CHAPTER 3

PHONETICS AND PHONOLOGY

III PHONETICS AND PHONOLOGY

Overview:

In chapter 2, we focussed on the study of meaning. The remaining chapters deal with the way the meaningful units discussed in chapter 2 are formed. We start by looking at the smallest elements of analysis in linguistics, i.e. sounds. Sounds are studied in the fields of phonetics and phonology. Phonetics is concerned with how sounds are produced, transmitted and perceived. Phonology is concerned with how sounds function in relation to each other in a language. In other words, phonetics is about sounds of language, phonology about sound systems of language. Phonetics is a descriptive tool necessary to the study of the phonological aspects of a language.

Phonetics and phonology are worth studying for several reasons. One is that as all study of language, the study of phonology gives us insight into how the human mind works. Two additional reasons are that the study of the phonetics of a foreign language gives us a much better ability both to hear and to correct mistakes that we make, and also to teach pronunciation of the foreign language (in this case English) to others.

As phonetics and phonology both deal with sounds, and as English spelling and English pronunciation are two very different things, it is important that you keep in mind that we are not interested in letters here, but in sounds (see also chapter 1, p. 6). For instance, English has not 5 or 6 but 20 different vowels, even if these vowels are all written by different combinations of 6 different letters, *a*, *e*, *i*, *o*, *u*, *y*. The orthographic spelling of a word will be given in italics, e.g. *please*, and the **phonetic transcription** between square brackets [pliːz]. Thus the word *please* consists of three consonants, [p], [l] and [z], and one vowel, [iː]. And sounds considered from the phonological point of view are put between slashes (i.e. /p/).

For the purposes of phonetic and phonological transcription, we will use the symbols given on the following page. These symbols are based on what is called the **International Phonetic Alphabet (IPA)**. To represent the sounds of all languages in the world about 200 symbols are needed. For English we use 44. In the following list, each sound symbol is accompanied by a word in which this sound occurs. Note however that illustrations for specific sound symbols may not always hold for all varieties of English. Pronunciation can vary across different varieties of English (cf. e.g. British English vs. American English), so a

given word may not always be transcribed in the same way in each variety. Our transcriptions will represent what is referred to as **Received Pronunciation (RP)**, i.e. the standard variety spoken in Great Britain (sometimes also called BBC or Oxford English).

List of symbols

1. *Consonants*

p	as in *pea*	b	as in *bee*
t	as in *toe*	d	as in *doe*
k	as in *cap*	g	as in *gap*
f	as in *fat*	v	as in *vat*
θ	as in *thing*	ð	as in *this*
s	as in *sip*	z	as in *zip*
ʃ	as in *ship*	ʒ	as in *measure*
h	as in *hat*		
tʃ	as in *chin*	dʒ	as in *gin*
		m	as in *map*
		n	as in *nap*
		ŋ	as in *hang*
		l	as in *led*
		r	as in *red*
		j	as in *yet*
		w	as in *wet*

2. *Vowels*

ɪ	as in *pit*	iː	as in *key*
e	as in *pet*	ɑː	as in *car*
æ	as in *pat*	ɔː	as in *core*
ʌ	as in *putt*	uː	as in *coo*
ɒ	as in *pot*	ɜː	as in *cur*
ʊ	as in *put*		
ə	as in *about*		
eɪ	as in *bay*	əʊ	as in *go*
aɪ	as in *buy*	aʊ	as in *cow*
ɔɪ	as in *boy*		
ɪə	as in *peer*		
eə	as in *pear*		
ʊə	as in *poor*		

You can now do exercises 1 to 5.

1. PHONETICS

If you have read or seen George Bernard Shaw's play *Pygmalion* or the musical *My Fair Lady*, you might already have some idea of what is done in phonetics. One of the principal characters in this play, Professor Henry Higgins, is a phonetician. Phonetics is the study of speech sounds. It is generally divided into three subfields:

(i) *Articulatory phonetics*: The study of how speech sounds are produced. To produce sounds we use parts of our chest, of our throat and of our head. Sound production is an extremely complex process in which the movements of more than 100 muscles have to be coordinated. But when we speak, we are entirely unaware of this complexity.

(ii) *Acoustic phonetics*: The study of the physical properties of the sound waves a speaker produces.

(iii) *Auditory phonetics*: The study of the way listeners perceive sounds. This includes the study of hearing mechanisms, and of how the brain receives and processes phonetic information.

In our discussion of phonetics in this section, we will focus on **articulatory phonetics**.

1.1. The speech organs

In order to study the production of speech sounds, we have to consider some aspects of human anatomy. All the organs shown in Figure (1) contribute to the production of speech.

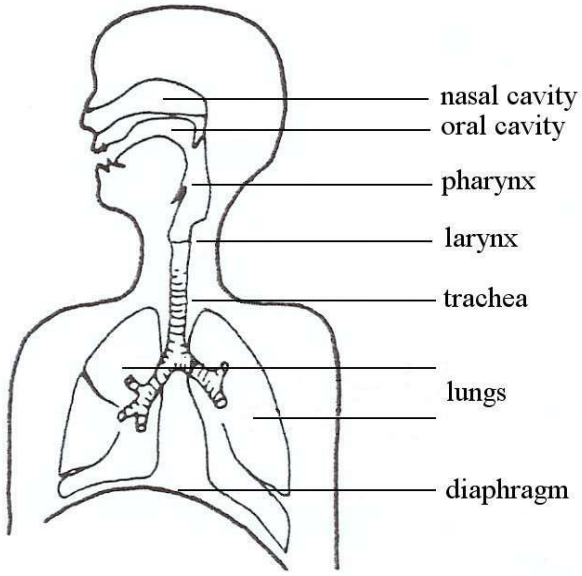


Figure 1: *The speech organs*

All the sounds of English are made using air on its way out from the lungs. The lungs pull in and push out air, helped by the diaphragm. Speech is therefore sometimes described as "modified breathing". The differences between speech and regular breathing are the following: (a) The breathing rhythm is changed. During speech, inhalation is more rapid and exhalation is much more drawn out. The number of breaths therefore decreases. (b) During

quiet breathing, the air generally flows freely whereas during speech the airflow encounters obstructions in various places. The first potential obstruction the air meets is the larynx. Inside the larynx the air passes by the vocal folds, which, if they are closed, vibrate and make the sound voiced. Afterwards the air goes up through the pharynx and escapes via the oral or the nasal cavity. Figure (2) illustrates airflows with and without involvement of the nasal cavity. Circle the parts that are modified in B to produce nasal sounds.

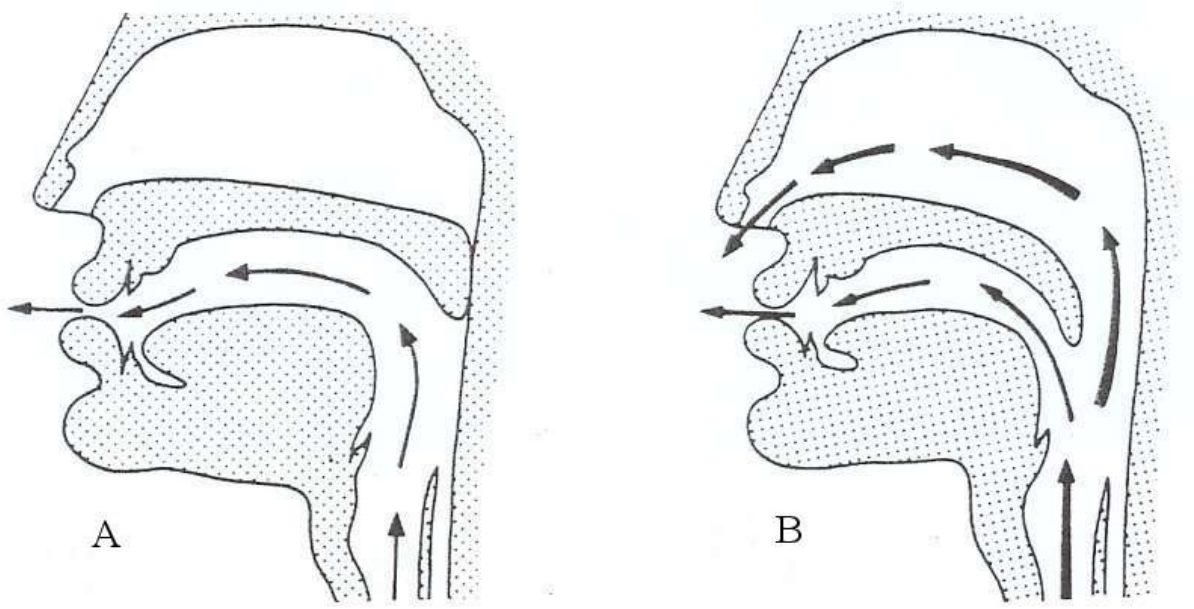


Figure 2: *The production of oral and nasal sounds* (Thomas 1976: 32)

After the larynx the airflow can be modified in four places. These different places are shown in Figure (3).

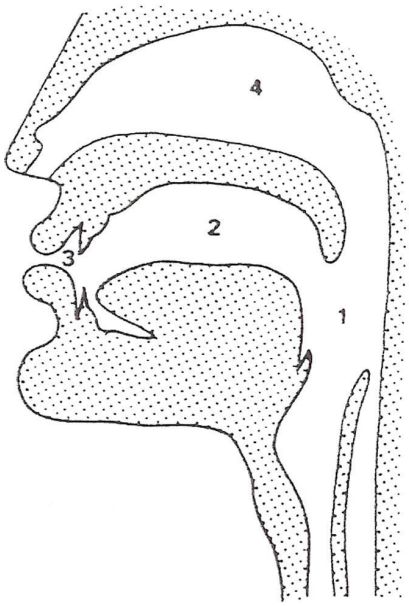


Figure 3: *Places of sound modification* (Thomas 1976:33)

Almost all the organs involved in speech production also have other functions. The lungs and the diaphragm are obviously involved in breathing, as is the nasal cavity, which cleans, heats and humidifies the air that is breathed in. The teeth and the tongue play a part in manipulating and breaking up food for digestion. Finally, the vocal folds prevent food from entering the lungs when they are closed.

You can now do exercises 6 and 7.

1.2. Consonants

Let us now consider sound production in some more detail. On the way out of the lung, the airflow can be more or less obstructed, producing a consonant, or is simply modified, giving a vowel. If you pronounce the first sound of the word *paper* you close your mouth completely and that is the utmost obstruction, whereas if you pronounce the first sound of the word *after* the mouth is more open than normally and the air flows as freely as it possibly can.

Consonants are often classified by being given a so-called VPM-label. VPM stands for three properties of sound production, namely Voicing, Place and Manner:

- Voicing means that the vocal folds are used. If they are not used, the sound is voiceless. Note that the production of vowels always implies the use of vocal folds.
- Place of articulation is the place where the airflow is obstructed.
- Manner is concerned with the nature of the obstruction.

1.2.1. *Voicing*

The larynx is in the neck, at a point commonly called Adam's apple. It is like a box, inside which are the vocal folds, two thick flaps of muscle. In a normal position, the vocal folds are apart and we say that the glottis is open (Figure 4a). When the edges of the vocal folds touch each other, air passing through the glottis will usually cause vibration (Figure 4b). This opening and closing is repeated regularly and gives what is called voicing.

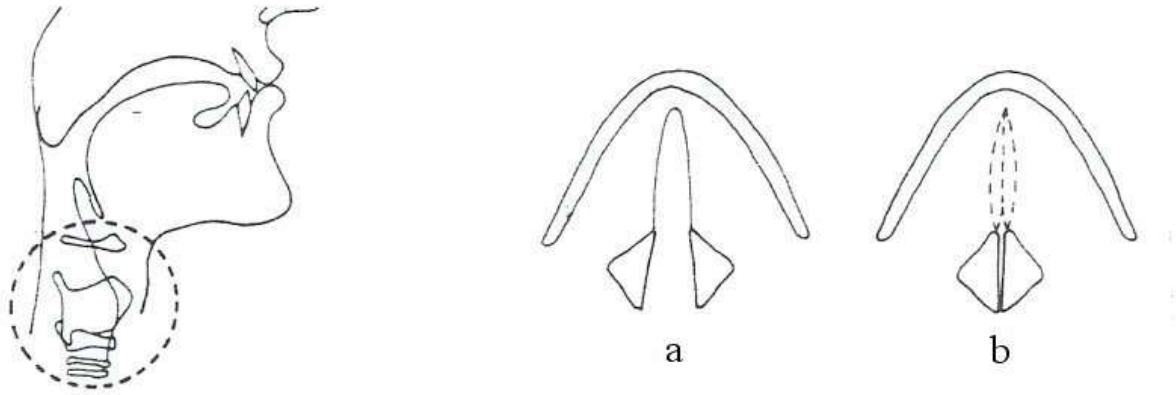


Figure 4: *Voicing* (Roach 1983:23/25)

The only distinction between the first sounds of *seal* and *zeal* for example is that [s] is voiceless, [z] is voiced. The same goes for *feel* and *veal*. [f] is voiceless, [v] is voiced. If you now say [sssssszzzzzsssss] or [fffffvvvvvfffff] you can either hear the vibrations of the [zzzzz] or [vvvvvv] by sticking your fingers into your ears, or you can feel them by touching the front of your larynx (the Adam's Apple).

This distinction is quite important in English, as there are many pairs of sounds that differ only in voicing. In the examples below the first sound is voiceless, the other is voiced: *pie/buy*, *try/dry, clue/glue*, *chew/Jew*, *thigh/thy*. This distinction can also be made between two vowels: *rapid/rabid*, *metal/medal*, or at the end of a word: *pick/pig*, *leaf/leave*, *rich/ridge*.

In English the consonants in (1a) below are voiced, and the consonants in (1b) are voiceless.

(1) a. [b, d, g, v, ð, z, ʒ, l, r, j, w, dʒ, m, n, ŋ]
b. [p, t, k, f, θ, s, ʃ, h, tʃ]

You can now do exercises 8 and 9.

1.2.2. *Place of articulation*

As we saw above [p, t, k] are all voiceless, so there must be another way to distinguish them, otherwise we would not be able to tell *try* apart from *pry* or *cry*, or *pick* from *tick* or *kick*. Apart from the behaviour of the vocal folds, sounds can also be distinguished as to where in the oral cavity they are articulated, i.e. where in the mouth we can observe the highest degree of obstruction when they are pronounced.

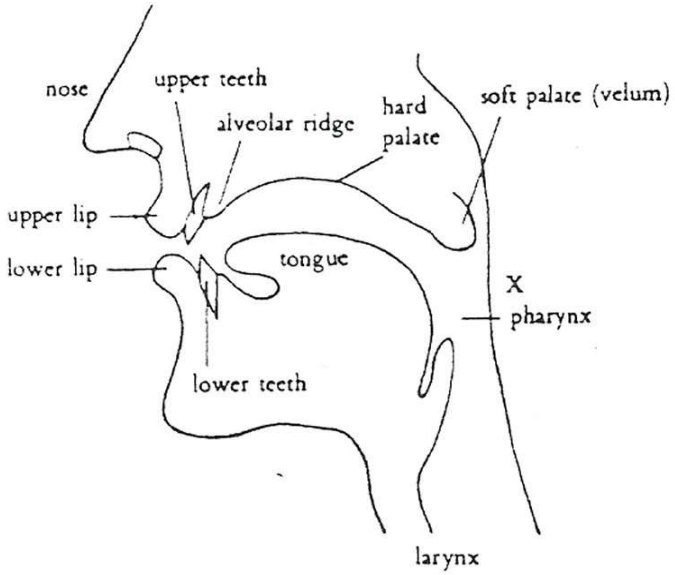
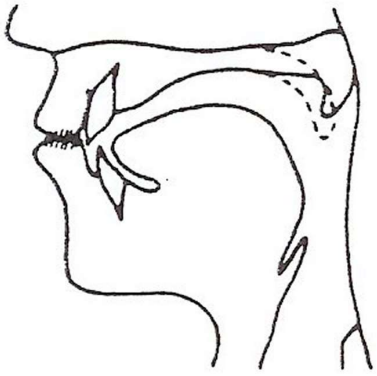
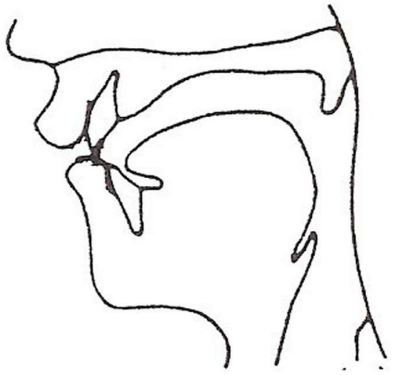


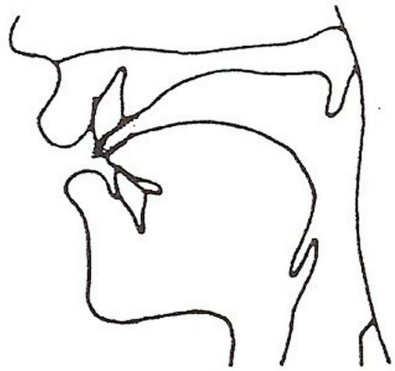
Figure 5: *The articulators* (Roach 1983:8)



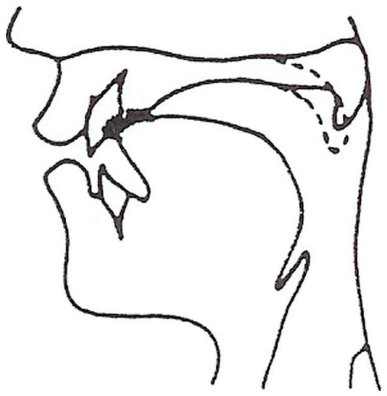
Bilabial sounds are produced when the lips are brought together. Examples are [p], which is voiceless, as in *pay*, or [b] and [m], which are voiced, as in *bay* and *may*.



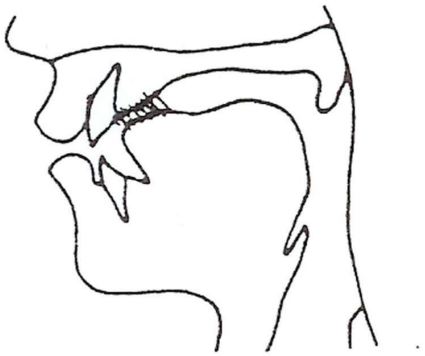
Labiodental sounds are made when the lower lip is raised towards the upper front teeth. Examples are [f] (*safe* – voiceless) and [v] (*save* – voiced).



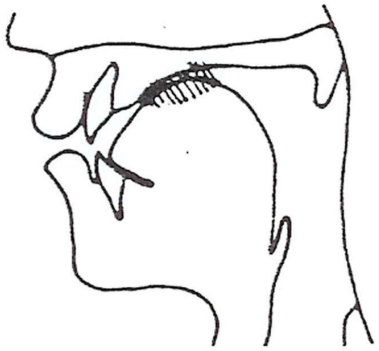
Dental sounds are produced by touching the upper front teeth with the tip of the tongue. Examples are [θ] (*oath* – voiceless) and [ð] (*clothe* – voiced).



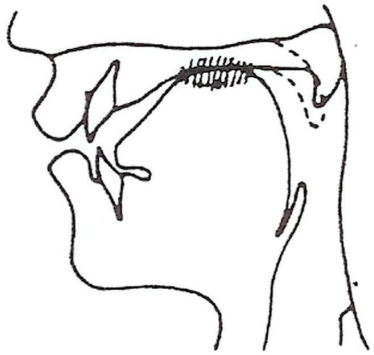
Alveolar sounds are made by raising the tip of the tongue towards the ridge that is right behind the upper front teeth, called the alveolar ridge. Examples are [t, s] (*too*, *sue* – both voiceless), and [d, z, n, l, r] (*do, zoo, nook, look, rook* – all voiced).



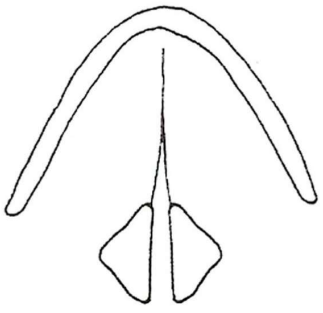
Palatoalveolar sounds are produced by raising the blade of the tongue towards the part of the palate just behind the alveolar ridge. Examples [ʃ, tʃ] (*pressure*, *batch* – voiceless) and [ʒ, dʒ] (*pleasure*, *badge* – voiced).



