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The sounds of language

I take it you already know
Of tough and bough and cough and dough?
Others may stumble but not you
On hiccough, thorough, lough and through.
Well done! And now you wish, perhaps,
To learn of less familiar traps?

Beware of heard, a dreadful word,
That looks like beard and sounds like bird.
And dead: it's said like bed, not bead –
For goodness sake don't call it 'deed'!
Watch out for meat and great and threat
(They rhyme with suite and straight and debt).

T. S. W. quoted in Mackay (1970)

Imagine the manager of a small restaurant, a man who has always had trouble with the spelling of unusual words, writing out a sign which he puts in the front window, advertising that they have a new *SEAGH*. You see the sign and you decide to ask what kind of new thing this is. When you hear the pronunciation, you recognize the word usually written as *chef*. How did he arrive at that other spelling? Well, it's very simple, he says. Take the first sound of the word *sure*, the middle sound of the word *dead*, and the final sound of the word *laugh*. Isn't that a *seagh*?

This tale, however unlikely, may serve as a reminder that the sounds of spoken English do not match up, a lot of the time, with letters of written English. If we cannot use the letters of the alphabet in a consistent way to represent the sounds we make, how do we go about describing the sounds of a language like English? One solution is to produce a separate alphabet with symbols that represent sounds. Such a set of symbols does exist and is called the **phonetic alphabet**. In this chapter, we will look at how these symbols are used to represent both the consonant and vowel sounds of English words and what physical aspects of the human vocal tract are involved in the production of those sounds.

Phonetics

The general study of the characteristics of speech sounds is called **phonetics**. Our main interest will be in **articulatory phonetics**, which is the study of how speech sounds are made, or ‘articulated’. Other areas of study are **acoustic phonetics**, which deals with the physical properties of speech as sound waves in the air, and **auditory phonetics** (or perceptual phonetics) which deals with the perception, via the ear, of speech sounds.

Voiced and voiceless sounds

In articulatory phonetics, we investigate how speech sounds are produced using the fairly complex oral equipment we have. We start with the air pushed out by the lungs up through the trachea (or ‘windpipe’) to the larynx. Inside the larynx are your vocal cords, which take two basic positions.

- 1 When the vocal cords are spread apart, the air from the lungs passes between them unimpeded. Sounds produced in this way are described as **voiceless**.
- 2 When the vocal cords are drawn together, the air from the lungs repeatedly pushes them apart as it passes through, creating a vibration effect. Sounds produced in this way are described as **voiced**.

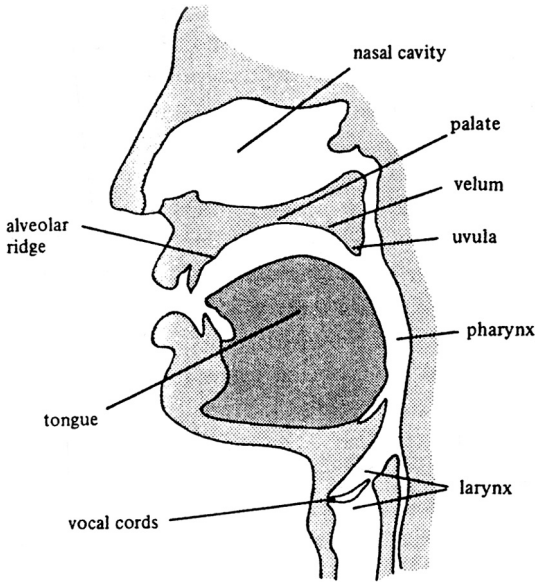
The distinction can be felt physically if you place a fingertip gently on the top of your ‘Adam’s apple’ (i.e. that part of your larynx you can feel in your neck below your chin), then produce sounds such as Z-Z-Z-Z or V-V-V-V. Because these are voiced sounds, you should be able to feel some vibration. Keeping your fingertip in the same position, now make the sounds S-S-S-S or F-F-F-F. Because these are voiceless sounds, there should be no vibration. Another trick is to put a finger in each ear, not too far, and produce the voiced sounds (e.g. Z-Z-Z-Z) to hear and feel some vibration, whereas no vibration will be heard or felt if you make voiceless sounds (e.g. S-S-S-S) in the same way.

