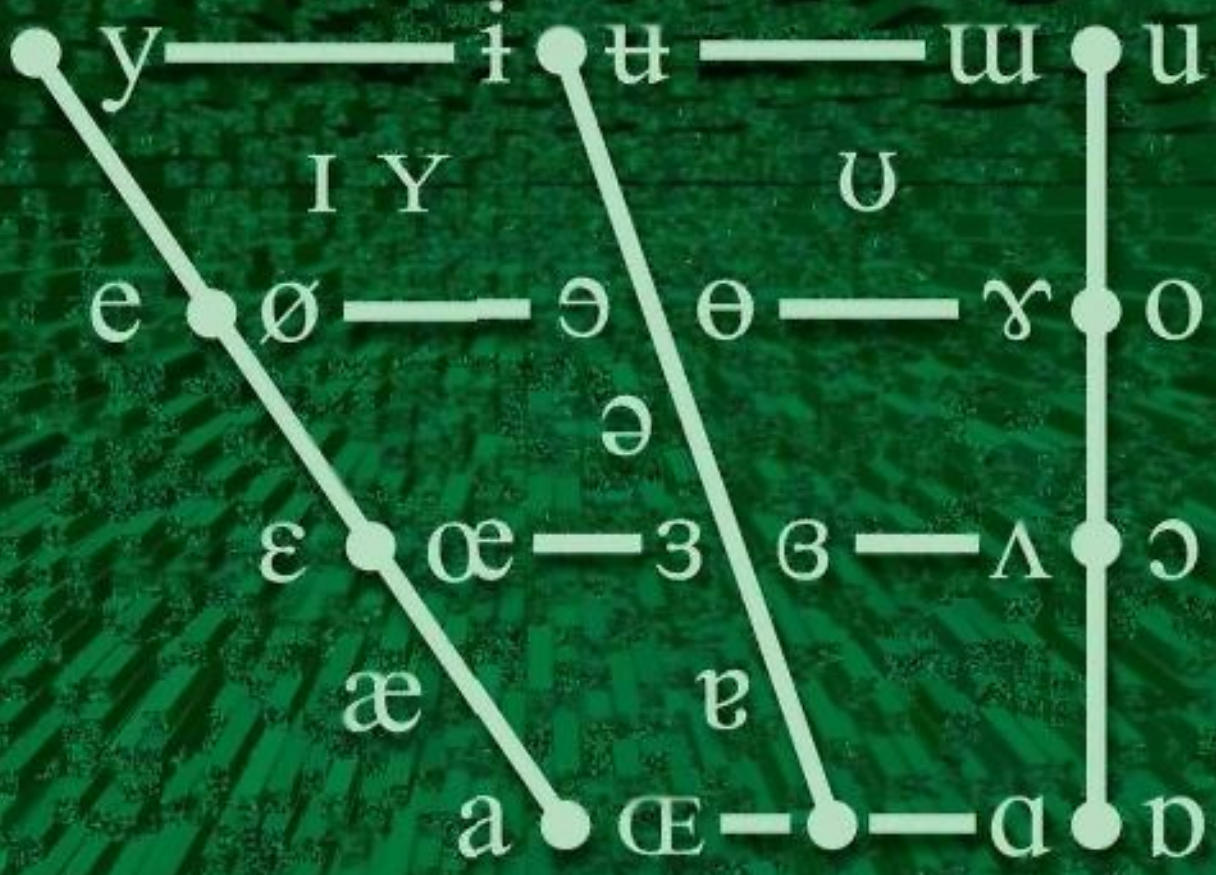
Articulatory Phonetics

Tools for Analyzing the World's Languages



Fourth Edition

Anita C. Bickford and Rick Floyd

First edition 1981
Second edition 1986
Third edition 2003
Fourth edition 2006
Library of Congress Catalog No.: 2005937534
ISBN10: 1-55671-165-4
ISBN13: 978-1-55671-165-7

Printed in the United States of America

Copies of this and other publications of SIL International may be obtained from

International Academic Bookstore
7500 West Camp Wisdom Road
Dallas, TX 75236-5699

Voice: 972-708-7404
Fax: 972-708-7363
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Internet: http://www.ethnologue.com

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Preface

Our primary goals for you as a phonetics student are threefold:

- ⌘ that you gain confidence as a linguist, capable of transcribing data accurately as a basis for good analysis of a language;
- ⌘ that you gain confidence as a language learner whose spoken language will sound virtually identical to that of native speakers because you can mimic all the aspects of the language accurately and readily; and
- ⌘ that you gain facility in using other linguists' written materials, especially their phonetic transcription, from which you can derive data, ideas, and information for further research in your own language(s) of interest.