Palatal sounds are very similar to palatoalveolar ones, they are just produced further back towards the velum. The only palatal sound in English is [j] as in *yes*, *yellow*, *beauty*, *new* and it is voiced.



Velar sounds are made by raising the back of the tongue towards the soft palate, called the velum. Examples: [k] as in *back*, voiceless, and [g, ŋ] as in *bag*, *bang*, both voiced. [w] is a velar which is accompanied by lip rounding. Given that both the velum and the lips are involved in the production of [w], this sound is often also referred to as **labial-velar**.



Glottal sounds are produced when the air passes through the glottis as it is narrowed: [h] as in *high*.

Figures 6 to 13: *Places of articulation*

You can now do exercises 10 and 11.

1.2.3. *Manner of articulation*

We can now distinguish between English consonants from two points of view, that of voicing and that of place. We can see that [b] and [t] are different in both respects, [b] is voiced and bilabial, and [t] is voiceless and alveolar. [p] differs from [b] only in being voiceless, as both are bilabial, and [p] differs from [t] only in being bilabial, as both are voiceless.

There are still pairs of sounds where we cannot yet describe the difference in production between the two, e.g. [b] and [m] (*bend*, *mend*) as both are voiced and bilabial, and [t] and [s] (*ton*, *son*) which are both voiceless and alveolar. As the examples show, we can however tell the words apart, and this is because the sounds are different in a way we have not yet discussed, and that is with respect to their manner of articulation.

The manner of articulation has to do with the kind of obstruction the air meets on its way out, after it has passed the vocal folds. It may meet a complete closure (plosives), an almost complete closure (fricatives), or a smaller degree of closure (approximants), or the air might escape in more exceptional ways, around the sides of the tongue (laterals), or through the nasal cavity (nasals).

Plosives (also sometimes called **stops**) are sounds in which there is a complete closure in the mouth, so that the air is blocked for a fraction of a second and then released with a small burst of sound, called a plosion (it sounds like a very small explosion). Plosives may be bilabial like [p] and [b] (*park*, *bark*), alveolar like [t] and [d] (*tar*, *dark*) or velar [k] and [g] (*car*, *guard*). There is a fourth kind of plosive, the glottal stop. The word *football* can be pronounced without interruption in the middle as in [fʊtbɔːl] or with a complete closure of the glottis instead of [t]: [fʊʔbɔːl].

In English a voiceless plosive that occurs at the beginning of a word and is followed by a vowel is rather special in the sense that at the release of a plosion one can hear a slight puff of air (called aspiration) before the vowel is articulated. Hence, in *pen* we hear [p^{h}en]. These aspirated voiceless plosives are not considered to be different sounds from unaspirated voiceless plosives from the point of view of how they function in the sound system. This difference, which can be clearly heard, is said to be phonetic. We will discuss this point in more detail in section 2.1 below.

Fricatives have a closure which is not quite complete. This means that the air is not blocked at any point, and therefore there is no plosion. On the other hand the obstruction is big enough for the air to make a noise when it passes through it, because of the friction. This effect is similar to the wind whistling around the corner of a house. Fricatives may be labio-dental like [f] and [v] (*wife*, *wives*), dental like [θ] and [ð] (*breath*, *breathe*), alveolar like [s] and [z] (*sink*, *zinc*), palato-alveolar like [ʃ] and [ʒ] (*nation*, *evasion*), or glottal like [h] (*help*). [h] is a glottal fricative. As it has no closure anywhere else, and as all air passes between the vocal folds, this means that [h] is like aspiration unaccompanied by any obstruction.

Affricates are a combination of a plosive and a fricative (sometimes they are called "affricated plosives"). They begin like a plosive, with a complete closure, but instead of a plosion, they have a slow release, with the tongue moving backwards to a place where a friction can be heard (palatoalveolar). The two English affricates are both palatoalveolar: [tʃ], which is voiceless (*chin*, *rich*), and [dʒ], which is voiced (*gin*, *ridge*). The way an affricate

resembles a plosive followed by a fricative is mirrored in the symbols. Both consist of a plosive symbol followed by a fricative one ([t+ʃ], [d+ʒ]).

Nasals resemble plosives in that there is a complete closure in the mouth. But as the velum is lowered the air can escape through the nasal cavity. Though most sounds are produced with the velum raised, the normal position for the velum is lowered, as this is the position for breathing (your velum is probably lowered right now when you are reading this). The three English nasals are all voiced, and [m] is bilabial (*ram*), [n] is alveolar (*ran*) and [ŋ] is velar (*rang*). In the section on places of articulation, the dotted lines on the pictures of bilabial, alveolar, and velar articulations illustrate the three nasals.

Laterals are sounds where the air escapes around the sides of the tongue. There is only one lateral in English, [l], a voiced alveolar lateral. It occurs in two versions, the so-called "clear *l*" before vowels (e.g. *light*, *long*) and the "dark *l*" in other cases (*milk*, *ball*). Words like *little* or *lateral* have one of each type. Dark *l* is written with the symbol [ɬ]. Clear *l* is pronounced with the top of the tongue raised, whereas for dark *l* it is the back of the tongue which is raised. Here again, as with aspirated and unaspirated voiceless plosives, even though clear *l* and dark *l* are phonetically different, they cannot be said to be different sounds from the point of view of how they function in the sound system. If you produce a dark *l* where usually you have a clear *l*, for example at the beginning of the word *long*, your pronunciation will sound odd but nobody will understand a different word (cf. also sections 2.1 and 2.3.3 below).

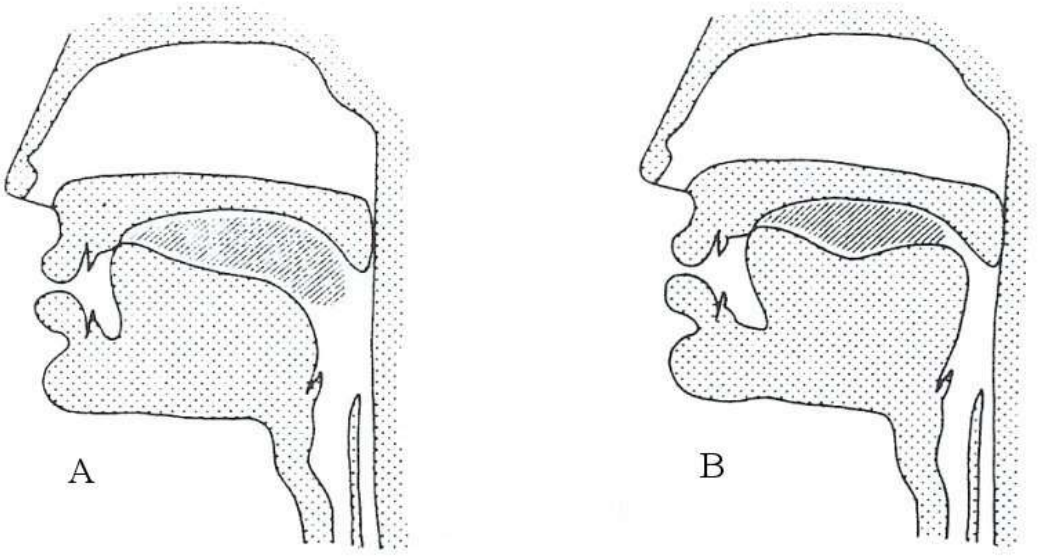


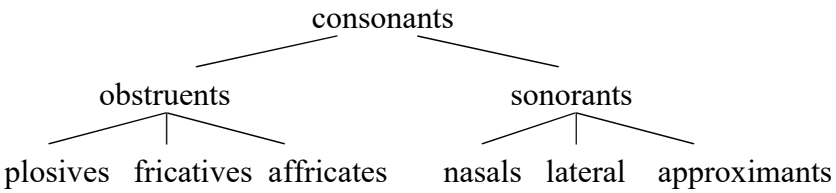
Figure 14: *Clear and dark* l. (Thomas 1976:44)

Approximants are sounds where the tongue only approaches the roof of the mouth, so that there is not enough obstruction to create any friction. English has three approximants, which are all voiced. [r] is an alveolar sound (*right*, *brown*). Sometimes the place of articulation of [r] is also called post-alveolar because [r] is produced slightly further back than the other alveolar sounds ([t], [d], [s], [l]). The other two approximants are [j] and [w]. [j] is a

palatal approximant (*use*, *youth*) and [w] is a velar (or more precisely a labial-velar) approximant (*why*, *twin*, *square*).

[r] only occurs before vowels in Received Pronunciation, whereas other accents, e.g. Scottish, Irish, and most varieties of American English, can also have [r] after vowels. Therefore the latter accents can make a distinction between e.g. *saw* and *sore*, which are pronounced exactly alike in Received Pronunciation.

The manners of articulation can be put into two major groups, obstruents and sonorants. The obstruents are plosives, fricatives and affricates, i.e. all sounds with an increased air pressure due to strong obstruction. Obstruents usually come in pairs, one voiceless, one voiced, e.g. [p, b] or [t, d]. With sonorants, the air stream exits in a relatively unhindered fashion and there is therefore only a small increase in the air pressure. Furthermore, sonorants are all voiced and therefore more sonorous. They include nasals, the lateral and approximants. The manners of articulations can thus be grouped as shown in the following diagram:



You can now do exercises 12 to 14 (reconsider also exercises 6 and 7 on nasals).

1.2.4. *Table of consonants*

The discussion on consonants above can be summarised in the table below. A sound on the left-hand side of a column is voiceless, one on the right-hand side is voiced.

	Bilabial	***Labiodental***	***Dental***	***Alveolar***	***Palato-alveolar***	***Palatal***	***Velar***	***Glottal***
Plosive	p b			t d			k g	
Fricative		f v	θ ð	s z	ʃ ʒ			h
Affricate					tʃ dʒ			
Nasal	m			n			ŋ	
Lateral				l				
Approximant				r		j	w	

1.3. Vowels

In this section, we will consider the phonetic properties of vowels. We will start by having a closer look at the way in which vowels differ from consonants. Then we will analyze vowels phonetically, i.e. according to:

- Tongue position: How high in the mouth is the tongue, and which part of the tongue is the highest?

- Length: Are the vowels long or short?
- Rounding: Are the lips rounded or not?
- Nasality: Is there free passage of air through the nose?
- Diphthongs: Is the vowel steady, or does it somehow change in character?

1.3.1. *Difference from consonants*

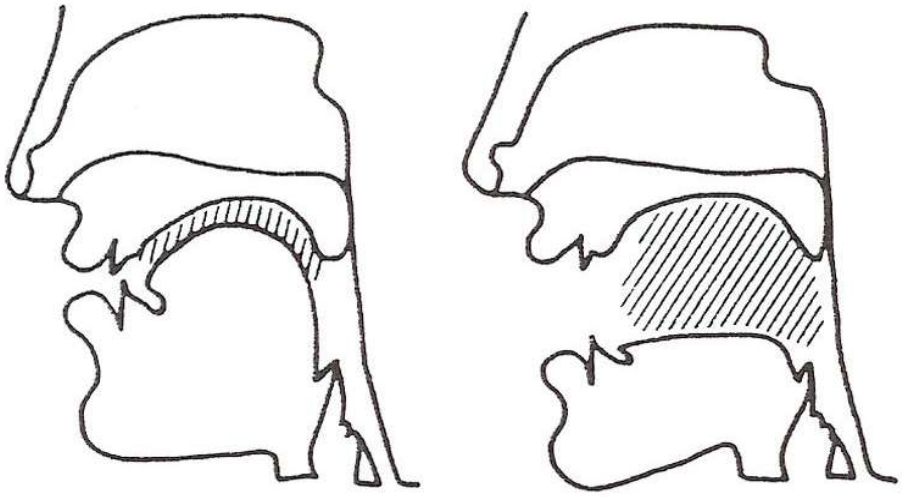
Even though all the languages of the world contain both vowels and consonants, and although almost everybody has some idea of whether a given sound is a vowel or a consonant in his or her language, there is actually more than one way to distinguish between the two classes of sounds. From a **phonetic** point of view one way of distinguishing is by considering which sounds have the highest degree of obstruction. Vowels are produced without radical obstruction of the airflow from the lungs, whereas most consonants have a high degree of obstruction (obstruents, nasals, and the lateral). However, there is a group of consonants (the approximants) which would have to be classified as vowels if this criterion was used alone: the production of approximants does not seem to give rise to more obstruction than the production of vowels. This can be seen by comparing the approximant [j] in *yeast* [jiːst] with the vowel [iː] in *east* [iːst].

From a **phonological** point of view, it is possible to distinguish between vowels and consonants by testing which sounds may be the nucleus of a syllable, i.e. the part of a syllable that cannot be left out. If you consider a syllable such as [kɑːt] (*cart*), the initial [k] may be left out and we still have a syllable, [ɑːt] (*art*). The final [t] may also be left out and we still have a syllable, [kɑː] (*car*). In fact [k] and [t] may both be left out, and the remainder is still a syllable, [ɑː] (*are*). If, however, you try to leave out the vowel, then we do not obtain a possible syllable anymore: *[kt]. [aː] is thus the sound that cannot be left out. Consider now the status of the initial sounds in *yeast* again. Whereas [j] can be left out, giving [iːst], the omission of [iː] is not possible: *[jst]. Syllabicity thus seems to be the most adequate criterion to determine whether a sound is a vowel or a consonant.

The above discussion would not be complete if we did not mention the problem of so-called **syllabic consonants**. This problem arises when sounds like [r], [l] or [n] function as a separate syllable consisting of a single sound, as in [kɒtn̩] (*cotton*) or [æpl̩] (*apple*), where English speakers clearly hear two separate syllables. In these words, [n] and [l] seem to function as the nucleus of the second syllable. However they cannot be classified as vowels, as they can never occur alone as a word. We will return to the issue of syllabic consonants and syllabification in more detail in section 2.3.

1.3.2. *Tongue position*

Tongue position is described in terms of two properties: height (How high is the tongue?) and location (Which part of the tongue is highest?). With respect to height, we can observe that in English the tongue may be either **high**, as for example when a speaker produces [iː] as in [biːt] (*beat*) or [uː] as in [buːt] (*boot*), **mid**, as with [e] in [bet] (*bet*) or [ɔː] in [bɔːt] (*bought*) or **low**, as with [æ] in [bæt] (*bat*) or [ɑː] in [bɑːt] (*Bart*).



(a) *Tongue is at the highest.* (b) *Tongue is at the lowest.*

Figure 15: *Tongue height* (Thomas 1976:56)

Depending on the language we can have several intermediate tongue heights. Whereas English has three heights (high, mid, low), French has two intermediate tongue heights with a total of four tongue heights: high, mid high, mid low and low.

The second property defining vowels concerns the part of the tongue that is highest in the production of the sound. If you say for example [iː] and then [uː] just after it, you almost have the feeling that you are moving your tongue backwards. This is because the highest point in the pronunciation of [iː] is the front of the tongue, whereas the highest point in [uː] is the back of the tongue. [iː] is therefore called a **front** vowel, and [uː] is a **back** vowel. Figure (16) shows two different tongue positions. Illustration (a) is an example of the front of the tongue being at the highest. In (b), it is the back of the tongue which is nearest to the palate.

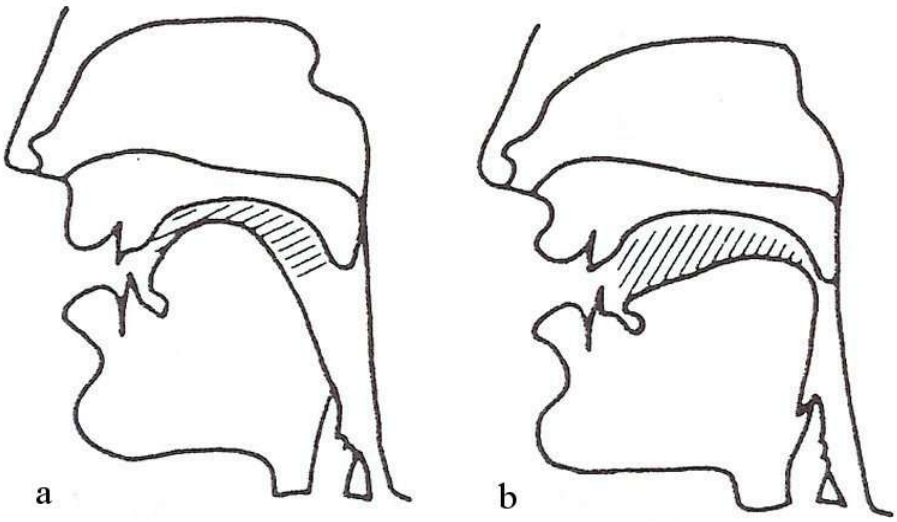
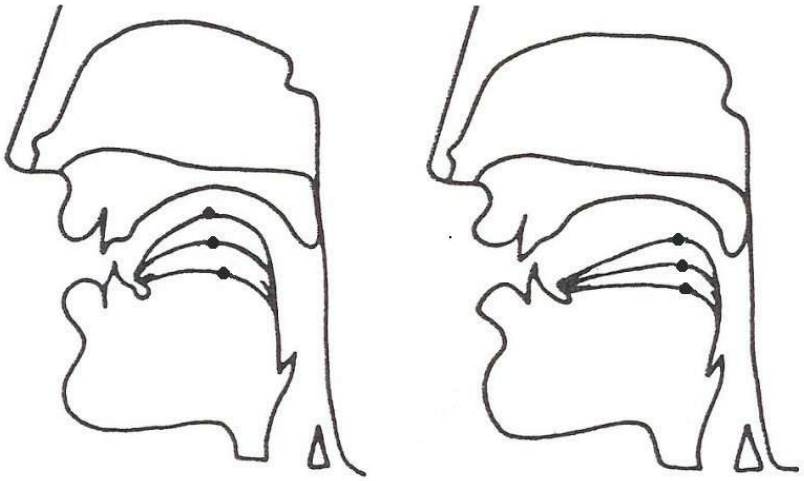


Figure 16: *Tongue position* (Thomas 1976:56)

Other illustrations of front vowels are [e] and [æ] whereas [ɔ:] and [ɑ:] are both additional back vowels. There are also vowels where the highest point of the tongue is between front and back. These are called **central** vowels. Examples of central vowels are [ɜ:], [ə] and [ʌ] as in [wɜ:d], [əwɔ:d] and [mʌd] (*word*, *award*, *mud*). [ɜ:] for instance is between [e] and [ɔ:], as can be seen in [bed] – [bɜ:d] – [bɔ:d] (*bed*, *bird*, *board*).

To give an accurate account of tongue position one has to combine height of the tongue and part of the tongue involved.



(a) Height for front vowels (b) Height for back vowels

Figure 17: *Tongue height and position* (Thomas 1976:57)

If you put Figures (17a) and (17b) together and isolate tongue position, you get the following diagram:

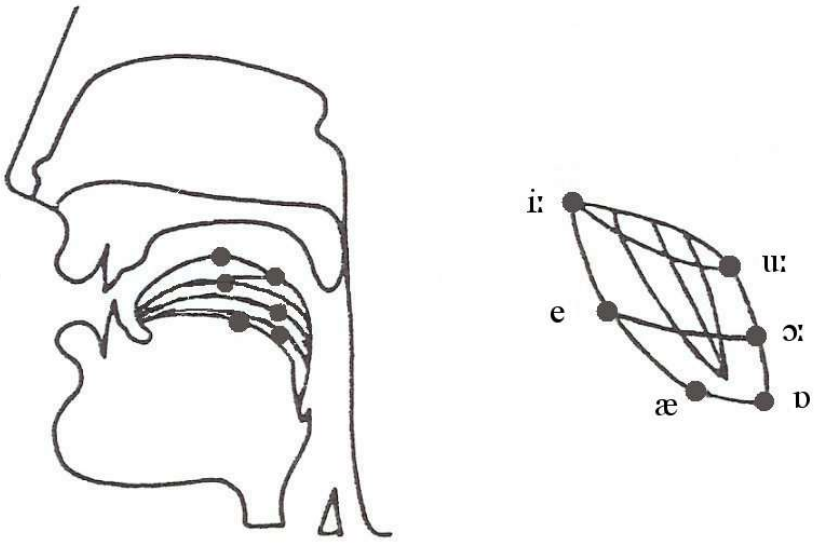


Figure 18: *Vowel diagram* (Thomas 1976:57)

The diagram in Figure 18 is conventionalised as shown in Figure 19.

