1 Sounds and segments

1.1 Introduction

It is a commonly held view that speech consists of sounds: morphemes, words, phrases and sentences are thought of as made up of a series of sounds, one following the other. Speakers of English will readily agree that a word such as *plot* starts with the sound [p], which is followed by [l], then the vowel [ɒ], and ends with a [t] sound. Likewise, speakers of French are not likely to object to the word *garder* 'look after' being recorded as [gaʁˈde], and speakers of Icelandic will find nothing strange about *bráðum* 'soon' being transcribed as ['prauːðʏm]. Phonetic transcription, just like the alphabetic writing systems on which it is modelled, encourages the view that speech consists of individual, separate or discrete sounds strung together in much the same way as beads on a string. Although there exist non-alphabetic orthographies which do not necessarily impose this view, phonetic transcription, which is believed to be an objective record of pronunciation, leaves no doubt as to the divisibility of speech into small chunks called sounds; within this system of recording speech, separate symbols are available for what are regarded as sufficiently different sound units. The procedure whereby words are divided into smaller units is called **segmentation**.

Phonetic transcription was originally devised to remove ambiguities that conventional spelling systems could not cope with: in English what is spelt *wind* can be pronounced [wɪnd] or [waɪnd], depending upon the meaning, while *lower* can be either [ləʊə] or [laʊə], again with different meanings; conversely, the same phonetic chunk [æŋ] is spelt as differently as *ang* and *ingue* in *bang* and *meringue* respectively, while what is phonetically [ʃuː] can be spelt – depending on the word that is intended – either *shoe* or *choux*. Although English offers probably an extreme example of the discrepancy between sounds and spelling, arguably all languages which have an orthography display some orthographic departures from a consistent one-letter–one-sound and one-sound–one-letter model. The system of phonetic transcription, which is intended to overcome the various ambiguities, adopts the basic mechanism of any orthographic convention, as it embraces the assumption that speech is segmentable, with vowels and consonants following each

other in different arrangements. The intuitive recognition of the segmentable nature of speech is thus reinforced by the linguistic tradition of phonetic transcription.

Speakers' intuitions and traditional orthography find support in the way the segmented chunks of sound function in languages. It is frequently the case that by replacing one sound with another we obtain different words; a substitution test of this kind shows that speech does indeed consist of **segments** or significant sounds which can be called independent sound units of the language. Consider the following set of English words:

[1]

met [met]	net [net]	pet [pet]
bet [bet]	let [let]	set [set]
get [get]	vet [vet]	debt [det]
het [het]	yet [jet]	wet [wet]
jet [dʒet]		

In all these words there is a chunk which is repeated, i.e. [et], and an initial consonant which differs in every case. Since we are dealing with separate words, the initial segment must be regarded as the first independent unit of the word. If we replace the vowel [e] by the diphthong [ai], in several cases the result is an existing English word:

[2]

might [maɪt]	night [naɪt]	bite [baɪt]
light [laɪt]	site/sight [saɪt]	white/Wight [waɪt]

to which others may be added:

[3]

kite [kaɪt]	fight [faɪt]	rite/right [raɪt]
tight [taɪt]	(in)dict [daɪt]	

Finally, while maintaining the first two segments we can replace the last consonant in the words:

[4]

Meg [meg]	men [men]
mess [mes]	met [met]

It is also possible to omit the consonant preceding the vowel [5a] or the one following it [5b], e.g.