Place of articulation

Once the air has passed through the larynx, it comes up and out through the mouth and/or the nose. Most consonant sounds are produced by using the tongue and other parts of the mouth to constrict, in some way, the shape of the oral cavity through which the air is passing. The terms used to describe many sounds are those which denote the place of articulation of the sound: that is, the location inside the mouth at which the constriction takes place.

What we need is a slice of head. If you crack a head right down the middle, you will be able to see which parts of the oral cavity are crucially involved in speech production. To describe the place of articulation of most consonant

sounds, we can start at the front of the mouth and work back. We can also keep the voiced–voiceless distinction in mind and begin using the symbols of the phonetic alphabet for specific sounds. These symbols will be enclosed within square brackets [].



Bilabials

These are sounds formed using both (= bi) upper and lower lips (= labia). The initial sounds in the words *pat*, *bat* and *mat* are all **bilabials**. They are represented by the symbols [p], which is voiceless, and [b] and [m], which are voiced. We can also describe the [w] sound found at the beginning of *way*, *walk* and *world* as a bilabial.

Labiodentals

These are sounds formed with the upper teeth and the lower lip. The initial sounds of the words *fat* and *vat* and the final sounds in the words *safe* and *save* are **labiodentals**. They are represented by the symbols [f], which is voiceless, and [v], which is voiced. Notice that the final sound in the word *cough*, and the initial sound in *photo*, despite the spelling differences, are both pronounced as [f].

Dentals

These sounds are formed with the tongue tip behind the upper front teeth. The initial sound of *thin* and the final sound of *bath* are both voiceless **dentals**. The symbol used for this sound is [θ], usually referred to as ‘theta’. It is the symbol you would use for the first and last sounds in the phrase *three teeth*.

The voiced dental is represented by the symbol [ð], usually called ‘eth’. This sound is found in the pronunciation of the initial sound of common words like *the, there, then* and *thus*. It is also the middle consonant sound in *feather* and the final sound of *bathe*.

The term ‘interdentals’ is sometimes used for these consonants when they are pronounced with the tongue tip between (= inter) the upper and lower teeth.

Alveolars

These are sounds formed with the front part of the tongue on the alveolar ridge, which is the rough, bony ridge immediately behind and above the upper teeth. The initial sounds in *top, dip, sit, zoo* and *nut* are all **alveolars**. The symbols for these sounds are easy to remember – [t], [d], [s], [z], [n]. Of these, [t] and [s] are voiceless whereas [d], [z] and [n] are voiced.

It may be clear that the final sounds of the words *bus* and *buzz* have to be [s] and [z] respectively, but what about the final sound of the word *raise*? The spelling is misleading because the final sound in this word is voiced and so must be represented by [z]. Notice also that despite the different spelling of *knot* and *not*, both of these words are pronounced with [n] as the initial sound.

Other alveolars are the [l] sound found at the beginning of words such as *lap* and *lit*, and the [r] sound at the beginning of *right* and *write*.

Palatals

If you feel back behind the alveolar ridge, you should find a hard part in the roof of your mouth. This is called the hard palate or just the palate. Sounds which are produced with the tongue and the palate are called **palatals** (or alveopalatals). Examples of palatals are the initial sounds in the words *shout* and *child*, which are both voiceless. The *sh* sound is represented as [ʃ] and the *ch* sound is represented as [tʃ]. So, the word *shoe-brush* begins and ends with the voiceless palatal sound [ʃ] and the word *church* begins and ends with the other voiceless palatal sound [tʃ].

One of the voiced palatals, represented by the symbol [ʒ], is not very common in English, but can be found as the middle consonant sound in words like *treasure* and *pleasure*, or the final sound in *rouge*. The other voiced palatal is [dʒ], which is the initial sound in words like *joke* and *gem*. The word *judge* and the name

George both begin and end with the sound [dʒ] despite the obvious differences in spelling.