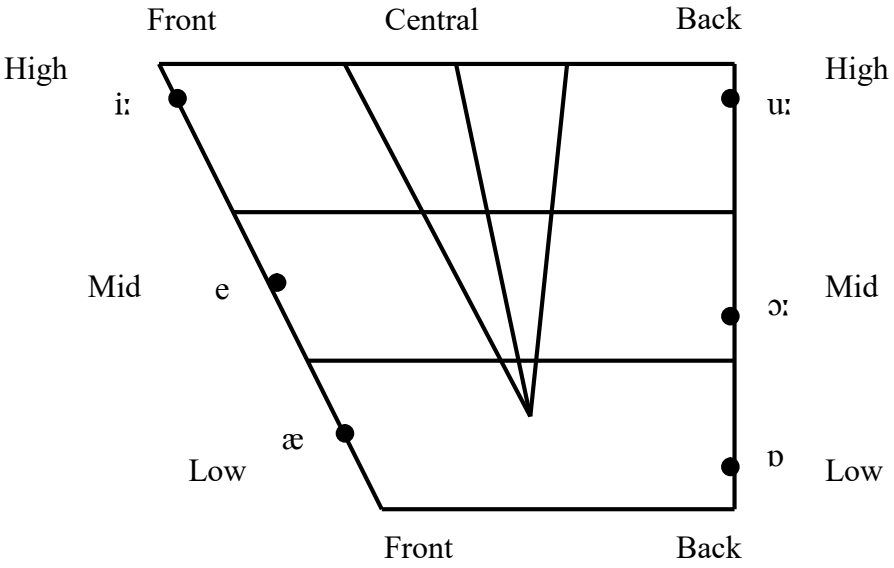


Figure 19: *Conventionalised diagram* (Thomas 1976:57)

The complete diagram of English vowels is shown in the following Figure:

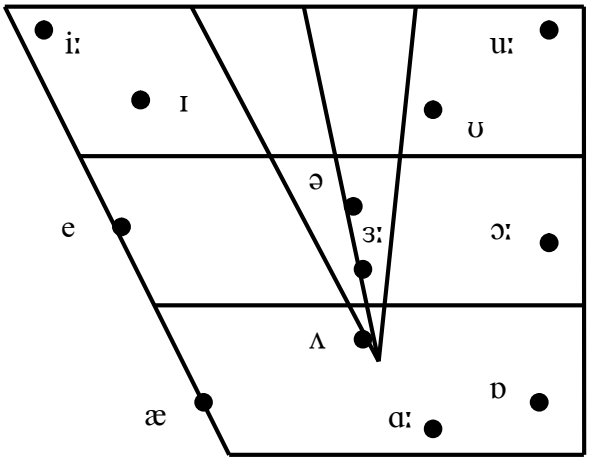


Figure 20: *Diagram of English vowels*

You can now do exercises 15 and 16.

1.3.3. *Length*

As you may have seen, there are two types of [i] sound in English placed in two different positions. However for the purposes of description, what is relevant is not the difference of position but that of the perceived length of the vowel. Thus it is said that [iː] is a long vowel and [ɪ] is a short one. The same is valid for [uː]/[ʊ], [ɜː]/[ə], [ɔː]/[ɒ]. Symbols for long vowels all have a colon.

Phonologically, one can establish the rule that only long vowels may be the last sound of a syllable in English, whereas short vowels are always followed by at least a consonant. If we take away the final [t] from *court*, [kɔː] is a possible syllable (*core*) whereas [kɒ] could not possibly occur. Exceptions to this rule are the three short vowels that occur in completely unstressed syllables in words such as [sɪtɪ], [ɪntʊ], or [swetə] (*city*, *into*, *sweater*).

You can have another look at exercise 3a.

1.3.4. *Rounding*

Vowels may also be different from each other with respect to rounding. If you compare [iː] in [tʃiːz] *cheese* with [uː] in [tʃuːz] *choose*, you will see that not only is [iː] a front vowel and [uː] a back vowel, but [iː] is also unrounded where [uː] is rounded. When pronouncing [uː] your lips are rounded, but when pronouncing [iː] the corners of the mouth are much further apart.

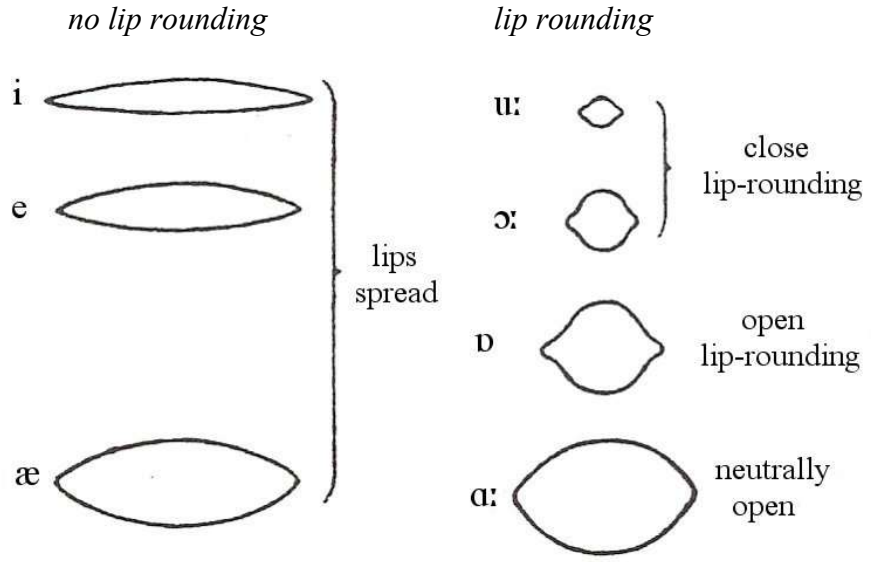


Figure 21: *Rounding* (McCarthy 1967:31)

1.3.5. *Nasality*

There are no nasal vowels in Received Pronunciation, i.e. no vowels in which the air also escapes through the nose.

1.3.6. *Diphthongs*

So far we have only been considering vowels that were constant, i.e. vowels that were pronounced at one and the same place. Such vowels are called monophthongs, and English has 12 of them.

English also has 8 diphthongs, which are vowels that change character during their pronunciation, that is, they begin at one place and move towards another place. Compare for

example the monophthong in *car* with the diphthong in *cow*, or the monophthong in *girl* with the diphthong in *goal*. The vowels of *cow* and *goal* both begin at a given place and glide towards another one. In *goal* the vowel begins as if it were [ə], but then it moves towards [ʊ]. Therefore it is written [əʊ], as in [gəʊl] *goal*, with two symbols, one for how it starts and one for how it ends.

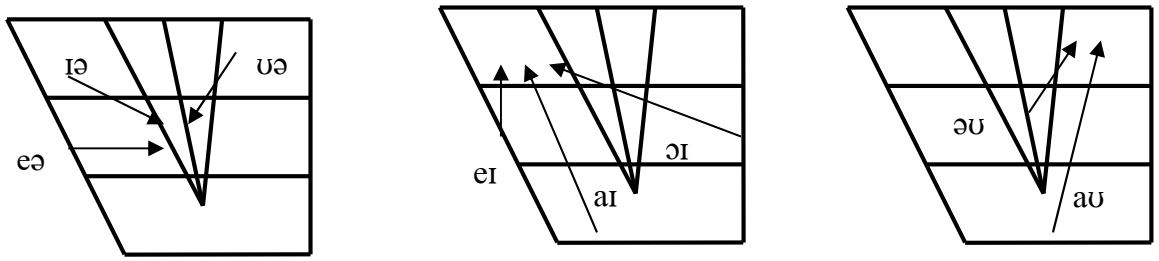
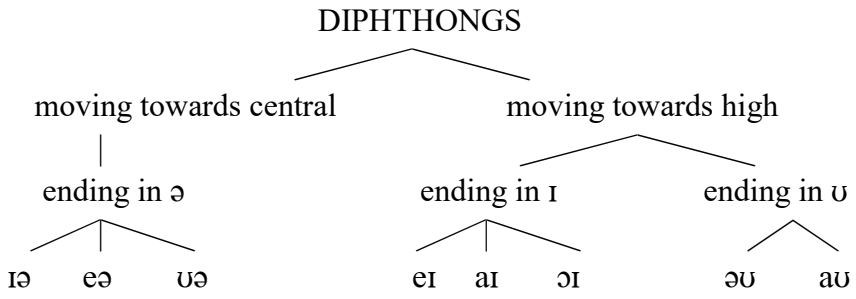


Figure 22: *Diphthongs*

The easiest way to remember diphthongs is in terms of three groups composed as follows:



Note that some people speak of triphthongs for groups of diphthongs + schwa (ə) Example: [məʊə] *mower*.

You can now do exercise 17.

1.3.7. *Summary of vowels*

As we saw above, the best way of defining the tongue position is by using the vowel diagrams (page 83), but as they do not contain information about length and rounding, we can summarize the description of English vowels as shown in the list on the following page.

iː	long high front unrounded monophthong
ɪ	short high front unrounded monophthong
e	short mid front unrounded monophthong
æ	short low front unrounded monophthong
ʌ	short low central unrounded monophthong
ɑː	long low back unrounded monophthong
ɒ	short low back rounded monophthong
ɔː	long mid back rounded monophthong
ʊ	short high back rounded monophthong
uː	long high back rounded monophthong
ɜː	long mid central unrounded monophthong
ə	short mid central unrounded monophthong

eɪ	diphthong moving from mid front unrounded to high front unrounded
aɪ	diphthong low central unrounded to high front unrounded
ɔɪ	diphthong low back rounded to high front unrounded
əʊ	diphthong mid central unrounded to high back rounded
aʊ	diphthong low central unrounded to high back rounded
ɪə	diphthong high front unrounded to mid central unrounded
eə	diphthong mid front unrounded to mid central unrounded
ʊə	diphthong high back rounded to mid central unrounded

TP EXERCISES PHONETICS

Phonetic symbols

1. Phonetic symbols

Find the phonetic symbol for the first sound in each of the following words:

a. this
b. usual
c. church
d. christian
e. thousand
f. psychology
g. knee
h. hear
i. phonetics
j. giant
k. one

2. Phonetic symbols

Find the phonetic symbol for the last sound in each of the following words:

a. tough
b. kicked
c. loved
d. health
e. dog
f. shapes
g. bones
h. parking
i. wave
j. large

3. Vowels

Put the following words into the corresponding columns.

a. ill – eel – kneel – nil – will – wheel – field – bean – filled – bin – ski – sick

ɪ	iː
sit	*seat*

b. caught – two – lawn – tall – pot – moth – cough – do – through – thought

ɔː	ɒ	uː
call		

c. horse – owe – coal – own – torn – mow – scowl – brow – wall – now – paw – found

ɔː	əʊ	aʊ

4. Phonetic transcription

Find the mistakes:

[craɪm] [θiːz] [sɪxtɪ] [yeləʊ]

[wɪslɪŋg] [jækɪt] [waɪvs]

5. Phonetic transcription

Transcribe the following text into orthographic spelling

mɪstə bɪŋlɪ wɒs gʊd lʊkɪŋ ænd dʒentlmənlaɪk   hɪ hæd ə pleznt kaʊntənəns ænd iːzɪ ʌnəfektɪd mænəz   hɪz sɪstəz wə faɪn wɪmɪn wɪð ən eər əv dɪsaɪdɪd fæʃən   hɪz brʌðərɪnlɔː mɪstə hɜːst mɪəlɪ lʊkt ðə dʒentlmən, bʌt hɪz frend mɪstə dɑːsɪ suːn druː ðɪ ətenʃən əv ðə ruːm baɪ hɪz faɪn tɔːl pɜːsn hændsəm fiːtʃəz nəʊbl miːn ænd ðə rɪpɔːt wɪtʃ wɒz ɪn dʒenərəl səkjʊleɪʃən wɪðɪn faɪv mɪnɪts ɑːftə hiz entrəns əv hɪz hævɪŋ ten θaʊzənd ə jɪə   ðə dʒentlmen prəʊnaʊnst hɪm tə biː ə faɪn fɪgər əv ə mæn   ðə leɪdɪz dɪkleəd hɪ wɒz mʌtʃ hændsəmə ðən mɪstə bɪŋlɪ ænd hɪ wɒz lʊkt æt wɪð greɪt ædmɪreɪʃən fɔː əbaʊt hɑːf ðɪ iːvnɪŋ

(Jane Austen, *Pride and Prejudice*, chapter 3)

Section 1.1.

6. Nasal sounds

Among the following words tick those which start with a nasal sound:

a. know
b. mother
c. another
d. power
e. tea
f. kill
g. mare
h. gnaw
i. look
j. go
k. beer
l. dear
m. near
n. pneumonia

7. Nasals and their non-nasal counterparts

All the nasal sounds have a non-nasal counterpart. In the following series add the missing sound:

e.g.	pæn	bæn	mæn
	tɪl	dɪl	…ɪl
	lɒg	lɒ…	lɒ…

Now find the missing word:

bæt	mæt	…
nɪə	dɪə	…
bɪd	bɪt	…
bæg	bæŋ	…
læm	læb	…
hæk	hæg	…

Section 1.2.

8. Voicing

Put the following words into two columns according to whether their consonant is voiced or not:
eight – do – here – pea – eager – ad – bay – tea – zoo – sew – thigh – of – off – the – she – edge

+voice	-voice

b. For each word in the column *+voice* find the word in the other column whose consonant is the voiceless counterpart.

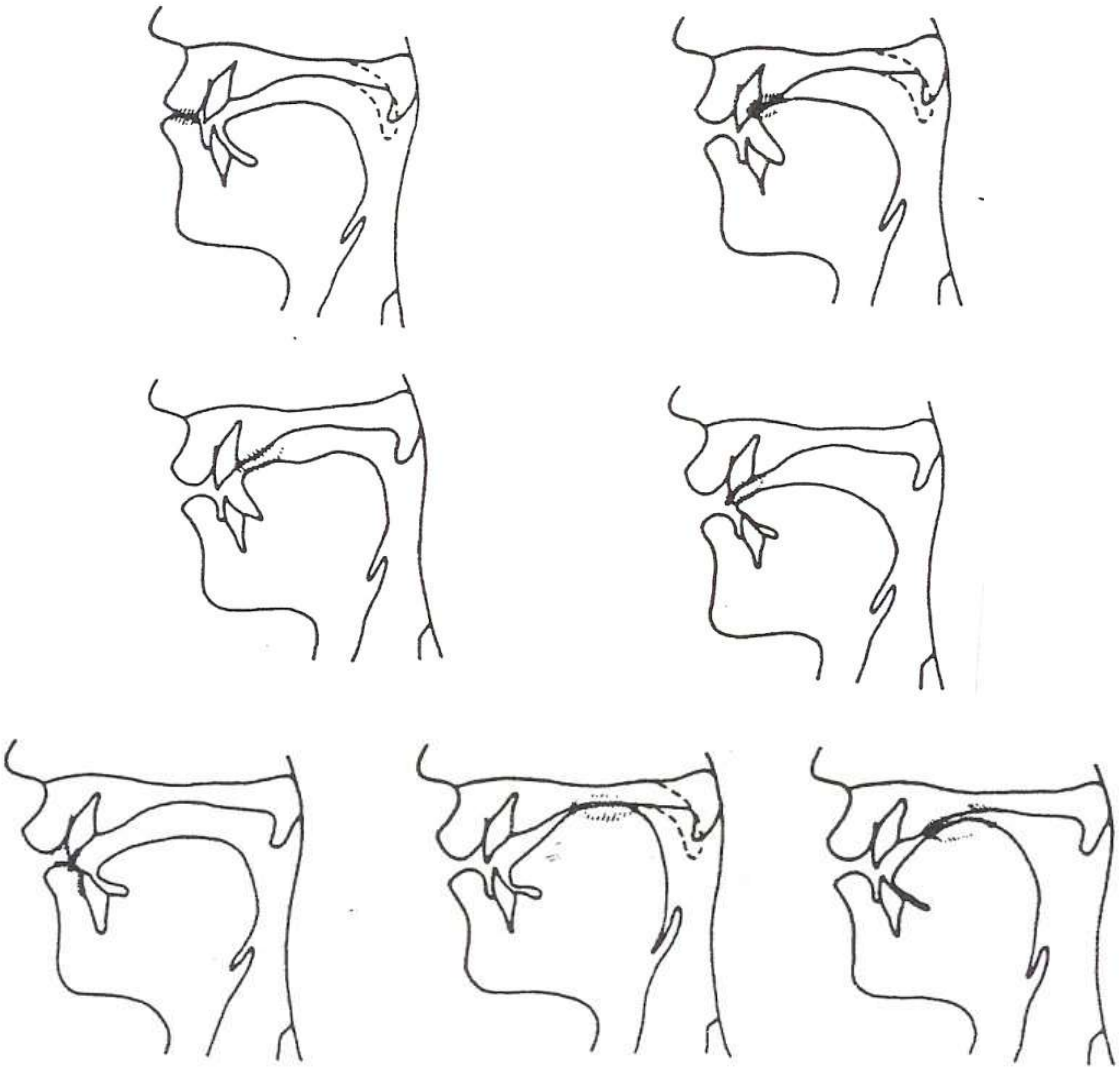
9. Voicing

Underline the words in which the second consonant is voiced.

tracking	mother	robber	leisure	massive
stomach	razor	column	thief	lighter

10. Places of articulation

Each of the following figures represents a different place of articulation.
a. Can you name them?



b. Can you list the sounds that are produced at each of these places?

c. For each of these sounds, give a word in which it appears.

11. Places of articulation

a. Underline the words that begin with a bilabial consonant.
   mat gnat sat bat rat pat
b. Underline the words that begin with a velar consonant.
   knot got lot cot hot pot
c. Underline the words that begin with a labiodental consonant.
   fat cat that mat chat vat

d. Underline the words that begin with an alveolar consonant.
zip nip lip sip tip dip
e. Underline the words that begin with a dental consonant.
pie guy shy thigh thy high
f. Underline the words that begin with a palato-alveolar consonant.
sigh shy tie thigh thy lie

12. Manner of articulation

a. Underline the words that end with a fricative.
race wreath bush bring breathe bang
rave real ray rose rough
b. Underline the words that end with a nasal.
rain rang dumb deaf
c. Underline the words that end with a plosive.
pill lip lit graph crab
dog hide laugh back
d. Underline the words that begin with a lateral.
nut lull bar rob one
e. Underline the words that begin with an approximant.
we you one run
f. Underline the words that end with an affricate.
much back edge ooze

13. Manner of articulation

a. Put the following words in the relevant column according to the manner of articulation of the underlined consonant.
sɪstə**m**, sɪlə**b**əl, meɪ**l**, kɒndə**z**, vaʊəlɪ**ŋ**, **f**əʊniːmɪk, leŋ**θ**, st**r**es, tiː**tʃ**ə, me**ʒ**ə, rɪ**dʒ**, **v**iːləm, **w**ʌn, **j**æp, **ʃ**ɔːt, **p**ælət, brʌ**ð**ə, **s**pelɪŋ, wiː**k**, læŋ**g**wɪdʒ, **h**aɪ, glɒ**t**əl, laʊ**d**, de**n**tl

Plosive	fricative	Affricate	nasal	lateral	approximant

b. Give the English spelling of the words in (a).

14. Descriptions of consonants

Write the symbol that corresponds to each of the following descriptions, and then give a word that contains the sound.

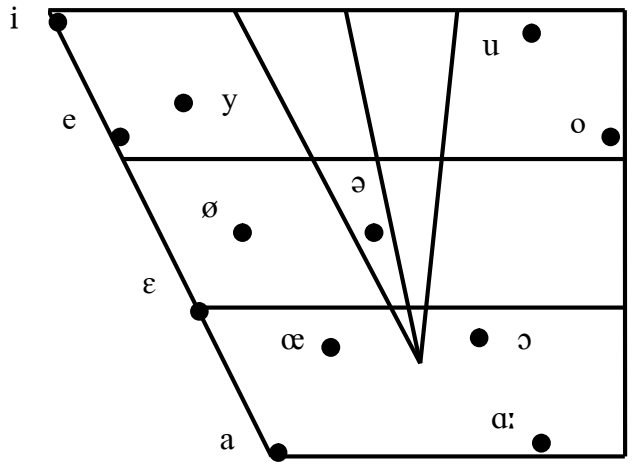
Example: voiceless alveolar plosive: [t] *two*

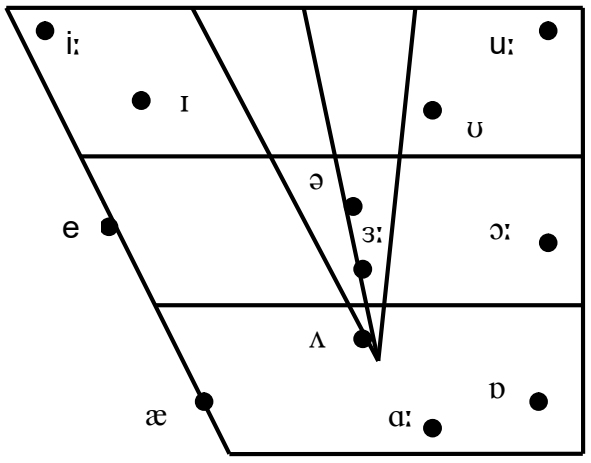
a. voiced alveolar lateral
b. voiced dental fricative
c. voiced velar nasal
d. voiced palatal approximant
e. voiceless palato-alveolar affricate
f. voiced bilabial plosive

Section 1.3.