[5]

a.	ate [et]	egg [eg]	Ed [ed]
	isle [aɪl]	aim [eɪm]	oak [əʊk]
	earn [ɜːn]	eel [iːl]	ooze [uːz]
b.	sigh [saɪ]	pie [paɪ]	vie [vaɪ]
	guy [gaɪ]	tie [taɪ]	rye [raɪ]
	dye/die [daɪ]	by/buy [baɪ]	lie/lye [laɪ]
	nigh [naɪ]	why [waɪ]	

The replacement tests show very clearly that the intuitive division of the words in [1] into three segments, confirmed by the transcription, is linguistically real since the language exploits the three separate chunks for making different words. Admittedly, it is not the case that every possible combination is actually attested as a real word – hence there are gaps – but these gaps must be regarded as an accident. The following could be regular words of English which just happen not to have found their way into dictionaries:

[6]	pite/pight [paɪt]	vite [vaɪt]
	weg [weg]	kie [kaɪ]

Sound combinations such as those in [6] are referred to as **potential words** while those in [1] – [5] are **attested words**. This distinction is generally recognised in phonology (linguistics) as it reveals an important property of language: it is not a closed system but has the potential to expand and develop.

Speakers' intuitions, phonetic transcription and the replacement test all tell the same story: speech is segmental, words consist of sequences of units following each other. As we will see below, this very simple statement will need to be seriously revised and modified. Caution must be exercised in the use of the very notion of **speech sound** or **segment**.

The popular conviction that speech is segmentable and each word can be broken up into a limited number of sounds leads to the conclusion that each language has at its disposal a definite number of such sounds which it uses in different combinations. Observation of the spoken language shows that this conclusion is very much oversimplified. Phonetic events by their very nature are unique; hence, strictly speaking, no two sounds are ever exactly identical even if they are perceived as such by users of the language: there are individual differences between speakers as far as their voice quality goes, and even the same speaker on different occasions will produce sounds that differ, for example, in loudness. These differences can be identified and described by means of the rigorous physical methods of acoustic phonetics but they contribute little to the way sounds are used for linguistic purposes. All linguistic practice tends to disregard such minute phonetic distinctions, but this means the sounds we speak of are in reality not physical but **abstract sounds**. For practical reasons we continue to use the term **sounds** but it is worth keeping in mind that this is nothing but a convenient shortcut.

There is a linguistically more relevant difficulty connected with the notion of sounds. It is easy to see that what speakers treat as the same sound displays marked differences depending on the context in which it appears. Such **contextual variability** of sounds is found in every language. Phonetically we can describe the different sounds, for example, by indicating the articulatory differences involved

such as degree of length or voicing, presence or absence of aspiration and the like. Phonetics, however, will not tell us that we are dealing with contextual variability of what are in some sense the same sound units. This constitutes one of the areas of interest of phonology. To see what is involved in the variation of sounds and how this affects the very notion of a language sound, we shall now look at a few examples, starting with a simple case of consonant differences in English.

1.2 Aspiration of plosives in English

English voiceless plosive consonants – the initial sounds in words like *peace*, *tease*, *keen* – are pronounced with a puff of air called **aspiration** and transcribed by means of the diacritic [ʰ] following the plosive: [pʰiːs], [tʰiːz], [kʰiːn]. No aspiration is found when voiceless plosives appear after [s]; as a result we find pairs of very similar consonants: [pʰ – p], [tʰ – t], [kʰ – k]. In [7] we list some words differing in the presence or absence of the initial fricative which consequently differ slightly as regards the following plosive.

[7]	pain/pane [pʰeɪn]	Spain [speɪn]
	teem/team [tʰiːm]	steam [stiːm]
	key/quay [kʰiː]	ski [skiː]

English dialects, it should be added, differ considerably with respect to the extent and details of this phenomenon. Below we describe the situation found in the variety of southern British English known as Received Pronunciation (RP). It should be kept in mind, however, that in this dialect, just like in any other, some variation is bound to occur. In general, a voiceless plosive before a stressed vowel is accompanied by strong aspiration. As mentioned above, no aspiration is found when a plosive appears after [s]. This is shown in [7] where the left-hand words begin with an aspirated stop, while the plosives following [s] in the right-hand column are all pronounced without aspiration. By and large, the same holds true for word-internal position as shown in [8a], although phonetic descriptions usually note that aspiration before an unstressed vowel is relatively weak. Word-finally the situation is slightly more complicated since single plosives may be either aspirated or unaspirated; furthermore, the aspiration may be reinforced or even replaced by the glottal stop [ʔ]. A word such as *kick* may be pronounced in any of the following ways: [kʰɪkʰ], [kʰɪk], [kʰɪʔ] or [kʰɪʔ]. Assuming the careful, perhaps somewhat studied pronunciation with the released plosive, we observe that an aspirated plosive after [s] is just as

impossible in word-final position [8b] as it is word-internally [8b] and word-initially.