One other voiced palatal is the [j] sound used at the beginning of words like *you* and *yet*.

Velars

Even further back in the roof of the mouth, beyond the hard palate, you will find a soft area, which is called the soft palate, or the velum. Sounds produced with the back of the tongue against the velum are called **velars**. There is a voiceless velar sound, represented by the symbol [k], which occurs not only in *kid* and *kill*, but is also the initial sound in *car* and *cold*. Despite the variety in spelling, this [k] sound is both the initial and final sound in the words *cook*, *kick* and *coke*.

The voiced velar sound heard at the beginning of words like *go*, *gun* and *give* is represented by [g]. This is also the final sound in words like *bag*, *mug* and, despite the spelling, *plague*.

The velum can be lowered to allow air to flow through the nasal cavity and thereby produce another voiced velar which is represented by the symbol [ŋ], typically referred to as ‘angma’. In written English, this sound is normally spelled as the two letters ‘ng’. So, the [ŋ] sound is at the end of *sing*, *sang* and despite the spelling, *tongue*. It occurs twice in the form *ringing*. Be careful not to be misled by the spelling of a word like *bang* – it ends with the [ŋ] sound only. There is no [g] sound in this word.

Glottals

There is one sound that is produced without the active use of the tongue and other parts of the mouth. It is the sound [h] which occurs at the beginning of *have* and *house* and, for most speakers, as the first sound in *who* and *whose*. This sound is usually described as a voiceless **glottal**. The ‘glottis’ is the space between the vocal cords in the larynx. When the glottis is open, as in the production of other voiceless sounds, and there is no manipulation of the air passing out of the mouth, the sound produced is that represented by [h].

Charting consonant sounds

Having described in some detail the place of articulation of English consonant sounds, we can summarize the basic information in the accompanying chart. Along the top of the chart are the different labels for places of articulation and, under each, the labels –V (= voiceless) and +V (= voiced). Also included in this chart, on the left-hand side, is a set of terms used to describe ‘manner of articulation’ which we will discuss in the [following section](#).

| | Bilabial | | Labiodental | | Dental | | Alveolar | | Palatal | | Velar | | Glottal | |
|------------|----------|----|-------------|----|--------|----|----------|----|---------|----|-------|----|---------|----|
| | -V | +V | -V | +V | -V | +V | -V | +V | -V | +V | -V | +V | -V | +V |
| Stops | p | b | | | | | t | d | | | k | g | | |
| Fricatives | | | f | v | θ | ð | s | z | ʃ | ʒ | | | | |
| Affricates | | | | | | | | | tʃ | dʒ | | | | |
| Nasals | | | | | | | | n | | | | ŋ | | |
| Liquids | | | | | | | l,r | | | | | | | |
| Glides | | | | | | | | | | j | | | | h |

Limitations of the chart

This chart is far from complete. It contains the majority of consonant sounds used in the basic description of English pronunciation. There are, however, several differences between this basic set of symbols and the much more comprehensive chart produced by the International Phonetic Association (IPA). The most obvious difference is in the range of sounds covered.

We would go to an IPA chart for a description of the sounds of all languages. It includes, for example, symbols for the velar fricative sound you may have heard in the German pronunciation of the *ch* part of *Bach* or *Achtung*. It also includes sounds made with the back of the tongue and the uvula (at the end of the velum) which represents the *r* parts of the French pronunciation of *rouge* and *lettre*. Uvular sounds also occur in many native languages of north and south America. Other non-English sounds such as pharyngeals (produced in the pharynx) occur in languages such as Arabic. There are many other consonant sounds in the languages of the world.

Another way in which the chart is incomplete is the single entry covering *r* sounds in English. There can be a lot of variation among speakers in the pronunciation of the initial sound in *raw* and *red*, the medial sound in *very*, and the final sound in *hour* and *air*. Different symbols (e.g. [ɹ], [ʀ]) may be encountered in transcriptions where the different *r* sounds are distinguished.