15. Vowels in English and French

Below are the tables of French and English vowels. Look at them carefully and answer the following questions.





a. In English, how do you account for the difference between [i:], [e] and [æ]?
b. Can you apply the same system to account for the difference between [i], [e], [ɛ] and [a] in French? How would you describe the differences between these sounds, knowing that they are all considered to be front.
   You see that the description of a sound is constrained by the system it is in.
c. In English, what is the difference between [i:] and [ɪ] on the one hand and [u:] and [ʊ] on the other?
   Do you have such a difference in French?
d. Where do you find rounded sounds in English?
   Where do you find rounded sounds in French?
   How do you account for the difference between [i] and [y] in French, considering that they are both front?
   Is rounding a relevant feature in French (cf. [ri] *riz* and [ry] *rue*)?
   Is it a relevant feature in English?

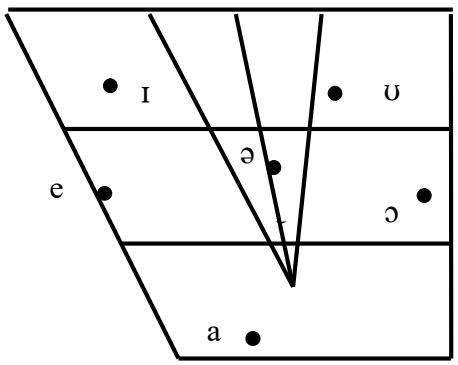
16. Articulation of vowels

Which sound do you get if you follow the instructions below? Start at [i:].

a. Which part of the tongue is involved and at what height is it?
b. Now the back of your tongue is at its highest and you keep the same opening. Is this a possible sound of English? If not, what do you have to do to get one without changing the other parameters?
c. Now lower your tongue to the next possible position. Which sound do you get?
d. Lower your tongue again. What do you get?
e. What is the only thing you have to do to get [a:]?
f. Now where do you move to get [ʌ]?
g. From this position, move to [æ]. Describe the move.
h. What are the two intermediate steps to reach [i:] again?

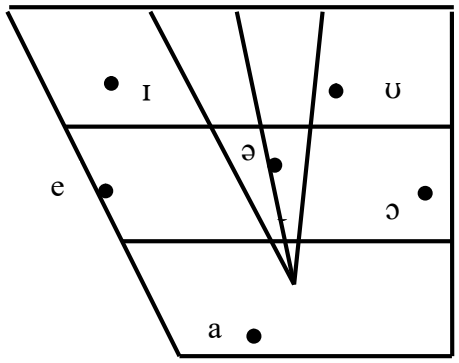
17. Diphthongs and triphthongs

On the following diagram indicate with an arrow the movement of the tongue for the diphthongs in the given words. Give a phonetic transcription first.



hair
sure
high
owl
own

Do the same thing for the triphthongs in the following words.



player
fire
royal
lower
hour

Additional exercises:

18. Different phonetic transcription systems

There are several phonetic transcription systems. We have given you the vowels of four of them:

Type I	*Type II*	*Type III*	*Type IV*
ii	i:	i:	i:
i	i	i	ɪ
e	e	e	e
a	a	æ	æ
aa	a:	ɑ:	ɑ:
o	o	ɔ	ɒ
oo	o:	ɔ:	ɔ:
u	u	u	ʊ
uu	u:	u:	u:
ʌ	ʌ	ʌ	ʌ
əə	ɔ:	ɔ:	ɜ:
ə	ə	ə	ə
ei	ei	ei	eɪ
ou	ou	ou	əʊ
ai	ai	ai	aɪ
au	au	au	aʊ
oi	oi	ɔi	ɔɪ
iə	iə	iə	ɪə
eə	eə	ɛə	eə
oə	oə	ɔə	ɔə
uə	uə	uə	ʊə

a. Which is the one we use?

b. Here is a list of words written in Type I. Transcribe them into Type IV:
pii
roup
mooniŋ
səətnli
sad

c. In the following list, identify the transcription system used and retranscribe the words into Type IV:
paːt
dɔg
baabə
hæbit
kod

19. The American transcription system

Below is the American transcription system, as used for example in Fromkin, Rodman and Hyams (2003) (chapters 6 and 7).

Consonants			Vowels	
p ***p**ill*	t ***t**ill*	k ***k**ill*	i *b**ee**t*	ɪ *b**i**t*
b ***b**ill*	d ***d**ill*	g ***g**ill*	e *b**ai**t*	ɛ *b**e**t*
m ***m**ill*	n ***n**il*	ŋ *ri**ng***	u *b**oo**t*	U *f**oo**t*
f ***f**eel*	s ***s**eal*	h ***h**eal*	o *b**oa**t*	ɔ *b**o**re*
v ***v**eal*	č ***ch**ill*	l ***l**eaf*	æ *b**a**t*	a *p**o**t/b**a**r*
θ ***th**igh*	ǰ ***J**ill*	r ***r**eaf*	ʌ *b**u**tt*	ə *sof**a***
ð ***th**y*	ʍ ***wh**ich*	j ***y**ou*	aj *b**i**te*	aw *b**ou**t*
š ***sh**ill*		w ***w**itch*	ɔj *b**oy***	
ž *a**z**ure*				

a. Find the sounds that are pronounced the same way in Standard American English and Received Pronunciation, but transcribed differently.
b. Indicate those which do not exist in Received Pronunciation.

Analysis of your own data – Task 3a

Transcribe a sentence (containing at least 6 words) from your speech sample in phonetic spelling. Please include stresses in the transcription you hand in (for the notion of "stress" cf. section 2.4 below).

2. PHONOLOGY

Section 1 was concerned with articulatory phonetics, i.e. with the way speakers produce English sounds. Articulatory phonetics is a very concrete side of studying sounds in that we examine the way the human anatomy is used in the production of specific sounds. However, there is also a slightly more abstract side of studying the sounds of language, and that side is dealt with in phonology. In phonology, we examine how sounds function in a language and how they are related to each other. Phonology is the study of the sound system of language.

2.1. Phonemes and allophones

Mark and Mary Brown are both doctors in the same hospital. One of them is a physician, the other is a biologist. When an invitation addressed to *Dr M. Brown* arrives, the secretary of the hospital wants to know which Dr Brown is invited. She asks a colleague: "Who's the physician?". The answer is: "She is". Hence it is Mary who is invited. Had the answer been "He is", it would have been Mark. This important information is conveyed by a single segment of the utterance. If we transcribe the two possible answers in phonetic symbols, we get:

(1) a. [ʃiː ɪz] 'she is' = Mary
b. [hiː ɪz] 'he is' = Mark

If we replace [ʃ] by [h] we change the meaning of the sentence and we are not speaking about the same person any more.

Consider also the following sentence:

(2) [ðə kæt ɪz ɒn ðə mæt]
'The cat is on the mat.'

If we change the first consonant of the noun *cat* and insert [h] instead, we obtain the following.

(3) [ðə hæt ɪz ɒn ðə mæt]
'The hat is on the mat.'

The meaning of the sentence in (3) is different from the meaning in (2). We could then substitute [b] for [h] to get:

(4) [ðə bæt ɪz ɒn ðə mæt]
'The bat is on the mat'

The three strings of sounds [kæt], [hæt] and [bæt] differ only in their initial sound. Despite these apparently small differences, the three strings of sounds stand for three completely different meanings.

Certain other differences among sounds are much less important. Imagine you are in London and you want to go to Bond Street. You ask a couple: "Excuse me, could you tell me where Bond Street is?". They both answer in chorus: "Second left and then right", which can be transcribed as:

(5) a. [sekənd left ən ðen ɹaɪt]
b. [sekənd left ən ðen raɪt]

Both have given you the same information although there is a difference in the sounds used. The first person used [ɹ], the sound used in Received Pronunciation, whereas the second person used the rolled [r] instead (an alveolar trill). This difference in the pronunciation may allow you to deduce that the person uttering (5a) is English and the other person Scottish (5b), but it does not entail a change in meaning.

The two segments [ɹ] and [r] are regarded as the same by speakers of English in the sense that the difference does not have a semantic effect. Within the sound system of English, [ɹ] and [r] can therefore be considered as two distinct realizations of a single abstract unit or mental category. This unit is called a **phoneme**. We refer to a specific phoneme by putting the sound symbol between slashes (e.g. /r/). Each phoneme is phonetically realized as one or more **phones** (notation with angled brackets). In our example (5), the phoneme /r/ is realized as the phone [ɹ] in (5a) and as the phone [r] in (5b). [ɹ] and [r] are called **allophones** of the phoneme /r/. When a sound contrast leads to a meaning difference as in (1) to (4), then we do not have a case of allophony. Instead we have distinct sound units within the phonological system. Thus, data like those in (1) to (4) suggest that /h/, /ʃ/, /k/, /m/ and /b/ are different phonemes.

The distinction between phonemes and allophones has an analogy in the domain of writing. Letters are not always realized in the same way. People have different handwritings and computers have different fonts. But we know that for example A, 𝖺, a, 𝒶, *a*, or 𝐚 all represent the same letter or grapheme. A, 𝖺, a, 𝒶, *a*, or 𝐚 are different realizations of this grapheme in the same way that allophones are different realizations of a phoneme. B, b, 𝒷, *b*, or 𝐛, however, cannot replace for example 𝐚 without altering the basic spelling of the word. These symbols are therefore realizations of a different grapheme.

In (5), we saw an example where the two different realizations of the phoneme /r/ are related to particular varieties spoken by different speakers of English (e.g. RP vs. Scottish English). However, there are many cases of allophony where it is the same speaker who uses different realizations of a phoneme. Consider for example the production of the voiceless plosives in English in the following words:

(6) a. *pill, till, kill*
b. *spill, still, skill*

The words *pill, till* and *kill* in (6a) all end in [ɪl] and are therefore distinguished only by the initial consonant. This suggests that /p/, /t/ and /k/ are different phonemes. But /p/, /t/ and /k/ are not always pronounced the same. If you carefully compare the pronunciation of the plosives in (6a) and (6b), you will notice a small difference. If you hold a piece of paper in front of your mouth and pronounce the words *pill, till* and *kill*, you might observe that after the pronunciation of the plosive a little puff of air is released which makes the piece of paper move slightly (this may be most obvious with /p/). This phenomenon is called **aspiration**. In the IPA notation, aspiration is represented by a superscript *h*: [^{h}]. The phonemes /p/, /t/ and /k/ can thus be realized phonetically as [p^{h}], [t^{h}] and [k^{h}]. When we examine the pronunciation of *spill, still* and *skill* in (6b), we notice that the little puff of air characteristic of aspirated sounds is absent. The plosives in these words are indeed produced without aspiration. /p/, /t/ and /k/ can therefore also be realized as unaspirated [p], [t] and [k].

From the point of view of articulatory phonetics, the difference between aspirated and unaspirated plosives is that with the former the vocal cords remain open briefly after the release of the plosive (due to the little puff of air) whereas with the former the vocal cords are immediately closed. Given that closed vocal cords give rise to voicing and that voicing is absent with open vocal cords, the consequence is that, with an aspirated plosive, the voicing of the following sound (e.g. of [ɪ] in the case of *pill*) is delayed, whereas voicing starts immediately after the release of the plosive in *spill*. Acoustic measurements also show that voicing is delayed after a plosive that is aspirated as compared to voicing after a plosive that is unaspirated.

The difference between the aspirated versions of the voiceless plosives and the unaspirated versions is a phonetic (i.e. allophonic) contrast rather than a phonemic one. If the aspirated voiceless plosive and the unaspirated voiceless plosive were two different phonemes, we should find contrasts like those in (1) to (4) where the substitution of the aspirated sound by the unaspirated one leads to a meaning difference. This never happens in English. If we produce for example the unaspirated sound [k] instead of the aspirated [k^{h}] in words like *kill, kin, key* etc., we never obtain a meaning difference. The pronunciation simply sounds unusual. For example it would mean that we pronounce the word *key* with an initial sound corresponding to the initial sound in the French word *qui*. For an RP speaker, this would be an odd pronunciation. However, you can often observe this for example in the English spoken in India. Voiceless plosives indeed tend to be unaspirated in Indian English.

Thus, aspiration with voiceless plosives is a case of allophony in English. The phoneme /p/ has the two allophones [p] and [p^{h}] in RP, /k/ has the two allophones [k] and [k^{h}], and [t] and [t^{h}] are two allophones of the phoneme /t/. It is important to note that the variation with respect to aspiration is not random. Instead, we can predict when one sound occurs and when the other one occurs. As a first approximation, we can formulate the following rule (but cf. section 2.3 below for a slightly revised version of this rule):

(7) Voiceless plosives are aspirated in word-initial position.

(7) accounts for the aspiration differences between words like *pill, till* and *kill* on the one hand and *spill, still* and *skill* on the other. /p/ is aspirated in *pill* because the sound occurs at the

beginning of the word, but it is not aspirated in *spill* because in *spill* /p/ occurs as the second sound of the word. The fact that we can formulate a rule like (7) determining where one allophone occurs and where the other allophone occurs means that the two allophones can never occur in the same position. In a context where we have [p^h] we can never have [p], and in contexts where we have [p] we can never have [p^h]. The allophones are therefore said to be in **complementary distribution**.

Note that the question whether two sounds represent two distinct phonemes or whether they are allophones of the same phoneme can only be answered if we examine the sound system of a particular language. The fact that aspiration never leads to meaning differences in English means that the aspirated version of a voiceless plosive and the unaspirated one are allophones of the same phoneme. In other languages, however, aspiration can be phonemic. This is shown in the Korean examples in (8):

(8) a. [pul] 'fire' - [p^hul] 'grass'
b. [tal] 'moon' - [t^hal] 'mask'
c. [kɛda] 'fold' - [k^hɛda] 'dig'

In Korean, the aspirated voiceless plosives and the unaspirated voiceless plosives are not in complementary distribution as they occur in exactly the same environments in (8). Furthermore, aspiration alone can lead to a difference in meaning. We therefore conclude that aspiration is phonemic in Korean and that Korean has for example a phoneme /p/ and a phoneme /p^h/. Aspiration thus has a different status in the sound system of Korean as compared to the sound system of English.

Given our discussion of allophony, we can now briefly return to a phenomenon already mentioned in section 1.2.3 (p. 78). We observed there that the lateral consonant can be realized in more than one way, as a clear *l* and as a dark *l*. This contrast can clearly be observed in words like *lull* or *lilt*. The first *l* in these words is produced with the tip of the tongue up behind the top front teeth. This sound is the clear *l*, represented phonetically as [l]. The second *l* in *lull* or *lilt* is a dark *l*, which differs from the clear *l* in that we also have raising of the back of the tongue (cf. Figure 14 on p. 78 above). Dark *l* is transcribed phonetically as [ɬ]. The different realizations of *l* never give rise to meaning differences. Furthermore, they occur in complementary distribution. As a first approximation, we can say that [l] occurs before a vowel, whereas [ɬ] occurs after a vowel. The absence of meaning differences and the complementary distribution mean that the distinction between clear *l* and dark *l* is not phonemic. Instead, we can say that [l] and [ɬ] are two allophones of a single phoneme, the phoneme /l/.[1]

To conclude our discussion of phonemes and allophones, let us briefly summarize what the criteria are that we have been using to distinguish the two. In other words, if we have two distinct sounds how can we tell whether they are allophones of a single phoneme or whether they are distinct phonemes?

[1] Note that our discussion here implies that the inventory of sounds presented at the very beginning of this chapter (p. 70) is actually an inventory of phonemes as we did not include allophonic variants like [ɬ] or [p^h] there.

(A) *Opposition: Minimal pairs*.

If substitution of one sound by another one in a word leads to a meaning difference, we have identified a phoneme. If substitution of one sound by another one in a word does not lead to a meaning difference, the two sounds are allophones of a single phoneme. We thus apply what has been called the **minimal pair** test. Minimal pairs are sequences of sounds that are identical except for one sound. Thus, for example *pig* and *big* form a minimal pair. The fact that these two words differ in meaning suggests that the initial sounds are realizations of different phonemes (i.e. /p/ and /b/). When we have minimal pairs that do not differ in meaning, we have a case of allophony.

One can say that the phonemes of a given language form a system in which they are all opposed to one another. This can be shown on the basis of a series of minimal pairs. Consider for example /p/ and its status within the English sound system:

(9)

/p/ is opposed to /b/ as in	/pɪg/ : /bɪg/	*pig : big*
/p/ is opposed to /t/ as in	/piː/ : /tiː/	*pea : tea*
/p/ is opposed to /d/ as in	/pɪg/ : /dɪg/	*pig : dig*
/p/ is opposed to /k/ as in	/pæt/ : /kæt/	*pat : cat*
/p/ is opposed to /g/ as in	/pɒt/ : /gɒt/	*pot : got*
/p/ is opposed to /m/ as in	/pæt/ : / mæt/	*pat : mat*
/p/ is opposed to /n/ as in	/pɪt/ : /nɪt/	*pit : knit*
/p/ is opposed to /ŋ/ as in	/rɪp/ : /rɪŋ/	*rip : ring*
/p/ is opposed to /f/ as in	/piˡt/ : /fiˡt/	*peat : feet*
/p/ is opposed to /v/ as in	/pet/ : /vet/	*pet : vet*
/p/ is opposed to /θ/ as in	/pɔːt/ : /θɔːt/	*port : thought*
/p/ is opposed to /ð/ as in	/pæt/ : /ðæt/	*pat : that*
/p/ is opposed to /s/ as in	/pæt/ : /sæt/	*pat : sat*
/p/ is opposed to /z/ as in	/pɪp/ : /zɪp/	*pip : zip*
/p/ is opposed to /ʃ/ as in	/piː/ : /ʃiː/	*pea : she*
/p/ is opposed to /ʒ/ as in	/lepə/ : /leʒə/	*leper : leisure*
/p/ is opposed to /tʃ/ as in	/piːp/ : /tʃiːp/	*peep : cheap*
/p/ is opposed to /dʒ/ as in	/piːp/ : /dʒiːp/	*peep : jeep*
/p/ is opposed to /l/ as in	/pɪt/ : /lɪt/	*pit : lit*
/p/ is opposed to /r/ as in	/pɒt / : /rɒt/	*pot : rot*
/p/ is opposed to /w/ as in	/piː/ : /wiː/	*pea : we*
/p/ is opposed to /j/ as in	/pəʊk/ : /jəʊk/	*poke : yolk*
/p/ is opposed to /h/ as in	/piː/ : /hiː/	*pea : he*

This procedure can theoretically be applied to each phoneme of the language. But note that in the chart above, /p/ is opposed to other consonants only. This is because even though all phonemes of a given language form a system, oppositions in that language are organised in such a way that consonants can only be opposed to consonants and vowels to vowels. We shall see in the next sections how oppositions are organised according to the rules of syllable structure, word formation and other contingencies.

(B) *Complementary distribution.*

If two phones always occur in mutually exclusive environments, they can be considered as allophones of the same phoneme. In other words, the distribution of the two phones is predictable. For example in the case of aspiration we saw that where the aspirated allophones of /p/, /t/, /k/ occur, the unaspirated versions cannot occur, and vice versa. This distribution is predictable in terms of rule (7).

Note, however, that the fact that all voiceless plosives behave in the same way means that for example [p] and [t^h] are in complementary distribution. Nevertheless, we would not want to say that they are allophones of the same phoneme. An important condition on allophony is therefore the condition of **phonetic similarity**. Phonetic similarity can be defined in terms of the phonetic properties discussed in section 1, i.e. for consonants the properties of voicing, place of articulation and manner of articulation. [p] and [p^h] are allophones of the same phoneme because they are phonetically similar whereas [p] and [t^h] are not allophones because the production of [t^h] involves a place of articulation that implies phonetic similarity with [t] rather than with [p].