This textbook is a revision of an earlier book, *A Manual for Articulatory Phonetics*, compiled by Rick Floyd in 1981; a second edition was published in 1986 and a third in 2003. All three versions include many other people's materials and derive their basic organization from articulatory phonetics courses as taught for over sixty years in the training schools of SIL International. We also include much information from sources outside of SIL. However, much of the content is original work by Rick Floyd and reflects techniques and ideas that he used during several years of teaching phonetics. He also did extensive research to provide most of the language data included in the book, some of which is his own field data and some of which he found in published sources. The third edition, besides retaining portions of Floyd's book verbatim and others reworded and amplified but still essentially his, also contains many ideas original to me which have evolved during my years as a phonetics teacher; it also reflects extensive research that I have done in phonetics publications since 1990. This fourth edition is essentially the same as the third except for the chapters on vowels and palatography; many corrections and minor rewordings have been incorporated.

This book is oriented primarily towards native speakers of American English, particularly with reference to examples used to guide pronunciation of new sounds. However, most of the information included should be profitable to students regardless of their native language.

Articulatory phonetics is only one of several disciplines dealing with the production, perception, identification, and categorization of speech sounds. The study of the other disciplines serves to complement, clarify, and explain many areas not covered in an articulatory phonetics course. Rather than attempting to be exhaustive, this manual is meant to introduce you, a beginning linguistics student, to principles that will enable you to approach any language and begin to describe and mimic its sounds with accuracy and confidence.

We have three main purposes for revising Floyd's earlier editions: (1) to update some of the linguistic terminology to match what is in current use, (2) to replace the Americanist transcription system with the symbols approved by the International Phonetic Association (IPA), since those symbols are used more commonly throughout the linguistics world, and (3) to make some pedagogical adjustments, in particular to expand on some of the explanations so that class hours for a course utilizing the book can be spent more on production, mimicry, and transcription practice and less on lecture and explanation of phonetic theory and terminology. We are also including some commonly used symbols from non-IPA transcription systems in the hope that seeing alternative symbols side-by-side with IPA symbols will facilitate your becoming somewhat familiar with the one while focusing on learning the other. This contributes to our third goal above, that of equipping you to use other linguists' materials, regardless of which system they use to transcribe their data.

Besides agreeing wholeheartedly with the credits and acknowledgments that Rick Floyd listed in his 1986 version (Eunice Pike for contributing valuable suggestions and skill as a linguist and phonetician, Norris and

Carol McKinney for guiding him to many of the sources mentioned, and Lil Howland for providing continual enthusiastic encouragement), we would like to express appreciation to Ruth Mary Alexander for her input and comments on the lesson plans and early drafts, to Albert Bickford for his comments and generous contribution of time in helping with computer aspects of the manuscript, to Norris McKinney for his numerous and invaluable suggestions on almost every page, and to Kathryn Keller for her early lesson plans around which these chapters are organized. Our editors, Mary Ruth Wise and Rhonda Hartell Jones have done marvelous, careful editorial work on many drafts of this book and provided gracious encouragement and wisdom. Credit is also due to the SIL graphic artists for providing the face diagrams. Others who gave input and comments on early drafts of the 2003 edition were Dave Whisler, Barbara Allen, Paul Kroeger, and William Sischo. Marvel Bascom also gave input on the lessons plans; Beth Merrill, Gene Burnham, and Joyce Kiester helped with verifying the language data included herein and determined how to credit its sources; Lloyd Milligan and Gene Burnham gave input and corrections from a teacher's perspective, and Sue Montag spent hours proofreading. Others including Ken Olson, Velma Pickett, Kathryn Keller, Kari Ranta, Keren Everett, and Mike Cahill offered very helpful discussions of various issues—they all greatly improved this book. All remaining errors are mine. Finally, we offer thanks and praise to the Lord for including such fascinating stuff in language as he was creating it. What fun it is to work with sound systems and see the wide variety of sounds and combinations that he has built into them, yet all neatly arranged into comprehensible patterns!

Anita C. Bickford, March 2006

1

Sound Identification

Goals

- ⌘ You will be able to define each of the terms listed at the end of this chapter. They are fundamental to your understanding of the rest of the book.
- ⌘ You will be able to identify each part of the vocal apparatus by name and to find it on a diagram and in your own mouth.
- ⌘ You will be able to explain the difference between *articulators* and *places of articulation* and to state which *active articulator* and *passive articulator* is involved in each place of articulation.

Speech sounds are produced by a moving and vibrating stream of air that is shaped and altered in various ways by the vocal tract. There are many parameters by which speech sounds can be identified and classified. These parameters specify where the stream of air comes from, in what direction it is moving, how the vibrations are initiated, what specifically happens to change it as it moves and resonates, and what part or parts of the vocal apparatus interact to cause the change. Six such parameters, sometimes called PHONETIC CHARACTERISTICS,[1] form the basis for the sound identification used in this book. The list is incomplete—there are other parameters that can also be used to identify and classify sounds, but these six are the most basic ones.

State of the vocal folds

The VOCAL FOLDS, which are in the larynx (sometimes called the voice box, and located in the throat), function differently for different sounds. The main differences involve whether they are together or apart and whether or not they are vibrating. At this point, we will consider only two different states of the vocal folds: for VOICED sounds, the vocal folds are close together and vibrating; for VOICELESS sounds, the vocal folds are usually apart and stationary.[2] Examples of voiced sounds include *b*, *d*, and *z*. Examples of voiceless sounds include *p*, *t*, and *s*. We can group these six sounds into pairs whose sounds are identical in all ways except for voicing: *b* and *p; d* and *t; z* and *s*. In each pair, the first sound is voiced and the second is voiceless.

