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# **Comparative Phonetics and Phonology of the English and the Slovak Language**

**A Practical Coursebook**

**Renáta Gregová**

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# COMPARATIVE PHONETICS AND PHONOLOGY OF THE ENGLISH AND THE SLOVAK LANGUAGE

A PRACTICAL COURSEBOOK

*Vysokoškolská učebnica*

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## LIST OF ABBREVIATIONS

A	acute
A <sup>0</sup>	non-acute
Adj	adjective
C	consonant
	consonantal
C <sup>0</sup>	non-consonantal
Cc	compact
Cc <sup>0</sup>	non-compact
cons	consonantal
cont	continuant
CVs	cardinal vowels
D	diffuse
D <sup>0</sup>	non-diffuse
delrel	delayed release
dB	decibel
FFT	fast Fourier transform
G	glide
G <sup>0</sup>	non-glide
GenAm	General American
Hz	Hertz
IPA	International Phonetic Alphabet International Phonetic Association
Lb	labial
Lb <sup>0</sup>	non-labial
Lg	quantitative
Lg <sup>0</sup>	non-quantitative
Lt	lateral
Lt <sup>0</sup>	non-lateral
N	nasal
	nucleus
	noun

N''	syllable node
N <sup>0</sup>	non-nasal
Nr	narrow
Nr <sup>0</sup>	non-narrow
O	occlusive
O <sup>0</sup>	non-occlusive
RP	Received Pronunciation
σ	syllable
S	sibilant
S <sup>0</sup>	non-sibilant
S1	sound one
S2	sound two
SF	strong form
SSA	Syllable Structure Algorithm
SE	Standard English
SPE	Sound Pattern of English
son	sonorant
syll	syllabic
V	vocalic
	vowel
	verb
V <sup>0</sup>	non-vocalic
Vc	voice
Vc <sup>0</sup>	non-voice
vs.	versus
WF	weak form

## INTRODUCTION

*The Comparative Phonetics and Phonology of the English and Slovak Languages: A Practical Coursebook* is designed as the essential source for the first-year students of the study programme “English Language for European Institutions and Economy”, whose curriculum encompasses the compulsory subject “Comparative Phonetics and Phonology”. Considering the content of this book, it will also be useful for the first-year students of the study programme “British and American Studies” and its subject “Phonetics and Phonology”.

A number of English-language books on general phonetics and phonology are available in printed form or as e-books. Books concentrating on the phonetics and phonology of the English language aimed at students of English as a first language or as a second/foreign language are rife too. Although Slovak is a language spoken by a much smaller number of users, there are various books dealing with the phonetics and phonology of standard Slovak written for native Slovak speakers, as well as for speakers who study Slovak as a foreign language. Nevertheless, as far as I know, there is no handbook concentrating on both English and Slovak phonetics and phonology.

Having been teaching the phonetics and phonology of the English language and comparative phonetics and phonology for more than a decade, I have noticed that certain topics are easy for students to get familiar with while others cause constant difficulties for them. Consequently, I have decided to prepare a book offering a comparative view on the sound systems of the English and the Slovak languages with a concentration on those phenomena that seem to be more intricate.

The structure of the coursebook reflects the structure of the subject “Comparative Phonetics and Phonology”. The book is divided into eleven chapters, starting with the primary information about the differences regarding standard languages and standard accents (Chapter 1) and transcription (Chapter 2), knowledge of which is vital for the study of phonetics and phonology of any language since both

disciplines deal with the sound form of human language. Then physiological phonetics (Chapter 3) and acoustic phonetics (Chapter 4) are briefly delimited. The division of speech sounds into two basic categories – vowels and consonants – and phonetic descriptions of both categories of sounds in both languages can be found in Chapter 5. Chapter 6 focuses on the selected sound phenomena given by the mutual combinations of vowels and consonants into higher-level units used in communication. The crucial phonological terms and the disparity between phonemes and allophones in English and in Slovak are introduced in Chapter 7. The general theory of distinctive features and distinctive features theories as delimited for the standard accent of British English and for standard Slovak are specified in Chapter 8. The syllable in general and the structure of the English and the Slovak syllable from the viewpoint of the Syllable Structure Algorithm of Lexical Phonology can be found in Chapter 9. Chapter 10 is dedicated to general aspects of prosodic features and to the prosodic structure of the English and the Slovak word and sentence. The final chapter of the book, Chapter 11, offers a concise introduction to experimental phonetics.

Each chapter starts with a delimitation of the given issue, then the information specific for English and for Slovak follows. Of course, the aim of the book is not to provide the readers – the students – with comprehensive descriptions of the phonetics and phonology of English and Slovak. On the contrary, as indicated above, the theory included in this coursebook focuses on topics considered difficult for students and should function as complementary material to my lectures and to the list of reference books that can be found in the syllabus of the subject.

The theoretical part of each chapter is followed by *Suggestions for further reading* in which I recommend additional sources I believe to be useful for first-year students of phonetics and phonology. Not all books selected for deeper studying of the given topics are the up-to-date ones. I concentrated on those whose authors were the first to come up with a certain idea and who are still

frequently cited in contemporary books in the given field. The second criterion for the selection of the books was their availability for students.

At the end of each chapter, there are practical exercises whose goal is to evaluate students' knowledge of the theme introduced in the given chapter to help students understand which aspects of human speech are language-universal and which are language-specific to help them comprehend what the similarities and differences are between the sound systems of English and Slovak.

*The Comparative Phonetics and Phonology of the English and Slovak Languages: A Practical Coursebook* has been prepared with an emphasis on the practical application of the theoretical knowledge on the sound levels of both languages to minimise mother tongue interference when speaking English and thus to increase students' communicative competence in English.

Renáta Gregová

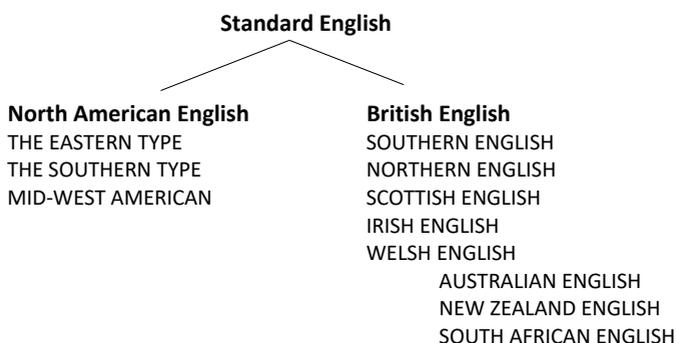
# 1 STANDARD LANGUAGE AND STANDARD ACCENT

Following the Saussurean tradition, **language** can be defined as an abstract system of signs used for **communication** among people. The practical application of this system in the particular process of communication is **speech**. Language encompasses various subsystems, for example, phonological, semantic, morphological, syntactic, lexical, etc. Language refers to both the spoken and the written form of human communication. An official form of a language regulated by a **codification** of its grammar and usage is known as a **standard language**. A standard language is supposed to be used for formal spoken and written communication among its users. On the other side, the term **accent** only refers to the spoken type of human interaction. It is a socially and geographically determined form of pronunciation. It says where you come from (area) or to which social class you belong. A form of a language that is different from others not just in pronunciation but also in vocabulary, grammar and word order is called a **dialect**. An accent that is learned and accepted as the correct one is referred to as a **standard accent**. This can be seen as the best form of pronunciation of a language.

## 1.1 STANDARD ENGLISH AND RECEIVED PRONUNCIATION

**Standard English** (SE) is the official language of the whole English-speaking world. It covers grammar, vocabulary, orthography and pronunciation. It is used in speech and writing and is “called ‘standard’ because it has undergone standardization, which means that it has been subjected to a process through which it has been selected, codified and stabilised, in a way that other varieties have not” (Trudgill & Hannah 2008: 1). Present-day **Standard English** is a

world language with the status of either a first language, a second language, or a foreign language. Consequently, there are many varieties of **Standard English** (see Figure 1) with bigger or smaller distinctions at different language levels, inclusive of pronunciation. However, it is important to emphasise that SE is not a matter of pronunciation only. **Standard English** as a language “is spoken in a wide variety of accents (including, of course, any prestige accent a country may have, such as British RP)” (Crystal 2003: 110).



**Figure 1.** Some geographical varieties of present-day English

**Received Pronunciation (RP)** is a standard accent of British English. This term was introduced as a technical term by phoneticians (Abercrombie 1967) that enables us to divide speakers of English by the way they talk into three groups: (1) RP speakers of Standard English, that is, those without an accent; (2) non-RP speakers of Standard English, that is, those with an accent; and (3) dialect speakers, that is, those that do not speak Standard English. Historically, **RP** was an accent of a social class. The term ‘**Received Pronunciation**’ indicated the speech typical of the great public boarding schools. It was maintained and transmitted especially by people educated at those schools. Nowadays, the character of **RP** is not strictly bound to a social type of pronunciation. Gimson (1970)

presented a new conception of this term whereby **RP** represents a style of pronunciation that has a geographic, regional basis and is considered the most intelligible form of pronunciation of British English. **Received Pronunciation** is a model and an accent “that is most often recommended for foreign learners studying British English” (Roach 2000: 3).

## **1.2 STANDARD SLOVAK LANGUAGE AND STANDARD SLOVAK PRONUNCIATION**

**Standard Slovak** is a national language of the Slovaks and an official state language of the Slovak Republic. It is characterised by the codification of the individual language levels. Similar to other languages, Standard Slovak also has different pronunciation forms, that is, different accents, which depend primarily on the region a speaker comes from. Considering the pronunciation (the sound) form of **Standard Slovak**, there are three basic types (or styles, accents) that have gradually developed: (1) **the neutral style**, regarded as the basic and the most frequent type of standard pronunciation that is used in formal public communication. It is also known as the ‘explicit form’ of the Slovak standard pronunciation, the standard accent; (2) **the higher style**, sometimes called **stage speech**, is represented by careful pronunciation, a slower pace, a lower melodic range, the pronunciation of the sound [ä], and the pronunciation of foreign words very close to the original form; and (3) **the lower style**, characterised by the highest number of deviations from the norm, pronunciation without Ľ, the influence of slang and dialect, being without assimilation, etc. (Kráľ 1988: 33–35).

## **SUGGESTIONS FOR FURTHER READING**

The issue of standard languages and standard accents in general is debated in Mistrík et al. (1993) or in Crystal (2003). The difference

between Standard English and its accents is perfectly explained by Wells (1982a, 1982b: 1–111). When considering the relationship between Received Pronunciation and Standard English, Kerswill (2006) is a very useful source. The question of Standard Slovak and its pronunciation styles is discussed by Král' (1988: 33–35). More about the geographical and social stratification of Standard Slovak is available in Horecký (1988: 98–110).

## EXERCISES

**1. Explain** the following terms:

accent

dialect

standard accent

standard language

**2. Complete** the following statements:

(1) In speaking, an accent is an identifiable style of \_\_\_\_\_.

(2) Your accent is the way you pronounce English when you speak it.

Your dialect, on the other hand, also has to do with the \_\_\_\_\_ forms that you use, in addition, perhaps, to any regional \_\_\_\_\_ that you employ.

(3) A \_\_\_\_\_ is a verbal departure from standard language.

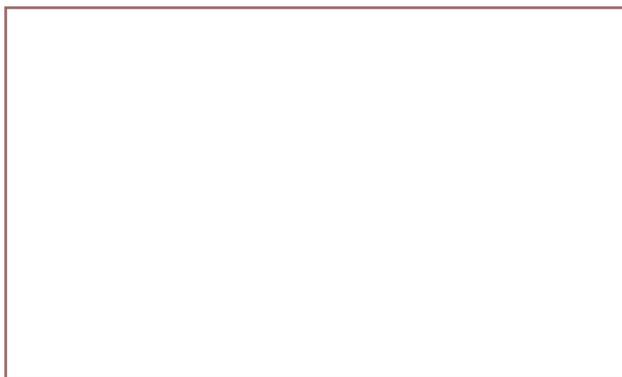
(4) An \_\_\_\_\_ is a particular way of pronouncing a language.

*(based on Trudgill 2004)*

**Answer** the following questions:

- (1) What is Standard English?
- (2) What is Received Pronunciation?
- (3) Explain the difference between standard British English and standard American English (if any).
- (4) What do Irish English, Scottish English, and Welsh English have in common?