For the criterion of complementary distribution discussed here, we can again find an analogy in writing (cf. also p. 97). The variation between capital letters and small letters is predictable. According to the rules of English spelling, the letter at the beginning of a sentence or the initial letter of a name is a capital letter. A small letter cannot occur in these positions. Thus, for example *A* and *a* are in complementary distribution and they are simply two versions of the same letter.

(C) *Free variation.*

The criterion in (B) allows us to identify one type of allophony, namely allophony where the allophones never occur in the same phonological environment (i.e. never in the same position within a word with the same sounds preceding and/or following it). However, our initial example of allophony in (5) was not of this type. There, we saw that speakers may produce different sounds in exactly the same phonological context ([ɹ] and [ɾ] in our example). Another illustration of this variation can be found in the pronunciation of words like *butter* and *bottle*. In RP, the second consonant in these words is pronounced as [t]. However, for example with some speakers in Britain, we can also sometimes hear a glottal stop [ʔ] in this position. The phonetic variation observed here satisfies the requirement of allophony according to (A) because we do not observe a meaning difference but not according to (B) because the sounds occur in exactly the same context. This suggests that (A) is the most important test for identifying phonemes and allophones, and that once we have identified something as a case of allophony we can distinguish two types of allophony: Allophony involving complementary distribution and allophony involving what has been called **free variation**.

The term ‘free’ refers to the fact that we cannot identify a phonological factor determining the appearance of one allophone rather than the other one. So from a phonological point of view, the variation is free, i.e. apparently unconstrained. However, this does not mean that the variation is entirely random. Generally, this type of allophony is determined by **sociolinguistic** factors. For example the use of the rolled

allophone of /r/ in (5b) is characteristic of speakers coming from a certain geographic area (e.g. Scotland). Or speakers using the glottal stop [ʔ] in *butter* may use it more frequently in informal speech than they would do in more formal speech.

In summary, we have three types of criteria that we can take into account when trying to decide whether a sound contrast is phonemic or not. If we can find a minimal pair giving rise to a meaning difference, we are dealing with two distinct phonemes. If no meaning difference arises, the two sounds are allophones of the same phoneme. The allophonic status of a sound contrast can then be confirmed by one the following two properties: Either the two sounds are in complementary distribution or they show free variation.

You can now do exercises 1 to 5.

2.2. Phonological features

A phoneme can be opposed to all other phonemes of its subsystem (i.e. the subsystem of consonants or the subsystem of vowels) by means of the phonetic criteria identified in section 1. /p/ has to be defined as a voiceless bilabial plosive to account for all the oppositions found with the other consonants in English. These three features are all necessary because if /p/ were described as a voiceless consonant it could be opposed to /b/, /d/, /g/, /v/, /ð/, /z/, /ʒ/, /dʒ/ but would not appear as distinct from all other voiceless sounds. If /p/ were described as a bilabial only it could be opposed to all non-bilabials but would not appear as distinct from /b/ and /m/. If /p/ were described only as a plosive it would be opposed to all non-plosives but would not appear distinct from /t/, /d/, /d/, /b/, /k/.

Given these observations, we can say that phonemes are combinations of **features** which are phonetically based (cf. section 1). For example the phoneme /p/ is characterized by the phonological features [–voiced], [+bilabial] and [+plosive]. Thus, phonemes are not the minimal units of analysis in phonology. Instead phonemes are decomposable into features in the same way that we proposed in semantics that word meaning is decomposable into smaller units (cf. chapter 2, pp. 27-36).

The features [–voiced], [+bilabial], [+plosive] are called the **distinctive features** of /p/ as they are all needed to distinguish /p/ from the other consonants in English. But consider now for example the phoneme /m/. Phonetically it is described as a voiced bilabial nasal. However if bilabiality is necessary to account for its opposition to /n/ for example and nasality is necessary to account for its opposition to /b/, voicing is not a phonologically relevant feature since there are no voiceless nasals. As voicing is not a distinctive feature of /m/, we call it a **redundant feature** from a phonological point of view. The distinctive features of /m/ are therefore simply [+bilabial] and [+nasal]. The phoneme /l/ also has redundant features. It is described phonetically as a voiced alveolar lateral. However, since there are no other lateral sounds in English, voicing and alveolarity are redundant phonological features. Voicing is also a redundant feature for vowels since there are no voiceless vowels.

Each language has its own set of phonemes. Oppositions among those phonemes may differ from language to language. For example nasality exists both in French and in English.

However, in French nasality is a distinctive feature of both consonants and vowels whereas in English it is distinctive for consonants only. French /m/ is opposed to /p/ and /b/ because it is nasal, as in English. But whereas there are no nasal vowels in English (at least in RP) in French there are nasal and oral (non-nasal) vowels and the contrast is phonemic (i.e. leads to meaning differences): /bo/ *beau* ('beautiful') is opposed to /bõ/ *bon* ('good') because of its nasality. So is /pla/ *plat* ('flat') when it is opposed to /plɑ̃/ *plan* ('map').

Another example of the relevance of sets of features would be the role of lip rounding in French and in English. Lip rounding exists in both languages. In English, only back vowels are rounded and rounding alone will never account for the opposition between two vowels. So rounding is a redundant feature of English vowels. In French, both /i/ and /y/ are high front vowels, but /i/ is distinct from /y/ because of its rounding only: /vy/ *vu* ('seen') is opposed to /vi/ *vit* ('saw'). Rounding is a distinctive feature of French vowels.

Phonological features allow us to identify precisely what distinguishes one phoneme from another and thus to express oppositions between phonemes. But there are further advantages in postulating phonological features as the minimal units of analysis in phonology. Phonological features allow us to account for the following phenomena:

- *Speech production: slips of the tongue*
  As we already observed in our discussion of semantic features on pp. 34/35, certain speech errors can be revealing as to how language is organized in a speaker's brain/mind. In the area of phonology, slips of the tongue often involve the switching of two sounds, with each taking the place of the other. This type of speech error is known as a spoonerism, a term referring to the Reverend Spooner, the head of an Oxford college, who is reported to have been particularly prone to this type of speech error. Two examples that have bee attributed to the Reverend Spooner are given in (10).

(10) a. that **qu**eer old **d**ean – *intended*: that **d**ear old **qu**een
  b. you have **h**issed my **m**ystery lecture –
  intended: you have **m**issed my **h**istory lecture

In (10), entire sounds are exchanged. However, in some instances of speech errors, it is not the entire sound that is moved but only one or more phonological features. This is illustrated in (11).

(11) a. **t**e**b**estrian – *intended*: **p**e**d**estrian
  b. **g**lear **p**lue sky – *intended*: **c**lear **b**lue sky

In (11a), an intended /p/ ([–voiced, +*bilabial*, +plosive]) becomes /t/ ([–voiced, +*alveolar*, +plosive]) and an intended /d/ ([+voiced, +*alveolar*, +plosive]) becomes /b/ ([+voiced, +*bilabial*, +plosive]). So what happens in this case is the exchange of the place feature whereas the other features remain unaffected. The feature [+bilabial] is moved from the first consonant in the word *pedestrian* to the second consonant, and the feature [+alveolar] is moved from the second consonant to the first one. In (11b), the switch concerns the

feature of voicing. In the intended utterance, the first sound of the first word is [–voiced] and the second sound of the second word is [+voiced], in the slip of the tongue we have the opposite order of voicing but the other features are unaffected (e.g. [+velar, +plosive] for the first sound of the first word).

The fact that speakers produce speech errors in which features are exchanged rather than entire sounds suggests that phonological features are psychologically real (albeit unconscious) units to the speaker, i.e. that speakers mentally organize sounds as being made up of a set of articulatory properties.

- *Phonological rules*

  Reconsider the phenomenon of aspiration discussed in section 2.1. As we observed, aspiration occurs in a well-defined context and it can therefore be described in terms of the aspiration rule given in (7). We can think of this rule as a rule that affects an underlying phoneme (e.g. /p/) to create a specific (aspirated) phone (e.g. [p^h]). We thus obtain the following picture for the way sounds obtain their exact phonetic status:

(12) *Input*: phonemic representation of words (e.g. /pɪt/)

↓

phonological rule (e.g. aspiration rule, cf. 7 above)

↓

Output: phonetic representation (e.g. [p^hɪt])

The aspiration rule affects three phonemes in word-initial position: /p/, /t/ and /k/. If we had only phonemes in phonology, this would seem to be an arbitrary group, and for example /b/, /s/ and /n/ would be an equally likely group of phonemes to be affected by a phonological process. But in English and other languages, this group of sounds generally does not pattern together from a phonological point of view whereas phonological processes affecting /p/, /t/ and /k/ can frequently be found across languages.

In terms of phonological features, the fact that /p/, /t/ and /k/ pattern together with respect to a rule is not surprising. We can observe that this group has certain properties in common (i.e. the features [–voice] and [+plosive]) that distinguish it from all the other items in the phonemic inventory of English. A set of phonemes which shares common features such that the set plays a significant role in expressing phonological regularities and generalizations found in language is said to form a **natural class**.

Apart from allowing us to explain why certain sounds pattern together for the purposes of phonological processes, phonological features also have the advantage of considerably simplifying the system of rules that we have to postulate. Without phonological features, we would have to formulate three aspiration rules, one for each phoneme (/p/ → [p^h]; /t/ → [t^h]; /k/ → [k^h]). With features, a single rule is sufficient which expresses that every [–voice, +plosive] becomes [+aspirated] in a particular phonological context (cf. 7). Thus, phonological rules are best expressed in terms of features as we would otherwise be missing important generalizations.

Note that the rules we have been referring to here are of the type discussed in chapter 1. Phonological rules are part of the linguistic knowledge that native speakers possess and consistently apply even though they may not be consciously aware of it. Other types of phonological knowledge we have seen so far include knowledge of the inventory of phonemes and knowledge of the features that define the phonemes. Further aspects of phonological knowledge will be introduced in the following sections.

- *Phonotactics*
  Phonotactics is the area of phonology dealing with constraints on sound sequences (i.e. which sounds can occur next to each other). In order to identify such constraints we need to have a closer look at the structure of the syllable, something that will be done in the next section. For the purposes of our discussion of phonological features, we can simply point out for the moment that phonotactic constraints often apply to groups of phonemes sharing certain phonological features (i.e. natural classes). Phonotactics therefore provides additional support in favour of postulating phonological features as linguistically relevant units. Illustrations for this observation will be given in the next section.

2.3. The syllable

So far we have been looking at individual sound segments (vowels, consonants) and the features they are composed of. Vowels and consonants are combined to form entire utterances. However, they are not just joined together randomly into long, unstructured strings, but they form larger units with their own internal structure and distribution, governed by their own rules: the syllable.

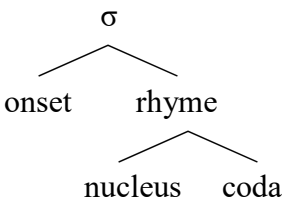
2.3.1. *Syllable structure*

A syllable consists of a phoneme or a sequence of phonemes. If the syllable receives word stress it can be associated with meaning and form what is usually called a word. No word in English can consist of anything less than a syllable and a syllable generally cannot consist of anything less than a vowel (but see the discussion of syllabic consonants at the end of this section for an apparent exception to this). The minimal ingredient of a word is therefore a vowel. Monosyllabic words in English consisting only of a vowel include /ɑː/ *are*, /ɔː/ *or*/*awe*, /aɪ/ *eye/I/ay(e)*, and /əʊ/ *owe*. But not all English vowels can form a word by themselves. /ʊə/, for instance, is not an existing English word. However, what matters is that it could be a word. If we were to invent a name for a new product, we could well use the single-vowel syllable [ʊə]. We would then have made use of what is called an **accidental gap**. Accidental gaps are formed of possible combinations of phonemes at any level of the structure of the sound system of a language which have not yet been assigned meaning.

The vowel being the central element, it is referred to as the **nucleus** of the syllable. But most words and syllables contain more than just a vowel. One or more consonants can be added before and/or after the vowel. These positions within a syllable are called the **onset** (before the vowel) and the **coda** (after the vowel). The latter forms a subunit with the nucleus,

which is called the **rhyme**. Thus, we obtain the following basic syllable template (σ = syllable (Greek sigma)).

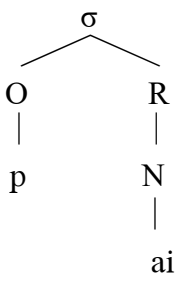
(13)



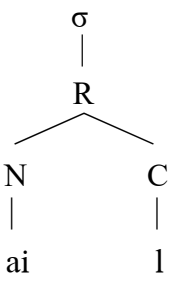
This template can be realized in four different ways: only the nucleus is filled (14a); the onset and the nucleus are filled (14b); the nucleus and the coda are filled (14c); the onset, the nucleus and the coda are filled (14d).

(14) a.

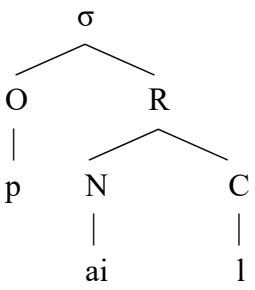
b.



c.



d.



As discussed above, the nucleus position in the syllable structure is generally occupied by a vowel. However, in the speech of English speakers, it can happen that certain consonants become nuclear, in particular when the rate of speech increases. Consider for example a word like *bottle*. For some speakers, this word has the alternative pronunciations [bɒtəl] or [bɒt̩l]. In the second (more common) pronunciation, the second vowel is "lost" but the word is nevertheless perceived by speakers of English as having two syllables. This suggests that in this context the final consonant can exceptionally become nuclear. Such a consonant is called a **syllabic consonant** and it is transcribed by means of a syllabic diacritic, placed under the consonant symbol. Other consonants that can be syllabic in English are /n/ (e.g. in [bʌt̩n̩] *button*), /m/ (e.g. in [bɒtm̩] *bottom*) and /r/ (e.g. in [p̩ɹeɪd] *parade*). However, given that these consonants never form a syllable independently (in the way vowels do as e.g. in 14a) but only become syllabic in certain circumstances, syllabicity is not considered as a phonological property of these consonants but rather a phonetic one. It has been argued that in the words mentioned above a vowel is present in the phonological representation which is then deleted

in the phonetic realization of the syllable (cf. the alternative pronunciations of *bottle* ([bɒtəl], [bɒt̩l]) mentioned above or of *parade* ([pəɹeɪd], [p̩ɹeɪd]).

To conclude our discussion of syllable structure, we should point out that the distinction between nucleus and onset/termination sheds some light on the distinction between vowels and consonants. As observed in section 1.3.1, approximants like /j/ and /w/ differ only minimally from sounds like /ɪ/ and /ʊ/ from a purely phonetic point of view (i.e. sound production). Thus, it is not immediately clear why the former are classified as consonants and the latter as vowels. However, from the point of view of syllable structure, the distinction can be accounted for. Whereas /ɪ/ and /ʊ/ can occupy the nucleus of a syllable, /j/ and /w/ cannot. This can be shown by the fact that we cannot have words like *[jl] or *[pwl] in English but we do have [ɪl] and [pʊl]. Words like *[jl] and *[pwl] are impossible because the nucleus of the syllable would remain unfilled. The different distribution of approximants like /j/ and /w/ and vowels like /ɪ/ and /ʊ/ within a syllable also has effects on certain phonological rules. Consider the pronunciation of the indefinite article. The rule is that we use *a* before consonants and *an* before vowels. In other words, /n/ is inserted when the onset of the following syllable is empty. A word starting with /ɪ/ requires *an* (e.g. *an idiot*) but a word starting with /j/ does not allow *an* (e.g. **an year*). This (and the phonetic realizations of the definite article *the* ([ðə] vs. [ðɪ])) confirms that approximants are indeed sounds that have to be classified as consonants rather than as vowels despite their phonetic similarity with vowels.

2.3.2. *Patterns of acceptability in syllables*

A speaker's knowledge of a language includes information about what sequences of sounds are possible and what sequences are not. For example, if we had to form a word out of the sounds /b/, /ɪ/, /k/, /l/, speakers of English would agree that e.g. /blɪk/ or /kɪlb/ are permissible arrangements of these phonemes in English but not */bkɪl/ or */ɪlkb/. This kind of knowledge is studied in the domain called **phonotactics**. Phonotactics deals with constraints on sound sequences and in particular with restrictions on what consonants and consonant clusters can occur in the onset and the coda. A consonant cluster is a sequence of two or more consonants.

Let us start by considering constraints on **sound sequences in onsets**:

- An onset consisting of a **single consonant** can contain any consonant except for /ŋ/. /ŋ/ always occurs in a coda and never in an onset. Furthermore, /ʒ/ is very rare in an onset but it can be found in certain loanwords such as /ʒiːg/ *gigue* or /ʒɪgələʊ/ *gigolo* (the latter sometimes also being pronounced as /dʒɪgələʊ/, however).
- With onsets consisting of **two consonants**, many combinations are permissible, but there are also many restrictions (cf. e.g. /bl/ vs. */bk/ in the examples above). The following table provides an overview of the possible two-consonant clusters in English.

	p	t	k	b	d	g	f	θ	s	ʃ	h	v	ð	z	ʒ	m	n	ŋ	l	r	w	j	tʃ	dʒ
p	-	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	play	pray	-	pew	-	-
t	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	tray	twin	tune	-	-
k	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	clay	cry	quick	queue	-	-
b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	blue	brow	-	beauty	-	-
d	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	dry	dwell	due	-	-
g	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	glue	grin	1	-	-	-
f	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	flu	fry	-	few	-	-
θ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	throw	thwart	-	-	-
s	spy	stay	sky	-	-	-	sphere	-	-	-	-	-	-	-	-	smug	snow	-	sly	1	sweat	sue	-	-
ʃ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	shrew	1	-	-	-
h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	huge	-	-
v	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	view	-	-
ð	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
z	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ʒ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	muse	-	-
n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	new	-	-
ŋ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	lewd	-	-
r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
w	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
j	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
tʃ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
dʒ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes :

1. Examples for these clusters could be found but they are all foreign or onomatopoeic: *pterodactyl - psoriasis - pshaw - tsetse - gwen - Sri-Lanka - Schweppes.*
2. Given that the combination of an alveolar plosive and a palato-alveolar fricative is analyzed as a single consonant in English (an affricate), this combination is not included here as a cluster.
3. Impossible in RP, but some dialects pronounce words like *where* as [ʍeəɹ]. /ʍ/ is a voiceless velar approximant which sounds similar to the combination of /h/ and /w/.

- Combinations of **three consonants** in an onset are very restricted. Below is a list of the possible three-consonant clusters in English:

(15)

					l	spleɪ	*splay*
			p	+	r	spreɪ	*spray*
					j	spjuː	*spew*
					r	strɔː	*straw*
	s	+	t	+	j	stjuː	*stew*
					l	sklɪərəʊsɪs	*sclerosis*
					r	skruː	*screw*
			k	+	w	skwiːz	*squeeze*
					j	skjuː	*skew*

The generalization based on (15) is the following: In a three-consonant onset, (i) the first sound must be /s/; (ii) the second sound is one of /p/, /t/, or /k/; (iii) the third sound is one of /l/, /r/, /w/, or /j/.

It is interesting to point out that, as in the aspiration rule discussed in sections 2.1 and 2.2, the phonemes /p/, /t/ and /k/ pattern together. Here, they have the common property of being able to occur in the second position of a three-consonant cluster. In terms of an analysis of phonemes as indecomposable units, this fact would seem accidental. However, once we assume that phonemes are combinations of phonological features, the common phonotactic behaviour of /p/, /t/ and /k/ can be related to the fact that these sounds resemble each other from the point of view of the phonological features that characterize them, place being the only feature that distinguishes the three sounds. Thus, as briefly mentioned at the end of section 2.2, phonotactic constraints provide further evidence in favour of a feature analysis of phonemes as it sometimes allows us to account for shared distributional properties of certain consonants in clusters.

- Finally, combinations of **four or more consonants** in an onset cannot be found in English.

Whereas it was possible to list the combinations of onset clusters fairly precisely, it is practically impossible to present **coda clusters** in a chart that would allow immediate reading. Trnka (cited in Troubetzkoy 1967: 269) devotes over 22 pages trying to enumerate and explain possible clusters in English and yet does not succeed in producing simple rules. Hence we will restrict ourselves to showing some of the most frequent coda clusters.