[8]

a.	supper ['sʌpʰə]	aspen ['æspən]
	batter ['bætʰə]	pester ['pʰestə]
	acorn ['eɪkʰɔːn]	husky [hʌski]
b.	hope [həʊpʰ]	gasp [gɑːsp]
	hate [heɪtʰ]	haste [heɪst]
	break/brake [breɪkʰ]	tusk [tʰʌsk]

Aspirated and non-aspirated plosives are phonetically different as sounds, but in English they are felt to be closely related. The question is how to express this relatedness in a phonological description.

One way of capturing the relatedness of aspirated and non-aspirated plosives in English words is to concentrate on the contexts in which they appear. Contexts where sounds occur are known technically as their **distribution**. RP requires aspirated plosives in some contexts whereas non-aspirated ones must occur in others. The plosives may be viewed as associated with specific positions within a word. Thus the position before a stressed vowel displays strongly aspirated voiceless plosives; after a stressed vowel, including the word-final position, there are weakly aspirated plosives; the postconsonantal position, regardless of stress, shows unaspirated voiceless plosives. By adopting this perspective we move away from individual sounds and concentrate on what is possible or impossible in specific points or positions in a word.

It must be added that the very existence and distribution of aspirated plosives is a fact about English phonology: there is no particular reason why voiceless plosives should be aspirated in the first place – French, Russian and numerous other languages do not have aspirated plosives, and, indeed, some dialects of English itself have no aspiration. Other languages aspirate some plosives but not others: in Modern Icelandic, where all plosives are uniformly voiceless, some words contain aspirated consonants, whereas others have non-aspirated ones, and thus aspiration is a property that distinguishes one group of words from the other. This gives rise to contrasting pairs such as those in [9]:

[9]	panna ['pʰanːa] 'frying pan'	banna ['panːa] 'forbid'
	tæma ['tʰaiːma] 'empty, vb.'	dæma ['taiːma] 'judge, vb.'
	kola ['kʰɔːla] 'coal, gen. pl.'	gola ['kɔːla] 'breeze'

The distribution of aspirated and non-aspirated plosives varies depending on the language. Note that before a following sonorant – liquid or semivowel – aspiration in English is not present while the sonorant is partly or completely voiceless.

In Icelandic, on the other hand, aspiration is realised on the plosives also in this context. Word-internally, however, when a weakly aspirated plosive follows a nasal or a lateral, these sonorants remain voiced in English and the plosive itself may in fact lose its aspiration. In Icelandic, instead of the expected aspirated plosives we find non-aspirated ones, while the preceding sonorants are partially or completely voiceless. Compare some examples from the two languages, noting that a circle under or over a consonantal symbol denotes voicelessness:

[10]

	English	Icelandic
a.	plate [pl̥eɪtʰ]	plata ['pʰlaːtʰa] 'disc'
	prone [pr̥əʊn]	prjóna ['pʰrjouːna] 'knit'
	tulip ['tʲ̊juːlɪpʰ]	tjörn [tʰjœrtn̥] 'lake'
	clear [kl̥ɪə]	klæða ['kʰlaiːða] 'dress, vb.'
b.	banker ['bæŋk(h)ə]	bankar ['bauŋ̊kar] 'bank, nom. pl.'
	banter ['bænt(h)ə]	panta ['pʰan̥ta] 'order, vb.'
	pamper ['pʰæmp(h)ə]	lampi ['lam̥pɪ] 'lamp'
	silky ['sɪlk(h)i]	túlkur ['tʰul̥kʏr] 'interpreter'
	filter ['fɪlt(h)ə]	piltur ['pʰɪl̥tʏr] 'boy'