**3. Draw the scheme representing the various forms of Standard English**, as well as the **standard accents** of two basic varieties of SE, and comment on this:



**4. Complete** the following statements:

Gimson (1980) – see *References* for further details – distinguishes three basic types of Received Pronunciation:

- 1) \_\_\_\_\_ RP forms,
- 2) general \_\_\_\_\_, and

3) \_\_\_\_\_ RP forms.

Later editions of the book (2008) use the terms \_\_\_\_\_,  
\_\_\_\_\_, and \_\_\_\_\_.

**5. Define the basic pronunciation styles of Standard Slovak.**

**6. Identify** the significant properties of the western, eastern and central **accents** of **Standard Slovak**.

**7. What is codification?**

**8. What is the role of a standard accent** in language?

## 2 TRANSCRIPTION

As indicated in Chapter 1, language as a system has two basic forms: the written form that is captured by means of **orthography** (spelling) and the spoken form that is noted down by means of **transcription**. Transcription is the representation of speech sounds in written form. There are two basic types of transcription:

- (1) **an alphabetic system (notation)** in which one sound segment is recorded by symbols made up of multiple signs. Individual signs represent the articulatory properties of speech sounds.
- (2) **an alphabetic system (notation)** uses symbols taken from the Latin or Greek alphabet, and one simple symbol is used for one sound segment (Urbanová & Chamonikolasová 2000: 25). For example, the vowel sound in the English word *bee* is transcribed as *i:* in an alphabetic notation, and the same sound is noted down as *ʔkð0e1* in an alphabetic notation (transcription). Obviously, the alphabetic system is more detailed but less practical. That is why alphabetic transcription systems are usually used when writing down speech sounds in languages.

An **alphabetic notation** can be either **phonetic**, in which a symbol represents a **sound (phone)** and is enclosed in square brackets [ ], or **phonological (phonemic)**, where a symbol represents a **phoneme** and is noted down in slashed brackets / /. Transcription symbols for phones and phonemes are usually identical. However, not all phones have their own phonemic representation. In such cases, special transcription symbols for phones are used, as will be explained later in this book.

## 2.1 TRANSCRIPTION SYMBOLS FOR ENGLISH SPEECH SOUNDS

The transcription symbols presented in this subchapter are the symbols used for the notation of the speech sounds from the standard accent of **British English**, that is, **Received Pronunciation**.

### 2.1.1 VOWELS

Symbols for **phonemes**:

<b>ɪ</b>	as in <i>fit</i> <b>fi:t</b>	<b>i:</b>	as in <i>feet</i> <b>fi:t</b>
<b>e</b>	as in <i>bet</i> <b>bet</b>	<b>ɜ:</b>	as in <i>bird</i> <b>bɜ:d</b>
<b>ʌ</b>	as in <i>come</i> <b>kʌm</b>	<b>ɑ:</b>	as in <i>far</i> <b>fɑ:</b>
<b>ɒ</b>	as in <i>dot</i> <b>dɒt</b>	<b>ɔ:</b>	as in <i>more</i> <b>mɔ:</b>
<b>ʊ</b>	as in <i>full</i> <b>fʊl</b>	<b>u:</b>	as in <i>fool</i> <b>fu:l</b>
<b>ə</b>	as in <i>alone</i> <b>ələʊn</b>		
<b>æ</b>	as in <i>cat</i> <b>kæt</b>		
<b>eɪ</b>	as in <i>day</i> <b>deɪ</b>	<b>ɪə</b>	as in <i>hear</i> <b>hiə</b>
<b>aɪ</b>	as in <i>my</i> <b>maɪ</b>	<b>eə</b>	as in <i>air</i> <b>eə</b>
<b>ɔɪ</b>	as in <i>oil</i> <b>ɔɪl</b>	<b>ʊə</b>	as in <i>moor</i> <b>mʊə</b>
<b>əʊ</b>	as in <i>mow</i> <b>məʊ</b>		
<b>aʊ</b>	as in <i>about</i> <b>əbaʊt</b>		

The **non-phonemic** (phonetic) symbols occurring in this book are:

<b>i</b>	as in <i>very</i> <b>veri</b>
<b>u</b>	as in <i>to eat</i> <b>tu i:t</b>

## 2.1.2 CONSONANTS

Symbols for **phonemes**:

<b>p</b>	as in <i>pen</i> <b>pen</b>	<b>s</b>	as in <i>sit</i> <b>sɪt</b>
<b>b</b>	as in <i>bit</i> <b>bɪt</b>	<b>z</b>	as in <i>zoo</i> <b>zu:</b>
<b>m</b>	as in <i>mud</i> <b>mʌd</b>	<b>ʃ</b>	as in <i>shell</i> <b>ʃel</b>
<b>w</b>	as in <i>well</i> <b>wel</b>	<b>ʒ</b>	as in <i>beige</i> <b>beɪʒ</b>
<b>f</b>	as in <i>fit</i> <b>fɪt</b>	<b>tʃ</b>	as in <i>chop</i> <b>tʃɒp</b>
<b>v</b>	as in <i>vain</i> <b>veɪn</b>	<b>dʒ</b>	as in <i>age</i> <b>eɪdʒ</b>
<b>ð</b>	as in <i>this</i> <b>ðɪs</b>	<b>r</b>	as in <i>ray</i> <b>reɪ</b>
<b>θ</b>	as in <i>tooth</i> <b>tu:θ</b>	<b>j</b>	as in <i>yes</i> <b>jes</b>
<b>t</b>	as in <i>ten</i> <b>ten</b>	<b>k</b>	as in <i>kin</i> <b>kɪn</b>
<b>d</b>	as in <i>day</i> <b>deɪ</b>	<b>g</b>	as in <i>get</i> <b>get</b>
<b>n</b>	as in <i>not</i> <b>nɒt</b>	<b>ŋ</b>	as in <i>king</i> <b>kɪŋ</b>
<b>l</b>	as in <i>love</i> <b>lʌv</b>	<b>h</b>	as in <i>hot</i> <b>hɒt</b>

The **non-phonemic** (phonetic) symbols occurring in this book are:

ʔ	glottal stop	
h	aspiration	as in <i>tin</i> <b>tʰɪn</b>
ɫ	dark l	as in <i>pill</i> <b>pɪɫ</b>
l̥	devoiced l	as in <i>play</i> <b>pl̥eɪ</b>
ˌ	syllabic consonant	as in <i>bottle</i> <b>bɒtl̩</b>
t̚	unreleased t	as in <i>but</i> <b>bʌt̚</b>

## 2.1.3 PROSODY

ˈ	primary stress	as in <b>ˈfəʊtə</b> <b>ˈgræfɪk</b>
ˌ	secondary stress	as in <b>ˌfəʊtə</b> <b>ˈgræfɪk</b>
ˋ	falling tone	as in <b>ˈjes</b>
ˊ	rising tone	as in <b>ˈjes</b>
ˋˊ	fall-rise tone	as in <b>ˈjes</b>
ˊˋ	rise-fall tone	as in <b>ˈjes</b>

- level tone as in *y*es

(based on Roach 2000; see also Wells 1990)

## 2.2 TRANSCRIPTION SYMBOLS FOR SLOVAK SPEECH SOUNDS

Both phonetic and phonemic symbols for the notation of the sounds of **Standard Slovak pronunciation** presented in this book are slightly simplified; however, they are ample enough for the purposes of the comparative study of the English and Slovak sound systems.

### 2.2.1 VOWELS

Symbols for **phonemes**:

<b>i</b>	as in <b>pit</b> 'to drink' <sup>1</sup> / <b>byt</b> 'to be'	<b>í</b>	as in <b>píla</b> 'saw'
<b>e</b>	as in <b>pero</b> 'pen'	<b>é</b>	as in <b>tér</b> 'tar'
<b>a</b>	as in <b>dat</b> 'to give'	<b>á</b>	as in <b>áno</b> 'yes'
<b>o</b>	as in <b>pol</b> 'half'	<b>ó</b>	as in <b>óda</b> 'ode'
<b>u</b>	as in <b>ulica</b> 'street'	<b>ú</b>	as in <b>úl</b> 'hive'
<b>ia</b>	as in <b>piatok</b> 'Friday'		
<b>ie</b>	as in <b>dielo</b> 'piece of work'		
<b>iu</b>	as in <b>cudziu</b> G. sg. F 'stranger'		
<b>uo</b>	as in <b>kôl</b> 'stake'		

Symbols for **phones** (only those are mentioned here that differ from phonemes):

---

<sup>1</sup> In Slovak, the difference between the sound form of a word and its graphic version is not as obvious as, for example, in English. That is why the sound forms of Slovak words are used only when they differ from the orthographic notation.

<b>i:</b>	as in <b>píla</b> ‘saw’ / <b>býk</b> ‘bull’
<b>e:</b>	as in <b>tér</b> ‘tar’
<b>a:</b>	as in <b>áno</b> ‘yes’
<b>o:</b>	as in <b>óda</b> ‘ode’
<b>u:</b>	as in <b>úl</b> ‘hive’

<b>ja</b>	as in <b>piatok</b> ‘Friday’
<b>je</b>	as in <b>dielo</b> ‘piece of work’
<b>ju</b>	as in <b>cudziu</b> G. sg. F ‘stranger’
<b>uo</b>	as in <b>kôl</b> ‘stake’

## 2.2.2 CONSONANTS

Symbols for **phonemes**:

<b>p</b>	as in <b>pero</b> ‘pen’	<b>š</b>	as in <b>šest’</b> ‘six’
<b>b</b>	as in <b>bit’</b> ‘beat’	<b>ž</b>	as in <b>žaba</b> ‘frog’
<b>m</b>	as in <b>múka</b> ‘flour’	<b>č</b>	as in <b>čin</b> ‘deed’
<b>f</b>	as in <b>fajka</b> ‘pipe’	<b>ž</b>	as in <b>džem</b> ‘jam’
<b>v</b>	as in <b>váza</b> ‘vase’	<b>t’</b>	as in <b>t’ava</b> ‘camel’
<b>t</b>	as in <b>tma</b> ‘darkness’	<b>d’</b>	as in <b>d’alej</b> ‘further’
<b>d</b>	as in <b>dolu</b> ‘down’	<b>ň</b>	as in <b>deň</b> ‘day’
<b>n</b>	as in <b>noha</b> ‘leg’	<b>l’</b>	as in <b>l’ad</b> ‘ice’
<b>s</b>	as in <b>sol’</b> ‘salt’	<b>j</b>	as in <b>ja</b> ‘I’
<b>z</b>	as in <b>zeler</b> ‘celery’	<b>k</b>	as in <b>král</b> ‘king’
<b>c</b>	as in <b>cena</b> ‘prize’	<b>g</b>	as in <b>guma</b> ‘rubber’
<b>ʒ</b>	as in <b>medza</b> ‘balk’	<b>x</b>	as in <b>chlad</b> ‘cold’
<b>r</b>	as in <b>ryba</b> ‘fish’	<b>h</b>	as in <b>hlava</b> ‘head’
<b>l</b>	as in <b>lano</b> ‘rope’		

The symbols for **phones** used in this book are:

<b>ŋ</b>	as in <i>amfora</i> <b>amfora</b> ‘amphora’
<b>ŋ</b>	as in <i>činka</i> <b>činka</b> ‘dumbbell’

ŋ	as in <i>dedinský</i> <b>d'ed'ɪŋski:</b> 'village'
ɲ	as in <i>bronchitída</i> <b>brɔɲxiti:da</b> 'bronchitis'
ɣ	as in <i>hrach rastie</i> <b>hɾaɣ rast'je</b> 'pea grows'
ʃ	syllabic consonant as in <i>vlna</i> <b>vʃna</b> 'wool'

(based on Sabol 1989)

### 2.2.3 PROSODY

ˈ	stress	as in <b>do</b> 'biela' 'into white'
	short pause	
	long pause	
`	falling tone	as in <b>nie</b> 'no'
ˈ	rising tone	as in <b>nie</b> 'no'
-	level tone	as in <b>nie</b> 'no'

### SUGGESTIONS FOR FURTHER READING

For details about IPA transcription, see <https://www.internationalphoneticassociation.org/content/full-ipa-chart>. PDF files with transcription symbols in various fonts can be downloaded from this website. The webpage <https://ipa.typeit.org/full/> allows you to type transcription symbols directly as text. For transcription symbols different from those appearing in this book, see Giegerich (1992: 34–42, 45–48). The author uses transcription symbols applicable to three different accents of English: Received Pronunciation, General American, and Scottish Standard English. The distinctions between transcription symbols for Slovak phones and phonemes with illustrative examples can be found in Sabol (1989: 9–10) and Král' (1988: 39–46; 2005: 36–38).