Any consonant may be the only element of a coda except for /h/, /w/, and /j /. In some varieties of English /r/ is also absent in the coda position. These varieties include for example RP, certain other varieties of British English, Australian English, New Zealand English and some varieties of American English (e.g. some east coast varieties), in which post-vocalic *r* is not pronounced in words like [nɪə] *near* or [ka:] *car* (**non-rhotic varieties** of English). In certain other varieties, however, /r/ is pronounced in this position (**rhotic varieties**, e.g. most American English dialects or Scottish English).

Examples of two-consonant clusters in a coda are given in (16) (examples in 16 to 18 from Roach 1983:59-61):

(16)	bump	/mp/
	rent	/nt/
	bank	/ŋk/
	belt	/lt/
	beds	/dz/
	bets	/ts/
	nest	/st/
	bathes	/ðz/

Many other clusters such as /pm/, /pn/, /kn/ or /tm/ cannot occur in a coda.

A coda can also contain three consonants (17) or even four (18).

(17)	bumps	/mps/
	bonds	/ndz/
	banks	/ŋks/
	helped	/lpt/
	belts	/lts/
	twelfth	/lfθ/
	fifths	/fθs/
	next	/kst/
	lapsed	/pst/

(18)	twelfths	/ lfθs/
	sixths	/ksθs/
	texts	/ksts/

Combinations of more than four consonants in a coda cannot be found in English.

The discussion above has given an overview of some basic phonotactic properties of onsets and codas in English. As already observed, it is not possible to explain all the restrictions on consonant clusters with simple rules. However, some generalizations can be made.

(i) *The sonority rule.*

Sonority can be defined as relative openness of the vocal tract, which corresponds directly to the relative loudness of a sound. For example, the vocal tract is much more open when a vowel is produced than when a consonant is produced, and a vowel has therefore greater acoustic carrying power than a consonant. So if someone is standing in front of a large room and tries to produce a single sound as clearly as possible, a listener could identify a highly sonorous sound like [a] much more easily than a sound at the other end of the sonority range such as [t]. But sonority contrasts cannot only be observed between vowels and consonants but also among different types of consonants. As pointed out already in our discussion of consonants (p. 79), a distinction is sometimes made between sonorants (nasals, laterals, approximants) and obstruents (plosives, fricatives, affricates), the former being more sonorous than the latter. Finally, among obstruents, voiced obstruents are more sonorous than voiceless ones. These sonority distinctions are confirmed by acoustic measurements. The picture that emerges then is a sonority scale that looks as follows:

(19)

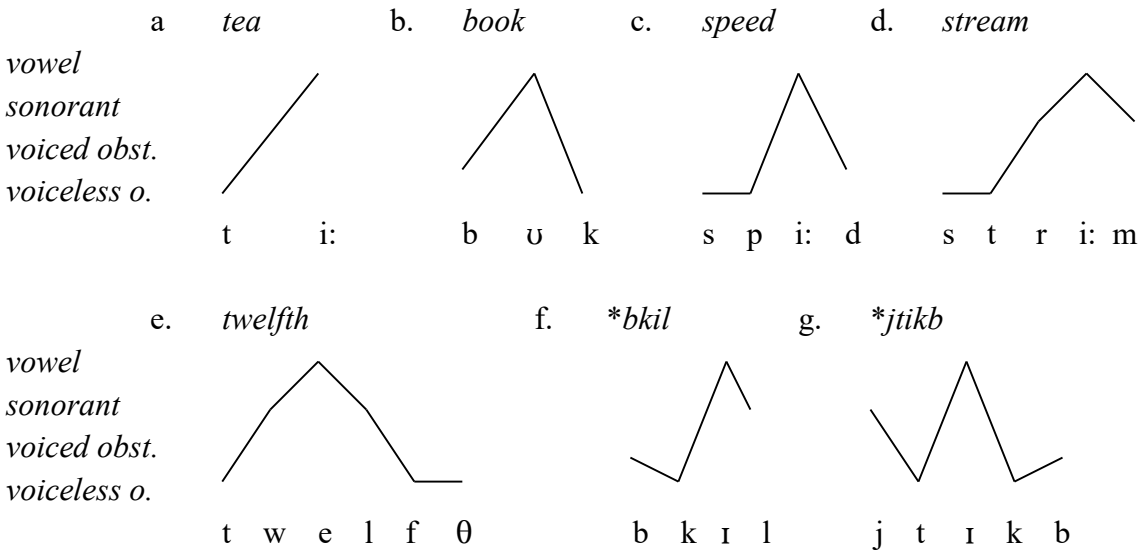
most sonorous	↓	vowels
		sonorants
		voiced obstruents
least sonorous		voiceless obstruents

Sonority is important in the discussion of phonotactics because it has been proposed that sound sequences within a syllable follow what is called the sonority rule.

(20) **Sonority rule**: The nucleus is the sonority peak of a syllable. If any sounds occur in the onset and/or the coda, sonority decreases towards both margins of the syllable.

The sonority rule allows us to distinguish between possible sound sequences in a syllable (21a to 21e) and impossible sound sequences (21f/g).

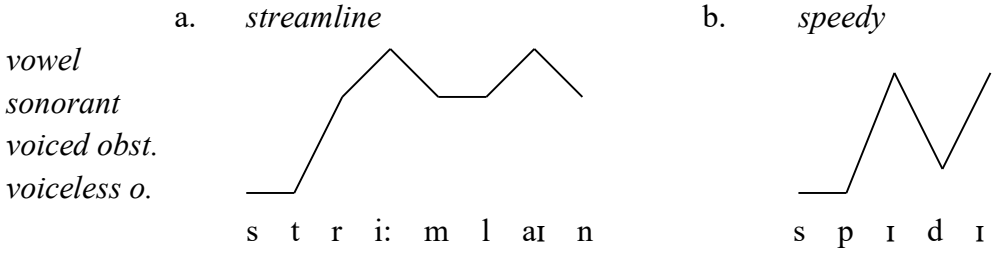
(21)



(21a) to (21e) are monosyllabic words (i.e. words consisting of a single syllable) and they all contain a single sonority peak. Sonority decreases towards the margins of the syllable or, once sonority cannot decrease further because the lowest level is reached (e.g. with the voiceless obstruents in the second position of the onset of *speed* and in the second position of the coda of *twelfth*), sonority remains constant. The examples in (21a) to (21e) therefore satisfy the sonority rule. In (21f), we again have a monosyllabic word, but we have two sonority peaks, one related to /b/ and one related to /ɪ/. The sonority rule is violated because in the onset sonority is not decreasing towards the margin (i.e. the beginning) but it is increasing (from voiceless obstruent to voiced obstruent). In (21g), we even have three sonority peaks (/j/, /ɪ/, /b/). Here the sonority rule is violated both in the onset of the syllable and in the coda (increasing rather than decreasing sonority towards the edges of the syllable).

More than one sonority peak is only possible in polysyllabic words (i.e. words consisting of more than one syllable):

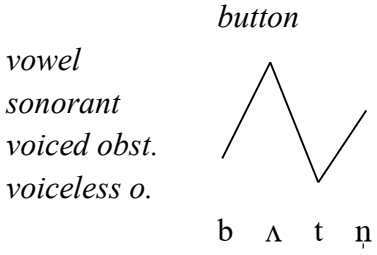
(22)



The words in (22a) and (22b) both consist of two syllables. In each word, there is one sonority peak per syllable (related to the vowels) and within the syllables the sonority rule is respected.

Before turning to a second general constraint on sound sequences, let us briefly reconsider syllabic consonants in the light of the sonority rule. The sonority of the sounds forming the word [bʌtn̩] *button* is shown in (23).

(23)



In (23), we have two sonority peaks, one related to the vowel and a second one related to the nasal consonant. According to the sonority rule, we must conclude that we have two syllables here because a one-syllable analysis would mean that there would be an increase in sonority at the end of the coda, a property which would violate the sonority rule. Our assumption made above that certain consonants like /n/ can sometimes become nuclear is thus in line with the generalization expressed by the sonority rule.

(ii) *The homorganic nasal rule.*

The homorganic nasal rule expresses a constraint on consonant clusters in a coda. More specifically, this rule concerns sequences of nasals and plosives. As shown in the first three examples in (16), we can find coda clusters such as /mp/ (*bump*), /nt/ (*rent*) and /ŋk/ (*bank*). However, clusters like /mt/ (**bumt*), /mk/ (**bumk*) or /np/ (**renp*) do not occur in English codas although they would respect the sonority rule. Why should there be such restrictions then? An answer to this question can be given once we have a closer look at the nasal-plosive clusters that are possible. What we can observe is that they all have something in common: The two sounds in the cluster share their place of articulation. Thus, for example /m/ and /p/ in *bump* are both bilabial whereas /n/ and /t/ in *rent* are both alveolar. We can therefore formulate the following rule.

(24) **Homorganic nasal rule**: If a nasal is followed by a plosive in a coda, they have the same place of articulation.

Note that (24) applies to codas only. In onsets, the sequence nasal-plosive is ruled out completely as such a sequence would violate the sonority rule. The order of nasal and plosive is important in (24) as well. (24) only applies to the order nasal-plosive. The sequence plosive-nasal is never possible in English, whether in an onset or in a coda (spelling is sometimes misleading in onsets, cf. *knitting* /nɪtɪŋ/ or *pneumonia* /njuːməʊnjə/). The absence of plosive-nasal in a coda is expected from the point of view of the sonority rule. However, there is no obvious reason why such a sequence should be

ruled out in onsets. This observation concerning plosive-nasal onsets shows that although the sonority rule and the homorganic nasal rule account for a wide range of phonotactic constraints in English, there are certain restrictions on sound sequences that are more difficult to explain in a systematic way.

2.3.3. *The role of the syllable*

In this subsection, we have introduced the syllable as a unit of phonological structure, and we have seen that the syllable is a useful tool to analyze phonotactic constraints. However, there are several other important reasons for postulating the syllable as a unit of phonological analysis.

- *Phonological rules*.
  The syllable allows us to state generalizations about allophonic variation. As a matter of fact, the two cases of allophony discussed on pages 97 to 99 cannot be analyzed adequately without reference to the syllable.
  (i) *Aspiration*. In (7), we stated that voiceless plosives are aspirated in word-initial position. This accounts for contrasts like *pill* (aspiration) vs. *spill* (no aspiration). However, this rule is not sufficient to account for all aspects of aspiration. We also find aspiration contrasts word-internally. For example, the voiceless plosives in *re**p**air*, *re**t**urn* and *re**c**ord* are all aspirated whereas no aspiration can be observed with the voiceless plosives in *res**p**ond*, *dis**t**urb* and *dis**c**ard*. What is common to the second set of words is that the voiceless plosive is preceded by another consonant which is part of the same syllable whereas in the first set of words the voiceless plosive is the initial consonant of the second syllable. So what is crucial for aspiration is not the position of the voiceless plosive within the word but its position within the syllable. Let us therefore revise our aspiration rule:

(7') Voiceless plosives are aspirated in syllable-initial position.

Although (7') is an improvement compared to (7) as it captures a wider range of data, this is still not quite the final version of the rule yet. Consider for example a word like *happy*. Here, the voiceless plosive occurs at the beginning of the second syllable but it is nevertheless not aspirated. This problem will be solved once we have introduced an additional phonological concept, namely the notion of stress (section 2.4.3).

(ii) *Clear and dark l.* On the basis of the different realizations of /l/ in words like *lull*, we proposed on page 99 as a first approximation that clear l [l] occurs before vowels and that dark l [ɬ] occurs after vowels. However, this is again not precise enough. In words like *hilly* and *holy*, /l/ occurs between vowels so we would not know which allophone to choose. In both of these words /l/ is realized as a clear l [l]. So why should it be that /l/ in *holy* is phonetically realized like the first /l/ in

lull? Taking syllables into account, the answer is simple: In both cases [l] occurs in the onset of the syllable (in *holy* in the onset of the second syllable). As for [ɬ], it occurs in the coda of a syllable (e.g. the second /l/ in *lull*).

To complete our discussion of clear and dark l, we should briefly consider the status of /l/ when used as a syllabic consonant as in *bottle*. As discussed on pages 106/7 and 112, the lateral behaves like the nucleus of the second syllable here. In such contexts, /l/ is realized as a dark l. We can include this observation in our generalization by referring to the rhyme as the context in which /l/ is realized as [ɬ]. This covers both the nucleus and the coda (see example 13). The rule determining the allophony of /l/ is therefore the following:

(25) /l/ is realized as: (i) clear l [l] in an onset; (ii) dark l [ɬ] in a rhyme.

- *Alliteration and rhyme*.
  Syllable structure plays an important role in two rather different literary traditions:
  (i) *Alliterative poetry*. In alliterative poetry, as found frequently for example in medieval English literature, the important linguistic unit is the onset of a syllable. Alliteration occurs when we have several identical onsets within a single line. This is illustrated in the following line from the Old English poem *The Battle of Maldon* where we can observe alliteration of /r/.

(26) **r**ad and **r**ædde, **r**incum tæhte (*The Battle of Maldon,* l.18)
(ModE: … rode and counselled, taught the soldiers …)

In (26), word-initial onsets alliterate, but sometimes alliteration can also involve word-internal onsets.

(ii) *Poetic rhyme*. A poetic device that is more common nowadays than alliteration is the rhyme. Here, it is the second part of the syllable structure that is crucial. For a perfect rhyme, the nucleus and the coda (if any) must be exactly the same. In other words, the part of the syllable referred to as the rhyme must be identical. The onset is irrelevant. Hence, for example *meet* rhymes with *eat*, *beat* or *sweet* but not with *might* (different nucleus), *keep* (different coda), or *bee* (no coda).

- *Stress placement*.
  Syllable structure also plays an important role in stress placement. This is an issue that we will consider in section 2.4.

2.3.4. *Problems of syllabification*

So far, we have used the notion of syllable without examining exactly how we divide words into syllables. Speakers of English generally have fairly clear intuitions as to how many syllables a word contains. However, in words with several syllables, it is not always

immediately obvious where the syllable boundaries are. For example, in the word *hilly* discussed in the previous section (p. 113/4), is /l/ part of the first syllable or of the second syllable? Or does /d/ in *leader* belong to the first syllable or to the second syllable? What about /m/ and /b/ in *member*? Or /l/ and /t/ in *falter*? In order to deal with such questions, we can take the following two main criteria into account.

(i) *Phonotactic constraints*. Phonotactic constraints as discussed above are generally assumed to apply not to words but to syllables. Hence, if a cluster cannot occur at the beginning or at the end of a word, it cannot begin or end a syllable. This rules out syllabifications like *me.mber* or *fa.lter*.

(ii) *Maximal Onset Principle*. The Maximal Onset Principle is a principle governing syllable division which states that, where there is a choice, as many consonants as possible should be assigned to the onset. This is a principle that has been derived from studies on syllable structure in many different languages, and it is generally considered as a universal principle of syllabification. The Maximal Onset Principle means that syllabifications like *lead.er*, *memb.er* or *falt.er* are ruled out because these divisions leave the onset of the second syllable empty although there would be a consonant that could occupy it.

Given (i) and (ii), we obtain the following correct syllabifications for *leader*, *member* and *falter*: *lea.der*, *mem.ber*, *fal.ter*. Finally, *hilly* is syllabified as *hi.lly* due to the Maximal Onset Principle. /l/ is therefore realized as a clear l in terms of rule (25).

You can now do exercises 6 to 11.

2.4. Stress

One or more syllables together can form a word. The most important phonological property of words in English is stress. Certain syllables of each word, and one syllable in particular, are phonetically more prominent than the others. For example in the word *mother*, the first syllable is stressed (hence '*mother*, stress being marked by an apostrophe at the beginning of the stressed syllable) whereas in the word *about* it is the second syllable that is stressed (*a*'*bout*). Before considering some aspects of stress placement, let us briefly have a closer look at what stress is from a phonetic point of view.

2.4.1. *The phonetic properties of stress*

From a phonetic point of view, stressed syllables have the following characteristic properties:

(i) The vowels of stressed syllables are produced with higher fundamental frequency, that is, the vocal folds vibrate more quickly. A stressed syllable is therefore perceived as having a **higher pitch**.

(ii) The duration of stressed syllables is greater. A stressed syllable is therefore perceived as being **longer**.

(iii) Stressed syllables are produced with greater intensity. A stressed syllable is therefore perceived as being **louder**.

(iv) Finally, stress can also have effects on vowel **quality**. Under low stress, vowels often reduce to schwa, schwa being the most central and hence the most neutral of all vowels. Sometimes unstressed vowels may even be omitted entirely. For example, we do not say /'sɪlæbel/ but /'sɪləbəl/ or /'sɪləbl/. The influence of stress on vowel quality can also be shown if we consider the pronunciation of related words like *phonology* and *phonological*. In the first word, the second syllable is stressed and the nucleus is pronounced as the full vowel /ɒ/ whereas the nucleus of the third syllable is a schwa: /fəʊˈnɒlədʒɪ/. The second word is derived from the first one through attachment of the ending *–(i)cal*. The stress shifts to the third syllable, and at the same time the nucleus of the second syllable changes to schwa and the nucleus of the third syllable to /ɒ/: /fəʊnəˈlɒdʒɪkəl/. Similar observations can be made when we consider loanwords (i.e. words borrowed from other languages) such as *banana*. As the spelling indicates, *banana* was pronounced /banana/ (/a/ corresponds to the vowel in French /lak/ *lac*) when it was borrowed from the Spanish and Portuguese who themselves based it on a Guinean word. The placement of the stress in English required that the only "full" vowel /a/ to be kept as such was the one in the stressed syllable. The others, being unstressed, came to be pronounced in a very neutral way as schwa: /bəˈnɑːnə/. These examples all show that schwa is the typical nucleus in unstressed syllables. As a matter of fact, the vowel schwa is never found in a stressed syllable.

An important observation that emerges from (i) to (iii) in the above list is that stress is a relative property and can only be detected by comparison with other syllables within a word (hence the comparatives 'higher', 'longer', 'louder'). A consequence of this is that we can distinguish degrees of stress in polysyllabic words. The most prominent syllable bears what is called the **primary stress**. But among the syllables not bearing primary stress, there may be one syllable that is more stressed than the other syllable(s). This syllable carries what we call **secondary stress**. Consider for example the word *entertainment*. This word consists of four syllables and its main stress falls on the third syllable. But the initial syllable is more prominent than the second and the fourth one. It therefore carries secondary stress. We thus obtain the following phonetic transcription for the word *entertainment*, with secondary stress marked on the first syllable and primary stress marked on the third syllable: /ˌentəˈteɪnmənt/. Note that this example once again illustrates point (iv) above. Whereas the stressed syllables both have full vowels in their nucleus, the unstressed ones contain the reduced vowel (schwa).

2.4.2. *Stress placement*

Among the world's languages, we can distinguish two broad classes in terms of stress position: (a) Fixed stress languages in which stress always falls on one particular syllable. For example in French, although stress is fairly weak, it generally falls on the last syllable whereas in Scots Gaelic it is always the first syllable that is stressed. (b) Free stress languages in which there is no systematic distribution of stress within a word. An example of such a language would be Russian or Modern Greek.

The situation in English is a bit more complex as English does not fall fully within either (a) or (b). This is mainly due to its history. As a language with Germanic origins, English inherited a system with fixed stress falling on the first syllable of a stem. But during its historical development, English has been strongly influenced by Romance languages like Latin and French (word **borrowing**). The result of this is that we now have a mixture of the **Germanic** and **Romance** stress systems.

One aspect of this system is that we can observe contrasts that typically characterize free stress languages. In such languages, stress can fall on any syllable and we can therefore find minimal pairs that are distinguished only by stress. A certain number of minimal pairs of this type also occur in English as shown in (27).

(27) a. /ˈæbstrækt/ *abstract (adjective)* - /æbˈstrækt/ *abstract (verb)*
b. /ˈɪnkriːs/ *increase (noun)* - /ɪnˈkriːs/ *increase (verb)*

Whereas stress falls on the first syllable in the first item in these pairs, it is the second syllable that is stressed in the second word. But the quality of the sounds in the two words is identical.

Note, however, that minimal pairs like (27) are rather rare in English. In many other pairs that look like (27), the contrast actually concerns not only stress but also the quality of the vowels. This is illustrated in (28).

(28) a. ˈkɒndʌkt (noun) kənˈdʌkt (verb) *conduct*
b. ˈdezət (noun) dɪˈzɜːt (verb) *desert*
c. ˈprezn̩t (noun, adjective) prɪˈzent (verb) *present*

These examples confirm our observation made above that placement of stress often affects the quality of the nucleus of the syllable. Stressed /ɒ/ in / ˈkɒndʌkt / becomes unstressed /ə/ in /kənˈdʌkt/. Stressed /e/ in /ˈdezət/ becomes unstressed /ɪ/ in /dɪˈzɜːt/ and unstressed /ə/ becomes stressed /ɜː/. Even more interesting is our third example (28c) where in the unstressed second syllable of /ˈprezn̩t/ we find a syllabic consonant, i.e. no vowel at all, in the position where vowel+consonant /en/ occur in the stressed syllable of the corresponding verb.

Even though they are not very frequent, pairs like (27) might suggest that English has the properties of a free stress language, i.e. that stress can occur anywhere. However, such a conclusion is not correct. It is indeed possible to make certain **generalizations** about stress patterns in English. However, these generalization are not as simple as those usually found in fixed stress languages (e.g. French: stress on the final syllable), and they also have frequent exceptions.

Consider for example stress on **nouns**. With most nouns, primary stress falls either on the second-last (penultimate) syllable (29a) or on the third from the last (antepenultimate) syllable (29b).

(29) a. poˈtato, aˈpartment, reˈlation, preˈdiction, diˈsaster
b. ˈcamera, ˈcinema, ˈquantity, ˈemperor, ˈcustody

The variation in (29) is not random. Instead it is related to the structures of the syllables contained in these words. An important role is played here by the distinction between heavy and light syllables. Heaviness refers to the content of the rhyme in a syllable (i.e. the onset is irrelevant in this context). A **heavy syllable** is either (a) a syllable with a long vowel or a diphthong (with or without a coda) or (b) a syllable with a short vowel and a coda. A **light syllable** is either (a) a syllable with a short vowel and no coda or (b) any syllable containing a schwa.

The generalization that can be established for (29) on the basis of the distinction between heavy and light syllables is the following:

(30) *Stress generalization for nouns with more than two syllables*: If the penultimate syllable is heavy, it is stressed. Otherwise it is the antepenultimate syllable that is stressed.

Consider first the examples in (29a). The penultimate syllable is heavy in all these examples: the rhyme contains a diphthong in *pot<u>a</u>to* and *rel<u>a</u>tion*, a long vowel in *ap<u>a</u>rtment* and *dis<u>a</u>ster*, and a short vowel and a coda in *predi<u>c</u>tion*. Stress therefore falls on the penultimate syllable according to (30). In each word in (29b), however, the penultimate syllable has a rhyme with a short vowel and nothing in the coda (e.g. /mə/ in the first word). The rhymes in (29b) are therefore light and in terms of (30) it is the antepenultimate syllable that has to be stressed.

We based the stress rule in (30) on stress patterns in words containing more than two syllables. In words with two syllables, the "otherwise" clause can of course not hold as there is no antepenultimate syllable. It is therefore generally the penultimate syllable that is stressed in two-syllable nouns regardless of whether it is heavy or not. Thus, we obtain *ˈmoney*, *ˈproduct*, or *ˈlarynx*. Finally, for monosyllabic words, the issue of stress placement obviously does not arise as stress must fall on the only syllable available in the word.

The stress generalization in (30) and its extension to two-syllable nouns is confirmed by a large number of other nouns. However, there are also numerous exceptions to this generalization. For example a noun like *spaghetti* should have stress on the antepenultimate syllable according to (30) because the penultimate syllable /ge/ is light. Stress nevertheless falls on the (light) penultimate syllable, thereby following the stress pattern in the word's source language (Italian). Furthermore, while (30) focuses on stress on penultimate or antepenultimate syllables, there are also words in English that have word-final stress. Examples are *report*, *degree*, *police*, *machine*, or *balloon*. The class of nouns stressed on the final syllable is relatively small however, and many of these nouns are loanwords.

The examples discussed in the preceding paragraph show that English does not have an entirely rigid and predictable stress system. However, this is not to say that basic generalizations like that given in (30) are of no importance. (30) seems to be part of the linguistic knowledge a native speaker of English possesses. This can be shown if we test speakers' stress intuitions for unknown words. For example, in a study on stress, linguists presented foreign words like *Gigondas*, *Zaventem* or *tavola* to speakers of English. The first word is of French origin and has stress on the final syllable in French. The second word is of Dutch origin and it has stress on the first syllable in its source language. Finally, the third

word is from Italian and is stressed on the initial syllable in Italian. What is interesting now is that speakers of English who knew no French, Dutch or Italian and who had never heard these words before had a strong tendency to pronounce them with stress on the penultimate syllable. This is expected in terms of (30): all these three words have a heavy rhyme in their penultimate syllable (short vowel and coda in *Gigondas* and *Zaventem*, diphthong in the English pronunciation of *tavola* (i.e. /əʊ/)). This suggests that (30) is part of the linguistic knowledge of speakers of English. If this were not the case, we would expect fairly random variation of stress assignment among speakers – some stressing the first syllable, some the second one and some the third one. (30) can therefore be considered as the **default stress rule** for English nouns. Stress in words like *spaghetti*, *report* or *degree* are exceptions to this basic stress rule. As you will see in the phonology exercises (12) and (13), there are additional generalizations that can be made concerning stress placement in English.

2.4.3. *Further aspects of stress*

- *Weak forms*.
  In principle, every word can have a word stress. But when speakers utter a sequence of words in a row, i.e. when they produce what we call **connected speech**, certain words can remain unstressed. Thus, for example a sentence like *She must leave* is often pronounced with a single stress on the verb *leave* but without any stress on the first two words. The absence of stress in connected speech can be found in particular with function (or grammatical) words like articles, prepositions, auxiliary verbs, conjunctions or pronouns. These words generally lack stress when they occur in their weak form, that is, in the form with a schwa as in /ðə/ *the*, /ə/ *a*, /ənd/ *and*, /əv/ *of*, /bət/ *but*, /ðən/ *than*, /əs/ *us*, /həv/ *have*, /əz/ *as*, /məs/ *must*, /ðə/ *there* etc., or in the form in which a long vowel is shortened as in /ʃi/ *she*, /bi/ *be*, /ju/ *you*. Weak forms of certain words also sometimes lack their initial /h/ as in /ɪz/ *his*, /i/ *he*, /ə/ *her*.

  Function words generally have both a weak and a strong form. They usually appear in their weak form when unstressed. They can appear in their strong form without a stress, but if they are stressed, they necessarily appear in the strong form.

- *Compounds*.
  Lexical words (e.g. verbs, nouns, adjectives) may also lose their stress sometimes and that is when they occur in compounds. Compound words are single words that can be analysed as a combination of two lexical words, both of which exist independently as English words and hence bear their own stress.[2] Examples of this are '*White House* which is a compound consisting of '*white* and '*house*; '*typewriter* which combines '*type* and '*writer*; '*car-ferry* which contains the words '*car* and '*ferry*. As one can see, when these words are brought together, one of them loses its stress. In our examples, it is the first word that remains stressed in the compound. However, there are also certain compounds in which it is the second word that is stressed.

[2] For a more general discussion of compounds, see chapter 4, section 3.

Sometimes compounding can lead to phonological changes that go beyond the loss of stress. If one considers *cupboard* /ˈkʌbəd/ as a compound word, one could say that upon losing its stress, the word *board* /bɔːd/ changed the nucleus of its single syllable into a schwa. This case of compounding would tend to prove that unstressed syllables lose the specific quality of their vowel.

- *Phonological rules*.
  The notion of stress sometimes plays an important role in phonological processes. The phenomenon of aspiration illustrates this point. In our discussion of aspiration so far we have concluded that voiceless plosives are aspirated if they occur in syllable-initial position. However, with this rule we still do not always obtain the right results. In section 2.3.3, we observed that, according to this rule, the voiceless plosive in /hæpɪ/ *happy* would have to be aspirated because it occurs in the initial position of the second syllable. However, /p/ is unaspirated in *happy*. The reason for this is that stress has an influence on aspiration. It is only in the initial position of a stressed syllable that a voiceless plosive has to be aspirated. Everywhere else, there is no or at best only very weak aspiration – this includes the initial position of an unstressed syllable. The complete and final version of the aspiration rule is therefore the following:

(7'') Voiceless plosives are aspirated in the initial position of a stressed syllable.

We therefore have aspiration in ˈ*pill* and *re*ˈ*pair* but not in ˈ*spill*, *re*ˈ*spond* or ˈ*happy*. (7'') shows that phonological processes may treat stressed syllables differently from unstressed ones.

You can now do exercises 12 to 16.

2.5. Intonation

The field of phonology is sometimes divided into two separate areas: **segmental phonology** and **suprasegmental phonology**. In segmental phonology, we study individual sounds and their features (cf. sections 2.1 and 2.2). Suprasegmental phonology deals with larger units, such as the syllable (section 2.3), words (cf. stress in section 2.4) and sentences. An important aspect of suprasegmental phonology above the word level is intonation. Intonation refers to patterns of pitch variation in phrases or sentences. Pitch is an auditory sensation caused by the rate of vibration of the vocal folds (or also for example the vibration of a musical instrument). If the rate of vibration is high, we hear a high pitch, if the rate is low we hear a low pitch.

The topic of intonation is a fairly complex one and, given the introductory nature of this course, we will not pursue it in much detail here. Instead, we will simply give a very brief overview of some issues concerning intonation.

There are two major determinants of intonation:

(i) Whether the pitch of the voice falls, raises, or stays level.
(ii) The placement of the most prominent stress within a sentence.

A simple illustration for point (i) can be given if we look at the different ways the word *no* can be produced. Three possibilities are given in (31) with the different interpretations in italics (rising intonation is marked by /, falling intonation by \, and level intonation by –).

(31) a. A: Did you see the documentary on sheep last night?
B: \ **No.**
… and I am not interested. Falling pitch expressing completeness.
b. A: Did you see the documentary on sheep last night?
C: **/ No.**
… but I'm interested. Rising pitch expressing incompleteness.
c. D: Have you ever been refused car insurance?
E: **- No.**
D: Have you ever been charged with a traffic violation, except parking?
E: **- No.**
Pitch staying level – expressing routine or boredom

The examples in (31) show that pitch has effects on how we interpret *no*. Intonation is therefore relevant from the point of view of semantics/pragmatics.

Let us now consider point (ii) mentioned above, that is, the placement of stress within a sentence. While there are several words within a sentence that are stressed, there is generally one among these that is more prominent than the others. Consider the following sentences:

(32) a. He's from \London.
b. He's from /London?
c. Place the book \on the table. (not under or next to it)

(32a) illustrates the typical intonation pattern in an English sentence. There is a fall in pitch in the stressed syllable of the last content word of a sentence. This syllable is generally referred to as the **tonic syllable** of a sentence. Tonic syllables are perceptually more salient than the other syllables within a major grammatical unit or a sentence. A change in the basic English intonation pattern in (32a) can lead to a different meaning. This is shown in (32b) where the pitch is rising rather than falling. This intonation is typical for a question (cf. also 31b – rising pitch expressing incompleteness). Finally, rather than occurring on the final content word of the sentence, falling pitch can sometimes also occur on another word (cf. 32c). However, this option is used only to express emphasis or contrast, as suggested by the comment in italics in (32c). By putting the falling pitch on *on*, we stress this preposition and thereby imply that we really mean *on* rather than *under* or *next to*.

To conclude this section, let us briefly consider the functions of intonation. We can distinguish three main functions:

(i) **Attitudinal** function. Intonation can be used by a speaker to express a wide range of attitudes such as for example interest (cf. e.g. 31b), boredom (31c), certainty, uncertainty, or enthusiasm. Here, intonation may interact with other properties such as tempo, voice quality or facial expressions.

(ii) **Accentual** function. This function is illustrated in (32c) where intonation is used to stress one aspect of the sentence.

(iii) **Grammatical** function. A tonic syllable indicates the boundary of a major grammatical unit or a sentence. Intonation can therefore sometimes disambiguate ambiguous sentences. Example (33a), in its written form, is ambiguous. However, specific intonation patterns can make the sentence unambiguous. This is shown in (33b) and (33c).

(33) a. Those shareholders who bought quickly reaped the benefits.
Paraphrase 1: The benefits were reaped by those shareholders who bought quickly.
Paraphrase 2: The benefits were reaped quickly by those shareholders who bought.
b. Those shareholders who bought \quickly reaped the benefits. (=Paraphrase 1)
a. Those shareholders who \bought quickly reaped the benefits. (=Paraphrase 2)

In (33b), we have a tonic syllable in *quickly* suggesting that the relative clause ends there (paraphrase 1), whereas in (33a) *bought* has a tonic syllable, which implies that the relative clause ends with *bought* and excludes *quickly*. Thus, intonation can have the function of indicating grammatical structure.

Each of these aspects of intonation could of course be studied in much more detail, but the brief overview presented here will have to be sufficient for our purposes.

2.6. Phonological processes in sound sequences

We normally speak by producing a continuous, connected stream of sounds. When sounds combine to form syllables, words, phrases or sentences, various phonological processes can occur. These processes are generally referred to as **connected speech phenomena**. Here, we will present four main types of processes:

- ***Assimilation***
Assimilation is a process whereby one sound becomes phonetically similar to an adjacent one. Different criteria can be used to classify assimilation processes:
(i) The type of feature that is involved in assimilation.
- **Voice assimilation**. For example, the labiodental fricative /v/ in the verb *have* (/hæv/) often loses its voicing when it is immediately followed by a voiceless consonant. This is shown in (34).

(34) I have to – *connected speech*: [aɪ hæf tə]

In (34), /v/ is realized as [f] before the voiceless sound /t/. The two sounds thus become phonetically more similar because they now share the feature [-voiced].

- **Place assimilation**. Adjacent sounds can also be assimilated with respect to their place of articulation. This phenomenon can be found for example with word-final alveolar consonants (/t/, /d/, /n/). If a word ending in one of these consonants is followed by a word whose initial consonant has a different place of articulation, the word-final alveolar consonant is likely to change so that it has the same place of articulation.

(35) a. *o**dd m**essage* → [ɒb mesɪdʒ]
b. *tha**t g**irl* → [ðæk gɜ:l]

In (35a), the alveolar /d/ becomes bilabial [b] before bilabial /m/. The voicing and manner features remain identical. In (35b), it is the velar feature of /g/ that influences the preceding alveolar /t/, giving rise to the sequence [kg] where both sounds share their place of articulation.

(ii) The direction of the assimilation process.

- **Regressive assimilation**: A sound is influenced by the following sound, that is, the assimilation process goes backwards. Examples (34) and (35) are examples of regressive assimilation as it is the second sound that remains constant and the first one that changes its quality.
- **Progressive assimilation**: This process is the opposite of regressive assimilation. A sound is influenced by the preceding sound, that is, the assimilation process takes a forward direction. The pronunciation of *happen* provides an illustration of this phenomenon.

(36) *happen*: [hæpən] → [hæpm]

The first transcription in (36) represents careful pronunciation. However, in connected speech, the schwa can be deleted and the quality of the final sound then often changes, as shown in the second phonetic transcription in (36). What happens in the second pronunciation is that the alveolar nasal changes into a bilabial nasal through place assimilation with the preceding sound, a bilabial plosive.[3]

- ***Lenition***

The weakening or reduction of a sound is referred to as lenition. Allophonic realizations of the phoneme /t/ in different varieties of English illustrate this process. For example, in words like *bet**t**er*, /t/ is realized as a [d]-like sound in American English, transcribed as [ɾ]. This process is called **Flapping**, and it is an instance of weakening because the degree of obstruction created by the tongue is reduced as compared to [t]. As pointed out on p. 101 already, another allophone of /t/ is the glottal stop [ʔ], which occurs in different varieties

[3] Note that this assimilation process can also occur regressively, as in [ɪmpʊt] (*input*).

of English (e.g. Cockney (East London)) in words like *ci**t**y* or *bu**tt**er*. Here we again have a case of lenition. The articulatory effort is reduced because the tongue does not have to move at all and obstruction only occurs at the larynx. Note that this lenition process also starts affecting RP, at least in certain phonological contexts. Glottalling can already be found regularly before obstruents in RP (e.g. [fʊʔbɔːl] *foo**t**ball*), but increasingly also before other consonants (e.g. [æʔməsfɪə] *a**t**mosphere*). However, before vowels as in *ci**t**y* or *bu**tt**er*, the glottal stop does not occur in RP.

Weakening can also be found with vowels. As observed already in section 2.4.3 above, some words have strong and weak forms. In weak forms, the vowel of an unstressed syllable is typically reduced to schwa (e.g. *of* [ɒv] → [əv]) or it is shortened (e.g. *he* [hiː] → [hɪ]). These processes are instances of lenition.

It should be pointed out that there is also a process which has the opposite effect of lenition. This process is called **fortition** or strengthening. Although fortition is a fairly rare phonological feature phenomenon, we have come across one example in our discussion so far, and that is the process of aspiration. With aspiration, a phonetic property is added and the duration of voicelessness is slightly longer. We can therefore consider aspiration as an instance of fortition.

- ***Elision***

  This process involves the deletion of a sound. The phoneme /t/ provides again some clear illustrations of this process. When surrounded by other consonants /t/ can sometimes be deleted. This is shown in (37a). In the same context, /d/ is also often deleted, as (37b) shows. Finally, another consonant phoneme that can be subject to elision in connected speech is /h/ (37c).

(37) a. *nex**t** month* → [neks mʌnθ]
  b. *thousan**d** points* → [θaʊzn pɔɪnts]
  c. *I saw him* → [aɪ sɔː ɪm]

Sometimes, elision affects not just a single sound but entire syllables may be omitted.

(38) *February*: [febrʊərɪ] → [febrɪ]

- ***Epenthesis***

Epenthesis is the opposite of elision and involves the insertion of a sound. It is a relatively rare process, but in British English there is a good example of this phenomenon. As pointed out on p. 109, we can distinguish two types of English with respect to the pronunciation of /r/: rhotic varieties, in which post-vocalic /r/ is pronounced (e.g. most varieties of American English), and non-rhotic varieties, in which post-vocalic /r/ is generally not pronounced (e.g. RP). The varieties that are of interest here are the non-rhotic ones. In these varieties, post-vocalic /r/ is often pronounced in connected speech when a vowel follows. Thus, while the word *near* is generally pronounced without the /r/

sound (i.e. [nɪə]), the /r/ reappears before a vowel as in *near and far* (i.e. [nɪə**r** ən fɑ:]). What is interesting now is that speakers sometimes add [r] between [ɑ], [ɔ] or [ə] and a following vowel although there is no r in the spelling and no etymological /r/ in the word concerned. This phenomenon is called **intrusive r** and it is an illustration of the process of epenthesis. Examples are given in (39).

(39) a. *the idea*[r] *is*
b. *India*[r] *and Pakistan*

In (39), the [r] emerges between two words. However, "intrusive r" can sometimes even be observed within words, and more precisely between what we will call morphemes in the next chapter. Thus, the word *drawing* can sometimes be heard pronounced as [drɔ:**r**ɪŋ] in British English.

Finally, some general observations can be made about phonological processes occurring in connected speech:

- Many of these phonological processes have a similar rationale. They make pronunciation easier for speakers from an articulatory point of view and therefore allow the speech tempo to be kept consistently fast.
- The different processes can sometimes be combined. Consider for example the word *handbag*. In connected speech, this word can be pronounced as [hæmbæg]. This pronunciation is the result of two processes: (i) /d/ **elision** before a consonant: /hæn**d**bæg/ → hænbæg; (ii) regressive place **assimilation** of /n/: hæ**n**bæg → [hæ**m**bæg].
- The processes described above can occur at different levels. They can occur between syllables of a single word (e.g. 36 or different forms of lenition of /t/), between words (e.g. 34, 35, 37) or between parts of words that we will refer to as morphemes in the next chapter (e.g. *handbag* and plural formation discussed below).
- Many of these processes are optional and may be absent in more formal situations and in slower speech. However, some processes such as aspiration are obligatory.

To conclude this chapter, we will look at an obligatory phonological process that is directly related to the topic of next chapter, i.e. morphology. It concerns the formation of plurals in English. English has a regular plural form generally spelt as *–s* as in *cabs* or *cats* or sometimes as *–es* as in *catches*. This ending is referred to as the **plural morpheme**. If we look at the pronunciation of this morpheme, we can observe that there are not just two options but three. These are shown in (40).

(40) a. *cab-s* [kæb**z**]
b. *cap-s* [kæp**s**]
c. *catch-es* [kætʃ**ɪz**]

Thus, we can see that the ending spelt as *–s* can correspond to a voiced alveolar fricative or to a voiceless alveolar fricative. The question that arises then is whether we can find a reason why the regular plural morpheme varies the way it does in (40). Or in other words, we want to find out what a speaker's knowledge consists of concerning the use of the plural ending. There would be several possibilities:

(a) It could be that plural forms are memorized for each word. However, this does not seem to be plausible. Speakers of English can form plurals of words they have never heard before. Thus, if we ask speakers to form the plural of the non-existing word *wug*, they all produce [wʌgz]. This suggests that plural formation must be based on a rule rather than on memorization.

(b) But then, what is the nature of this rule? Could the rule be based on phonemes? We can indeed observe that the different plural endings shown in (40) only occur in specific phonological contexts. These contexts are given in (41).

(41) a. [ɪz] after /s, z, ʃ, tʃ, ʒ, dʒ/
b. [z] after /b, d, g, v, m, n, l, ŋ, r, ð, vowels/
c. [s] after /t, p, k, f, θ/

However, to say that speakers know lists of phonemes after which the different endings are used would not seem sufficient. Speakers can produce plurals for words ending with sounds that are not part of the phonemic inventory of English. For example, the sound spelt *ch* in German and transcribed as /x/ does not exist in RP. If we now take a German name ending in /x/ such as *Bach* and we want to pluralize it (*the Bachs*), speakers of English would agree that it is pronounced as [baxs] although /x/ is not part of the list in (41).

(c) This suggests that plural formation is based on something more abstract than simply phonemes. Given our assumption that phonemes are composed of phonological features, the obvious way of analyzing (40) and (41) is in terms of **features**. Features indeed allow us to describe the situation in (41) very concisely. We can observe that (41b) contains only voiced phonemes and (41c) only voiceless phonemes. The regular plural formation rule in English can therefore be formulated as follows.

(42) (i) [ɪz] after alveolar/palatoalveolar fricatives and affricates. Otherwise:
(ii) a. [z] after [+voiced]
b. [s] after [-voiced]

Note that (ii) illustrates a progressive **assimilation** process as it is the voicing of the final sound of the word that determines the voicing property of the following sound. In terms of this system, the problem raised under (b) above can be solved. /x/ in *Bach* is a voiceless sound and therefore requires the presence of the voiceless variant of the plural morpheme. As for (42i), it is a form of **epenthesis**. The presence of the vowel /ɪ/ ensures that two phonetically very similar sounds do not occur next to each other. For example, if we took the noun *bus* and simply applied (42iib) we would get [bʌss]. But [ss] is a sound sequence

which is not possible in English because gemination (the doubling of consonants) does not exist in English. Insertion of /ɪ/ is then extended to the position following the phonetically very similar sounds /ʃ/, /tʃ/, /ʒ/ and /dʒ/. Given the combination of phonological processes (assimilation, epenthesis) and morphological ones (plural formation) the rule in (42) can be referred to as a **morphophonological rule**. We will come back to this issue in the next chapter.

Summing up, this chapter has presented some basic aspects of the phonetic and phonological knowledge that speakers of English have. It includes knowledge of: sound production, an inventory of phonemes, the phonological features defining phonemes, syllable structure, constraints on sound sequences, stress patterns, patterns of intonation, and various types of phonological rules and processes.

You can now do exercises 17 to 21.

Recommended further reading:

Fromkin, Rodman and Hyams (2003), chapters 6 and 7. (But careful: Fromkin et al. use the American transcription system whereas we are using the IPA system.)

Some further references:

Carr, P. 1999. *English Phonetics and Phonology.* Oxford: Blackwell.

Forel, C. and G. Puskas. 1996. *Phonetics and Phonology*. Ms., University of Geneva. (this chapter is a revised and extended version of this manuscript)

McMahon, A. 2002. *An Introduction to English Phonology.* Edinburgh: Edinburgh University Press.

Roach, P. 1983. *English Phonetics and Phonology.* Cambridge: Cambridge University Press.

Thomas, J. M. C., L. Bouquieux, F. Cloarec-Heiss. 1976. *Initiation à la phonétique*. Paris: PUF.

TP EXERCISES PHONOLOGY

2.1. Phonemes and allophones

1. Minimal pairs

Using example (9) in the text as a model, show the oppositions the phoneme /f/ can enter into in English. You may have difficulties with the phoneme /ʒ/.

2. Distinctive features of allophones

The aim of this exercise is to prove that [pʰ] and [p] share exactly the same set of distinctive features. In order to do so, you have to place both [pʰ] and [p] in opposition to all other consonants of the system, wherever possible. If there is no difference, i.e. if [pʰ] and [p] share the same distinctive features, they can be said to be allophones.

a. Fill in the gaps in the list below, following the model in the first three lines.
b. For each contrast in the first column (aspirated p), indicate the feature(s) that distinguish the second sound from [pʰ] (e.g. *[pʰ] vs. [b]: voiced*).
c. Then consider the second column (unaspirated p): Are the features distinguishing the second sound from [p] in each pair different from those found in (b)?

[pʰ] is opposed to [b] as in [pʰɪg] : [bɪg]	[p] is opposed to [b] as in [rɪp] : [rɪb]
[pʰ] is opposed to [t] as in [pʰiː] : [tʰiː]	[p] is opposed to [t] as in [suːp] : [suːt]
[pʰ] vs. [d] as in [pʰɪg] : [dɪg]	[p] vs. [d] as in [rəʊp] : [rəʊd]
[pʰ] vs. [k] as in [pʰæt] : [kʰæt]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [g] as in [pʰɒt] : [gɒt]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [m] as in [pʰæt] : [mæt]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [n] as in [pʰɪt] : [nɪt]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [ŋ] as in *[-] : [-]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [f] as in [pʰiːt] : [fiːt]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [v] as in [pʰet] : [vet]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [θ] as in [pʰɔːt] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [ð] as in [pʰæt] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [s] as in [pʰæt] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [z] as in [pʰɪp] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [ʃ] as in [pʰiː] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [ʒ] as in ?[ ] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [tʃ] as in [pʰiːp] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [dʒ] as in [pʰiːp] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [l] as in [pʰɪt] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [r] as in [pʰɒt] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [w] as in [pʰiː] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [j] as in [pʰəʊk] : [ ]	[p] vs. [ ] as in [ ] : [ ]
[pʰ] vs. [h] as in [pʰiː] : [ ]	[p] vs. [ ] as in [ ] : [ ]

3. Allophones

In certain dialects of English (not RP), there is a predictable variant [əɪ] (an allophone) of the diphthong /aɪ/. On the basis of the data below determine in which context /aɪ/ is realized as [əɪ] instead of [aɪ]. The context should be described in terms of the relevant phonological feature(s) of the preceding and/or following sound(s).

To answer this question, you can start by listing the sounds that occur before and after the diphthong when it is realized as [aɪ] and the sounds that occur before and after the diphthong when it is realized as [əɪ] (e.g. for (1): *[əɪ]: b_t*). Then try to find a common property of the contexts for [əɪ] that distinguishes them from the contexts in which [aɪ] occurs.

a.	bite	[bəɪt]	i.	fight	[fəɪt]
b.	tie	[taɪ]	j.	buy	[baɪ]
c.	ride	[raɪd]	k.	rice	[rəɪs]
d.	file	[faɪl]	l.	type	[təɪp]
e.	life	[ləɪf]	m.	ninth	[naɪnθ]
f.	time	[taɪm]	n.	fire	[faɪr]
g.	rise	[raɪz]	o.	bike	[bəɪk]
h.	write	[rəɪt]			

4. Phonemes: Varieties of English

In exercise (3), we saw that varieties of English may differ with respect to the allophones they have. But the phonemic inventory found in different varieties of English may vary as well. The following data sets are from General American (GA), Scottish Standard English (SSE) and RP. On the basis of the presence of minimal pairs in one variety vs. the absence of such pairs in another variety, determine to what extent GA and SSE differ from RP with respect to the phonemic contrasts that can be found in these different varieties.

	GA	SSE	RP	
a.	[weɪlz]	[ʍelz]	[weɪlz]	*whales*
b.	[weɪlz]	[welz]	[weɪlz]	*Wales*
c.	[lɑk]	[lɔx]	[lɒk]	*loch*
d.	[lɑk]	[lɔk]	[lɒk]	*lock*
e.	[wɪn]	[ʍɪn]	[wɪn]	*whin*
f.	[wɪn]	[wɪn]	[wɪn]	*win*
g.	[p^{h}u:ɬ]	[p^{h}ʉɬ]	[p^{h}u:ɬ]	*pool*
h.	[p^{h}ʊɬ]	[p^{h}ʉɬ]	[p^{h}ʊɬ]	*pull*
i.	[k^{h}ɔ:t]	[k^{h}ɔt]	[k^{h}ɔ:t]	*caught*
i.	[k^{h}ɑt]	[k^{h}ɔt]	[k^{h}ɒt]	*cot*

5. Phonemes: Cross-linguistic variation

In English, the voiceless plosives (/p/, /t/, /k/) and the voiced plosives (/b/, /d/, /g/) are all considered as distinct phonemes. For Korean, however, it is assumed that there are no voiced plosive phonemes. Instead, voiced plosives are analyzed as allophones of the voiceless plosive phonemes (i.e. [b] is an allophone of /p/, [d] is an allophone of /t/, and [g] is an allophone of /k/). Show how the data below illustrate this difference between English and Korean. In your answer, you should focus on the criterion of complementary distribution.

English:

a.	[pʊl]	[bʊl]
b.	[kɒp]	[kɒb]
c.	[kɒt]	[gɒt]
d.	[bæk]	[bæg]
e.	[tæt]	[dæd]

Korean:

a.	[pul] ‘fire’	[ibul] ‘this fire’
b.	[tal] ‘moon’	[idal] ‘this moon’
c.	[kan] ‘liver’	[igan] ‘this liver’
d.	[pap] ‘cooked rice’	[pabi] ‘cooked rice’ (subject)
e.	[tat] ‘close’	[tadaɾa] ‘close it’
f.	[tʃɛk] ‘book’	[tʃɛgi] ‘book’ (subject)

2.3. The syllable

6. Onset clusters

In the table on p. 108:

a. Analyze the entries: Have the sounds been placed identically in the horizontal and vertical entries? In which way have they been ordered?
b. Define the zone where most clusters occur.
c. List the clusters of this zone: What do they consist of?
d. Do all second elements of these clusters have a common feature?
e. Concentrate on the first elements of these clusters: Which manners of articulation are represented?
f. Do all the manners listed in (e) accept the same second elements? If not, list the various behaviours you can find.
g. The phoneme /s/ as the first element of a cluster accepts many different second elements: What are they (in terms of VPM)? Can you see a connection between the VPM description of /s/ and that of the elements it accepts in an onset cluster?

7. Clusters

Give:

a. a syllable beginning with a cluster *labio-dental fricative + lateral*
b. a syllable beginning with a cluster *labio-dental fricative + palatal*
c. a syllable beginning with a cluster *fricative + alveolar nasal*
d. a syllable beginning with a cluster *s + plosive + velar*
e. a syllable ending with a cluster *lateral + plosive + alveolar*
f. a syllable ending with a cluster *velar nasal + plosive*
g. a syllable ending with a cluster *voiced plosive + alveolar fricative*

You may have had to eliminate some of the syllables of the exercise which are not possible in English. If you did, explain on what basis you did so.

8. Sound sequences

Are the following strings of sounds possible words in English?

a.	[rbeɪ]	e.	[ɪŋ]	i.	[ɒksts]
b.	[tʰæm]	f.	[spjuː]	j.	[ruːʒ]
c.	[kniː]	g.	[rʌgh]	k.	[sɪfθs]
d.	[ŋɪt]	h.	[dwiːɬ]	l.	[ɬɪmp]

9. Complementary distribution and allophony

Consider the following pairs of sounds:

i. l - ɬ
ii. h - ŋ

a. Why can't you ever find [l] in the same position as [ɬ]?
b. Why can't you ever find [h] in the same position as [ŋ]?
c. Intuitively, it is clear that the problem encountered in (a) is not the same as the one in (b). What is the difference?
d. How can you account for this intuition? To answer this question, consider the distinctive features involved in [l]-[ɬ] and [h]-[ŋ].
e. On the basis of your answers in (a) to (d), write a short essay discussing the following question: What are the differences between the pairs of sound [l] - [ɬ] and [h] - [ŋ]?

10. Clear and dark l

Consider the following two strings of sounds:

a. [hiːlɑɪz]
b. [hiːɬɑɪz]

Both of these strings can be divided into two words, but no word boundaries are given in the phonetic transcription above. Taking into account the distributional properties of clear and dark l, show how the two strings can be divided into words by providing regular spelling.

11. Syllabification

For each of the following words, say how it is syllabified, and why alternative syllabifications are disallowed. For (a) and (b) also provide syllable structures along the lines of examples (13) and (14) in the text (i.e. structures with onset, nucleus and coda).

a. revise /rɪvaɪz/
b. anxious /æŋkʃəs/
c. danger /deɪndʒə/
d. unstable /ʌnsteɪbl/
e. residential /rezɪdenʃəl/

2.4. Stress

12. Stress placement in verbs

Given the following examples (partly from Roach 1983:76), find the characteristics that seem relevant for the placement of stress with verbs.

(i)	a.	əˈplɑɪ	*apply*	(ii)	a.	əˈtrækt	*attract*
	b.	əˈrɑɪv	*arrive*		b.	əˈsɪst	*assist*
	c.	juːˈzɜːp	*usurp*		c.	ɪnˈvent	*invent*
	d.	entəˈteɪn	*entertain*		d.	rezəˈrekt	*resurrect*
(iii)	a.	ˈentə	*enter*	(iv)	a.	əˈtæk	*attack*
	b.	ˈenvɪ	*envy*		b.	fʊlˈfɪl	*fulfill*
	c.	ˈhʌrɪ	*hurry*		c.	ˈiːkwəl	*equal*
	d.	ɪŋˈkaʊntə	*encounter*		d.	dɪˈtɜːmɪn	*determine*

13. Stress placement in adjectives

Consider the stress patterns in the following adjectives. Does stress placement follow the stress generalizations for nouns on p. 118 or the stress generalization for verbs established in exercise (12)?

(i)	a.	ˈlʌvlɪ	*lovely*	(ii)	a.	dɪˈvaɪn	*divine*	(iii)	a.	ˈɒnɪst	*honest*
	b.	ˈprɪtɪ	*pretty*		b.	kəˈrekt	*correct*		b.	ˈbjuːtɪfʊl	*beautiful*
	c.	ˈbetə	*better*		c.	dɪˈstɪŋkt	*distinct*		c.	ˈderɪlɪkt	*derelict*
									d.	ˈregjʊlə	*regular*

14. Stress shifts

A. As you can see in the examples below, the addition of a suffix may modify the placement of stress. (based on Roach 1983:82)

- əd'vɑːntɪdʒ	*advantage*	- ædvən'teɪdʒəs	*advantageous*
- 'fəʊtəʊ	*photo*	- fə'tɒgrəfɪ	*photography*

a. How would you describe the shift of stress?
b. Can you predict the placement of stress in the second word of these pairs?

- 'prɒvɜːb	*proverb*	- prəʊvɜːbɪəl	*proverbial*
- 'klɑɪmət	*climate*	- klɑɪmætɪk	*climatic*
- 'træŋkwəl	*tranquil*	- træŋkwɪlɪtɪ	*tranquillity*

B. You probably answered question (A.b) by using (A.a) and applying it systematically. However, there is another clue, based on vocalic quality in weak and strong syllables. Using the following example as a model,

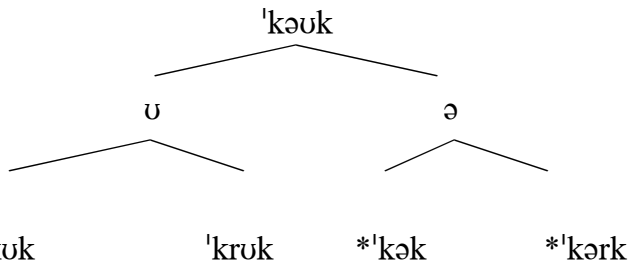
əd'vɑːntɪdʒ ˌædvən'teɪdʒəs

place the stress on the following pairs of words:

- pɜːfɪkt	*perfect*	- pəfekʃn̩	*perfection*
- ɪndʒə	*injure*	- ɪndʒʊərɪəs	*injurious*
- riːfleks	*reflex*	- rɪfleksɪv	*reflexive*

15. Schwa vs. ʊ

Consider the following data, presented by Martinet (1974:119).



It seems that in the diphthong /əʊ/ you can take /ə/ away and still get a possible word, but you cannot take /ʊ/ away. How can you explain this situation?

16. Impossible words

Why are the strings below not possible words in English?

a. /ˈbədɔː/	b. /rˈŋɪt/	c. /təhˈiːz/
d. /ˈsɪtɑː/	e. /bɑtˈn̩/	f. /ˈpediː/

2.6. Phonological processes in sound sequences

17. Nasal vowels in American English

American English shows nasal vowels. Here are some examples (from Fromkin & Rodman 2003:283):

a.	[bi] *bee*	d.	[bid] *bead*	g.	[bĩn] *bean*
b.	[le] *lay*	e.	[les] *lace*	h.	[lẽm] *lame*
c.	[bæ] *baa*	f.	[bæd] *bad*	i.	[bæ̃ŋ] *bang*

Note that the American transcription system is used, but it does not interfere with the problem we are going to discuss.

i. Where do nasal and non-nasal vowels occur?
ii. Is there a set of nasal vowels in AE that can be opposed to non-nasal vowels (as in French [o/õ] in *beau*/*bon*, [a/ã] in *bas*/*banc* etc.).
iii. Are nasal vowels phonemic in AE?
iv. If not, give a rule which accounts for nasal vowels in AE.

18. Assimilation

Here is a nice French assimilation found in baby talk. Children may say:

a. /kromnad/ for *promenade* b. /kravaj/ for *travail*

Describe this assimilation process, motivating it in terms of features.

19. Flapping in American English

In Standard American English *photograph* and *photography* would be pronounced as [ˈfourə˛græːf] and as [fəˈtɑgrə˛fi] where [ɾ] represents the flap. Here we see that the sound written *t* represents two sounds: [t] and [ɾ]. Assume that one of the two is the basic, underlying form (corresponding to the phonemic form). Then, using the data below, formulate a rule which will account for the distribution of these two sounds.

a.	[sɪt] *sit*	e.	[sətɪrɪkl] *satirical*
b.	[sɪɾɪŋ] *sitting*	f.	[toun] *tone*
c.	[sɪɾə] *sitter*	g.	[ətoun] *atone*
d.	[sætaɪr] *satire*	h.	[tiːtaɪm] *teatime*

20. /mb/ clusters

a. In English, the phonological transcription of the words *bomb*, *crumb* and *tomb* are:
/bɒm/ /krʌm/ /tuːm/
What constraint seems to rule out the following words in English:
*/bɒmb/ */krʌmb/ */tuːmb/

b. And yet, words like [bɒmbədɪə], [krʌmb̩] and [tuːmbəl] (or [tɒmbəl]) are perfectly possible. Explain the re-apparition of /b/ in these words using
- the rule you proposed in (a)
- and syllabification

c. Assuming that the words in (b) provide the basic phonological forms of the roots in (a), by what phenomenon do we get the correct /bɒm/ and not the starred */bɒmb/ or the correct /tuːm/ rather than */tuːmb/?

21. Morphophonological rules: The regular past tense ending

The regular past tense ending *-ed* can be realized as [d] or [t]:
(i) pliːz - pliːzd ('to please')
(ii) pæk - pækt ('to pack')

a. Can you find other (regular) verbs whose past tense ending is [d]?
b. Can you find other (regular) verbs whose past tense ending is [t]?
c. Can you find other variants of the regular past tense ending *-ed*?
d. On the basis of (a) to (c), can you find a phonological rule for past tense formation? (I.e. what is the environment where [d] occurs, what is the environment where [t] occurs, and (if you found another variant) what is the environment where the other variant occurs?)

Analysis of your own data – Task 3b

On the basis of an example taken from your speech sample, explain and illustrate ONE phonological phenomenon. Your answer should consist of an explicit and coherently written paragraph (approximately 75-100 words).

Two general essay questions for revision:

(I) On the basis of the various elements of the definition of "phoneme" that you can find in the text, write a short essay in which you give a clear picture of what a phoneme is and what the problems around the definition of the phoneme can be.

(II) Taking into account the data from the text and the exercises, write a short essay on how to determine whether two distinct sounds have to be considered as two phonemes or as being two allophones of the same phoneme.