There is an aspect of the appearance of aspiration which we cannot discuss at any length here but which is worthy of note: as the English and Icelandic examples indicate, aspiration and sonorant devoicing seem to be connected or, in some sense, are really the same thing. Where the two languages differ is that in English a sonorant following a plosive is voiceless (e.g. *plate*), while in Icelandic it is a sonorant before a plosive that is voiceless (e.g. *piltur*). In general the existence of a particular property within a language and its distribution in the words of the language is subject to language-specific conditions. English plosives are aspirated most readily when they precede a vowel and do not follow a consonant, hence typically in word-initial and intervocalic position; word-finally, aspiration is subject to variation, while aspirated plosives do not occur before voiceless sonorants. Thus, the vocalic environment generally favours the appearance of aspiration, while consonantal contexts tend to disfavour it.

We started by noting that aspirated and non-aspirated plosives are phonetically similar but distinct speech sounds. In terms of the structure of English, however, their appearance is conditioned by the environment in such a way that where one appears, the other cannot. In this sense they are closely associated with specific positions. Below we will look at a few more examples of contextually conditioned segmental relatedness, concentrating on the factors in the context that determine the specific sound shape of segments.

1.3 The Muskerry Irish [ɑ – a] alternation

Consonants in Modern Irish are divided into **palatalised** and **velarised** groups. Palatalised consonants involve the secondary articulation of raising the front of the tongue towards the hard palate; in phonetic transcriptions such palatalised consonants are marked with the diacritic [ʲ], e.g. [pʲ, tʲ, gʲ], a practice we will adopt below. Velarised consonants display a secondary articulation whereby the back of the tongue is raised towards the soft palate; this property may be marked in transcription by the diacritic [ˠ], e.g. [pˠ, tˠ], but traditionally this diacritic is disregarded in order not to overspecify the consonants thereby making the transcription cumbersome and cluttered. We will adopt this practice but it should be kept in mind that consonants without diacritics are velarised, hence a word such as *madra* 'dog', which we transcribe ['mɑːdərə], would appear as ['mˠɑːdˠərˠə] in a detailed or narrow transcription. Finally, consonants whose primary articulation is palatal, as [ʃ], or velar, as [k, x], cannot have a secondary articulation of palatalisation or velarisation, e.g. *seo* [ʃo] 'this', *cá* [kɑː] 'where', *chun* [xun] 'towards'.

In what follows we shall be interested in the relation between consonants and the two low vowels – front [a] and back [ɑ] – in West Muskerry variety of southern Irish. The two vowels are restricted in their occurrence by the surrounding consonants in ways which are quite complex. We will consider only two possibilities, illustrated in the examples below.

[11]

a. bagairt ['bɑgərtʲ] 'threat'
capall ['kɑpəl] 'horse'
bás [bɑːs] 'death'
garda ['gɑːrdə] 'policeman'
féileacán ['fʲeːlʲəkɑːn] 'butterfly'

b. meaig [mʲagʲ] 'magpie'
geaitire ['gʲatʲirʲi] 'splinter'
oileáin [ə'lʲaːnʲ] 'island, gen. sg.'
geáitse ['gʲaːtʲʃə] 'pose'
milleáin [mʲi'lʲaːnʲ] 'blame, gen. sg.'

The first thing we note is that the appearance of a front or a back vowel is independent of its length – as the examples in [11] show, both long and short vowels can be back or front. Fundamentally, however, the nature of the vowel which can appear in words of the type illustrated in our examples seems to depend on the consonants flanking the vowel. In [11a] the back vowel [ɑ] is surrounded by velarised consonants, while in [11b] the front vowel [a] appears between palatalised consonants. Since velarised consonants involve the superimposition of the raising

of the back part of the tongue on the primary articulation, they may be classified as back themselves; by the same reasoning palatalised consonants are front. Looking now at the two Irish vowels [a] and [ɑ] we can say that in a back environment, the intervening low vowel must itself be back and, conversely, a front vowel is required between two consecutive front consonants. This conclusion is strengthened by what might be called negative facts: there are no examples of words in this dialect with a back vowel between palatalised consonants or a front vowel between velarised consonants. This is to say, sequences such as, e.g. *[tʲɑtʲ] or *[tat] are not well formed and hence inadmissible as Muskerry Irish words – in the terminology we introduced above, these are not potential words in this dialect.