Finally, in some phonetic descriptions, there are different symbols for a few of the sounds represented here. These alternatives are [š] for [ʃ], [ž] for [ʒ], [č] for [tʃ], [j] for [dʒ] and [y] for [j]. For a fuller discussion of the use of these symbols, see Ladefoged (2001).

Manner of articulation

So far, we have concentrated on describing consonant sounds in terms of where they are articulated. We can also describe the same sounds in terms of how they are articulated. Such a description is necessary if we want to be able to differentiate between some sounds which, in the preceding discussion, we have placed in the same category. For example, we can say that [t] and [s] are both voiceless alveolar sounds. How do they differ? They differ in their manner of articulation, that is, in the way they are pronounced. The [t] sound is one of a set of sounds called stops and the [s] sound is one of a set called fricatives.

Stops

Of the sounds we have already mentioned, the set [p], [b], [t], [d], [k], [g] are all produced by some form of ‘stopping’ of the airstream (very briefly) then letting

it go abruptly. This type of consonant sound, resulting from a blocking or stopping effect on the airstream, is called a **stop** (or a ‘plosive’). A full description of the [t] sound at the beginning of a word like *ten* is as a voiceless alveolar stop. In some discussions, only the manner of articulation is mentioned, as when it is said that the word *bed*, for example, begins and ends with voiced stops.

Fricatives

The manner of articulation used in producing the set of sounds [f], [v], [θ], [ð], [s], [z], [ʃ], [ʒ] involves almost blocking the airstream and having the air push through the very narrow opening. As the air is pushed through, a type of friction is produced and the resulting sounds are called **fricatives**. If you put your open hand in front of your mouth when making these sounds, [f] and [s] in particular, you should be able to feel the stream of air being pushed out. The usual pronunciation of the word *fish* begins and ends with the voiceless fricatives [f] and [ʃ]. The word *those* begins and ends with the voiced fricatives [ð] and [z].

Affricates

If you combine a brief stopping of the airstream with an obstructed release which causes some friction, you will be able to produce the sounds [tʃ] and [dʒ]. These are called **affricates** and occur at the beginning of the words *cheap* and *jeep*. In the first of these, there is a voiceless affricate [tʃ], and in the second, a voiced affricate [dʒ].

Nasals

Most sounds are produced orally, with the velum raised, preventing airflow from entering the nasal cavity. However, when the velum is lowered and the airstream is allowed to flow out through the nose to produce [m], [n], and [ŋ], the sounds are described as **nasals**. These three sounds are all voiced. The words *morning*, *knitting* and *name* begin and end with nasals.

Liquids

The initial sounds in *led* and *red* are described as **liquids**. They are both voiced. The [l] sound is called a lateral liquid and is formed by letting the airstream flow around the sides of the tongue as the tip of the tongue makes contact with the middle of the alveolar ridge. The [r] sound at the beginning of *red* is formed with the tongue tip raised and curled back near the alveolar ridge.

Glides

The sounds [w] and [j] are described as **glides**. They are both voiced and occur at the beginning of *we*, *wet*, *you* and *yes*. These sounds are typically produced with the tongue in motion (or ‘gliding’) to or from the position of a vowel and are sometimes called semi-vowels or approximants.

The sound [h], as in *Hi* or *hello*, is voiceless and can be classified as a glide because of the way it combines with other sounds. In some descriptions, it is treated as a fricative.

The glottal stop and the flap

There are two common terms used to describe ways of pronouncing consonants which are not included in the chart presented earlier.