## EXERCISES

1. What is **transcription**?
2. Explain the difference between **alphabetic** and **analphabetic notation**.
3. Square brackets [ ] represent \_\_\_\_\_ **transcription** and slashed brackets / / enclose \_\_\_\_\_ **transcription**.
4. **Transcribe** the following words (**broad, phonemic transcription**):

pet \_\_\_\_\_

cat \_\_\_\_\_

mud \_\_\_\_\_

pot \_\_\_\_\_

would \_\_\_\_\_

alone \_\_\_\_\_

fill \_\_\_\_\_

far \_\_\_\_\_

fool \_\_\_\_\_

meat \_\_\_\_\_

more \_\_\_\_\_

bird \_\_\_\_\_

day \_\_\_\_\_

my \_\_\_\_\_

boy \_\_\_\_\_

low \_\_\_\_\_

cow \_\_\_\_\_

ear \_\_\_\_\_

pour \_\_\_\_\_

here \_\_\_\_\_

sheep \_\_\_\_\_

chip \_\_\_\_\_

method \_\_\_\_\_

father \_\_\_\_\_

wet \_\_\_\_\_

yet \_\_\_\_\_

dark \_\_\_\_\_

sun \_\_\_\_\_

smoke \_\_\_\_\_

them \_\_\_\_\_

**5. Transcribe the following words phonemically and phonetically:**

tyčinka	_____	_____
bronchitída	_____	_____
melanchólia	_____	_____
amfiteáter	_____	_____
visí	_____	_____
potôčik	_____	_____
dedína	_____	_____
džavot	_____	_____
sadza	_____	_____

### 3 PHYSIOLOGICAL PHONETICS

**Physiological phonetics** concentrates on the process of the creation of a human speech sound in a particular language code, as well as on the issues of feedback mechanisms connected with speech (Dvončová 1980: 11). In other words, **physiological phonetics** encompasses the whole process of **speech production (articulatory, genetic phonetics)** and **speech perception (perceptual, auditory phonetics)**. Since both articulatory and auditory phonetics, although linguistic disciplines, use information from anatomy and physiology, they represent the ‘biological’ part of phonetics, as you will see below.

#### 3.1 ARTICULATORY PHONETICS

**Articulatory (genetic) phonetics** concentrates on three organogenetic processes of speech production: **respiration, phonation** and **articulation**.

**Respiration** (breathing) is done by the respiratory organs, that is, the lungs, the respiratory system, and the respiratory muscles. In most languages, it is the **egressive airstream** (the one expelled from the lungs), also known as the **expiratory** airstream, that is used for sound production. This air further continues into the bronchi, trachea (windpipe) and larynx.

The larynx is the place of **phonation** (sound production) because, inside the larynx, there are the **vocal cords** (the vocal folds or the voice reeds). Vocal cords are two small bands of muscles and connective tissue. The space between them is called the **glottis**. The **glottis** is open during breathing and tightened up before **phonation** (sound production). When the power of the air exhaled from the lungs overcomes the power of the muscles holding the vocal cords together, the glottis opens, the airstream passes through it, and the glottis closes again. A rapid opening and closing of the glottis is known as **vocal**

**cord vibration**, which results in an audible sound. This sound, together with the exhaled airstream, proceeds from there into the **supraglottic space**.

In the supraglottic space, the sound is modified by **speech organs (articulators)**. The modification of the sound by the movement of speech organs is known as **articulation**<sup>2</sup>.

The speech organs are divided into cavities and articulators.

#### **Cavities (supraglottic space):**

1. pharyngeal (pharynx)
2. oral (mouth)
3. nasal
4. labial

The cavities function as the resonators of the sound produced by the vocal cords. They determine the overall quality (**timbre**) of the voice.

#### **Articulators:**

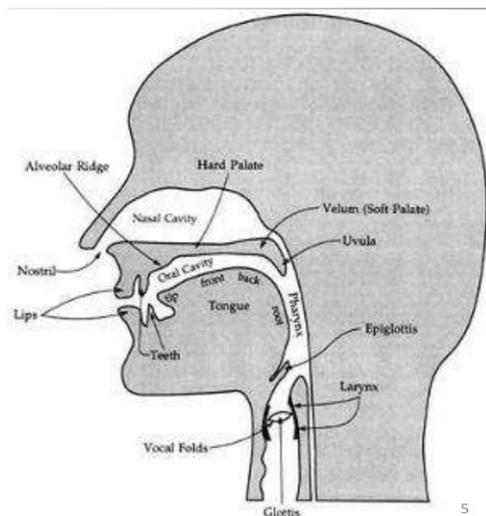
1. lips (labia)
2. teeth (dentes)
3. upper jaw (maxilla)
4. alveoli
5. hard palate (palatum)
6. soft palate (velum) with uvula
7. lower jaw (mandible)
8. tongue (lingua)

The upper jaw, the teeth, the alveoli and the hard palate are the passive articulators. The lips, the tongue, the lower jaw and the soft palate

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<sup>2</sup> In the broader sense, the term **articulation** indicates the entire process of speech production: **respiration**, **phonation** and **modification** (articulation proper).

with the uvula are the active ones. The articulatory space of **the tongue** is further divided into the **tip** (apex), the **back** (dorsum) and the **root** (radix).



**Figure 2.** The articulators and the cavities (Ladefoged 1962: 8)

## SUGGESTIONS FOR FURTHER READING

The issue of articulatory phonetics is perfectly described in a number of books on phonetics. Students interested in details about the anatomy and physiology of the organs of speech can consult, for example, Dvončová (1980: 21–67), Král and Sabol (1989: 107–135), Giegerich (1992: 1–12), or any other book on phonetics in general or on physiological (articulatory) phonetics in particular.

## EXERCISES

**Complete the following statements:**

1. Speech sounds can be studied and classified according to different aspects. Attention paid to the **creation of speech sounds** and to **mechanical processes in the ear** is described as \_\_\_\_\_, which can be further divided into \_\_\_\_\_ **(genetic) phonetics** and \_\_\_\_\_ **(auditory) phonetics**. The **transmission of sound waves** and the acoustic signal itself are the subject of \_\_\_\_\_ phonetics.

2. **Articulatory phonetics** studies the entire **process of speech production** that comprises **three organogenetic processes**: \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

3. \_\_\_\_\_ studies the process of **reception** (hearing connected with the peripheral auditory system, i.e., the one not in the brain) and the \_\_\_\_\_ of speech sounds (in the brain).

4. Air **expelled from the lungs** passes first through the \_\_\_\_\_ into the \_\_\_\_\_. It then passes through the open \_\_\_\_\_ into the \_\_\_\_\_ and out through the nose or mouth, or both.

5. The **larynx is composed** of four \_\_\_\_\_.

6. The **larynx is located** at the top of the \_\_\_\_\_.
7. The **vocal cords are located** in the \_\_\_\_\_.
8. The **opening between the vocal cords** is called the \_\_\_\_\_.
9. An **increase in the frequency of vibration** of the vocal cords \_\_\_\_\_ (raises/lowers) voice pitch.
10. By modifying the \_\_\_\_\_ and \_\_\_\_\_ of **resonance cavities**, we can control the quality of a resonated sound.
11. List the **cavities (articulatory space)**: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
12. A **labio-dental sound** is articulated by bringing the lower \_\_\_\_\_ in contact with the upper \_\_\_\_\_.
13. A **bilabial sound** is produced by bringing the upper and the lower \_\_\_\_\_ together.
14. **Palatal sounds** are articulated at the \_\_\_\_\_.
15. **Velar sounds** are articulated at the \_\_\_\_\_.

16. **Nasal sounds** are produced when the \_\_\_\_\_ is lowered.

17. **Alveolar sounds** are articulated at the \_\_\_\_\_.

18. **Uvular sounds** are articulated at the \_\_\_\_\_.

19. To produce **sound with nasal quality**, the velum must be \_\_\_\_\_.

20. When **both lips** are used in the production of a sound, it is called a(n) \_\_\_\_\_.

21. Sounds articulated at the \_\_\_\_\_ are called **palatals**.

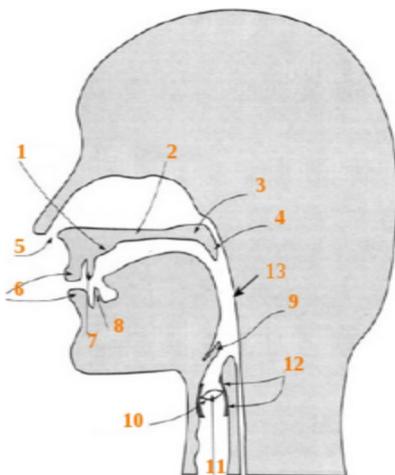
22. Sounds articulated at the \_\_\_\_\_ are called **velars**.

23. An **apico-alveolar sound** is articulated with the apex of the tongue against the \_\_\_\_\_ ridge.

24. When the \_\_\_\_\_ is raised, the passage into the **nasal cavity** is \_\_\_\_\_.

*(based on Buchanan 1963)*

25. Try to identify the individual organs participating in **speech production** and the **articulatory cavities**:



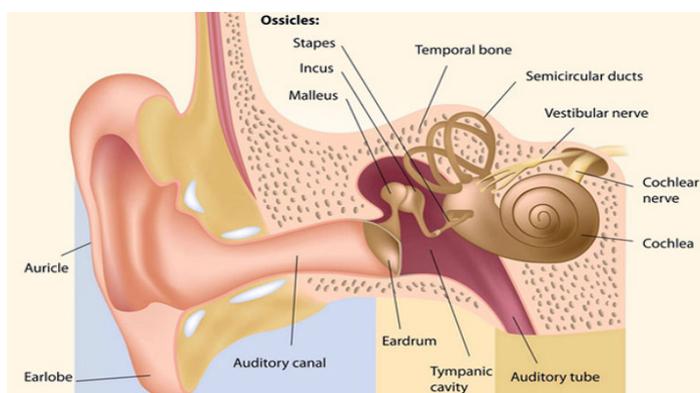
### 3.2 PERCEPTUAL PHONETICS

**Perceptual (auditory) phonetics** deals with the process of **reception** (hearing) and the **perception** of speech sounds.

The organ of speech reception is the **ear** (Figure 3). The **outer ear** collects sound waves and transmits them into the ear canal. Here, the sound waves vibrate the eardrum (tympanic membrane). The vibrations set the ossicles of the **middle ear** – the malleus (hammer), incus (anvil) and stapes (stirrup) – into motion. The stapes joins the oval window connecting the middle ear to the **inner ear**. The vibrations from the oval window put in motion a fluid that fills the cochlea in the inner ear. The fluid movement sets in motion 25,000

nerve endings that transform the vibrations into electrical impulses travelling to the brain (<http://www.hopkinsmedicine.org/>). The function of the ear is essential for speech perception and, consequently, for correct speech production.

**Speech perception** is the transformation of an acoustic speech signal into linguistic representations, phonemes, syllables or words. Research in this field is interested in the way the human brain recognises speech sounds and interprets them to understand verbal messages.



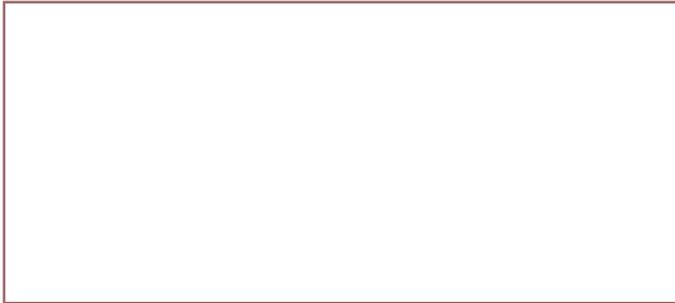
**Figure 3.** The organ of hearing  
(<http://www.organsofthebody.com/ears/>)

## SUGGESTIONS FOR FURTHER READING

Although the organ of hearing, its anatomy and physiology – as the central part of perceptual phonetics – is usually omitted in books on general phonetics, Král and Sabol (1989: 99–105) and Johnson (2003: 46–58) are very helpful on this topic. Johnson (2003: 59–78) also deals with details on speech perception.

## EXERCISES

1. Draw a simple picture (diagram) of **the ear**. In this diagram, label each of the following: pinna, tympanic membrane, malleus, incus, stapes, Eustachian tube, cochlea, semicircular canals.



2. What is the primary **function of the outer ear**?

3. What is **the function of the three small bones** in our middle ear?

4. How does **the inner ear function**?

5. The receptor organ of hearing located in the **cochlea** is called the \_\_\_\_\_ or \_\_\_\_\_ organ.

6. \_\_\_\_\_ is the **process of receiving** sound stimuli by the organ of hearing.

7. The **process of the transformation** of the stimuli into meaningful information is known as \_\_\_\_\_.

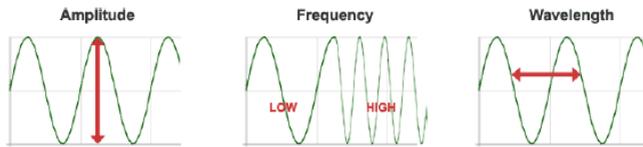
## 4 ACOUSTIC PHONETICS

The physical parameters of speech sounds are the subject of research in **acoustic phonetics**.

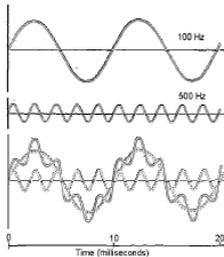
In physics, a **sound** is an oscillation or a vibration of air particles. This vibration can be caused by any flexible entity. A speech sound is the result of the vibration of the vocal cords (see section 3.1 above). A sound creates a **sound wave** that – as compressions and rarefactions of the air – travels along a conductive medium – for example, air.

A sound wave is characterised by four basic physical properties that are also used in linguistics when analysing speech sounds (an acoustic analysis of speech sounds themselves is presented in detail in Chapter 11): **amplitude**, **frequency**, **wavelength** and **simplicity/complexity** (Figure 4).

The **amplitude** is the peak magnitude in terms of deviation from the norm, and it determines the **loudness**, the intensity, of the sound – the higher the amplitude, the louder the sound. The **intensity** of sounds is measured in decibels (dB). The **frequency** of a sound wave indicates the number of oscillations (cycles) per second. This is measured in Hertz (Hz). The frequency is perceived as the **pitch**; however, there is no direct relationship. The distance a sound wave travels in a cycle is the wavelength. A **cycle** is a repetition of a sinusoidal pattern. Sine waves are **simple waves**, and they are very rare. The composition of at least two sine waves results in a **complex wave**, and this determines the **sound quality** or **timbre**.



**simple and complex sound waves**



**Figure 4.** Sound wave properties

**SUGGESTIONS FOR FURTHER READING**

The brief information about the acoustic properties of sounds presented in this chapter is sufficient for the purposes of this coursebook. Nevertheless, students interested in acoustic phonetics can consult Ladefoged (1962), Johnson (2003), and Sabol and Zimmermann (2015), as well as Král and Sabol (1989: 158–182) or Ladefoged (2000: 161–166).

## EXERCISES

### A. Complete the following statements:

1. **Acoustic phonetics** studies the \_\_\_\_\_ of speech sounds. In physics, a sound is a(n) \_\_\_\_\_ or oscillation of the air particles. A speech sound is produced on the basis of the \_\_\_\_\_ vibration.

2. A **sound wave** has **four basic properties** that are also used in linguistics when analysing speech sounds: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

3. The **amplitude** is the peak deviation from the norm, and it determines the \_\_\_\_\_, the \_\_\_\_\_ of the sound – the higher the amplitude, the \_\_\_\_\_ the sound.

4. The \_\_\_\_\_ of a sound wave indicates the number of (cycles) oscillations per second. The **frequency** is perceived as the \_\_\_\_\_, although there is no direct relationship.

5. The \_\_\_\_\_ is the distance a sound wave travels in a cycle.

6. The **composition of sounds** determines the sound \_\_\_\_\_ or \_\_\_\_\_.

### B. Match the letters with the numbers:

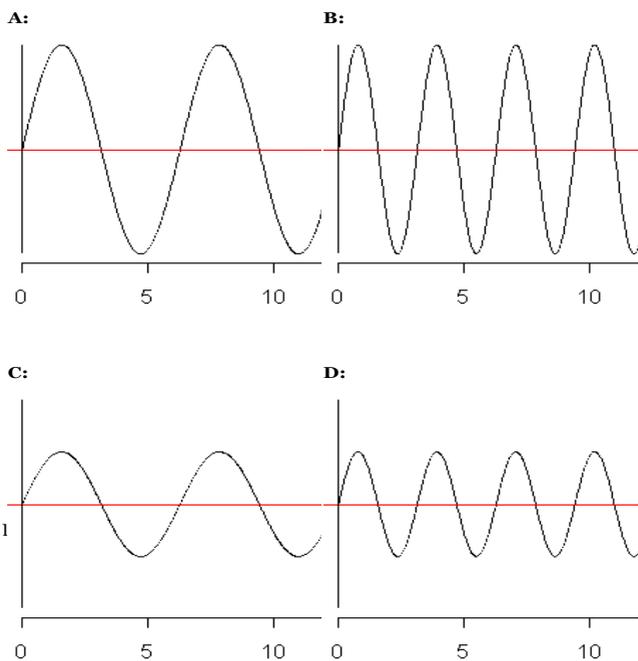
1. Amplitude \_\_\_\_\_ A. characteristic of vibratory motion; magnitude and direction of displacement; strength or magnitude of sound signal
2. Frequency \_\_\_\_\_ B. measure in Hz (1 cycle per second is 1 Hz)
3. Aperiodic waves \_\_\_\_\_ C. described both physically and psychologically (perceptually)
4. Sound \_\_\_\_\_ D. those that do not repeat themselves at regular intervals

*(based on <https://quizlet.com/>)*

**C. Draw a sine wave. Indicate its amplitude and cycle.**



**D. Look at the sine waves below. Identify those with the same frequency and those with the same amplitude:**



## 5 SPEECH SOUNDS

In phonetics<sup>3</sup>, the basic articulatory criterion for the classification of **speech sounds** is the presence or the absence of an obstacle in the supraglottic space during the production of a sound and the type of this obstacle. If there is no obstacle, that is, the expiratory air stream passes freely and is not stopped at any place in the supraglottic cavities, a **vowel** sound is produced. If the airstream is interfered with, either by a **closure** or by a **narrowing**, a **consonant** sound is articulated. The articulation, i.e., the production, of a sound has its reflection in the acoustic characteristics of this sound. In the case of free cavities (typical of vowel production), the sound is characterised by a **tone acoustic spectrum** (a periodic alternation of sound waves). When a consonant is produced, acoustically, the articulated sound is characterised by a **noise** (aperiodic alternation of sound waves). Thus, in phonetic terms, vowels are tones of free cavities, and consonants are noises at the place of an obstacle (Ondruš & Sabol 1987: 81).

### SUGGESTIONS FOR FURTHER READING

More detailed information about the classification of speech sounds into subcategories is offered by any book on phonetics in general or on English (or Slovak) phonetics in particular. The older division of sounds into so-called **vocoids** and **contoids**, which better reflects the possible clash between the traditional phonetic and phonemic understanding of vowels and consonants, is mentioned, for example, in Roach (2000) or Skandera and Burleigh (2005), and fully developed in Pike (1943) which is now also available online at <https://archive.org/details/PikePhonetics1943>.

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<sup>3</sup> For the phonemic classification of speech sounds, see Chapter 7.

## EXERCISES

### A. Complete the following statements:

As the air stream passes from our lungs, it may be \_\_\_\_\_ at various places of supraglottic \_\_\_\_\_. There are **three different types** of **interference**:

- (1) the \_\_\_\_\_ position – two **organs approximate** but are not connected. The difference between sounds is made by the different shape of the \_\_\_\_\_ cavity due to the different position of the \_\_\_\_\_. Sounds made in the **open position** are called \_\_\_\_\_ sounds.
- (2) \_\_\_\_\_ are produced by a **complete closure** of the air passage.
- (3) \_\_\_\_\_ – when two speech organs are brought very close together, the air passing through this **narrowing** becomes turbulent. When there is **either a closure or a narrowing**, the sounds produced are called \_\_\_\_\_ sounds.

### B. Answer the following questions:

1. What are the **basic categories of speech sounds**?

2. What is the **basic criterion** for the classification of speech sounds from the **articulatory** point of view?

3. What about the **classification** of speech sounds from the point of view of **acoustics**? What is it based on?

**C. Complete the following statement and comment on it:**

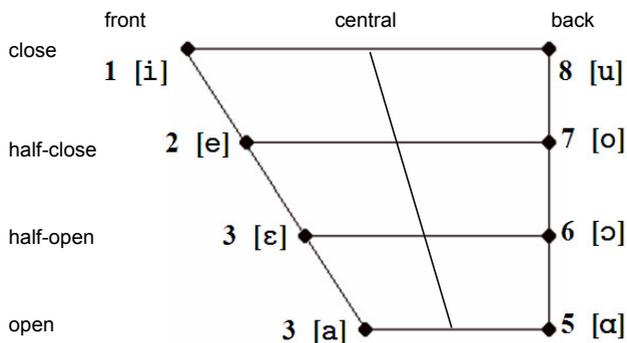
Phonetically speaking, vowels can be characterised as \_\_\_\_\_, while consonants are \_\_\_\_\_ of an obstacle (Ondruš & Sabol 1987: 81).

## 5.1 VOWELS

In languages, there are two basic categories of vowel sounds: **monophthongs** and **diphthongs**.

A **monophthong** is a pure vowel sound. The most important criterion for the classification of vowels in languages is **(1) the position of the tongue** (horizontally and vertically) in the oral cavity. According to the horizontal movement of the tongue, vowels can be **front**, **central** or **back**. The vertical movement of the tongue, that is, the height of the tongue in the oral cavity, divides vowels into **high**, **mid** or **low** (in languages with a lower number of vowels, e.g., Slovak; see Figure 7) or **close**, **half-close**, **half-open** and **open** (used in languages with a richer inventory of vocalic sounds (e.g., English; see Figure 6). The division of the articulatory space in line with the horizontal and vertical movements of the tongue during the articulation was the basis for the so-called **cardinal vowels** (CVs) (see Figure 5), introduced by Daniel Jones in the early 20<sup>th</sup> century (Jones

1917). Cardinal vowels are artificial sounds representing the extremes of vocalic quality, and they function as a reference system – they help describe vowels in languages.



**Figure 5.** Cardinal vowels scheme

Monophthongs are further classified in accordance with **(2) the position of the lips**, which can be neutral, spread or rounded. In the case of rounded lips, the monophthong is labialised. **Labialisation** usually accompanies back vowels. Vowels can be oral (e.g., in Slovak) or nasal (e.g., in Polish or French), depending on **(3) the position of the soft palate** during the articulation of a sound (for details, see below). In addition, **(4) the function of vocal cords** decides whether a vowel sound is voiced (most vowels in most languages) or voiceless (e.g., the so-called whispered vowels in Icelandic). Monophthongs can be short or long (Mistrík et al. 1993).

A segment consisting of two vocalic sounds is a **diphthong**. The articulation of diphthongs is characterised by a non-constant glide movement from the articulatory position of one vowel to the other (see Figure 7). Diphthongs can be **rising** (the second element is stronger and longer, that is, more decisive) or **falling** (the first element is stronger and longer). Diphthongs are considered long vowels.

### 5.1.1 ENGLISH VOWELS

In the standard accent of British English, there are

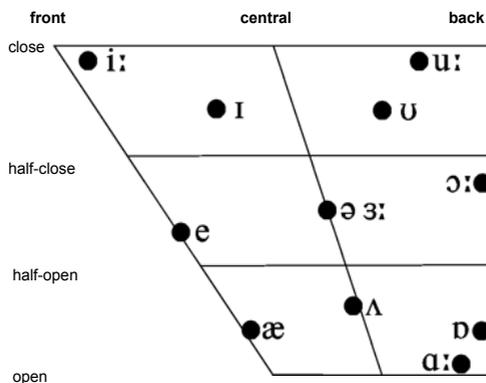
- seven relatively **short monophthongs**: ɪ, e, ʌ, ɒ, ʊ, ə, æ,
- five relatively **long monophthongs**: i:, ɜ:, ɑ:, ɔ:, u:,
- eight **diphthongs**: eɪ, aɪ, ɔɪ, əʊ, aʊ, ɪə, eə, ʊə, and
- five **triphthongs**: eɪə, aɪə, ɔɪə, əʊə, aʊə.

All these vowels are **voiced** and **oral**.

The length of **monophthongs** in English<sup>4</sup> is known as ‘relative’ because – compared to some other languages, e.g., Slovak and Ukrainian – it is characterised by considerable variability: a short monophthong is sometimes longer than the corresponding long monophthong, and vice versa. This variation in **length** is possible without losing the contrast between vowel sounds necessary for their phonological value (see below) since, in English, the difference in **vocalic quantity** goes hand in hand with the difference in **vocalic quality**, as can be seen in Figure 6.

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<sup>4</sup> ‘English’ is used hereafter to mean the standard accent of British English (for details, see Chapter 1).



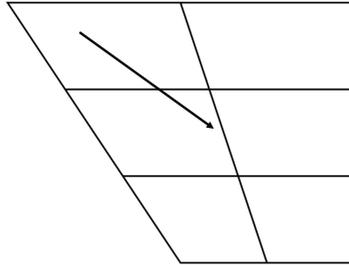
**Figure 6.** English monophthongs (Roach 2000: 242)

English **diphthongs** are divided into two main categories depending on their phonetic label, that is, the phonetic quality of their final element. Those ending in [ɪ] or [ʊ], which are close vowels (Figure 6), are called **closing diphthongs**, and those ending in [ə], known as a central vowel (Figure 6), are **centring diphthongs** (Table 1). See Figure 7 for the sample articulation of a diphthong.

diphthongs		
closing	ending in ɪ	eɪ aɪ ɔɪ
	ending in ʊ	əʊ aʊ
centring	ending in ə	ɪə eə ʊə

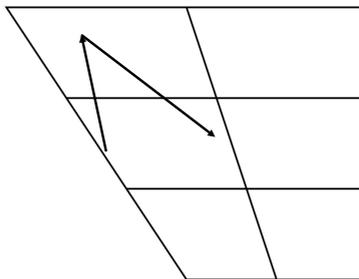
**Table 1.** English diphthongs (Gregová 2017: 64)

**Diphthongs** in English are **monosyllabic**, **long**, and are considered to be **rising** rather than falling.



**Figure 7.** Articulation of the diphthong ɪə

In English, besides monophthongs and diphthongs, there are also **triphthongs**, although their position in the sound subsystem of the English language is not stable yet. For some linguists, a triphthong is only a combination of a closing diphthong (Table 3) with the vowel schwa ə. In speech, triphthongs are usually diphthongised or even monophthongised (Roach 2000: 24). For other linguists, a triphthong is – phonetically speaking – a glide movement of the tongue from the position of one vowel to the second one and then to the third one (Figure 8). They are **monosyllabic** and **long**.



**Figure 8.** Articulation of the triphthong eɪə

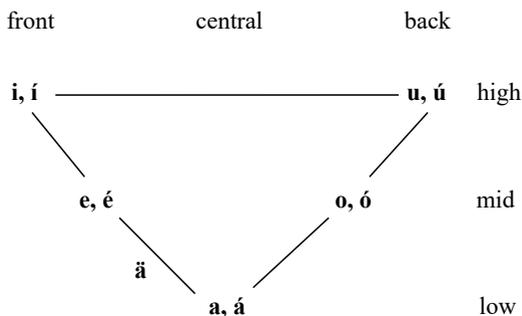
## 5.1.2 SLOVAK VOWELS

The inventory of vocalic sounds in Standard Slovak encompasses

- five (six) **short monophthongs**: i, e, a, o, u, (ä)<sup>5</sup>,
- five **long monophthongs**: á, é, í, ó, ú, and
- four **diphthongs**: ia, ie, iu, ô.

All Slovak vowels are **voiced** and **oral**.

Slovak **short** and **long monophthongs** differ only in their length, that is, their **quantity**<sup>6</sup>. As for the **quality** of Slovak short and long monophthongs, there are no differences between them, as illustrated in the so-called **vocalic triangle** in Figure 9.



**Figure 9.** The classification of Slovak monophthongs

Slovak **diphthongs** are **rising**. Consequently, they are described on the basis of the phonetic description of the second element: [ia] is central, [ie] is front, [iu] is high, and [uo] is back (see Figure 9). They

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<sup>5</sup> The short vowel ä is only pronounced in the so-called B-norm of Standard Slovak pronunciation connected with the higher style of pronunciation (see section 1.2).

<sup>6</sup> The length difference between monophthongs in Slovak is very important because it has the ability to change the meaning of words and word forms (see Chapter 10).

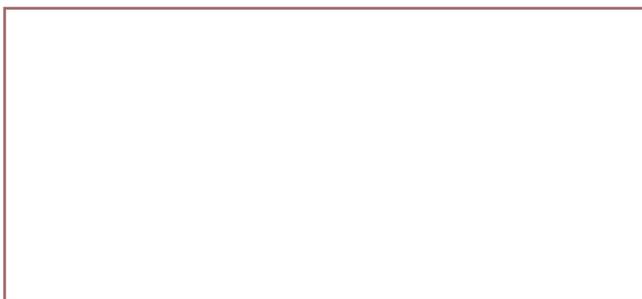
are all **monosyllabic**, and syllables with diphthongs are considered **long**.

## **SUGGESTIONS FOR FURTHER READING**

For more about the phonetic classification of vowels in various languages, see, for example, Ladefoged and Maddieson (1996) or Odden (2005). For more details about English vowels, I recommend Roach (2000), which is written in a clear, accessible way, and also McMahon (2002), who compares the production of vowels in Standard Southern British English (that is, Received Pronunciation) and General American. For a phonetic description of vowels in Standard Slovak, students can consult Král' and Sabol (1987).

### **EXERCISES**

1. What do you know about **cardinal vowels**? Draw the scheme and comment on them.



2. Explain the following **characteristics of vowels**:

- formant sounds; can be short or long (comment on the possible difference between English and Slovak)
- voiced sounds, tones, oral, some of them are labialised

3. Explain the following **characteristics of diphthongs**:

- glide sounds, monosyllabic
- falling, rising

4. **Transcribe** the following words:

cup \_\_\_\_\_

dark \_\_\_\_\_

keep \_\_\_\_\_

bed \_\_\_\_\_

bit \_\_\_\_\_

ago \_\_\_\_\_

bird \_\_\_\_\_

beard \_\_\_\_\_

bike \_\_\_\_\_

fool \_\_\_\_\_

bad \_\_\_\_\_

boy \_\_\_\_\_

day \_\_\_\_\_

lock \_\_\_\_\_

cared \_\_\_\_\_

cow \_\_\_\_\_

player \_\_\_\_\_

loyal \_\_\_\_\_

tired \_\_\_\_\_

more \_\_\_\_\_

put \_\_\_\_\_

moors \_\_\_\_\_

tower \_\_\_\_\_

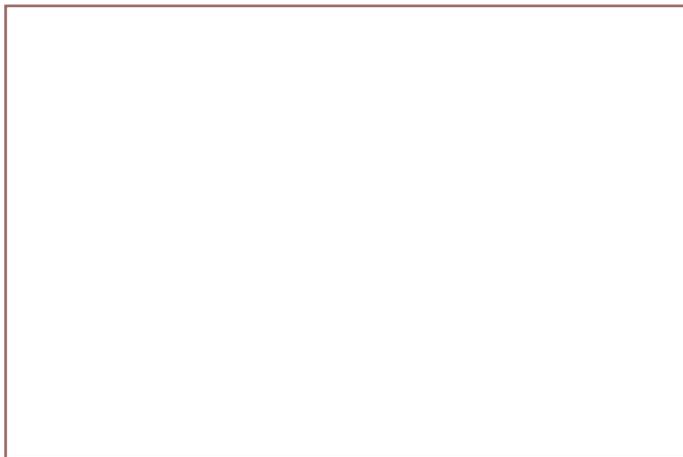
lower \_\_\_\_\_

a) Identify all **monophthongs**: \_\_\_\_\_

b) Identify all **diphthongs**: \_\_\_\_\_

c) Identify all **triphthongs**: \_\_\_\_\_

**5.** Draw a **quadrilateral for vowel description** and indicate the correct places for all vowels. Comment on this.



**6.** Draw the so-called **vocalic triangle** used for the **description of Slovak vowels**. Comment on this.



7. Explain the difference (if any) between **vocalic quality** and **vocalic quantity** in English and in Slovak.

8. Divide all English and Slovak vowels into the basic **vocalic types**:

i-type:

e-type:

a-type:

o-type:

u-type:

## 5.2 CONSONANTS

The classification of consonants is usually based on the following phonetic criteria:

1) the **place of articulation**, that is, where in the oral cavity the sound is articulated. Depending on the place of articulation, consonantal sounds can be **bilabial**, **labiodental**, **dental**, **alveolar** (**pre-alveolar** and **post-alveolar**), **alveopalatal** (or **palatoalveolar**), **palatal**, **velar**, **uvular** or **laryngeal** (**glottal**).

2) the **manner of articulation**. This indicates how the sound is produced, that is, what the type of obstacle (see above) is during the articulation of a given sound. When there is a complete closure, the sound is labelled as a **stop** (**occlusive**). When there is only a partial closure, made by the interference of the tip of the tongue with the alveolar ridge while the air flow escapes on one or both sides of the tongue, a **lateral** consonant is articulated. An intermittent closure gives rise to **vibrants** (see, e.g., Roach 2000). In the case of the creation of a narrowing during the production of a consonant, the given consonant is called a **spirant** (**constrictive**). A **semi-occlusive**

sound results from the combination of a complete closure and a narrowing. When two articulators are neither close enough to form a closure nor are far enough apart to articulate a vowel, an **approximant** is shaped, because it is said that the articulators approximate. The manner of articulation has its direct reflection in the next criterion.

**3) the acoustic impression.** The way our ear hears the sound (acoustic impression) is given by the way it is produced, that is, by the manner of articulation. Stops (occlusives) are known as **plosives** because of the impression of an explosion resulting from the sudden cancellation of the closure. Spirants (constrictives) are perceived as **fricatives**: the air passing through the narrowing creates friction. Sounds are called **affricates** when a closure combines with a narrowing during the articulation of a sound. Finally, all approximants are perceived as **frictionless continuants** by the human organ of hearing.

**4) the position of the soft palate.** When the soft palate is raised during the sound's production (see Chapter 3), thus preventing the air from escaping through the nose, the consonantal sound is called **oral**. In the case of a lowered soft palate, which means the air's free entrance into the nasal cavity, the sound is **nasal**.

**5) the participation of vocal cords (voicing).** A sound is **voiced** when vocal cords participate in the articulation of a sound. A sound is labelled as **voiceless** when it is produced without the participation of the vocal cords.

Oral stops, spirants and semi-occlusives are sometimes called **obstruents**. They can be voiced or voiceless. Nasal stops and approximants are known as **sonorants**. They are all voiced.

## 5.2.1 CONSONANTS IN ENGLISH

There are 24 consonants in English. The classification of these consonants on the basis of their phonetic criteria is represented in Table 2.

manner/ acoustic imp.	voicing	place							
		bilabial	labiodental	dental	alveolar	palato- alveolar	palatal	velar	glottal
stop/ plosive	voiceless	p			t			k	
	voiced	b			d			g	
spirant/ fricative	voiceless		f	θ	s	ʃ			
	voiced		v	ð	z	ʒ			h
semi-occlusive/ affricate	voiceless					tʃ			
	voiced					dʒ			
nasal stop/ nasal plosive	voiced	m			n			ŋ	
approximant/ frictionless continuant	voiced	w			l	r	j		

**Table 2.** The classification of the English consonants  
(Gregová 2017: 65)

The consonant /r/ is also known as a vibrant, while /l/ is a lateral.

## 5.2.2 CONSONANTS IN SLOVAK

There are 27 consonantal sounds in Standard Slovak, and their phonetic classification is provided in Table 3.

manner/ acoustic imp.	voicing	place							
		bilabial	labiodental	alveolar		palato- alveolar	palatal	velar	glottal
				pre- alveolar	post- alveolar				
stop/ plosive	voiceless	p		t		tʃ		k	
	voiced	b, m		d, n		dʃ, ŋ, ɽ		g	
spirant/ fricative	voiceless		f	s	ʃ			x	
	voiced		v	z	ʒ, r, l		j		h
semi-occlusive /affricate	voiceless			c	ç				
	voiced			ʒ	ʒ				

**Table 3.** The classification of the Slovak consonants

The consonants **n**, **m** and **ň** are **nasal**. All the other Slovak consonants are oral. The sound /l/ – similar to English – is lateral, and /r/ is a vibrant.

## SUGGESTIONS FOR FURTHER READING

The books recommended for the sections of this chapter dealing with vowels can also be used here: Ladefoged and Maddieson (1996) and Odden (2005) for a phonetic description of consonants in the languages of the world, Roach (2000) for a description of RP consonants, and McMahon (2002) for a mutual phonetic comparison of consonants in Standard Southern British English (that is, RP) and General American. Král' and Sabol (1987) is definitely the best choice when looking for a detailed phonetic depiction of consonants in Standard Slovak.

## EXERCISES

**A. Answer the following questions or complete the following sentences:**

1. Which **phonetic criteria** are used for the classification of consonants?
2. What does the **place of articulation** show?
3. The \_\_\_\_\_ classifies sounds on the basis of the type of obstacle during their production.

4. The sound is called a \_\_\_\_\_ ( \_\_\_\_\_ )  
when there is a **complete closure**.

5. When a **narrowing** is created during the articulation of a consonant,  
the consonant is called a \_\_\_\_\_  
( \_\_\_\_\_ ).

6. Sometimes a complete **closure combines with a narrowing**, which  
is referred to as a \_\_\_\_\_ sound.

7. When two **speech organs approximate**, \_\_\_\_\_ are  
created.

8. What does **acoustic impression** (how our ear hears sounds) depend  
on?

9. The **position of the soft palate** divides consonants into two groups:  
\_\_\_\_\_ sounds when the soft palate is raised and  
prevents air from escaping through the nose, and  
\_\_\_\_\_ sounds when the soft palate is lowered and the  
entrance into the nasal cavity is free.

10. The **function of vocal cords** also divides consonants into two  
categories: when the vocal cords participate in articulation, a sound is

\_\_\_\_\_, and when the sound is articulated without the participation of the vocal cords, it is \_\_\_\_\_.

11. Oral stops, spirants and semi-occlusives are also called \_\_\_\_\_. They can be voiced or voiceless. Nasal stops and approximants are \_\_\_\_\_. They are all voiced.

**B. Complete the following table:**

	place of articulation	manner of articulation	acoustic impression	position of the soft palate	participation of vocal cords	tension
p						
b						
r						
k						
w						
g						
f						
v						
s						
ʃ						
ð						
θ						
ʒ						
		spirant	fricative	oral	voiced	lenis
ŋ						
l						
dʒ						
		semi-occlusive	affricate	oral	voiceless	fortis

1. Explain the individual phonetic criteria.
2. Which sounds differ by one property only?

**C. Answer the following questions:**

1. Explain the special position of the consonant /h/ in the subsystem of English consonants.
2. What is **aspiration**?
3. What are **semi-vowels**?
4. Explain the relation (if any) between the voiced/voiceless character of the English consonants and their tension.
5. Compare English and Slovak **nasal** consonants, **lateral** consonants, and **affricates**.
6. What do you know about the feature **voiced** vs. **voiceless** in English and in Slovak?

## 6 ASPECTS OF CONNECTED SPEECH

In the process of communication, individual speech sounds (vowels and consonants) combine into the higher-level units (words, word forms) we use for communication. Segments, when getting close in speech, may influence each other to make their articulation as little demanding as possible, that is, to maintain the lowest articulatory effort on the side of the speaker, and at the same time to preserve the lowest perceptual effort on the site of the hearer. These are the so-called **aspects of connected speech**, also known as the **economy of an articulatory effort**. **Assimilation** and **linking** are the most frequent processes falling into this category.

### 6.1 ASSIMILATION

In linguistics, **assimilation**<sup>7</sup> is a process when “two dissimilar sounds become more similar when close to each other” (Štekauer 1993: 33). It is the mutual influence of neighbouring sounds, i.e., the accommodation of a sound to its sound environment. Depending on the direction of this mutual influence of sounds, there are two basic types of assimilation:

- a) **regressive assimilation** – a sound that follows changes a sound that is before it (S1  $\leftarrow$  S2),
- b) **progressive assimilation** – a preceding sound has an influence on the sound that comes after it (S1  $\rightarrow$  S2).

Assimilation may affect various characteristics of sounds (place of articulation, manner of articulation, voicing, etc.). An **assimilated sound** (the one that becomes similar to the adjacent sound or identical

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<sup>7</sup> In phonology, assimilation is known as neutralization.

with it) is usually a consonant. An **assimilating sound** (the one that triggers the assimilation of a neighbouring sound) can be a vowel or a consonant.

### 6.1.1 ASSIMILATION OF VOICE

A common type of assimilation occurring across languages is the **assimilation of voice (voicing assimilation)**. It is a phonological phenomenon because it is based on the change of an important phonological feature of a consonant (its voicing) into the opposite phonological feature. This change results – simply said – in the substitution of a voiced consonantal sound into a voiceless one and vice versa. The assimilation of voice can be both regressive and progressive, and it can occur within a word or on the word boundaries, that is, between words.

#### 6.1.1.1 Assimilation of voice in English

In the standard accent of British English, the assimilation of voice can be both progressive and regressive. A **progressive type of voice assimilation** affects the ending **-(e)s** (3<sup>rd</sup> person singular present tense, plural form of nouns, possessive case) and the ending **-(e)d** (past tense, past participle):

- the ending **-(e)s** is pronounced [s] if the consonant that precedes it is voiceless, as in, for example, *cats* [kæts], and its pronunciation is [z] if the foregoing consonant is voiced, as in, for instance, *dogs* [dɒgz];
- the ending **-(e)d** has the sound form [t] if the preceding consonant is voiceless, like in *watched* [wɒʃt], and is pronounced [d] if the preceding consonant is voiced, as in, for example, *played* [pleɪd].

A **regressive assimilation of voice** occurs on the word boundaries. It affects the consonants [v], [z] and [ð], which, when followed by a voiceless sound, change into [f], [s], [θ], respectively, as in, for example, *have to* [hæv tə] ⇒ [hæf tə].

### 6.1.1.2 Assimilation of voice in Slovak

In Standard Slovak, the assimilation of voice is the crucial assimilation process connected with correct standard pronunciation. It is regressive and occurs in a word or on the word boundaries. In detail, a voiced obstruent loses its voicing and is pronounced as its voiceless counterpart, and, vice versa, a voiceless obstruent becomes voiced. The assimilation of voice takes place

- (1) on the word boundaries,
- (2) on the boundaries of word stems in compounds,
- (3) on the boundary prefix + stem (word-base), or
- (4) on the boundary stem (word-base) + suffix.

The assimilation of voice affects the so-called **voice pairs**:

b	d	ď	g	z	ž	z	ž	h	v	(voiced)
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
p	t	tʰ	k	c	č	s	š	x	f	(voiceless)

The rule says that (1) when a **voiceless obstruent** is followed by a voiced sound (voiced obstruent, sonorant, vowel), it becomes voiced too, for example:

<i>chlap zavolal</i> ‘a man called’	————→	[xlab zavolal]
<i>hrstʰ dukátov</i> ‘a handful of ducats’	————→	[hrzdʰ duka:tou]
<i>desaťuholník</i> ‘decagon’	————→	[desađʰuholňi:k]
<i>včasráno</i> ‘early in the morning’	————→	[fčazra:no]

And (2) when a **voiced obstruent** is followed by a voiceless sound or occurs before a pause (the stop has the same influence as the voiceless sound), it becomes voiceless, for example:

<i>dážď</i> 'prší' 'it is raining'	—————>	[da:šʔ prši:]
<i>nad</i> <i>tebou</i> 'above you'	—————>	[nat t'ebou]
<i>bez</i> <i>tak</i> 'anyway'	—————>	[bestak]
<i>pod</i> <i>fuk</i> 'cheat'	—————>	[potfuk]
<i>dub</i> 'oak'	—————>	[dup]

A significant exception to this principle of voice assimilation is represented by the combination of the non-syllabic prepositions **s** 'with' and **k** 'to' with **personal pronouns**. In such cases, there is no assimilation, as illustrated below:

<i>s</i> <i>ním</i> 'with him'	—————>	[s ni:m]
<i>k</i> <i>nám</i> 'to us'	—————>	[k na:m]

This also applies to the vocalised forms **so** and **ku** that are always pronounced as [zo] and [gu], respectively; however, their pronunciation remains [so] and [ku] when these forms occur before a personal pronoun:

<i>so</i> <i>mnou</i> 'with me'	—————>	[so mnou]
<i>ku</i> <i>mne</i> 'to me'	—————>	[ku mňe]

## SUGGESTIONS FOR FURTHER READING

The relationship between assimilation and coarticulation, as viewed from various perspectives, is explained in Hardcastle and Hewlett (1999). Details about linking, elision and other types of assimilation can be found in Knight (2012: 189–216). The assimilation of manner and the place of articulation in Standard Slovak is only a marginal

issue. Nevertheless, Král' (2005: 73–75) provides descriptions of these phenomena and illustrative examples (in the dictionary part).

## EXERCISES

**1. Explain** the following terms: assimilation, assibilation, affrication, linking, elision

**2. Complete** the following statements:

1. When the phoneme t changes to p in the context 'football', there is an assimilation of \_\_\_\_\_ of \_\_\_\_\_.

2. When the phoneme v changes to f in the context 'have to', there is an assimilation of \_\_\_\_\_.

3. When a consonant causes a change in a consonant that precedes it, the assimilation is called \_\_\_\_\_.

4. When r is used to link a word ending with the letter 'r' in its spelling to a following vowel, we say there is a \_\_\_\_\_ r.

5. When r is used to link a word that does not end with the letter 'r' in its spelling to a following vowel, we say the r is \_\_\_\_\_.

6. \_\_\_\_\_ is the name for a sound realised as zero in casual, rapid speech. There can be \_\_\_\_\_ elision and \_\_\_\_\_ elision.

*(based on Roach 2000)*

**3. Transcribe the following expressions, and comment on them:**

- her eyes \_\_\_\_\_
- her nose \_\_\_\_\_
  
- your uncle \_\_\_\_\_
- your friend \_\_\_\_\_
  
- for Alan \_\_\_\_\_
- for Mike \_\_\_\_\_
  
- you were out \_\_\_\_\_
- you were there \_\_\_\_\_
  
- books \_\_\_\_\_
- bags \_\_\_\_\_
- catches \_\_\_\_\_
  
- worked \_\_\_\_\_
- governed \_\_\_\_\_
  
- let you \_\_\_\_\_
- last year \_\_\_\_\_
- did you \_\_\_\_\_
  
- this year \_\_\_\_\_
- dune \_\_\_\_\_
- issue \_\_\_\_\_

**4. Transcribe the following words:**

star \_\_\_\_\_ more \_\_\_\_\_ letter \_\_\_\_\_

Now transcribe the following phrases:

star above \_\_\_\_\_

more and more \_\_\_\_\_

letter of invitation \_\_\_\_\_

Explain the difference between the pronunciation of the words *star*, *more* and *letter* in isolation and in context.

([www.coursehero.com](http://www.coursehero.com))

**5.** Look at **the sound forms** of the following phrases and comment on them.

a) light colour /laɪk kʌlə/

b) flat pan /flæp pæn/

c) girls with pets /gɜ:lz wɪθ pets/

d) mint cafe /mɪŋk kæfeɪ/

e) that side /ðæt saɪd/

f) hen man /hem mæn/

g) good boy /gu:b bɔɪ/

**6.** What is the main purpose of the so-called **aspects of connected speech**?

**7. Compare** the basic principles of the **assimilation of voice in English and in Slovak**.

**8. Transcribe** the following Slovak words and phrases:

z Prešova \_\_\_\_\_ so mnou \_\_\_\_\_

z plota \_\_\_\_\_ so Zlaticou \_\_\_\_\_

nič nemá \_\_\_\_\_ s Vaším \_\_\_\_\_

ku mne \_\_\_\_\_ tak ako \_\_\_\_\_

ku Kláre \_\_\_\_\_ s Martinom \_\_\_\_\_

## 7 PHONOLOGY – KEY TERMS

**Phonology** is a linguistic discipline that concentrates on the sound level of language. The sound level of speech is the subject of research in **phonetics**, which studies the production (articulatory phonetics), transmission (acoustic phonetics) and perception (auditory phonetics) of speech sounds. The central unit of phonetic description is a **phone**, an articulatory-acoustic unit of the sound level of speech (Ondruš & Sabol 1987: 67). Taking into account the difference between language and speech as understood by structuralism, phonology is more abstract than phonetics and focuses on only those speech sounds that are important in communication, that is, that have an influence on meaning. The central unit of phonological analysis is a **phoneme**.

A **phoneme** is an abstract, system functional unit of the sound level of language (ibid.). This unit has a form but no meaning, which is why the phoneme is not a linguistic sign. It only has a **meaning differentiation function** – it can change the meaning of words. A phoneme is the smallest distinct unit of a sound level of language. All phonemes in a language are phones when used in speech, but the reverse is not the case: not all phones are phonemes (see 7.1 and 7.2 below). The particular realisation of the phoneme in speech is also called an **allophone**.

Allophones whose realisation depends on the sound environment are called **bound allophones** or **combinatory variants** (for example, **clear [l]** and **dark [ɫ]** in English; see below). These sounds are mutually exclusive, that is, they cannot occur in the same sound environment. They are in so-called **complementary distribution** – where one sound happens, the other cannot manifest itself. Allophones that can occur in the same environment (**parallel distribution**) but are non-distinctive are called **free allophones** or **facultative variants** (for example, [v] and [u] in Slovak; see below). Allophones of the same phoneme are not distinctive because they are

phonetically similar and the difference between them is too small to be distinctive, that is, to change the meaning.

The inventory of all phonemes of a given language is delimited via a technique known as a **commutation test**. This is based on a set of minimal pairs. A **minimal pair** is a pair of words that differ by one sound only. If the replacement of one sound by another in the identical sound environment results in a change in the meaning of the words, the sounds are separate phonemes. For example, in the pair *ten* [ten] – *pen* [pen], both ‘t’ and ‘p’ are separate phonemes – /t/ and /p/ – because the meaning of the word ‘ten’ differs from that of ‘pen’. However, in the pair [p<sup>h</sup>en] – [pen], the meaning is identical. These are two sound realisations of the word ‘pen’. The first one is the correct standard pronunciation with the aspirated [p<sup>h</sup>], and the second is an incorrect pronunciation of the word (the aspiration is missing) with no influence on meaning. That is why an **aspirated** [p<sup>h</sup>] is not a phoneme but only the allophone of the phoneme /p/. In a commutation test, vowels are evaluated against vowels and consonants against consonants.

Each phoneme is given as a set or a bundle of **distinctive features**. **Distinctive features** are the articulatory and acoustic properties necessary for the delimitation of the given phoneme. For example, the phonetic (articulatory and acoustic) characteristics forming the English phoneme /b/ are bilabial, stop, plosive, oral, and voiced (Table 2). If at least one of these properties is replaced with another, the phoneme /b/ will not be the phoneme /b/. For example, if the property ‘bilabial’ is substituted with the property ‘alveolar’, the set of features ‘alveolar, stop, plosive, oral, and voiced’ delimits the phoneme /d/ (Table 2). Consequently, the phonetic properties bilabial and alveolar are distinctive features. They represent a **functional difference** between sounds that results in a change of meaning: /b/ and /d/ are two distinct sounds with a meaning differentiation function, for example, *buck* /bʌk/ – *duck* /dʌk/ or *busy* /bɪzɪ/ – *dizzy* /dɪzɪ/. On the other hand, for example, aspiration is a non-functional

difference in English because it has no influence on the meaning of words, as explained above.

## 7.1 PHONEMES AND ALLOPHONES IN ENGLISH

### 7.1.1 VOWEL PHONEMES AND ALLOPHONES

In the standard accent of British English, there are 12 vocalic phonemes: short monophthongs /ɪ, e, ʌ, ɒ, ʊ, ə, æ/ and long monophthongs /ɑ:, ɜ:, i:, ɔ:, u:/. The phonological interpretation of English diphthongs is not clear yet. Some linguists (see, e.g., Vachek 1976) consider closing diphthongs (/eɪ, aɪ, ɔɪ, əʊ, aʊ/) **monophonemic** and centring diphthongs (/ɪə, eə, ʊə/) **biphonemic**. Nevertheless, more recent research indicates that both categories of English diphthongs are monophonemic rather than biphonemic. Triphthongs are treated as monophonemic, too. Consider the minimal pair distinction between some diphthongs, triphthongs and long/short monophthongs proving the monophonemic status of diphthongs and triphthongs:

*tie* /taɪ/ – *tea* /ti:/

*hear* /hɪə/ – *her* /hɜ:/

*soap* /səʊp/ – *soup* /su:p/

*tour* /tʊə/ – *too* /tu:/

*glared* /glɛəd/ – *glad* /glæd/

*fire* /faɪə/ – *far* /fɑ:/

*payer* /peɪə/ – *pay* /eɪ/

The vocalic sounds [ɪ] and [ʊ] are not separate phonemes, only phones. The phone [ɪ] has the quality of the phoneme /i:/ – it is a front close unrounded vowel but is short in length. It is manifested in

- (1) the word-final position as the sound realisation of the graphemes -y, -ey, as in *happy* [hæpi], *valley* [væli];
- (2) the prefixes *re-*, *pre-*, *de-*, for example, *react* [riækt];

- (3) the suffixes *-iate*, *-ious* when disyllabic, for instance, *hilarious* [hɪləˈɪəriəs];
- (4) in the grammatical words *he*, *she*, *we*, *me*, *be* when unstressed, for example, *he* [hi]; and
- (5) the definite article *the* when preceding a vowel, as in *the apple* [ði æpl] (Roach 2000: 85–86). The phonemic identification of the phone [i] is to the phoneme /ɪ/.

The phone [u] represents the short back high rounded vowel that occurs in the unstressed versions of the words *you*, *to*, *do*, *into*, *through* and *who*, for instance, [ju] (ibid.). The phonemic identification of the phone [u] is to the phoneme /ʊ/.

## 7.1.2 CONSONANT PHONEMES AND ALLOPHONES

The inventory of the consonant phonemes in English is as follows: /p, b, m, w, f, v, ð, θ, t, d, n, l, s, z, ʃ, ʒ, ʒ, ʒ, r, j, k, g, ŋ, h/. The oral plosives p, t, k are aspirated at the beginning of stressed syllables. The aspirated sounds [p<sup>h</sup>], [t<sup>h</sup>] and [k<sup>h</sup>] are not distinctive and represent the **combinatory variants (bound allophones)** of the phonemes /p/, /t/ and /k/, respectively.

The lateral phoneme /l/ manifests itself as

- (1) the so-called **clear [l]** before a vowel, as, for example, in the word *lip* [lɪp],
- (2) the so-called **dark [ɫ]** when occurring after a vowel and before and after a consonant, for example in the word *pill* [pɪɫ], and
- (3) the so-called **devoiced [l̥]** when pronounced after the plosives p, t and k in a stressed syllable, for instance in *play* [pleɪ].

**Clear, dark and devoiced l** are also **combinatory variants** of the phoneme /l/ because their phonetic realisations are bound to the sound environment.

In the flow of speech, the oral plosive /t/ can be pronounced without the post-released phase as the **unreleased [t̚]**, as, for example, at the end of the word *but* [bʌt̚]. The unreleased [t̚] is a **facultative variant (free allophone)** of the phoneme /t/ because its occurrence does not depend on the sound environment but on the speaker.

## 7.2 PHONEMES AND ALLOPHONES IN SLOVAK

### 7.2.1 VOWEL PHONEMES AND ALLOPHONES

In standard Slovak, there are the following vowel phonemes:

- short monophthongs: /i, e, a, ä<sup>8</sup>, o, u/
- long monophthongs: /í, é, á, ó, ú/
- diphthongs: /ia, ie, iu, uo/

Non-syllabic elements representing the first part of diphthongs – [i̯], [u̯] – are phones with clear phonemic identification to /i/ and /u/, respectively, that is, [i̯] – /i/ and [u̯] – /u/.

### 7.2.2 CONSONANT PHONEMES AND ALLOPHONES

The consonant phonemes in standard Slovak are /p, b, m, f, v, t, d, n, s, z, c, ʒ, r, l, š, ž, č, ʒ', t', d', ň, l', j, k, g, x, h/. Compared to English, the inventory of consonant allophones is higher.

The nasal phoneme /n/ has the following allophones:

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<sup>8</sup> See note 5.

- **[ŋ]** – a velar, stop, plosive, nasal, voiced sound that occurs before the sounds [k] and [g] and can be heard, for example, in the word *tenký* [tɛŋki:] ‘thin’;
- **[ɲ]** – a pre-alveolar, spirant, fricative, voiced, nasal sound that is pronounced when followed by [s], [z] and [š], [ž], as in *amazonský* [amazoŋski:] ‘Amazonian’; and
- **[ɳ]** – a velar, spirant, fricative, voiced, nasal sound occurring before [h] and [x], as in *bronchitída* [brɔxiti:da] ‘bronchitis’.

All these allophones of the phoneme /n/ are **bound (combinatory variants)** because their manifestations are conditioned by the sound environment.

The nasal phoneme /m/ has one **bound allophone** – [m̃]. It is a labio-dental, stop, plosive, voiced, nasal sound whose pronunciation is limited to occurrences before the labio-dental sounds [f] and [v], as, for example, in the word *amfóra* [am̃fɔra] ‘amphora’.

The velar, spirant, fricative, voiced, oral sound [ɣ] is a **combinatory variant (bound allophone)** of the phoneme /h/ and is pronounced as a voiced variant of a voiceless sound [x] as a result of the process of voice assimilation, as, for instance, in *mach na* [maɣ na] ‘moss on’.

The bilabial, spirant, fricative, voiced, oral sound [ɸ] is a **combinatory variant (bound allophone)** of the consonant phoneme /v/ and is pronounced when /v/ is in a syllable-final position, as in *domov* [domɔɸ] ‘home’. However, when /v/ is followed by a sonorant, both sounds can be pronounced [ɸ] and [v], for example, *rovno* [rov/ɸno] ‘directly’. In this position, [ɸ] is a **facultative variant (free allophone)** of the phoneme /v/.

The palatal, spirant, fricative, voiced, oral sound [j̃] manifests itself in the syllable-final position as a **combinatory variant** of the phoneme /j/. Nevertheless, when the phoneme /j/ is before a sonorant sound, both sounds can be pronounced, as in *krajný* [kraj/j̃ni:]. [j̃] is a

**facultative variant (free allophone)** in this position (Král' & Sabol 1989: 221–251; Sabol 1989: 9).

## SUGGESTIONS FOR FURTHER READING

Details on the phone–phoneme–allophone relationship, types of allophones, minimal pairs and commutation, parallel distribution, complementary distribution, etc. can be found in any book on phonology. The works of Katamba (1989: 16–26) or Král' and Sabol (1987: 263–271) are written in a way that is suitable for first-year students. For details about English vowel and consonant allophones, see Ladefoged (2000: 56–61, 82–85). More details on Slovak vowel and consonant allophones can be found in Sabol (1989: 65–77).

## EXERCISES

**Complete the following sentences:**

1. The presence or absence of aspiration is a non-functional difference in English. It \_\_\_\_\_ (changes/does not change) the meaning of an utterance.
2. A difference between speech sounds that does not change the meaning of an utterance is called a non-functional \_\_\_\_\_.
3. When the substitution of one sound for another in the same environment results in a change of meaning, we say that the difference between two sounds is \_\_\_\_\_.

4. If the difference between two sounds is functional, the substitution of one for the other in the same environment results in a change of \_\_\_\_\_.
5. If the difference between two speech sounds is functional, we say that they contrast in the same \_\_\_\_\_.
6. Is the environment for 'p' the same as the environment for 'b' in the pair of words PIN – BIN?
7. If a difference between two speech sounds is \_\_\_\_\_ (functional/non-functional), they will contrast in the same environment.
8. The term 'contrast' is used only when the substitution of sound X for sound Y, in the same environment, results in a change of \_\_\_\_\_.
9. /p/ and /b/ are phonemically \_\_\_\_\_ (the same/different).
10. [p] and [p<sup>h</sup>] are \_\_\_\_\_ (phonetically/phonemically) different sounds.
11. [p] and [p<sup>h</sup>] are not two different \_\_\_\_\_ because they do not contrast in the same environment.

12. The difference between [p] and [p<sup>h</sup>] is \_\_\_\_\_  
(functional/non-functional).
13. The utterances PIN and BIN differ by one \_\_\_\_\_.
14. DAN and TAD \_\_\_\_\_ (are/are not) a minimal pair. Why?
15. Utterances that differ from each other by one phoneme are called \_\_\_\_\_.
16. Which pair of words is a minimal pair?
- |                 |                |
|-----------------|----------------|
| 1. PILL – BILL  | 4. TAN – PAN   |
| 2. MINK – SINK  | 5. MEET – FEAT |
| 3. SPEAK – FEET |                |
17. Different sounds are phonemically different only if they \_\_\_\_\_ in the same environment.
18. If two sounds contrast in the same environment, the substitution of one for the other \_\_\_\_\_ (creates/does not creates) a difference in meaning.
19. Does the substitution of /p/ for /b/ in the word BIN make a difference in meaning?
20. BIN and PIN are a \_\_\_\_\_ pair.

21. Words that differ from each other by only one \_\_\_\_\_ are minimal pairs.
22. Select the two words that constitute a minimal pair: PIT, FIT, SKIT.
23. Find the minimal pairs:
1. THINK – PINK
  2. FAR – TAR
  3. DART – DARN
  4. DARK – HARP
24. Every language has a sound structure that can be divided into two levels: the phonetic level and the \_\_\_\_\_ level.
25. The inventory of all the perceptibly different sounds of a language is a \_\_\_\_\_ (phonetic/phonemic) inventory.
26. The inventory of all the contrasting sounds of a language is a \_\_\_\_\_ inventory.
27. Only \_\_\_\_\_ (phonemic/phonetic) differences can cause a difference in meaning.

28. The difference between aspirated and non-aspirated stops in English is \_\_\_\_\_ (phonetic/phonemic).
29. \_\_\_\_\_ ([t<sup>h</sup>] and [t]/[t<sup>h</sup>] and [d<sup>h</sup>]) are different phonemes.
30. When two sounds contrast in the same environment, the substitution of one of the sounds for the other results in a change of \_\_\_\_\_.
31. Different \_\_\_\_\_ contrast in the same \_\_\_\_\_.
32. The environments in which [t<sup>h</sup>] and [t] occur are mutually exclusive. That is to say, where [t<sup>h</sup>] occurs, \_\_\_\_\_ does not occur.
33. When the environments of two sounds are mutually \_\_\_\_\_, we say that they are in complementary distribution.
34. Sounds that are in complementary distribution can never contrast in the same environment because they never occur in the same \_\_\_\_\_.
35. Sounds in \_\_\_\_\_ distribution never contrast.

36. They cannot do so, because they never \_\_\_\_\_ in the same environment.
37. We call sounds that occur in the same environment, but do not \_\_\_\_\_ in the same environment, non-functional variants.
38. Sounds in non-functional (free) variation occur in the same \_\_\_\_\_.
39. Sounds in parallel distribution \_\_\_\_\_ (do not contrast/contrast) in the same environment.
40. Can two different phonemes ever be in free variation? Explain why/why not.
41. Sounds that belong to the same phoneme do not contrast in the same environment: they may be in \_\_\_\_\_ distribution or in free \_\_\_\_\_.
42. Sounds that belong to the same phoneme and are in complementary distribution are called \_\_\_\_\_.
43. Sounds that belong to the same phoneme and are in free variation are called \_\_\_\_\_.

44. Aspirated and non-aspirated voiceless stops occur in mutually exclusive environments. Thus, [p<sup>h</sup>] and [p], like [t<sup>h</sup>] and [t], are in \_\_\_\_\_.
45. At least one position of occurrence of sounds in \_\_\_\_\_ (parallel distribution/complementary distribution) is the same.
46. The difference between /s/ and /z/ is that of voicing. In English, this is a \_\_\_\_\_ (phonemic/non-phonemic) difference.
47. Members of the same phoneme class are always phonetically \_\_\_\_\_.
48. If two sounds are (1) phonetically \_\_\_\_\_ and (2) in complementary distribution, they can be considered to be the members of the same phoneme.
49. Sounds that are (1) phonetically similar and (2) in free variation can also be considered to be members of the same. \_\_\_\_\_.
50. A phoneme is not a sound, but a \_\_\_\_\_ of sounds.
51. Members of the same \_\_\_\_\_ class are called allophones.

52. Allophones of the same phoneme \_\_\_\_\_ (contrast/do not contrast) in the same environment.
53. \_\_\_\_\_ of the same phoneme must be phonetically similar.
54. Allophones of the same phoneme must be in complementary \_\_\_\_\_ or in free \_\_\_\_\_.
55. We know that /ð/ and /θ/ contrast in some words; they are \_\_\_\_\_ (the same phoneme/separate phonemes) in English.
56. Separate phonemes are in \_\_\_\_\_ (complementary/parallel) distribution.

*(based on Buchanan 1963)*

## 8 DISTINCTIVE FEATURES

A **distinctive feature** is a phonetic (articulatory or acoustic) property that distinguishes one phoneme from another (see Chapter 7). A **phoneme** is then seen as a bundle of simultaneous distinctive features. Distinctive features theories are usually based on the **binary principle**. If there is, for example, the feature *voice*, a sound characterised by the active participation of vocal cords during its production (voiced sound) will then be specified as *+voice*, and a sound that is voiceless will be specified as *-voice*.

Since languages use various sets of features for the delimitation of phonemes, there are certain generalisations about distinctive features theories that should be considered appropriate for a given language – a set of phonological features should be **contrastive**, **descriptive** and **classificatory**. The condition of **contrastiveness** is fulfilled when each phoneme differs from any other phoneme in a language by at least one feature. Distinctive features can be seen as **descriptive** when they fully reflect the phonetic nature of phonemes. And a distinctive features theory is **classificatory** when it describes the whole sound system fully and economically (Giegerich 1992: 90–91).

The fact that the two basic categories of speech sounds – **vowels** and **consonants** – are different not only in terms of their articulatory and acoustic properties (see Chapter 5) but also from the viewpoint of their functions in a language system has its reflection in distinctive features, too.

In **phonology**, a **vowel** is a segment creating the centre of the syllable, and a **consonant** is a sound with a non-syllabic function<sup>9</sup>. However, sometimes the phonetic interpretation of sounds contradicts their phonemic evaluation and vice versa. In other words, a sound treated as a vowel in phonetics can function as a consonant in

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<sup>9</sup> For the phonetic delimitation of vowels and consonants, see Chapter 5.

phonology and vice versa. For example, the sound [l] is a consonant phonetically (it is articulated by means of a partial closure; see Chapter 5), but, when creating the centre of the syllable (see Chapter 9 for the notion of the so-called syllabic consonants), it behaves like a vowel. The sounds [j] and [w] are also known as **semivowels** in phonetics, but in phonology, these sounds are consonants – they never create the syllable nucleus.

To capture all these differences between sounds, Jakobson and Halle (1956), whose work on distinctive features has inspired many linguists, suggested two distinctive features common to all phonemes in a language. The first is the **fundamental source features: vocalic–non-vocalic** and **consonantal–non-consonantal**. The basic criterion for the delimitation of distinctive features in Jakobson and Halle’s theory is the analysis of the acoustic spectrum of sounds<sup>10</sup> and their articulatory properties.

The feature **vocalic** means a single periodic source without the abruptness of the onset; a sound is produced without a barrier in the mouth cavity. Phonemes delimited by the feature **consonantal** are characterised by the presence of zeros in their spectrum and a type of closure during their production. On the basis of these two fundamental source features, the following basic classes of phonemes are delimited:

	vocalic	consonantal
vowels	+	-
sonorants	+	+
obstruents	-	+
glides	-	-

The distinction between vowels and consonants is language-universal; however, **glide** phonemes do not occur in all languages.

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<sup>10</sup> For more about the acoustic spectrum of a sound, see Chapter 11.

As for the role of phonemes in the syllable, the feature **syllabicity** describes the basic categories of sounds in this way:

	syllabicity
vowels	+
obstruents	-
sonorants	-/+

The other features suggested by the authors are **secondary consonantal source features** and **resonance features**. The secondary consonantal source features are as follows:

- **interrupted–continuant:** interrupted consonant phonemes have an abrupt onset, contrary to constrictives, whose onset is gradual;
- **checked–unchecked:** the spectrogram of checked phonemes is characterised by a sharper termination;
- **strident–mellow:** strident sounds have irregular waveforms as opposed to mellow sounds that have spectrograms with vertically/horizontally organised black areas; and
- **voiced–voiceless:** the spectrum of voiced phonemes contains formants (see note 21) of a harmonic source.

The resonance features are as follows:

- **compact–diffuse:** compact phonemes have one centrally located formant region; in diffuse phonemes, no central formant regions prevail. From the viewpoint of articulation, velars and palatals are more compact than sounds produced in the front part of the mouth;
- **grave–acute:** the phoneme is grave when the lower side of the spectrum prevails; in the event of the dominance of the upper side of the spectrum, the phoneme is acute. Acuteness is given by a smaller mouth cavity (dentals, velars, palatals);

- **flat–plain:** a flat phoneme is characterised by a downward shift of a set of formants, which is the result of the reduction of the lip rounding;
- **sharp–plain:** sharp phonemes are palatalised, which causes a slight rise in the second formant;
- **tense–lax:** tense phonemes exhibit a longer time interval.

## 8.1 DISTINCTIVE FEATURES OF ENGLISH PHONEMES

The distinctive features commonly used for the delimitation of English phonemes are those introduced by Halle and Clements (1983). Halle and Clements’ distinctive features theory encompasses the original features of Jakobson (1941), as well as the popular features of Chomsky and Halle (1968), described in the well-known publication *The Sound Pattern of English (SPE)*.

First, five so-called **major class features** are applied to all phonemes to divide sounds into major categories. These features are [syllabic] – sounds creating the syllable nucleus; [consonantal] – sounds produced with the obstacle in the oral cavity; [sonorant] – a sound characterised by voicing; [continuant] – the air’s continuous and free movement through the oral cavity; and [delayed release] – a sound with a longer aspiration phase than in oral stops.

These major class features combine to delimit major categories of sounds, as specified in Table 4.

	[syll]	[cons]	[cont]	[son]	[delrel]
<b>vowels</b>	+	-	+	+	0 <sup>11</sup>
<b>oral stops</b>	-	+	-	-	-
<b>nasal stops</b>	-	+	-	+	0
<b>fricatives</b>	-	+	+	-	0
<b>affricates</b>	-	+	-	-	+
<b>liquids</b>	-	+	+	+	0
<b>semi-vowels<sup>12</sup></b>	-	-	+	+	0

**Table 4.** The major categories of sounds in English

### 8.1.1 VOWEL FEATURES

When delimiting the distinctive features of vowel phonemes, four dimensions connected with the articulation of vowels are considered: height, backness, rounding, and tensity. Depending on the articulatory properties of vowels, vowel phonemes are then characterised by the following distinctive features:

- [high] – sounds produced by raising the body of the tongue against the palate,
- [low] – sounds produced by lowering the body of the tongue in the oral cavity,
- [central] – sounds produced with the central part of the tongue,
- [back] – sounds articulated with the back part of the tongue,
- [round] – sounds produced with rounded lips,
- [tense] – all long vowels are tense.

A matrix of the feature specification of English monophthongs can be found in Table 5.

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<sup>11</sup> The symbol 0 means that the feature is irrelevant (not necessary) for the given category of phonemes.

<sup>12</sup> Approximants are divided into liquids and semi-vowels.

The feature [pure] was introduced to differentiate between monophthongs and diphthongs. The feature [gliding to /ʊ/] is used to reflect the difference between closing and centring diphthongs, as illustrated in Table 6.

	ɪ	e	ʌ	ɒ	ʊ	ə	æ	ɑ:	ɜ:	i:	ɔ:	u:
[syll]	+	+	+	+	+	+	+	+	+	+	+	+
[cons]	-	-	-	-	-	-	-	-	-	-	-	-
[son]	+	+	+	+	+	+	+	+	+	+	+	+
[cont]	+	+	+	+	+	+	+	+	+	+	+	+
[high]	+	-	-	-	+	-	-	-	-	+	-	+
[low]	-	-	-	+	-	-	+	-	-	-	+	-
[central]	-	-	+	-	-	+	-	-	+	-	-	-
[back]	-	-	-	+	+	-	-	-	-	-	+	+
[round]	-	-	-	+	+	-	-	-	-	-	+	+
[tense]	-	-	+	-	-	-	-	+	+	+	+	+

**Table 5.** Feature specification of English monophthongs

	eɪ	aