1 Phonetics

1.1 Introduction

Our aim in this book is to study the sound patterns of English. The understanding of phonological patterns cannot be done without the raw material, phonetics. In order to be able to come up with reliable phonological descriptions, we need to have accurate phonetic data. Thus, students and professionals who deal with the patterns of spoken language in various groups of speakers (linguists, speech therapists, language teachers) need a basic knowledge of phonetics.

Phonetics, which may be described as the study of the sounds of human language, can be approached from three different perspectives. *Articulatory phonetics* deals with the physiological mechanisms of speech production. *Acoustic phonetics* studies the physical properties of sound waves in the message. *Auditory phonetics* is concerned with the perception of speech by the hearer. The coverage in this book will be limited to the first two of these approaches. The exclusion of auditory phonetics is basically due to the practical concerns of the primary readership as well as the little information available about the workings of the brain and speech perception. In this chapter, we will look at the basics of speech production. Acoustic properties, in a limited form of spectrographic analysis, will be the subject of chapter 5.

1.2 Phonetic Transcription

Because we are constantly involved with reading and writing in our daily lives, we tend to be influenced by the orthography when making judgments about the sounds of words. After all, from kindergarten on, the written language has been an integral part of our lives. Thus, it is very common to think that the number of orthographic letters in a word is an accurate reflection of the number of sounds. Indeed, this is the case for many words. If we look at the words pan, form, print, and spirit, for example, we can see the match in the number of letters (graphemes) and the sounds: three, four, five, and six, respectively. However, this match in number of graphemes and sounds is violated in so many

other words. For example, both though and choose have six graphemes but only three sounds. Awesome has seven graphemes and four sounds, while knowledge has nine graphemes and five sounds. This list of non-matches can easily be extended to thousands of other words. These violations, which may be due to 'silent letters' or a sound being represented by a combination of letters, are not the only problem with respect to the inadequacies of orthography in its ability to represent the spoken language. Problems exist even if the number of letters and sounds match. We can outline the discrepancies that exist between the spelling and sounds in the following.

(a) *Same sound is represented by different letters*. In words such as *each*, *bleed*, *either*, *achieve*, *scene*, *busy*, we have the same vowel sound represented by different letters, which are underlined. This is not unique to vowels and can be verified with consonants, as in *shop*, *ocean*, *machine*, *sure*, *conscience*, *mission*, *nation*.
(b) *Same letter may represent different sounds*. The letter a in words such as *gate*, *any*, *father*, *above*, *tall* stands for different sounds. To give an example of a consonantal letter for the same phenomenon, we can look at the letter s, which stands for different sounds in each of the following: *sugar*, *vision*, *sale*, *resume*.
(c) *One sound is represented by a combination of letters*. The underlined portions in each of the following words represent a single sound: *thin*, *rough*, *attempt*, *pharmacy*.
(d) *A single letter may represent more than one sound*. This can be seen in the x of *exit*, the u of *union*, and the h of *human*.

One or more of the above are responsible for the discrepancies between spelling and sounds, and may result in multiple homophones such as rite, right, write, and wright. The lack of consistent relationships between letters and sounds is quite expected if we consider that the alphabet English uses tries to cope with more than forty sounds with its limited twenty-six letters. Since letters can only tell about spelling and cannot be used as reliable tools for pronunciation, the first rule in studying phonetics and phonology is to *ignore spelling* and *focus only on the sounds* of utterances.

To avoid the ambiguities created by the regular orthography and achieve a system that can represent sounds unambiguously, professionals who deal with language (linguists, speech therapists, language teachers, etc.) use a phonetic alphabet that is guided by the principle of a consistent one-to-one relationship between each phonetic symbol and the sound it represents. Over time, several phonetic alphabets have been devised. Probably, the most widespread is the one known as the *International Phonetic Alphabet* (IPA), which was developed in 1888, and has been revised since then. One may encounter some modifications of some symbols in books written by American scholars. In this book, we will basically follow the IPA usage while pointing out common alternatives that are frequently found in the literature. First, we will present the symbols that are relevant for American English (see table 1.1) and later in the chapter

Table 1.1 English consonant and vowel symbols with key words

Phonetic symbol	Word positions		
	Initial	**Medial**	**Final**
Consonants			
p	*p*ack	su*p*er	ma*p*
b	*b*ed	ru*bb*er	ro*b*
t	*t*ea	a*tt*ack	grea*t*
d	*d*ate	a*d*ore	goo*d*
k	*c*atch	pi*ck*ing	loo*k*
g	*g*ate	do*gg*y	ba*g*
f	*f*at	co*ff*ee	loa*f*
v	*v*ery	mo*v*ing	do*v*e
θ	*th*in	ru*th*less	dea*th*
ð	*th*ey	mo*th*er	brea*th*e
s	*s*ad	sis*t*er	bu*s*
z	*z*oom	rai*s*in	bu*zz*
ʃ (š)	*sh*ine	ma*ch*ine	ca*sh*
ʒ (ž)	—	vi*s*ion	massa*g*e
h	*h*ead	be*h*ind	—
tʃ (č)	*ch*air	tea*ch*er	whi*ch*
dʒ (ǰ)	*j*ump	lar*g*er	hu*g*e
m	*m*ail	re*m*ind	roo*m*
n	*n*est	te*n*or	bea*n*
ŋ	—	a*ng*er	ki*ng*
j (y)	*y*ard	be*y*ond	so*y*
w	*w*ay	re*w*ind	lo*w*
ɹ (r, ɻ)	*r*ain	bo*r*ing	fou*r*
l	*l*ight	bu*ll*et	mai*l*
Vowels and diphthongs			
i (ij, iy)	*ea*se	f*ee*t	b*ee*
ɪ	*i*t	s*i*t	—
e (ej, ei, ey)	*ei*ght	b*a*ke	s*ay*
ɛ	*e*dge	r*e*d	—
æ	*a*nger	n*a*p	—
ʌ	*o*ven	l*o*ve	—
ə	*a*bove	ofte*n*	Tamp*a*
ɑ	*a*rch	f*a*ther	sp*a*
ɔ	*a*ll	h*a*ll	s*aw*
o (ow, oʊ)	*o*at	g*o*at	b*ow*
ʊ	—	b*oo*k	—
u (uw)	*oo*ze	l*oo*se	tw*o*
aɪ (aj, ay)	*i*ce	s*i*de	b*uy*
ɔɪ (ɔj, ɔy, oɪ, oj, oy)	*oi*l	v*oi*ce	b*oy*
aʊ (au, aw)	*ou*t	s*ou*nd	h*ow*

we will add some non-English sounds that are found in languages that our readership is likely to come in contact with. The dialectal variations, since they are examined in detail in chapters 3 and 4, will not be dealt with here.

The following should be pointed out to clarify some points about table 1. Firstly, certain positions that are left blank for certain sounds indicate the unavailability of vocabulary items in the language. Secondly, the table does not contain the symbol [ʍ] (or [hw], [w̥]), which may be found in some other books to indicate the voiceless version of the labio-velar glide. This is used to distinguish between pairs such as witch and which, or Wales and whales. Some speakers make a distinction by employing the voiceless glide for the second members in these pairs; others pronounce these words homophonously. Here, we follow the latter pattern. Finally, there is considerable overlap between final /j/ and the ending portion of /i/, /e/, /aɪ/, and /ɔɪ/ on the one hand, and between final /w/ and /o/, /u/, and /aʊ/ on the other. The alternative symbols cited make these relationships rather clear, and this point will be taken up in chapter 4.

1.3 Description and Articulation of Sounds of English

1.3.1 The vocal tract

Our examination of how sounds are made will begin with the vocal organs. The air we use in sound production comes from the lungs, proceeds through the larynx where the vocal cords are situated, and then it is shaped into specific sounds at the vocal tract. In sound production, it is generally the case that the articulators from the lower surface of the vocal tract (lower articulators, i.e. the lower lip, the lower teeth, and the tongue) move toward those that form the upper surface (upper articulators, i.e. the upper lip, the upper teeth, the upper surface of the mouth, and the pharyngeal wall). Figure 1.1 shows the vocal tract.

Starting from the outer extreme, we have the lips and the teeth. In the upper surface, behind the upper teeth, there is a bumpy area (alveolar ridge), which is followed by a larger bony area (hard palate). Further back is a flaccid area, the 'soft palate' (or 'velum') which is unsupported by bone. The soft palate is a movable organ, which opens and closes the velopharyngeal passage (the passage that links the pharynx to the nasal cavity). Finally, at the back, the velum narrows to a long, thin pointed structure that is called the 'uvula'.

In the lower part of the mouth, after the lower lip and the teeth, lies the tongue. The 'tip' (or 'apex') of the tongue is the foremost part. Just behind the tip is the small surface called the 'blade' (or 'lamina'). The so-called 'front' part of the tongue is the area between tip/blade and the center. The hindmost part of the horizontal surface of the tongue is called the 'back' (or 'dorsum'). At the end of the tongue, we have the 'root', which is the vertical surface against the pharyngeal wall. Finally, we have the 'epiglottis', which is a leaf-shaped cartilage that sticks up and back from the larynx.

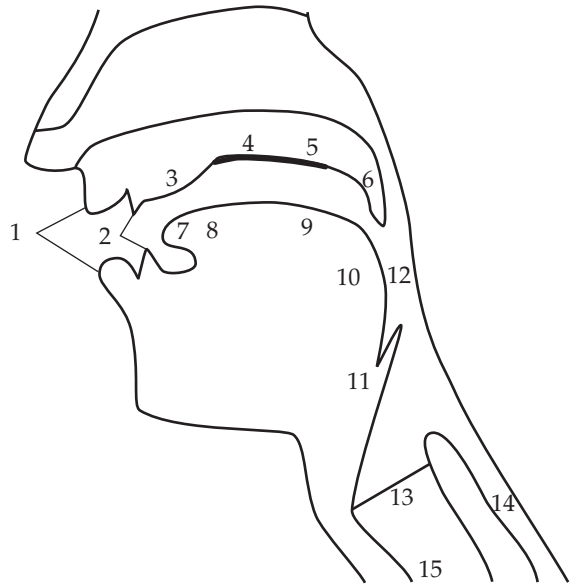


Figure 1.1 The vocal tract

1.3.2 Voicing

The larynx, which sits on top of the trachea, is composed of cartilages held together by ligaments. It houses the vocal cords, which lie horizontally just behind the Adam's apple (see figure 1.2). The space between the vocal cords, which is known as the 'glottis', assumes different configurations for sounds known as 'voiced' and 'voiceless'. When the cords are apart (open), the air passes freely through the glottis. Sounds made with such a configuration of the glottis are called 'voiceless' (see figure 1.3).

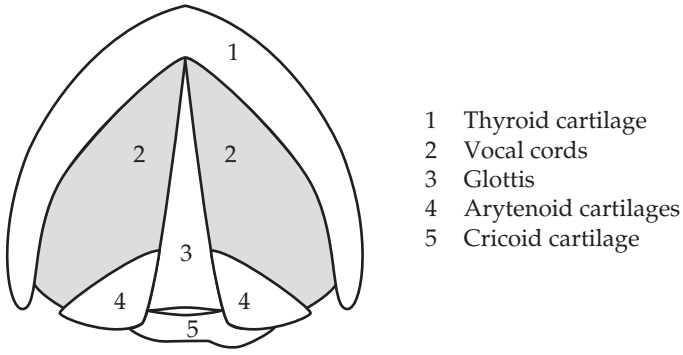


Figure 1.2 View of larynx, looking down

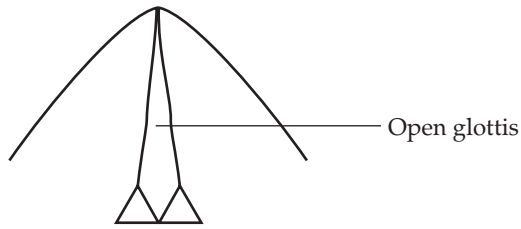


Figure 1.3 Configuration for voiceless sounds

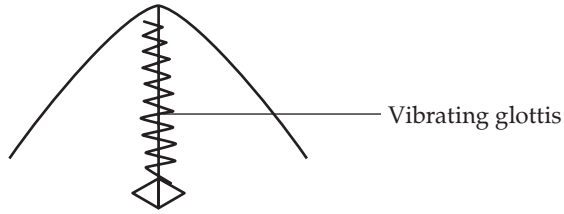


Figure 1.4 Configuration for voiced sounds

If, on the other hand, the vocal cords are brought together, the air passing through creates vibration, and the resulting sounds are 'voiced' (see figure 1.4). It is important to point out that the cord vibration is not a muscular action. When the cords are brought close to one another, the passing air creates a suction effect (Bernoulli principle), and the cords are brought together. As soon as the cords are together, there is no suction effect and the cords move apart. As soon as they are apart the suction is reinitiated, and the cycle repeats itself.

One can easily feel the difference between certain voiced and voiceless sounds. If you pronounce the initial sounds of the word pairs 'sip'–'zip' and 'cheap'–'jeep' and place your index finger on your Adam's apple or place your index fingers in both ears, you could feel the buzz created by the voicing of /z/ and /dʒ/; this effect will not be present in their voiceless counterparts /s/ and /tʃ/.

1.3.3 Places of articulation

The place of articulation of a consonant is the description of where the consonantal obstruction occurs in the vocal tract by the placement of the tongue or by lip configurations. Below are the places of articulation relevant for the consonants of English.

- **Bilabial:** In the production of bilabial sounds the two lips come together. The initial consonants of the words pay, bay, and may exemplify the English bilabials /p, b, m/.
- **Labiodental:** Labiodental sounds of English, /f, v/ (e.g. feel, veal), involve a constriction between the lower lip and the upper teeth. Bilabials and labiodentals together are called 'labials'.

- **Interdental:** /θ/ and /ð/ sounds of English (e.g. thin, that) are made by placing the tip or blade of the tongue between the upper and lower front teeth. For some speakers, the tongue tip/blade just barely touches behind the upper teeth (thus, the term 'dental' used instead in some manuals).
- **Alveolar:** When the active articulator, the tongue tip or blade, goes against the alveolar ridge, we have an alveolar sound. The initial consonants of the words tip, dip, sip, zip, nip, lip exemplify the English alveolars /t, d, s, z, n, l/ respectively.
- **Palato-alveolar:** In the production of palato-alveolar sounds of English, /ʃ, ʒ, tʃ, dʒ/ (exemplified by the final consonants of fish, garage, rich, ridge, respectively), the blade of the tongue moves towards the back of the alveolar ridge (approximates in the case of /ʃ, ʒ/ and touches in the case of /tʃ, dʒ/).
- **Retroflex:** Retroflex sounds are made by curling the tip of the tongue up and back towards the back of the alveolar ridge. The only retroflex in American English is the r-sound (/ɹ̣/). Although both in retroflex sounds and in palato-alveolars the constriction is at the back of the alveolar ridge, these two groups are not identical; the former is 'apical' (with the tip of the tongue), and the latter is said to be 'laminal' (with the blade of the tongue. It should also be noted that not all speakers use the retroflex r-sound; many speakers have a 'bunched' r-sound by raising the blade of the tongue with the tip turned down.
- **Palatal:** /j/, as in yes, is the only palatal sound of English, which is made with the front of the tongue articulating against the hard palate.
- **Velar:** In the production of English velars, /k, g, ŋ/, exemplified by the final sounds of back, bag, sing, respectively, the back of the tongue articulates against the velum (soft palate).
- **Glottal:** These are sounds formed at the glottis, which include /h/ (e.g. home), and the glottal stop /ʔ/.
- **Labio-velar:** The sound /w/ (e.g. we) is the only consonant that has two places of articulation. In the production of this sound, the lips are rounded (thus, 'labial'), while at the same time the back of the tongue is raised toward the velum (thus, 'velar'). As a result, we place the symbol both in bilabial and velar places and call the sound 'labio-velar'.

1.3.4 Manners of articulation

The manner of articulation of a sound is the degree and the kind of obstruction of a consonant in the vocal tract. For example, if we compare the first sounds of the words tip and sip, we realize that the airflow is obstructed in the same area (alveolar), and in both sounds, /t/ and /s/, the configuration of the vocal cords is the same (voiceless). The difference between the two sounds lies in the type of obstruction of the airflow. While in /t/ we stop the air completely before the release, we simply obstruct (not stop) the airflow with a narrowing created by the articulators in /s/.

- **Stop:** A stop consonant involves a complete closure of the articulators and thus total blockage of airflow. The stops found in English are /p, b, t, d, k, g/.
- **Fricative:** A fricative is a sound that is made with a small opening between the articulators, allowing the air to escape with audible friction. In English /f, v, θ, ð, s, z, ʃ, ʒ, h/ are the fricative sounds. The common denominator of fricatives is partial airflow with a friction noise. Some manuals, adhering strictly to the requirement of turbulent airstream, do not consider /h/ as a fricative. A subgroup of fricatives (alveolars and palato-alveolars), which are more intense and have greater amounts of acoustic energy at higher frequencies, are known as 'sibilants'.
- **Affricate:** In a stop sound, the release of the closure is quick and abrupt; however, in sounds where the closure release is gradual, it creates friction. Such sounds are called affricates. In other words, affricates start like stops (complete closure), and end like fricatives. Both affricates of English, /tʃ, dʒ/, are produced in palato-alveolar place of articulation. The symbols used for these sounds reveal the combination of stops /t/, /d/ with the fricatives /ʃ/, /ʒ/, respectively. An important point to remember is their one-unit (inseparable) status. Unlike consonant clusters (e.g. /sk/, /pl/), which are made up of two separable phonological units, affricates always behave like one unit. For example, in a speech error such as key chain /ki tʃen/ becoming /tʃi ken/, the affricate /tʃ/ is interchanged with a single segment /k/; clusters, on the other hand, are separated in a comparable situation, as illustrated in scotch tape /skʌtʃ tep/ becoming /kʌtʃ step/ and not /tʌtʃ skep/ (see section 3.3 for more on this). Since affricates /tʃ/ and /dʒ/ contain sibilant fricatives in them (/ʃ/, /ʒ/, respectively), they are also sibilants. Stops, fricatives, and affricates, which are produced by a considerable amount of obstruction of the laryngeal airstream in the vocal tract, are collectively known as 'obstruents'.
- **Approximant:** Approximants are consonants with a greater opening in the vocal tract than fricatives, and thus do not create any friction. Identifying a sound as an approximant or a fricative includes acoustic/auditory and aerodynamic considerations as well as articulatory factors. Catford (1977) states that the typical cross-sectional areas of the maximum constriction in a fricative range about 3 to 20 mm^2, while it is greater than 20 mm^2 in an approximant. The sounds /l, ɹ̠, j, w/ (initial consonants of lay, ray, yes, and week) are the approximants of English. Both fricatives and approximants, because they let the airflow continue in the production, are called 'continuants'. Two of the English approximants, /l, ɹ̠/, are 'liquids', vowel-like consonants in which voicing energy passes through a vocal tract with a constriction greater than that of vowels. The liquid /l/, which is called the 'lateral' liquid, is produced with the tongue tip creating a closure with the alveolar ridge while maintaining an opening at the sides of the tongue where the air escapes. The non-lateral approximant, /ɹ̠/, which is described earlier in relation to retroflex place of articulation and is also known as the 'rhotic', will not be repeated here.

Table 1.2 Consonants of English

	Bilabial	Labio-dental	Inter-dental	Alveolar	Retroflex	Palato-alveolar	Palatal	Velar	Glottal
Stop	p b			t d				k g	
Fricative		f v	θ ð	s z		ʃ ʒ			h
Affricate						tʃ dʒ			
Nasal	m			n				ŋ	
Liquid				l	ɹ				
Glide	w						j	w	

The remaining two approximants, /j/ and /w/, are known as 'glides' (also 'semivowels' in some manuals). These are vowel-like sounds that function like consonants. In other words, /j/ is like the vowel /i/, and /w/ is like the vowel /u/ in production, while functioning like consonants, as they do not occupy the syllable nuclei and they always need a vowel to lean on.

- **Nasal:** If we compare the initial sounds of beat and meat, /b/ and /m/, we see that both sounds share the place of articulation (bilabial), and voicing (voiced). The difference between them lies in the velopharyngeal opening and the channels of the outgoing airflow. In the production of /m/, the velum is lowered and the velopharyngeal passage is open. Thus, upon release of the closure, the air goes out through the nasal cavity as well as through the oral cavity. In the production of /b/, on the other hand, the velum is raised and the passage is closed. Consequently, the only outlet for the airflow is the oral cavity. Sounds that are made with the former configuration, e.g. /m, n, ŋ/, are called nasals; the others are oral sounds.

Approximants (liquids and glides) and nasals, because they include a relatively unobstructed flow of air between the articulator and the place of articulation, collectively form the group of consonants that is known as 'sonorants'.

Table 1.2 shows the places and manners of articulation for English consonants. Whenever a cell has two consonants, the voiceless is placed to the left and the voiced is to the right.

1.3.5 Voice onset time

As stated earlier, a stop articulation consists of a closure formed by the two articulators followed by an abrupt release of this closure. In this section, we will look at the production of stop sounds and the timing of vocal cord

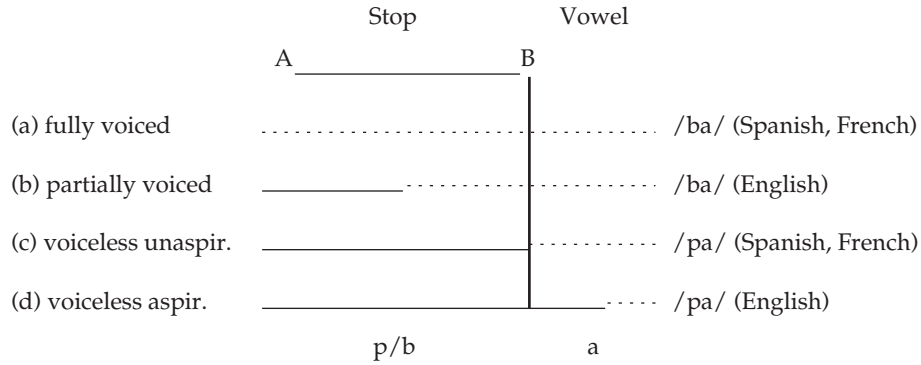


Figure 1.5 VOT continuum

vibration which is relevant for voiced, voiceless, aspirated, and unaspirated distinctions. The differences for these various kinds of stops can be explained with the time difference between the release of the stop closure and the beginning of vocal cord vibration. This timing relationship is known as the 'voice onset time' (hereafter VOT). Figure 1.5 represents the different stop productions in the VOT continuum.

If the voicing starts before the release (i.e. during the closure period), as in the case of lines (a) and (b), then the situation is described as the 'voice lead' and given a negative VOT value (in milliseconds). Line (a) represents a fully voiced stop; we have the vocal cord vibration throughout the closure which continues after the release. The /b, d, g/ sounds of Romance languages are said to be typical examples of fully voiced stops.

Not all voiced stops are produced in this fashion. In some languages, English and other Germanic languages included, /b, d, g/ are subject to a certain amount of loss of voicing ('partially devoiced') during their production. Line (b) in figure 1.5 represents this configuration; the voicing starts some time into the closure stage and continues into the following vowel (the mirror image of this is seen in final voiced stops; these will be given in detail in chapter 3).

If, on the other hand, the voicing starts after the release of the stop closure, then it is said to have a 'voice lag' and is described with a positive VOT value (in milliseconds; ms). Cross-linguistically, the amount of the lag may be significant; while a lag greater than 30 ms results in stops that are called 'aspirated' (or 'long lag'), a shorter voice lag or voicing simultaneous with release

results in stops that are known as 'unaspirated'. Lines (c) and (d) show these two possibilities. In neither case do we have vocal cord vibration during the stop closure (thus 'voiceless'). The difference between the two cases lies in the point at which the voicing starts with respect to the moment of release. In line (c), the vocal cord vibration is simultaneous with the stop release; the VOT is zero and we have a 'voiceless unaspirated stop'. The voiceless stops of Romance languages are given as examples for this.

In line (d) the lag is longer than the 30 ms threshold, and the resulting sound is a 'voiceless aspirated stop'. The diacritic used for aspiration is a small raised [^{h}] to the top right of the stop (e.g. [p^{h}]). English initial [p^{h}, t^{h}, k^{h}] sounds are produced in this way and we hear the resulting short burst before the buzz of voicing in the vowel. The degree of aspiration may be different in different languages. For example, while English voiceless stops are slightly aspirated, their counterparts in languages such as Mandarin, Thai, and Scots Gaelic are strongly aspirated.

In some languages (e.g. Hindi of India, Sindhi of Pakistan and India), the possibilities go beyond the three types of stops (voiced, voiceless unaspirated, voiceless aspirated) we discussed, by the addition of the so-called 'voiced aspirated stops'. These stops have, after the release of the stop closure, a period of breathy voice (murmur) before the regular voicing starts for the following segment. Thus we get the following four-way voicing distinction in Hindi.

[tal] 'beat'; [t^{h}al] 'plate'; [dal] 'lentil'; [d^{h}al] 'knife'

1.3.6 Vowels and diphthongs

When we examined consonants, we talked about the varying degrees of obstruction of the airflow in their production. As a general statement, we can say that the vocal tract is more open in vowels than in consonants. This, however, can be a tentative formulation, because as we saw in the discussion of glide/vowel separation, the consideration may be phonological and not phonetic.

For the characterization of vowels, we do not use the dimensions of place and manner of articulation, as there is no contact between the articulators. Instead, vowels are characterized by the position of the tongue and the lips. Since vowels are usually voiced, the voiced/voiceless distinction used for consonants is not relevant either.

If you examine the vowels of beat, bit, bait, bet, and bat in the order given, you will notice that your mouth opens gradually and the body of your tongue lowers gradually. A similar situation is observed if we go through the vowels of boot, book, boat, brown, and bought; that is, gradual opening of the mouth and gradual lowering of the tongue. The difference between the two sets lies in the part of the tongue involved. While in the former set the front part of the tongue is involved (tongue pushed forward), the latter set focuses on the back of the tongue (tongue pulled back). The traditional type of chart used to plot vowel positions places the front vowels on the left, back vowels on the

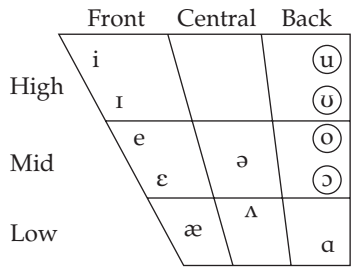


Figure 1.6 English vowels

right and the central vowels in the middle. There are height dimensions: 'high' (or 'close'), 'mid', and 'low' (or 'open'), while the 'mid' is frequently divided into 'high-mid' and 'low-mid'. Figure 1.6 shows the English vowels.

Another dimension of vowel description refers to the lip position. Four /ɔ, o, ʊ, u/ of the five back vowels, which are given in circles in the chart, are produced with rounded lips and thus are called 'round' (or 'rounded'); all other vowels are unrounded.

Finally, in addition to the height, backness and rounding characteristics, one other grouping, tense/lax, is given. This is a rather controversial issue and will be dealt with in detail in chapter 4. Here, suffice it to say that this book will follow the distributional criteria and group /ɪ, ɛ, æ, ʊ, ʌ/ as 'lax', while considering the rest 'tense'.

The vowels we have described so far are considered to have a single, unchanging quality and are called 'monophthongs'. (This is not uncontroversial for /i/, /u/, and especially for /e/ and /o/; see chapter 4 for details.) The vocalic elements of the words such as bite, brown, and boy, on the other hand, involve a complex articulation whereby we move from one vowel to another. More specifically, we have /aɪ/, /aʊ/, and /ɔɪ/, respectively. Such sounds are known as 'diphthongs'. The complete account of vowels and diphthongs, including their dialect variations will be discussed in chapter 4.

1.4 Additional Sounds

Our primary concern in this chapter has been the consonants and vowels of English. However, students of Speech Pathology and TESOL (teaching of English to speakers of other languages) as well as of applied linguistics frequently deal with speakers of other languages, either in the context of foreign language learning or in the context of bilingualism (or multilingualism). Such situations, needless to say, demand familiarity with several sounds that are not present in English. Thus, the following is intended to provide the necessary coverage.

1.4.1 States of glottis

Besides the two configurations (voiced and voiceless) we mentioned for the sounds of English, some languages use sounds that involve two additional states of glottis. These are **creaky voice** (also known as 'laryngealization' or 'vocal fry'), and **murmur** (also called 'breathy voice').

In creaky voice the arytenoid cartilages at the back of the glottis are together, and the cords vibrate at the other end. The result is a low-pitched sound. Many Chadic languages (e.g. Hausa, Bura, Margi of West Africa) use such sounds to make changes in meaning in opposition to a regularly voiced sound. Creaks can be transcribed by adding a subscript tilde to individual sounds (e.g. [a̰]).

Murmurs (or breathy voiced sounds) are produced in such a way that the vocal cords are apart at the back, while they vibrate at the front portions. The opening of the cords is narrower than in voiceless sounds, and the cords vibrate with high volume–velocity airflow through this gap that subsides soon because the high rate of flow cannot be maintained for long. Murmur sounds can be transcribed by placing two dots [..] under individual sounds (e.g. [d̤]). Niger-Congo languages in Africa (e.g. Zulu, Shona), and several languages spoken in India (Hindi, Sindhi, Marathi, Bengali, Gujarati) have murmured stops. Also, in Mazatec (an Oto-Mangean language spoken in Mexico) laryngealized vowels, breathy voiced vowels, and regular vowels can be found in contrast (substitutions for each other making meaning differences).

1.4.2 Places and manners of articulation

Stops

The bilabial, alveolar, and velar stops of English are very common in the languages of the world. Two additional places of articulation are noteworthy in stops. Voiceless and voiced *palatal* stops, which are transcribed as [c, ɟ] respectively, are found in Hungarian, Czech, Turkish, Basque, and Irish. *Retroflex* stops [ʈ, ɖ] (or [t̠, d̠]) are common in Hindi. As for *uvular* (the back of the tongue articulating against the uvula) stops, we can cite the voiceless [q] (found in Eskimo, Quechua), and the voiced [G] (found in Persian). Mention should also be made of *dental* stops [t̪, d̪], which are found in Romance languages (Spanish, Portuguese, Italian, etc.).

Fricatives

The fricative inventory of English is quite rich (nine fricatives), but there are many more possibilities that are entertained by several languages of the world. The voiceless *bilabial* fricative, [ɸ], is common in Greek and Hausa, while the voiced counterpart, [β], is found in Spanish. Ewe of West Africa has both of these bilabial fricatives. *Retroflex* fricatives (voiceless, which can be transcribed as [ʂ] (or [s̠]), and voiced, which can be transcribed as [ʐ] (or [z̠]) are found in Mandarin Chinese and in several Dravidian languages of India, such as Tamil

and Malayalam. *Palatal* fricatives are also found in several languages. While the voiceless [ç] is found in Irish, Bengali, German, Norwegian, and Greek, the voiced counterpart, [ʝ], is found in Swedish, Greenlandic, and Margi. *Velar* fricatives can be found in Indo-European languages. We can cite Welsh, Irish, Bulgarian, Czech, German, Sindhi, and Slovene for the voiceless [x], and Greek, Spanish, Arabic, Persian, German, and Irish for the voiced [ɣ]. The voiceless *uvular* fricative, [χ], is common in Dutch and Semitic languages (e.g. Arabic, Hebrew), and several Amerindian languages (e.g. Tlingit), while the voiced counterpart, [ʁ], is frequent in Portuguese and French. Finally, *pharyngeal* fricatives, both voiceless, [ħ], and voiced, [ʕ] are commonly found in Semitic languages (e.g. Arabic, Hebrew).

Affricates

The two palato-alveolar affricates of English are, by far, the most common ones in the languages of the world. Besides these, *alveolars* are also relatively frequent. The voiceless member, [t^s], of this group, which is the more common one, is found in Chinese, Croatian, Japanese, Slovene, and Czech, while the voiced [d^z] may be found in Bulgarian. Also worth mentioning is the voiceless *bilabial* fricative, [p^f], which is found in German.

Nasals

Just like the affricates, the nasals of English are among the most common in languages of the world. However, mention should be made of the next most common nasal, [ɲ], which is *palatal*. This sound is part of several languages such as French, Spanish, Portuguese, Vietnamese, Hungarian, Catalan, Irish, and Sundanese. Other nasals that are worth mentioning are the *uvular* [N], which is found in Japanese and in several Amerindian languages, and retroflex nasal [ɳ] (or [ɳ]) found in Malayalam.

Liquids

Under this group, we look at sounds that are known as 'l-sounds' and 'r-sounds', which present a wide variety. The voiced alveolar approximant [l], found in English, is one of the most common laterals in languages. Palatal [ʎ], which is found in languages such as Italian and Portuguese, is another common lateral approximant. Laterals are most likely to be approximants and voiced; however, neither of these qualities is necessarily the case. Fricative laterals are more commonly voiceless (e.g. voiceless, alveolar fricative [ɬ], as in Welsh).

The r-sounds, while they all are normally voiced, present a wider range in types than laterals. It is common to see a distinction between 'continuant' vs. 'interrupted' r-sounds. The r-sounds of English (retroflex approximant in American English, [ɹ], alveolar approximant in British English, [ɹ]) are examples of continuants.

More commonly, r-sounds belong to one of the 'interrupted' types (taps, flaps, trills). Both taps and flaps involve a momentary contact between the articulators. The Spanish [ɾ], in caro [kaɾo] "expensive" (or the American English

intervocalic /t/, as in writer), is made with a flicking movement of the tip of the tongue against the upper articulator. Taps are sometimes equated with flaps, which is not accurate. First of all, taps are mostly dental/alveolar while flaps are retroflex. Also, these two sounds are different in direction of the movement; in taps we have a movement up to down, and in flaps back to front.

Trills are produced by the repeated tapping of one flexible articulator against the other. The dental/alveolar trill, [r], (e.g. Spanish perro [pero] "dog") is one of the most common in languages. Also noteworthy is the uvular trill, [R], which is found in German and in some varieties of French (e.g. [Ruʒ] "red"). In some other varieties of French (e.g. Parisian), this sound is a uvular fricative or approximant (e.g. [ʁuʒ] "red"). Sometimes a trill may be accompanied with friction. The Czech r-sound [r̝] is a good example of a voiced alveolar fricative trill (e.g. Dvorak [dvor̝ak]).

Glides

The sounds /j/ and /w/ that are found in English are by far the most common glides in languages. A noteworthy addition to this category is the labiopalatal approximant, [ɥ], found in French (e.g. [mɥɛt] "mute").

While the additional symbols are useful in dealing with sounds that are not found in English, they may not be sufficient to deal with data from a disordered population. Here, we may require extra refinement in the form of new symbols and/or diacritics to accurately reflect the atypical productions, which are rarely found in natural languages, or not found at all. Among such articulations we may find the following: *dentolabials*, which are the reverse of labiodentals, are articulated between the upper lip and the lower front teeth. These may include stops [p̪, b̪], nasal [m̪], and fricatives [f̪, v̪]. *Labio-alveolars*, which are common with speakers with excessive overbite for target labials and labiodentals, are articulated between the lower lip and the alveolar ridge (e.g. [p̼, b̼, m̼, f̼, v̼]. In clinical data, fricatives may be found with simultaneously median air flow over the center of the tongue and laterally (e.g. [l̻s̻, l̻z̻]), as well as fricatives with friction located within the nasal cavity (i.e. fricatives with nasal escape), [m̤, n̤, ŋ̤]. Also commonly cited are labiodental stops [p̪͡f, b̪͡v], and the velopharyngeal fricative (more commonly known as the velopharyngeal snort), [fŋ]. The sounds cited above do not constitute an exhaustive list of possible atypical articulations found in disordered speech. For a more detailed account and complete diacritics, including transcription conventions for phonatory activities and connected speech modes, the reader is referred to Ball and Lowry (2001).

1.4.3 Consonants made with non-pulmonic airstream mechanisms

The sounds we have described so far are all produced using air from the lungs, and thus are called 'pulmonic' sounds. While the sounds in many languages are exclusively made with this pulmonic egressive (outgoing airflow) airstream, several other languages may, in addition, utilize one or two other

Table 1.3 Consonants (English and other languages)

	Bilabial	**Labio-dental**	**Dental / Interdental**	**Alveolar**	**Retroflex**	**Palato-alveolar**	**Palatal**	**Velar**	**Uvular**	**Pharyngeal**	**Glottal**
Stop	**p b**		t̪ d̪	**t d**	ʈ(t̠) ɖ(d̠)		c ɟ	**k** g	q ɢ		ʔ
Fricative	ɸ β	**f v**	**θ ð**	**s z**	ʂ(s̠) ʐ(z̠)	**ʃ ʒ**	ç ʝ	x ɣ	χ ʁ	ħ ʕ	**h**
Affricate	p^f			t^s d^z		**tʃ dʒ**					
Nasal	**m**			**n**	ɳ(n̠)		ɲ	**ŋ**	N		
Liquid				**l** r ɾ ɹ	ɻ(ɹ̠)		ʎ		R		
Glide	**w**						**j**	**w**			

Sounds given in **bold type** occur in English.

airstream mechanisms, especially for the stop sounds. These mechanisms are 'glottalic' airstream (which employs the air above closed glottis, that is, pharynx air, and produces 'ejectives' and 'implosives', which are sometimes called 'glottalized' or 'laryngealized' consonants), and 'velaric' airstream (which employs the air in the mouth, and produces 'clicks').

Ejectives

In order to produce ejectives the closed larynx is raised. This is accompanied with a closure in the mouth (bilabial, alveolar, velar), and a raised velum. Raising the larynx squeezes the air trapped between the glottis and the consonant closure in the vocal tract and raises the air pressure in this chamber. Upon release of the consonant closure, the air rushes out. Stops produced this way are called 'ejectives'. Because there is no vocal cord vibration, ejectives are typically voiceless. They are symbolized by the appropriate consonant symbol with the addition of an apostrophe ([pʼ, tʼ, kʼ]), and are common in many Amerindian languages (Nez Perce, Klamath, Nootka, Dakota), Circassian languages (Kabardian, Georgian), and African languages (Zulu, Hausa).

Implosives

The mechanism to produce implosives is the opposite to that of ejectives. Here, instead of squeezing the air and increasing the pressure, the downward-moving larynx sucks the air inward and reduces the air pressure. In general, the glottis cannot remain tightly closed during this downward movement of the larynx, and there is vocal cord vibration. When the closure in the vocal tract is released, the air rushes in, and thus 'implosives' are stops made by glottalic ingressive airstream. Implosives can be found in many African languages (e.g. Zulu, Hausa) and are symbolized by the addition of an upper rightward hook to the appropriate stop symbol ([ɓ, ɗ, ʄ, ɠ, ɗ̠]).

Clicks

The enclosed cavity for the production of a 'click' is created in the mouth, forming the back closure by raising the back of the tongue against the soft palate (velum), and the front closure somewhere more front in the mouth (e.g. alveolar ridge). The lowering of the body of the tongue rarefies the air, and when the front closure is removed, the air is sucked into the mouth. The result is a

Table 1.4 Stops made with pulmonic and non-pulmonic airstream mechanisms

	Bilabial	Dental	Alveolar	Palato-alveolar	Velar
Ejectives	pʼ		tʼ		kʼ
Implosives	ɓ		ɗ		ɠ
Clicks	ʘ	ǀ	ǁ	ǃ	

clicking sound; 'tsk-tsk' is one that we hear for disapproval in English. Since the airflow is inward, clicks are known as sounds made with velaric ingressive airstream mechanism. Clicks, as speech sounds, are confined to languages of southern Africa. To symbolize clicks, we find the following ([ʘ] bilabial, [ǀ] dental, [ǃ] post-alveolar, and [ǁ] alveolar lateral).

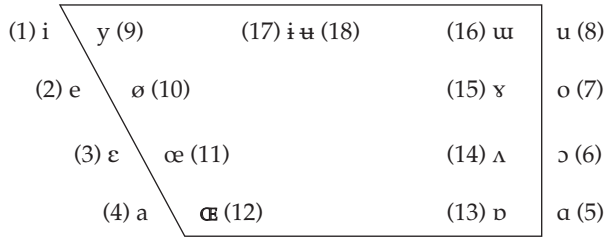
1.4.4 Vowels

American English has a rather rich vowel inventory that covers many of the positions on the vowel grid; however, there are many other possibilities that are entertained by other languages. UPSID (UCLA Phonological Segment Inventory Database) (Maddieson 1984), which looks at more than 300 languages that are representative of different language families, shows a grid with 37 different vowel symbols. We will not go into that detail here. Instead, we will first point out some non-English vowels that are common in several familiar languages, and then we will have a brief description of 'cardinal vowels', which are commonly used for reference points in talking about the vowels of other languages.

Although it is commonplace to find front vowels as unrounded in languages, there are some front rounded vowels that are found in several familiar languages. These are high front rounded, /y/ (/ü/), (the rounded counterpart of /i/), high-mid (close-mid) front rounded, /ø/ (/ö/), (rounded counterpart of /e/), and the low-mid (open-mid) front rounded, /œ/, (rounded counterpart of /ɛ/). All three are part of French and several Germanic languages (German, Swedish, Danish, Norwegian). Dutch and Hungarian have /y/ and /ø/, while Cantonese and Turkish have /y/ and /œ/. Another noteworthy vowel that is not part of English is the high back unrounded /ɯ/ (unrounded counterpart of /u/) which is found in Korean, Turkish, and many Amerindian languages.

1.5 Cardinal Vowels

Although we use similar traditional labels for vowel descriptions of different languages (e.g. high, front, rounded, etc.), we should not assume that vowels that are described the same way are identical in two languages. For example, both French and Galician have high front unrounded vowels, /i/, but their qualities are not the same. Similarly, identically transcribed vowels from different languages may not be the same. For example, if we look at /œ/ of Cantonese, French, and Dutch, we realize that they are all different; Cantonese has the highest tongue position, French is in the middle, and Dutch has the lowest. To avoid such problems in the description of vowels of different languages, phoneticians usually refer to the set of arbitrarily chosen vowels that is known as 'cardinal vowels' and describe the particular vowel of a language with reference to this system. The primary and secondary cardinal vowels are given in figure 1.7.



Note: Primary cardinal vowels are outside the grid, and the secondary cardinal vowels are inside it.

Figure 1.7 Cardinal vowels

The front vowels (1–4) and (9–12), and the back vowels (5–8) and (13–16) are equidistant from one another. As such, they do not necessarily represent the vowels of any language; rather, they are arbitrary reference points that the vowels of any language can be described against. The top left corner of the vowel space defines the highest and most front possible vowel, (1). The bottom right corner (5) is the other extreme, which is the lowest and most back vowel. The other two corners represent the extremes in low front (4) and high back (8). The secondary cardinal vowels (the ones inside the grid) repeat the primary set with the opposite lip rounding. As such, (9) is high front rounded, (12) low front rounded, (13) low back rounded, and (16) high back unrounded.

Before we conclude this section, we will show how, using this system, we can describe vowels from different languages. Although, as stated above /œ/ is in the inventory of Cantonese, Dutch, and French, the realizations are not identical; this can be shown in figure 1.8.

Thus, we can say that /œ/ of Cantonese is a little lower than (10) and a little centralized. As for the French and Dutch counterparts, we can state the following: while French /œ/ is a little higher than (11), the Dutch sound is a little lower than (11) and more centralized.

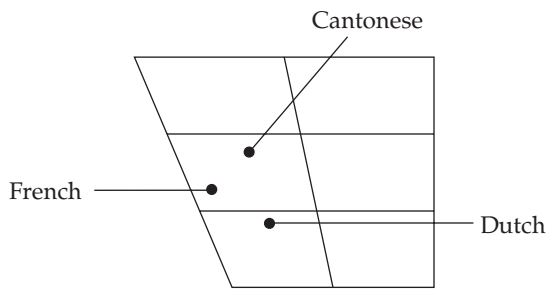


Figure 1.8 Realizations of /œ/ in Cantonese, Dutch, and French

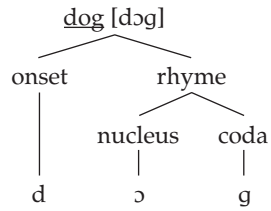
1.6 Syllables and Suprasegmentals

What we have considered so far in this chapter have been the phonetic characteristics of individual speech sounds or segments. However, segments do not exist in isolation and are part of larger units, such as syllables, which in turn make up larger units of utterances.

Syllable

The syllable is a phonological unit consisting of segments around the pivotal vowel or vowel-like (diphthong) sound, which is known as the *nucleus*. The nucleus is the element that every syllable contains, and the other elements are defined in relation to it; the consonant(s) we have before the nucleus are called the *onset*, and the consonant(s) after it the *coda*. Thus, in the following three words we have syllables with different elements. In 'a' [e], we have only the nucleus with no onset and no coda; in 'at' [æt], the syllable consists of the nucleus and the coda and there is no onset; finally, in 'cat' [kæt], we have all three elements present. We will not go into greater details of various other possibilities, as the detailed structure of English syllables will be discussed in chapter 6.

Nucleus and coda together (elements after the onset) are known as the *rhyme* (or '*rime*'), thus giving us the following hierarchical structure.



Depending on the structure of the rhyme, syllables are classified as *closed* (with coda(s)), and *open* (lacking coda(s)). Thus, in the word beacon [bi.kən] we have the open first syllable followed by the closed second syllable.

Suprasegmentals

In the context of utterances, certain features such as stress, length, and pitch are contributing factors to the messages. Such features, which are used simultaneously with units larger than segments, are called 'suprasegmentals'.

Pitch: The pitch of the voice refers to the frequency of the vocal cord vibration. It is influenced by the tension of the vocal cords and the amount of air that passes through them. In an utterance, different portions are produced in different pitches. The patterns of rises and falls (pitch variation) across a stretch of speech such as a sentence is called its *intonation.* The meaning of

a sentence may depend on its intonation pattern. For example, if we utter the sequence "her uncle is coming next week" with a falling pitch, this will be interpreted as a statement. If, on the other hand, the same is uttered by a rise in pitch at the end, it will be understood as a question.

In many languages, the pitch variation can signal differences in word meaning. Such languages, exemplified by several Sino-Tibetan languages (e.g. Mandarin, Cantonese), Niger-Congo languages (e.g. Zulu, Yoruba, Igbo), and many Amerindian languages (e.g. Apache, Navajo, Kiowa), are called *tone languages*. To demonstrate how tone can affect the lexical change, we can refer to the much-celebrated example of [ma] of Mandarin Chinese:

[ma]	if uttered by a *high level tone*,	/˥/,	"mother"
	high rising tone,	/˧˥/,	"hemp"
	low falling rising tone,	/˨˩˦/,	"horse"
	high falling tone,	/˥˩/,	"scold"

Such lexical changes cannot be accomplished in non-tonal languages such as English, Spanish, French, etc. In addition to the lexical differences, which are standard in all tone languages, some languages may utilize tonal shifts for morphological or syntactic purposes (e.g. Bini of Nigeria for tense shift, Shona of Zimbabwe to separate the main clause and the relative clause, Igbo of Nigeria to indicate possession).

Stress: Stress can be defined as syllable prominence. The prominence of a stressed syllable over an unstressed one may be due to a number of factors. These may include (a) loudness (stressed syllables are louder than unstressed syllables), (b) duration (stressed syllables are longer than unstressed syllables), and (c) pitch (stressed syllables are produced with higher pitch than unstressed syllables). Languages and dialects (varieties) vary in which of these features are decisive in separating stressed syllables from the unstressed ones. In English, higher pitch has been shown to be the most influential perceptual cue in this respect (Fry 1955, 1979).

Variation in syllable duration and loudness produce differences in rhythm. English rhythm (like most other Germanic languages) is said to be *stress-timed*. What this means is that stressed syllables tend to occur at roughly equal intervals in time (isochronous). The opposite pattern, which is known as *syllable-timing*, is the rhythmic beat by the recurrences of syllables, not stresses. Spanish, Greek, and Turkish are good examples of such a rhythm. One of the significant differences between the two types of languages lies in the differences of length between stressed and unstressed syllables, and vowel reduction or lack of it. We can exemplify this by looking at English and Spanish. If we consider the English word probability and its cognate Spanish probabilidad, the difference becomes rather obvious. Although the words share the same meaning and the same number of syllables, the similarities do not go beyond that. In Spanish (a syllable-timed language), the stress is on the last syllable, [proβaβiliðað]. Although the remaining syllables are unstressed, they all have

full vowels, and the duration of all five syllables is approximately the same. In English (a stress-timed language), on the other hand, the word [prabəbɪlər̬i] reveals a rather different picture. The third syllable receives the main stress (the most prominent) and the first syllable has a secondary stress (second most prominent syllable). The first, third, and the last syllables have full vowels, while the second and the fourth syllables have reduced vowels. Thus, besides the two stressed syllables, the last syllable, because it has a full vowel, has greater duration than the second and fourth syllables. Because of such differences in rhythm, English is said to have a 'galloping' rhythm as opposed to the 'staccato' rhythm of Spanish.

Several scholars (Dauer 1983; Giegerich 1992) object to the binary split between 'stress-timing' and 'syllable-timing', and suggest a continuum where a given language may be placed. For example, while French is frequently cited among 'syllable-timed' languages, it is also shown to have strong stresses breaking the rhythm of the sentence, a characteristic which is normally reserved for stress-timed languages.

A rather uncontroversial split among languages with respect to stress relates to 'fixed' (predictable) stress versus 'variable' stress languages. In English, similar to other Germanic languages, the position of stress is variable. For example, import as a noun will have the stress on the first syllable, [ímpɔrt], whereas it will be on the second syllable if it is a verb, [ɪmpɔ́rt].

In several languages, however, stress is fixed in a given word position. In such cases, the first syllable (e.g. Czech, Finnish), the last syllable (e.g. French), or the next-to-last syllable (e.g. Polish, Welsh, Swahili) is favored.

Length: Length differences in vowels or consonants may be used to make lexical distinctions in languages. Swedish, Estonian, Finnish, Arabic, Japanese, and Danish can be cited for vowel length contrasts (e.g. Danish [vilə] "wild" vs. [vi:lə] "rest"). English does not have such meaning differences entirely based on vowel length. Examples such as beat vs. bit, and pool vs. pull are separated not simply on the basis of length, but also on vowel height and tense/lax distinctions.

In consonantal length, we again make reference to languages other than English. For example, in Italian and in Turkish different consonant length is responsible for lexical distinctions (e.g. Italian nonno [nɔnno] "grandfather" vs. nono [nɔno] "ninth"; Turkish eli [ɛli] "his/her hand" vs. elli [ɛlli] "fifty"). In English, we can have a longer consonant at word or morpheme boundaries: [k] in black cat, [f] in half full, and [n] in ten names are produced with one long obstruction.

Summary

In this chapter, we examined the basic elements of phonetics, which are prerequisites to understanding the patterning of sounds. We looked at the fundamentals of articulatory phonetics including voicing, places and manners

of articulation, voice onset time, and dimensions that are relevant for vocalic articulations such as tongue height and backness, as well as lip positions. We also reviewed some common non-English sounds that might be of relevance. Finally, we had a brief account of syllable and suprasegmental features such as stress, tone, intonation, and length.

Exercises

1. Examine the following transcriptions. If you agree, do nothing; if the transcription is erroneous, correct it.

injured [ɪnjerd]	gelatin [gɛlətɪn]
measure [mɛshuɻ]	inches [intʃəs]
caution [kɔʃən]	topical [topɪkəl]
telephone [teləphon]	syllable [sələbəl]

2. How many segments are there in each of the following words?

homophone	equestrian
broach	writer
thatched	middle
knack	photographer
lesson	imagination

3. State if the place of articulation is same (S) or different (D) in the *initial consonants* of each pair. In either case, state the place of articulation.

Example:	now – pneumonia	Same; alveolar
	sun – sugar	Different; alveolar vs. palato-alveolar

(a) goose – gerrymander
(b) simple – shackle
(c) curious – cereal
(d) phonetic – fictional
(e) manners – wicker
(f) normal – location
(g) wander – yesterday
(h) those – Thursday
(i) scissors – zipper
(j) temperate – chestnut
(k) chromosome – chief
(l) baker – delegate
(m) happened – usual
(n) neuron – market
(o) painting – broccoli

4. State if the manner of articulation is same (S) or different (D) in the *final consonants* of each pair. In either case, state the manner of articulation.

Example:	bomb – ten	Same; nasal
	rough – zip	Different; fricative vs. stop

(a) album – broken
(b) ideal – keepsake
(c) prologue – confine
(d) aqueous – sociable
(e) variable – watch
(f) waste – adage
(g) barometer – finish
(h) inch – gauge
(i) fiord – equip
(j) barb – relief
(k) alive – fiftieth
(l) laughing – hydraulic
(m) opulence – paramedic
(n) outrage – swivel
(o) dominion – eminent

5. State if the *vowels in the underlined portions* are same or different in the following words. In either case, state the phonetic description of the vowels, together with the phonetic symbols.

Example:	k<u>ee</u>l – cit<u>y</u>	Same: /i/ high, front, tense
	m<u>e</u>ss – m<u>a</u>ss	Different: /ɛ/ mid, front – /æ/ low, front

(a) prim<u>a</u>ry – n<u>u</u>trition
(b) h<u>ea</u>l – electr<u>i</u>city
(c) b<u>eau</u> – <u>a</u>perture
(d) an<u>y</u>where – ph<u>a</u>ntasm
(e) exp<u>o</u>sure – c<u>oa</u>ster
(f) expl<u>i</u>cable – expl<u>i</u>cate
(g) w<u>a</u>ve – irrig<u>a</u>te
(h) m<u>ea</u>sure – f<u>i</u>nger
(i) b<u>u</u>tter – t<u>ou</u>gh
(j) ch<u>o</u>lesterol – b<u>o</u>ttom
(k) n<u>y</u>mph – j<u>u</u>mp
(l) ab<u>a</u>te – c<u>au</u>ght
(m) hydr<u>o</u>gen – hydr<u>o</u>lysis
(n) p<u>a</u>wn – h<u>a</u>rsh

6. Circle the words that:

   (a) start with a fricative
   foreign, theater, tidings, hospital, cassette, shroud
   (b) end in a sibilant
   wishes, twelfth, clutch, indicates, admonish, furtive
   (c) have an approximant
   winter, university, captive, ripe, little, mute
   (d) contain a back vowel
   putter, boost, roast, fraud, matter, hospital
   (e) start with a voiced obstruent
   government, pottery, taxonomy, jury, phonograph, sister
   (f) contain a lax vowel
   auction, redeem, ledger, cram, boat, loom
   (g) end in an alveolar
   went, atom, rigor, column, multiple, garnish

7. Give the phonetic symbols for the following English sounds.

   (a) voiceless stops _____
   (b) voiced fricatives _____
   (c) approximants _____
   (d) alveolar obstruents _____
   (e) nasals _____
   (f) voiced obstruents _____

   Now give the phonetic symbols for the following sounds that are not found in English.

   (g) alveolar affricates _____
   (h) voiceless velar and uvular fricatives _____
   (i) bilabial and palatal fricatives _____
   (j) non-lateral liquids _____
   (k) palatal and uvular stops _____

8. The sounds in the underlined portions of the following pairs of words share some phonetic properties and are different in some other properties. Give the phonetic symbol for each sound and state the shared feature(s) and difference(s).

   Example: [p] ‘<u>p</u>ark’ – ‘<u>ph</u>one’ [f] Shared: voiceless, obstruent
   Difference(s):
   [p] bilabial, stop
   [f] labiodental, fricative

(a) telephone – television
(b) atop – wiser
(c) bitter – easy
(d) mister – enemy
(e) shipment – justice
(f) wait – root
(g) lime – window
(h) alone – elevate
(i) feather – fought
(j) limp – soccer

9. The following groups consist of sounds that share a phonetic feature plus one sound that does not belong to this group. Circle the sound that does not belong to the group, and identify the feature shared by the remaining sounds of the group.

Example: /l, ɹ, d, s, t, k, z/ /k/ is a velar, the rest are alveolars

(a) /f, ʃ, tʃ, z, θ, ʒ, ð/ _____
(b) /t, z, n, m, d, l, s/ _____
(c) /ɪ, ɛ, ʊ, u, æ, ʌ/ _____
(d) /n, g, v, s, z, ɻ, m/ _____
(e) /m, w, ŋ, p, b/ _____
(f) /i, ɪ, æ, ɑ, e, ɛ/ _____

10. Fill in the boxes with the appropriate label for the *final sounds* of each word.

	sipped	latex	triumph	bridge	rough	fought	dogs	palm
Upper articulator								
Lower articulator								
Voicing								
Manner of articulation								

11. Do the same for the *initial sounds* of the same words.

	sipped	latex	triumph	bridge	rough	fought	dogs	palm
Upper articulator								
Lower articulator								
Voicing								
Manner of articulation								

12. Fill in the boxes for the first vowels of the following.

	park	ocean	make	ember	hamper	fought	hypocrite	chew
Tongue height								
Frontness/ backness								
Lip position								
Tenseness/ laxness								

13. Circle the correct alternative(s).

(a) Tensing the vocal cords makes them vibrate faster / slower, so that the pitch increases / decreases.
(b) In the production of stops / fricatives / glides / affricates, the air is blocked from going out through the nose and the mouth.
(c) In the production of stops / liquids / fricatives / nasals, the constriction of the vocal tract is such that a noisy airstream is formed.
(d) In the production of palato-alveolar sounds, the tip / front / blade / back of the tongue goes to the forward part of the hard palate / soft palate / uvula.
(e) In the production of labiodental / bilabial / labio-velar / velar sounds, the two lips approach one another, and the back of the tongue is raised towards the soft palate.

14. Transcribe the following (about 'the spread of English') *from* P. Trudgill and J. Hannah, *International English* (London: Edward Arnold, 2002).

The English language developed out of Germanic dialects that were ……..
brought to Britain, during the course of the 5th and 6th centuries, ……..
by Jutes (from modern Jutland, Denmark), Angles (from modern ……..
Schleswig, Denmark/Germany), and Frisians (from modern ……..
Friesland, Netherlands/Germany). By medieval times, this ……..
Germanic language had replaced the original Celtic language of Britain ……..
in nearly all of England as well as in southern and eastern Scotland. ……..
Until the 1600s, however, English remained a language spoken by a ……..
relatively small number of people and was confined geographically ……..
to the island of Great Britain. Indeed, even much of Britain ……..
remained non-English-speaking. The original Celtic language of ……..
Britain survived in the form of Welsh in nearly all of Wales and as ……..
Cornish in much of Cornwall. The Highlands and islands of western ……..
and northern Scotland spoke Gaelic, another Celtic language which ……..
had been brought across from Ireland in pre-medieval times. And ……..
the populations of the Northern Isles – Orkney and Shetland – still ……..
spoke the Scandinavian language, Norn, which they had inherited ……..
from their Viking ancestors.
……