The **glottal stop**, represented by the symbol [ʔ], occurs when the space between the vocal cords (the glottis) is closed completely (very briefly), then released. Try saying the expression *Oh oh*. Between the first *Oh* and the second *oh*, we typically produce a glottal stop. Some people do it in the middle of *Uh-uh* (meaning ‘no’), and others put one in place of *t* when they pronounce *Batman* quickly. You can also produce a glottal stop if you try to say the words *butter* or *bottle* without pronouncing the *-tt-* part in the middle. This sound is considered to be characteristic of Cockney (London) speech. (Try saying the name *Harry Potter* as if it didn’t have the *H* or the *tt*.) You will also hear glottal stops in the pronunciation of some Scottish speakers and also New Yorkers.

If, however, you are an American English speaker who pronounces the word *butter* in a way that is close to ‘budder’, then you are making a **flap**. It is represented by [D] or sometimes [ɾ]. This sound is produced by the tongue tip tapping the alveolar ridge briefly. Many American English speakers have a tendency to ‘flap’ the [t] and [d] consonants between vowels so that, in casual speech, the pairs *latter* and *ladder*, *writer* and *rider*, *metal* and *medal* do not have distinct middle consonants. They all have flaps. The student who was told about the importance of *Plato* in class and wrote it in his notes as *play-dough* was clearly a victim of a misinterpreted flap.

This rather lengthy list of the phonetic features of English consonant sounds is not presented as a challenge to your ability to memorize a lot of terminology and symbols. It is presented as an illustration of how a thorough description of the physical aspects of speech production will allow us to characterize the sounds of spoken English, independently of the vagaries of spelling found in written English. There are, however some sounds that we have not yet investigated. These are the types of sounds known as vowels and diphthongs.

Vowels

While the consonant sounds are mostly articulated via closure or obstruction in the vocal tract, **vowel** sounds are produced with a relatively free flow of air. They are all typically voiced. To describe vowel sounds, we consider the way in which the tongue influences the ‘shape’ through which the airflow must pass. To talk about a place of articulation, we think of the space inside the mouth as having a front versus a back and a high versus a low area. Thus, in the pronunciation of *heat* and *hit*, we talk about ‘high, front’ vowels because the sound is made with the front part of the tongue in a raised position.

In contrast, the vowel sound in *hat* is produced with the tongue in a lower position and the sound in *hot* can be described as a ‘low, back’ vowel. The next time you’re facing the bathroom mirror, try saying the words *heat*, *hit*, *hat*, *hot*. For the first two, your mouth will stay fairly closed, but for the last two, your tongue will move lower and cause your mouth to open wider. (You may also notice, the next time you’re getting some, that the sounds of relaxation and pleasure typically contain lower vowels.)

The terminology for describing vowel sounds in English (e.g. ‘high front’) is usually based on their position in a chart, like the one shown here, which provides a means of classifying the most common vowel sounds. Following the chart is a list of the sounds with some examples of familiar words that, for a lot of American English speakers, most of the time, contain those sounds. The list of examples goes from a high front vowel through to a low back vowel and ends with three diphthongs.

| | Front | Central | Back |
|------|--------|---------|--------|
| High | i | | u |
| Mid | ɪ e | ə | ʊ o |
| Low | ɛ æ | ʌ | ɔ a |

[i] *eat, key, see*

[ɪ] *hit, myth, women*

[e] *great, tail, weight*

[ɛ] *dead, pet, said*

[æ] *ban, laugh, sat*

[ə] *above, sofa, support*

[ʌ] *blood, putt, tough*

[u] *move, two, too*

[ʊ] *could, foot, put*

[o] *no, road, toe*

[ɔ] *ball, caught, raw*

[a] *bomb, cot, swan*

[aɪ] *buy, eye, my*

[aʊ] *cow, doubt, loud*

[ɔɪ] *boy, noise, void*

Diphthongs

The last three symbols in the list above contain two sounds. These ‘combined’ vowel sounds are called **diphthongs**. Note that in each case they begin with a vowel sound and end with the glides [j] or [w]. In pronouncing the majority of single vowel sounds, our vocal organs assume one position (very briefly), but in pronouncing diphthongs, we move from one vocalic position to another as we produce the sound.

This process of diphthongization can actually happen with a wide range of vowel sounds and is more common in some varieties of English (e.g. Southern British) than in others. Most American English speakers pronounce the word *say* as [sej], with a diphthong rather than a single vowel. You will also hear common pronouns such as *we* [wij] and *they* [ðej] diphthongized. If you try to pronounce the consonants and diphthongs in the following transcription, you should recognize a traditional speech-training exercise: [haw naw brawn kaw].

Subtle individual variation

Vowel sounds are notorious for varying between one variety of English and the next, often being a key element in what we recognize as different accents. So, you may find that some of the words offered in the earlier lists as examples are not spoken in your neighborhood with the vowel sounds exactly as listed. Also, some of the sound distinctions shown here may not even be used regularly in your own speech. It may be, for example, that you make no distinction between the vowels in the words *caught* and *cot* and use [a] in both. In some descriptions, the vowel sound in *cot* is represented as [ɑ].

Or, you may not make a significant distinction between the central vowels [ə] and [ʌ]. If not, then just use the symbol [ə], called ‘schwa’. In fact, in casual speech, we all use schwa more than any other single sound. It is the unstressed vowel (underlined) in the everyday use of words such as *afford*, *collapse*, *oven*, *photograph*, *wanted*, and in those very common words *a* and *the*.

There are many other variations in the actual physical articulation of the sounds we have considered here. The more we focus on the subtle differences of the actual articulation of each sound, the more likely we are to find ourselves describing the pronunciation of small groups or even individual speakers. Such subtle differences enable us to identify individual voices and recognize people we know as soon as they speak. But those differences don’t help us understand how we are able to work out what total strangers with unfamiliar voices are saying. We are clearly able to disregard all the subtle individual variation in the phonetic detail of voices and recognize each underlying sound type as part of a word with a particular meaning. To make sense of how we do that,

we need to look at the more general sound patterns, or the phonology, of a language.

■ Study questions

- 1 What is the difference between acoustic phonetics and auditory phonetics?
- 2 Which of the following words normally end with voiceless (–V) sounds and which end with voiced (+V) sounds?

| | | |
|-----------------|-----------------|----------------|
| (a) bang _____ | (c) smack _____ | (e) thud _____ |
| (b) crash _____ | (d) splat _____ | (f) wham _____ |
- 3 Try to pronounce the initial sounds of the following words and identify the place of articulation of each one (e.g. bilabial, alveolar, etc).

| | | |
|-----------------|----------------|-----------------|
| (a) belly _____ | (d) foot _____ | (g) mouth _____ |
| (b) calf _____ | (e) hand _____ | (h) thigh _____ |
| (c) chin _____ | (f) knee _____ | (i) toe _____ |
- 4 Identify the manner of articulation of the initial sounds in the following words (stop, fricative, etc.).

| | | |
|------------------|-----------------|-----------------|
| (a) cheery _____ | (d) funny _____ | (g) loony _____ |
| (b) crazy _____ | (e) happy _____ | (h) merry _____ |
| (c) dizzy _____ | (f) jolly _____ | (i) silly _____ |
- 5 Which written English words are usually pronounced as they are transcribed here?

| | | |
|---------------|-----------------|-----------------|
| (a) bæk _____ | (d) haw _____ | (g) klo:k _____ |
| (b) bɒt _____ | (e) hɒpɪŋ _____ | (h) tʃɪp _____ |
| (c) fes _____ | (f) hu _____ | (i) ðə _____ |
- 6 Using symbols introduced in this chapter, write a basic phonetic transcription of the most common pronunciation of the following words.

| | | |
|-----------------|-----------------|-------------------|
| (a) bake _____ | (d) noise _____ | (g) these _____ |
| (b) doubt _____ | (e) phone _____ | (h) thought _____ |
| (c) gem _____ | (f) shy _____ | (i) wring _____ |

■ Research tasks

- A Using a dictionary if necessary, try to decide how each of the following words is usually pronounced. Then, put the words in five lists as illustrations of each of the sounds [e], [i], [f], [k] and [ʃ]. Some words will be in more than one list.

air, belief, critique, crockery, Danish, gauge, giraffe, headache, keys, meat, mission, nation, ocean, pear, people, philosopher, queen, receipt, scene, Sikh, sugar, tough, weight

- B We can create a definition for each consonant (e.g. [k]) by using the distinction between voiced and voiceless plus the terms for place and manner of articulation (e.g. voiceless velar fricative). Write definitions for the initial sounds in the normal pronunciation of the following words.

fan, lunch, goal, jail, mist, shop, sun, tall, yellow, zoo

Are there any definitions in which the voiced/voiceless distinction is actually unnecessary and could be omitted?

- C The terms ‘obstruent’ and ‘sonorant’ are sometimes used in descriptions of how consonants are pronounced. Of the types of consonants already described (affricates, fricatives, glides, liquids, nasals, stops), which are obstruents, which are sonorants, and why?
- D What is forensic phonetics?

■ Discussion topics/projects

- I When we concentrate on the articulation of sounds, it’s easy to forget that people listening to those sounds often have other clues to help them recognize what we’re saying. In front of a mirror (or enlist a cooperative friend to be the speaker), say the following pairs of words. As you are doing this, can you decide which are rounded or unrounded vowels and which are tense or lax vowels? What clues are you using to help you make your decision?

bet/bought coat/caught feed/food late/let mail/mole neat/knit

(For background reading, see file 3.4 in *Language Files*, 2004.)

- II English has a number of expressions such as *chit-chat* and *flip-flop* which never seem to occur in the reverse order (i.e. not *chat-chit* or *flop-flip*). Perhaps you can add examples to the following list of similar expressions.

| | | |
|----------------------|----------------------|------------------|
| <i>criss-cross</i> | <i>hip-hop</i> | <i>riff-raff</i> |
| <i>dilly-dally</i> | <i>knick-knacks</i> | <i>see-saw</i> |
| <i>ding-dong</i> | <i>mish-mash</i> | <i>sing-song</i> |
| <i>fiddle-faddle</i> | <i>ping-pong</i> | <i>tick-tock</i> |
| <i>flim-flam</i> | <i>pitter-patter</i> | <i>zig-zag</i> |

- (i) Can you think of a phonetic description of the regular pattern of sounds in these expressions?
- (ii) What kind of phonetic description might account for these other common pairings?

| | | |
|-----------------------|--------------------|----------------------|
| <i>fuddy-duddy</i> | <i>hocus-pocus</i> | <i>namby-pamby</i> |
| <i>fuzzy-wuzzy</i> | <i>hurly-burly</i> | <i>razzle-dazzle</i> |
| <i>hanky-panky</i> | <i>lovey-dovey</i> | <i>roly-poly</i> |
| <i>helter-skelter</i> | <i>mumbo-jumbo</i> | <i>super-duper</i> |

(For background reading, see chapter 6 of Pinker, 1994.)

■ Further reading

For another introduction to phonetics, see chapter 3 in Finegan (2004) or chapter 6 in Fromkin *et al.* (2003). Specialized textbooks are Catford (2002), Collins

& Mees (2003), Ladefoged (2001) or Roach (2001a), any of which can be consulted on rounded vowels, tense vowels, obstruents and sonorants. Detailed phonetic descriptions of different languages are included in the *Handbook of the International Phonetic Association* (1999). For more information on phonetic symbols, see Pullum & Ladusaw (1996), for a dictionary of technical terms, see Crystal (2003a) or Trask (1996a), and for a dictionary of pronunciation, see Roach *et al.* (2003), Wells (1990) or Upton *et al.* (2001). On American English pronunciation, see Kreidler (2004), and on British English pronunciation, see Cruttenden (2001). The phonetic description of disordered speech is explored in Ball (1993). On acoustic and auditory phonetics, see Denes & Pinson (1993), Ladefoged (1996) or Stevens (1998) and, on forensic phonetics, see Baldwin & French (1990), Gibbons (2003) or Hollien (1990).