This very simple example is instructive since it casts some initial doubt on the view of speech which the notion of the segment entails. Recall that the ordinary assumption which we adopted at the outset is that linguistic units, such as words, consist of a series of segments. Thus the English word *apt* consists of three segments transcribed as [æptʰ]; since segments are separate units we can expect that they should be moveable, and this is indeed something which is partly attested in English, where we find the words *pat* [pʰætʰ] and *tap* [tʰæpʰ], although, of course, not *[tpæ] or *[ptæ]. Later on we will find reasons for excluding these ways of combining the three segments but even as things are *apt*, *tap*, *pat* show that the three segments are independent of each other. If the English situation were the norm, facts such as the Irish ones should not arise. However, the facts for the dialect of Irish in question are quite unambiguous: no front [a] vowel between back or velarised consonants and no front or palatalised consonants flanking the back [ɑ] vowel. If the segments were fully independent, there should be nothing unusual or unexpected about front consonants flanking both front and back vowels, for instance. This is simply not the case, which shows that segmental independence is anything but absolute. As we will see on many occasions below, segments are only partially independent of each other in a string and a degree of mutual interaction – or interdependence – is to be expected. The nature and degree of the interdependence are language-specific properties which contribute to the phonology of that language.

The full facts of Muskerry Irish determining the distribution of low vowels are much more complex than what we have presented above, since we have only singled out a uniformly palatalised or uniformly velarised environment. There are cases of consonant disagreement, i.e. cases when the consonants preceding and following a vowel do not belong to the same class. We shall not go into further detail here apart from noting that in the case of consonant disagreement, the frontness and backness of the vowel is partially unpredictable. Thus between a palatalised and a velarised consonant we find both the back vowel, e.g. *coileán* [kiˈlʲɑːn] ‘pup’ and the front one, e.g. *coimeád* [kiˈmʲaːd] ‘keep’. If, however,

in other forms of the words the two consonants are uniform, the quality of the vowel cannot differ from them in terms of frontness or backness. A case in point where the two consonants can be made uniform involves one of the morphological means found in the language for marking the genitive case of nouns, which consists in palatalising the final consonant. As an example we can offer two nouns from [11a]: *capall* ['kɑpəl] 'horse' and *bás* [bɑːs] 'death', which form their genitives as *capaill* ['kɑpəlʲ] and *báis* [bɑːʃ] respectively. Against this background consider the following nominative–genitive pairs:

[12]	coileán [ki'lʲɑːn] 'pup'	coileáin [ki'lʲaːnʲ]
	Seán [ʃɑːn] 'proper name'	Seáin [ʃaːnʲ]
	cineál [kʲi'nʲɑːl] 'species'	cineáil [kʲi'nʲaːlʰ]

The left-hand column nominatives show the back [ɑ] between consonants differing in their palatality–velarity value; the right-hand column genitives have uniformly palatalised consonants separated by a front vowel. Thus the genitives conform to the Muskerry Irish distributional requirement which disallows uniformly front or back consonants from being split by a low vowel of an opposite value. The examples in [12] illustrate what is traditionally known as an alternation: the presence of partially different phonetic chunks of what are otherwise the same words. We could say that the word for 'pup' has two **alternants** – [ki'lʲɑːn] and [ki'lʲaːnʲ] – or that the vowels [ɑː] and [aː] **alternate** in this word. The presence of partially different shapes of the same morpheme is quite common in languages and often offers evidence of a prevailing phonological regularity.