There are several other terms for the vocal folds that you may encounter in linguistic writings: VOCAL LIPS, VOCAL BANDS, VOCAL CORDS. They all mean the same thing.

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[1]We have chosen not to use the term "phonetic feature" in this text so as to minimize confusion for beginning linguistics students who are also learning to deal with phonological features. Phonological features and phonetic features do not always coincide exactly.

[2]There are other states of the vocal folds and other terms which represent them that will be introduced in chapter 27 "States of the Glottis."

Airstream mechanism and direction of airstream

A stream of air can be set in motion and provide the energy needed for a speech sound by what we refer to as an AIRSTREAM MECHANISM. Each airstream mechanism (of which there are three different possibilities) involves a CAVITY in the vocal apparatus which changes size due to a complex muscle movement or contraction, thus initiating the motion of the air. Table 1.1 shows the three airstream mechanisms, and the cavity and INITIATING MOTION pertinent to each. The INITIATOR(S) of the airstream mechanism, the specific part or parts of the body which move to create the airstream, are listed in the third column. The final column describes the motion of each initiator. The labels in table 1.2 should help identify parts of the vocal apparatus whose names are initially unfamiliar.

Table 1.1. Airstream mechanisms

Airstream mechanism	Cavity	Initiators	Initiating motion
pulmonic	pulmonary	muscles of the rib cage	downward and inward movement
		diaphragm	upward movement
glottalic	pharyngeal	larynx with closed glottis	movement up or down
		walls of the pharynx	contraction or expansion
velaric	oral	back of tongue	closure against back of roof of mouth (velum)
		tongue body	downward movement

Note: "Closed glottis" means that the vocal folds are tightly together, eliminating any space between them.

The airstream for every speech sound moves either inward or outward. An outward airstream, which is normally used in all English speech sounds, is called EGRESSIVE. An inward airstream is called INGRESSIVE. The distinction is crucial only for glottalic air, which may be either ingressive or egressive. Pulmonic air as used in speech sounds is always egressive, and velaric air is always ingressive.[3]

Velic closure and the cavities in which the sound resonates

A crude analogy to the vocal apparatus is a set of tiny rooms (CAVITIES) in which sounds resonate. The two rooms most commonly utilized to distinguish speech sounds are in the mouth (ORAL CAVITY) and the nose (NASAL CAVITY). The third room (the PHARYNGEAL CAVITY) is in the throat above the larynx. There is sometimes also a LABIAL CAVITY between the front teeth and the lips.[4] For now, you can ignore the pharyngeal and labial cavities; they will be discussed more fully in later chapters.

Unlike the rooms in a house, most of these cavities change shape and size freely and often, because their walls are mostly very flexible muscles. (Because the walls of the nasal cavity are bone and cartilage, the shape and volume of this one cavity are fixed.) The size and shape of a cavity in which the airstream moves and vibrates affect the sound.

Different speech sounds are produced by varying the size and shape of the cavities, thus changing the RESONANCES (sound frequencies at which the air vibrates most freely) of the vocal tract, in the same way that rooms of different sizes and shapes in a building have different echoes.

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[3]For a few sounds, ingressive glottalic or velaric air and egressive pulmonic air may be used simultaneously. They will be introduced in chapters 28 "Implosives" and 36 "Clicks."

[4]Projection and rounding of the lips creates a small cavity between the front teeth and the lips, which modifies the acoustic effect of the oral cavity. Speech sounds involving such lip positions resonate in the labial cavity as well as some combination of the other three cavities.

When the passageway between the nasal and oral "rooms" or cavities is open, there is said to be VELIC OPENING.[5] The upper part of the soft palate (the VELUM), which faces the pharyngeal wall, functions as a door to close off that passageway. When there is VELIC CLOSURE (that is, the velum is raised against the pharyngeal wall, closing the opening to the nasal cavity), air cannot enter the nasal cavity but instead enters only the oral cavity. Figure 1.1 offers side views of the head, tongue, etc., illustrating these two velic positions. Diagrams such as these, called "face diagrams," will be explained more fully in chapter 2.

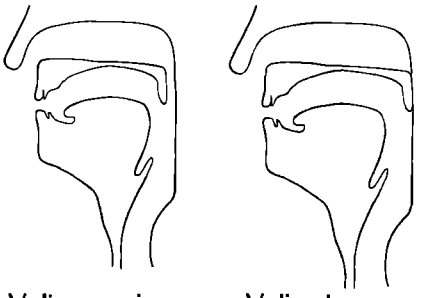

Figure 1.1.

Sounds produced with sound waves resonating in the oral cavity are called ORAL sounds. Sounds produced with sound waves resonating in the nasal cavity (for which there is velic opening) are called NASAL sounds. Some sounds have sound waves resonating in both the oral and nasal cavities, with an air passageway through both the nose and mouth simultaneously. Such sounds (for which there is velic opening) are called NASALIZED sounds.[6]

A somewhat more realistic analogy to the way in which the vocal tract actually functions is that of a tube whose width varies along the length of the tube. As was true for the rooms analogy, variation in the shape of the tube for different speech sounds results in the sounds having different resonances. If there is velic opening, then the nasal branch on the tube is participating in production of the sound; if there is velic closure, the nasal branch is not participating in production of the sound.

Consider the following pairs of sounds: *b* and *m; d* and *n*. In each pair, the vocal tract is shaped the same for the two sounds except for velic closure. For *b* and *d*, which are oral sounds, there is velic closure; for *m* and *n*, which are nasal sounds, there is velic opening.

Manner of articulation

Speech sounds involve a moving and vibrating stream of air that has something happen to it as it moves along. One thing that can happen is for the airstream to be IMPEDED (blocked) to some degree by some part or parts of the vocal mechanism. This alters the shape and size of the resonance cavities also. The MANNER OF ARTICULATION of a sound describes the DEGREE OF IMPEDANCE of the airstream and the type of closure that produces that impedance.

If the airstream is blocked altogether for a given sound, it is said to be COMPLETELY IMPEDED. Such sounds, all of which are consonants, are called STOPS (or occasionally PLOSIVES), for example, *p*, *t*, and *k*.

If the airstream is blocked quite a bit but not completely, audible turbulence is introduced into the airstream. The airstream for a sound characterized by audible turbulence is said to be GREATLY IMPEDED, and the sound is called a FRICATIVE. (The term fricative resembles the word "friction," and we can think of a fricative as a sound with audible friction.) Examples of fricatives include *s, f,* and *z*. All fricatives are consonants as well.

If the airstream is hardly blocked at all, instead being merely shaped or directed by some part of the tongue and perhaps the lips, then the airstream is said to be SLIGHTLY IMPEDED. Examples of such sounds include vowels like *a, i,* and *o* and approximants like *l* and *w* (to be defined in chapters 13 and 18).[7]

For the three sounds, *d, z,* and *l*, the vocal apparatus is the same in all ways except for how much the tip and sides of the tongue are turned up to impede the airstream, which determines the manner of articulation for these sounds: for *d* (a stop, according to its manner of articulation), the airstream is completely impeded by complete

[5]Some linguists call the backside of the uvula the VELIC, saying that "the velic is closed" when the velum is raised to close off passage of the airstream into the nasal cavity and that "the velic is open" when the velum is lowered to permit passage of the airstream into the nasal cavity.

[6]The distinction between sounds labeled *nasal* and *nasalized* is frequently not relevant. In phonological theories that use formal features, a *positive value* on the feature *nasal* is assigned to all sounds made with velic opening, whether or not there is unobstructed airflow through the mouth as well.

[7]For trills, which will be introduced in chapter 26, the airstream is said to be INTERMITTENTLY IMPEDED.

closure of both the tip and the sides of the tongue against the roof of the mouth; for *z* (a fricative), it is greatly impeded by complete closure of the tongue sides but only partial closure of the tongue tip against the roof of the mouth; and for *l* (a lateral approximant), the airstream is slightly impeded since, although the tongue tip is raised in complete closure against the roof of the mouth to shape and direct the airstream, the tongue sides are only slightly raised, resulting in neither closure nor friction between them and the roof of the mouth.

Articulators

The vocal apparatus contains many distinct parts. Carefully study figure 1.2, "Parts of the vocal apparatus," and learn the names of all the parts.[8]

There are two types of articulators. The term ACTIVE ARTICULATOR refers to a movable part of the vocal apparatus (Crystal 2003:33) that impedes or directs the air stream. We have already described sounds according to how much the airstream is impeded during their production. An active articulator is one that moves to cause an impedance. It may be the lower lip, some part of the tongue, or something else in the vocal apparatus.[9]

The other type of articulator is the PASSIVE ARTICULATOR. This is the more fixed part of the mouth that the active articulator touches or gets very close to as it articulates the sound, such as the upper lip, the front teeth, and various parts of the roof of the mouth.[10]

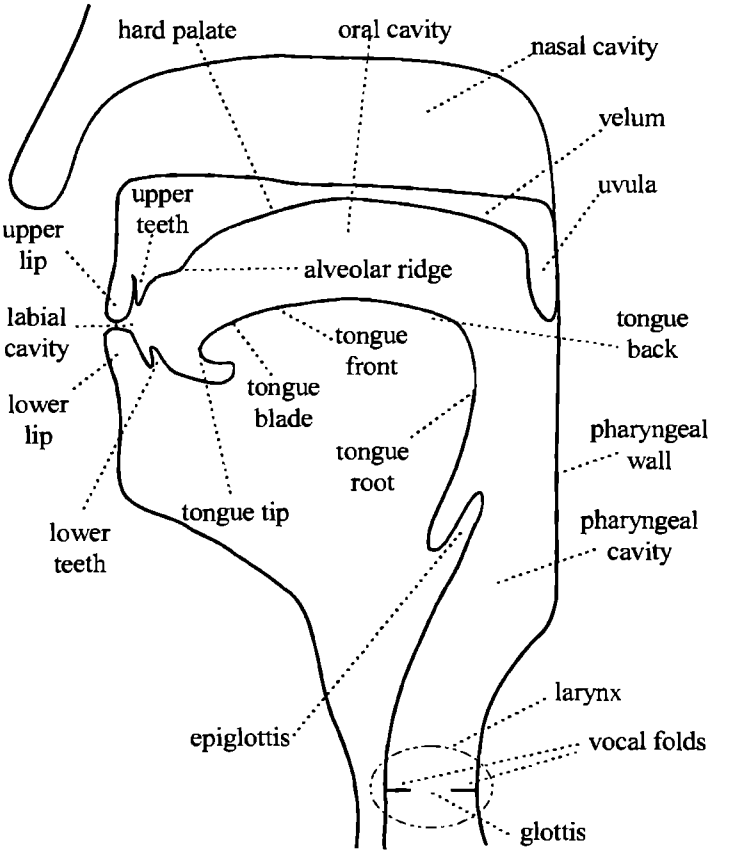

Figure 1.2. Parts of the vocal apparatus.

Since there are no clear boundaries drawn on the tongue to indicate where one region ends and the next begins, it is not surprising that there is confusion as to what the "blade" and "front" of the tongue are and what they do. According to Ladefoged (1993:4), "Behind the blade is what is technically called the front of the tongue; it is actually the forward part of the body of the tongue and lies underneath the hard palate when the tongue is at rest." On p. 7, he then lists the tongue blade as the active articulator of palato-alveolar sounds, and the front of the tongue as the active articulator for palatal sounds. In contrast, Crystal (1997:391) lists the tongue blade and front as equivalent terms but distinguishes between them in his discussion of palato-alveolar sounds on p. 276: "the BLADE of the tongue...makes contact with the alveolar ridge, while the FRONT of the tongue is raised in the direction of the hard palate." On p. 275 he lists the front of the tongue as the articulator of palatal sounds. The first sound in the English word "she" is palato-alveolar, articulated with the tongue blade; the first sound in the English word "key" is palatal, articulated with the tongue front. Ladefoged and Crystal treat palatal sounds as being articulated by the tongue front (which is sometimes called the "top").

[8]You will learn in later chapters that some parts of the vocal apparatus function as articulators of speech sounds and others as nonarticulators and, in fact, that some can function as articulators for some sounds and as nonarticulators for others. For now it is sufficient to learn the names of all the labeled parts in figure 1.2.

[9]See table 1.2 for a partial list of the active articulators.

[10]Table 1.2 also gives a partial list of the passive articulators.

Figure 1.3 shows in which directions the various active articulators move and thus which passive articulators they interact with. Experiment with some speech sounds, paying close attention to what part of your mouth is moving to make the sound and where that part is moving to. For example, compare the different tongue movements involved in *d* and *g* and the differences in the actions of your lips and teeth for *m* and *v*.

Since most passive articulators are located along the upper surface of the oral cavity, they are sometimes called UPPER ARTICULATORS. In contrast, most active articulators are located relatively lower in the vocal tract than the corresponding passive ones; active articulators are thus sometimes called LOWER ARTICULATORS. Whenever you see the term ARTICULATOR without specification as to whether it is an active or passive articulator being discussed, you can usually assume it is an active articulator.

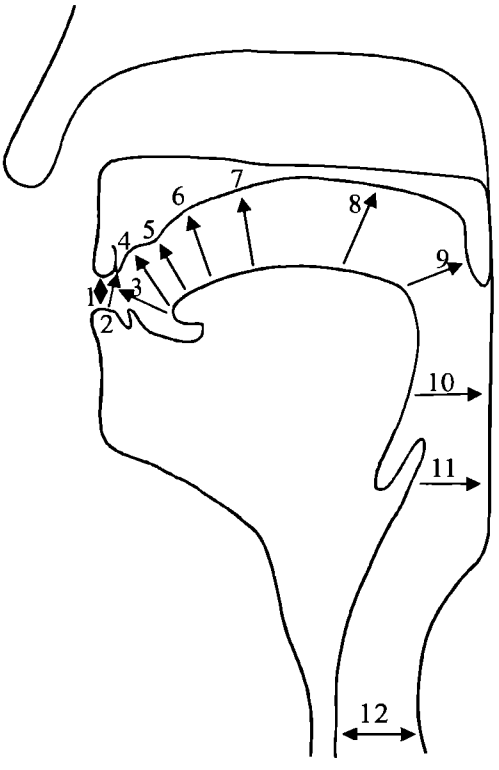

Figure 1.3. Articulator movement.

Place of articulation

Sounds are also described according to their PLACE OF ARTICULATION.[11] To understand the term "place of articulation," you need to consider first what it does *not* refer to. The place of articulation is *not* the place where the active articulator comes in contact with some other part of the vocal apparatus (for example, alveolar ridge or velum); such a place is called the PASSIVE ARTICULATOR. Rather, the "place of articulation" is actually the RELATIONSHIP (or "mapping" or "pairing") between the active and passive articulators as they shape or impede the airstream. Table 1.2 on the next page contains a partial list of the places of articulation and the articulators for each.[12]

The only difference between the pronunciations of the words *lip, lit,* and *lick* is the place of articulation of the final sound: *p* is bilabial, *t* is alveolar, and *k* is velar.

Table 1.3 shows what active articulators are used for each of the most basic places of articulation. Note that some of the active articulators can have a relationship with more than one passive articulator. For example, the tongue tip can articulate a sound between the teeth (the English *th* sound), right behind the top teeth and touching them (Spanish *t, n, l*), or slightly further back along the alveolar ridge, that is, the hard part of the roof of the mouth (English *t, n, l*). These three relationships are called INTERDENTAL, DENTAL, and ALVEOLAR, respectively.

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[11]Place of articulation is also often called POINT OF ARTICULATION. We choose to refer to a *place* rather than a *point*, since a point has no area and articulations involve areas on the articulators.

[12]The term "place of articulation" may be misleading since it implies that terms specifying the places of articulation will be nouns. Instead, they are adjectives. For example, an articulation made by the tongue tip touching the alveolar ridge is said to be "alveolar" because it is made with the alveolar place of articulation, that is, with the tongue tip and the alveolar ridge. Perhaps it will help you avoid confusion in this matter if you focus on the word *relationship* in the definition and draw a parallel with kinship relationships, such as maternal or filial, which are also labeled with adjectives. In any case, when you give the place of articulation of a sound, it should be an adjectival term such as those listed in the "Place of articulation" column of table 1.2, not a noun.

Table 1.2. Partial list of places of articulation and articulators

	Place of articulation	Active articulator	Passive articulator
1.	bilabial	lower lip	upper lip
2.	labiodental	lower lip	upper teeth
3.	interdental	tongue tip	teeth
4.	dental	tongue tip	behind top teeth
5.	alveolar	tongue tip	alveolar ridge
6.	palato-alveolar	tongue blade	behind alveolar ridge
7.	palatal	tongue front	hard palate
8.	velar	tongue back	front of soft palate; velum
9.	uvular	tongue back	back of soft palate; uvula
10.	pharyngeal	tongue root	back of
11.	glottal	vocal folds	(none)

Table 1.3. Articulation

Active articulator	Place of articulation
lips	bilabial labiodental
tongue tip / apex	interdental dental alveolar
tongue blade	palato-alveolar
tongue front	palatal
tongue back	velar uvular
tongue root	pharyngeal
vocal folds	glottal

Note: The IPA usually uses "postalveolar" instead of "palato-alveolar."

Key concepts

Each chapter in this book contains a list of key concepts and terms to serve as a summary of the new material introduced in the chapter.

phonetic parameters / characteristics
state of the vocal folds
    voiced: together and vibrating
    voiceless: apart (usually) and not vibrating
airstream mechanism
initiating motion
initiator
    pulmonic air: pulmonary; diaphragm and/or muscles of ribcage, etc.
    glottalic air: pharyngeal; larynx with closed glottis, etc.
    velaric air: oral; back of tongue against velum, etc.
direction of the airstream
    egressive: pulmonic and glottalic airstreams
    ingressive: glottalic and velaric airstreams

cavity
- oral cavity
- nasal cavity
- (pharyngeal cavity)
- (labial cavity)

resonance
- velic closure / velic opening / velum
- oral, nasal, and nasalized sounds

manner of articulation
- completely impeded (for stops)
- greatly impeded (for fricatives)
- slightly impeded (for vowels, etc.)

articulator: everything in columns two and three of table 1.2 and in figure 1.2
- active (lower, moves)
- passive (upper, remains relatively stationary)

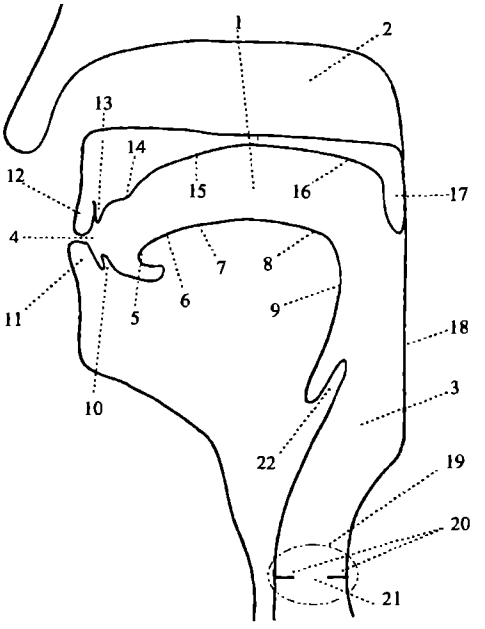
place of articulation: everything in table 1.2 (first column)

Exercises

1. List the three major airstream mechanisms and their initiators.

Airstream mechanism	Initiators

2. Study and memorize the terms in figure 1.2. Notice especially the velum and parts of the tongue. From memory, fill in the list of parts of the vocal apparatus numbered on the large facial diagram below. Check your answers against figure 1.2; with a contrasting pen or pencil, fill in any labels you missed.



Resonating cavities

1. _____
2. _____
3. _____
4. _____

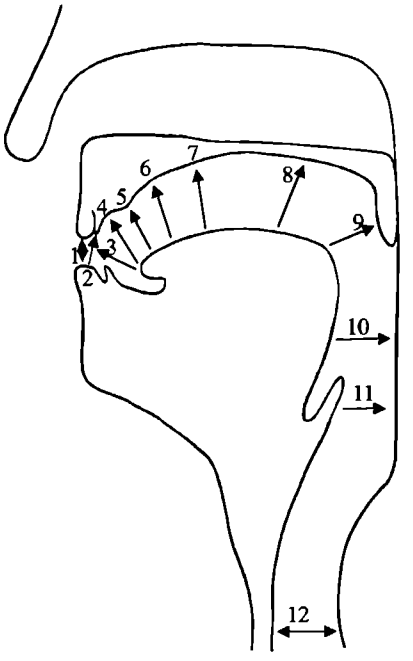
Parts of the tongue

5. _____
6. _____
7. _____
8. _____
9. _____

Other parts of the vocal apparatus

10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____

3. Study and memorize the terms in table 1.2 and table 1.3. From memory, fill in the list of places of articulation numbered on the following facial diagram. Check your answers against table 1.2 and table 1.3; with a contrasting pen or pencil, fill in any labels you missed.



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

4. Describe the first sound in the word "baby," using the six phonetic characteristics explained in this chapter.

State of the vocal folds	
Airstream mechanism and direction of the airstream	
Velic opening or closure	
Manner of articulation	
Articulators	
Place of articulation	

2

Face Diagrams

Goals

- ⌘ You will be able to explain the purpose of *face diagrams* and a few of their limitations.
- ⌘ You will be able to use *face diagrams* in a standard way to depict the state of the vocal folds, airstream mechanism and direction of the airstream, velic opening or closure, manner of articulation, and passive and active articulators for a given sound.

The list of phonetic characteristics for identifying speech sounds outlined in chapter 1 may be overwhelming at first. A device called a FACE DIAGRAM[13] is helpful for visualizing what is going on in the vocal apparatus during an individual speech sound. A face diagram, which depicts a side view of the head, jaw, tongue, etc., is a static representation of the six identifying characteristics of a particular speech sound.

Face diagrams have some limitations, being unable to represent the true nature of a stream of speech as a continuum of sounds that almost always slur together without definite boundaries. Nevertheless, a face diagram functions usefully as a cross-sectional representation of the vocal apparatus, frozen at one point in time during the articulation of a speech sound, as, perhaps, one "frame" in a videotape of a spoken word, frozen on "pause" during the utterance of one single speech sound in the word.

A face diagram should include information about each of the six characteristics of sound identification. Instead of using verbal labels, we depict each characteristic of the sound in a standardized pictorial fashion.

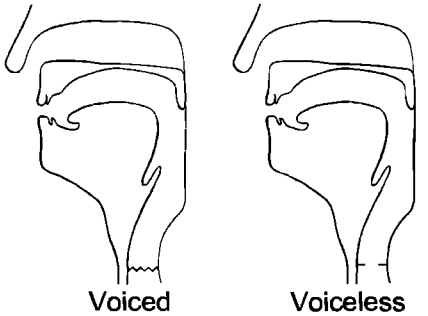


Figure 2.1.

1. *State of the vocal folds* is indicated in the larynx, where the vocal folds are located. To show that a sound is voiced, that is, that the vocal folds are vibrating, a wavy line is drawn across the area depicting the larynx. To show that a sound is voiceless, that is, that the vocal folds are apart and not vibrating, a short straight line is drawn on either side of the larynx, with a space between them. (See figure 2.1.)

[13]Face diagrams are sometimes called "sagittal sections."

2. *Airstream mechanism* is represented by an arrow near the initiator of the airstream. In the case of a pulmonic airstream, the arrow is drawn just below the glottis (nearly at the bottom of the diagram), not way down by the actual initiators (the diaphragm and muscles of the rib cage), because the face diagram only includes the head and neck, not the chest. Ways to represent the other two mechanisms will be described later.

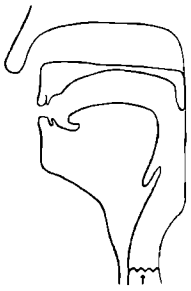


Figure 2.2.

Direction of the airstream is indicated by the direction in which the arrow is pointing. For egressive pulmonic air (by far the most common situation in speech), the arrow points upward toward the glottis, symbolizing air being pushed up out of the lungs. (See figure 2.2.)

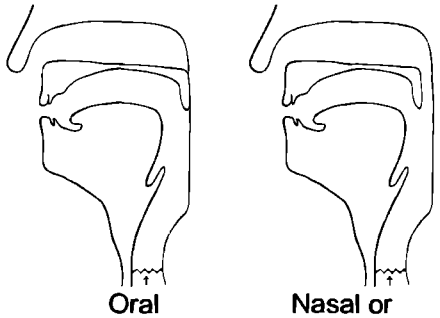


Figure 2.3.

3. *Velic opening or closure.* To indicate that only the oral resonating cavity is used for a sound, draw the back side of the velum pressed against the pharyngeal wall. To indicate that the nasal cavity is involved (as for a nasal or nasalized sound), allow a space between the back side of the velum and the pharyngeal wall. Think of there being a door to the nasal passage. Remember that for nasal and nasalized sounds that door is open, but for purely oral sounds it is closed. (See figure 2.3.)

4. The *manner of articulation* for a sound is reflected in how close the active articulator is drawn to the passive articulator. We portray a fricative by allowing a bit of space between the articulators, as shown for [f] in figure 2.4. Note that this deviates somewhat from reality, since, for example, your lower lip (active articulator) definitely touches your upper teeth (passive articulator) when you pronounce the fricatives *f* and *v*. Leaving a small space between the articulators is just a convenient way to symbolize that the airstream is not completely impeded for fricatives. For a stop, the active and passive articulators should actually touch in the drawing, as for [t] in figure 2.5. This symbolizes the complete impedance of the airstream for stops.

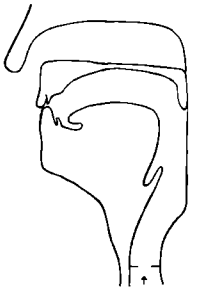


Figure 2.4. [f]

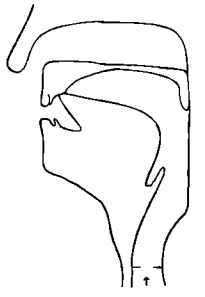


Figure 2.5. [t]

5. *Active and passive articulators.* Drawing ARTICULATORS into a face diagram provides information concerning not only the articulators themselves but also the place and manner of articulation for the sound depicted. Carefully draw the active articulator interacting with the pertinent passive articulator.

6. *Place of articulation.* If the articulators are correctly portrayed, a face diagram can be read to determine what *place of articulation* is symbolized. Look at figure 2.4. Since the active articulator is the lower lip and the passive articulator is the upper teeth, you know that the sound depicted in the diagram is labiodental. In figure 2.5, the tongue tip drawn to touch the alveolar ridge tells you that the sound depicted is alveolar.

One more thing to note about the preceding completed face diagrams is that they include all the articulators, not merely the ones that are directly involved in production of the sound depicted. For example, the tongue and lower teeth are drawn into the depiction of [f], even though they are neither active nor passive articulators of that sound. The less pertinent organs of the vocal tract are not removed from the diagram simply because they are not actively involved in producing a certain sound; even the neutral (relaxed) position they assume during production of a sound affects its acoustical properties. Consider how different the pronunciation of a person without teeth is, even on those segments that do not directly involve the teeth as active or passive articulators. Thus, it is common practice in face diagrams to include all articulators, not just the ones directly involved in the production of the sound being depicted.

Limitations of face diagrams

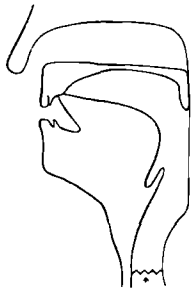
Before we leave this introduction to face diagrams, a few limitations need to be noted as to what can be shown in a face diagram. It is difficult to draw vowels on face diagrams since their articulators' positions are much less easily defined and described than those of consonants; indeed, analysts do not usually even try to specify places of articulation for vowels. Certain lip positions and some things that the sides of the tongue do in certain sounds cannot easily be shown because of the side view nature of a face diagram. You will also learn about other modifications to the consonants that cannot as easily be drawn on face diagrams because this would necessitate showing transition and change rather than a static representation of a frozen moment. However, for a large number of the sounds that are covered in this book, face diagrams can be very useful for presenting the basic facts about their production.

Key concepts and symbols

face diagram
lines in vocal fold area: wavy to show voicing, straight and broken to show voicelessness
arrow: placement of arrow indicates which airstream mechanism is used, direction of arrow indicates direction of airstream
velum: as an open or closed door to the nasal cavity
articulators: both active and passive ones drawn in to show how the sound is made; touching each other to depict a stop, slightly separated to depict a fricative

Exercises

1. Identify the six characteristics of each sound depicted in the two face diagrams shown below.



State of the vocal folds _____

Airstream mechanism _____

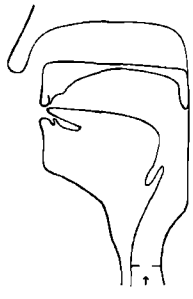
Direction of the airstream _____

Velic opening or closure _____

Manner of articulation _____

Articulators _____

Place of articulation _____



State of the vocal folds _____

Airstream mechanism _____

Direction of the airstream _____

Velic opening or closure _____

Manner of articulation _____

Articulators _____

Place of articulation _____

2. Complete a face diagram for the first sound in the word "baby." In chapter 1, you thought through the six characteristics of the sound; now you just need to draw their representations.