As another example of alternation revealing the Muskerry Irish vowel–consonant uniformity requirement we have been discussing, consider a suffix used to form verbal nouns. The suffix *-áil* forms verbal nouns, in some cases attaching to English stems; it appears in two shapes and provides an illustration of alternation. In the examples below we mark the boundaries between the stem and the suffix by placing a space before the suffix

[13]

a.	fadáil [fəˈd ɑːlʲ] 'delay'
	diúgáil [dʲuːˈg ɑːlʲ] 'drain'
	lódáil [loːˈd ɑːlʲ] 'load'
	cadragáil [kɑdrəˈg ɑːlʲ] 'chatter'
b.	tindeáil [tʲinˈdʲ aːlʲ] 'look after'
	graibeáil [grɑˈbʲ aːlʲ] 'grab'
	ciceáil [kʲiˈkʲ aːlʲ] 'kick'
	déileáil [dʲaiˈlʲ aːlʲ] 'deal'

In [13a] the verbal noun suffix contains the back vowel, and the surrounding consonants differ in their palatality–velarity specification; in [13b], however,

where the verbal stem ends in a palatalised consonant, the vowel of the suffix is sandwiched between two palatalised or front consonants and is itself front. The morpheme marking the verbal nouns appears in two alternating shapes – [ɑːlʲ] and [aːlʲ], where the nature of the vowel depends on the surrounding consonants. It is to be expected that if the final consonant in examples such as [13b] were to be made velarised, the preceding vowel should be back as it would no longer find itself between two palatalised consonants. This is exactly what is found in a group of agentive nouns based on verbal nouns.

In the examples below the verbal noun is morphologically turned into an agentive noun by means of the suffix [iː] which is attached to a depalatalised (or velarised) form of the verbal noun. Consider a few examples, where the verbal noun suffix is separated from both the preceding stem and the following suffix in the transcription:

[14]	bóiceáil [boːˈkʲ aːlʲ] ‘brag’	bóiceálaí [boːˈkʲ ɑːl iː] ‘braggart’
	beiteáil [bʲeˈtʲ aːlʲ] ‘bet’	beiteálaí [bʲeˈtʲ ɑːl iː] ‘one who makes bets, a better’
	cáibleáil [ˈkɑːbʲəlʲ aːlʲ] ‘prevaricate’	cáibleálaí [ˈkɑːbʲəlʲ ɑːl iː] ‘prevaricator’
	póitireáil [ˈpoːtʲər aːlʲ] ‘prepare delicacies’	póitireálaí [ˈpoːtʲər ɑːl iː] ‘one who prepares delicacies’

The alternation [aːlʲ – ɑːl] in [14] is somewhat different from the alternation [aːlʲ – ɑːlʲ] that we saw in [13]. In the latter case we found that the verbal noun suffix had different forms when attached to different stems, depending on whether the stem ended in palatalised or velarised consonants; in [14] on the other hand, the same verbal stem can be followed either by [aːlʲ] or [ɑːl], the latter alternant appearing in the derived agentive noun. It is still true that between two palatalised consonants we cannot have a back vowel; this is possible only when the consonants have a different palatalisation–velarisation value, exactly as in [13a]. Thus the vocalic alternations are determined by the context in both sets of examples. In [14] we note additionally that the lateral consonants of the verbal noun suffix alternate: [lʲ – l]. What is significant about the alternation of the laterals is that it does not depend upon the neighbouring segments, i.e. in *bóiceálaí* [l] is followed by a front vowel [iː], but it is velarised. This independence of the laterals of the context is further demonstrated below.

[15]	áil [ɑːlʲ] ‘wish, n.’	ál [ɑːl] ‘litter, brood’
	síl [ʃiːlʲ] ‘seed, gen. sg.’	síol [ʃiːl], ‘nom. sg.’
	míle [ˈmʲiːlʲə] ‘thousand’	míola [ˈmʲiːlə] ‘insect, nom. pl.’

The examples show clearly that the palatalised and the velarised lateral consonant can appear in the same context, irrespective of what follows or precedes, if anything. The two consonants are thus independent segments. The alternations of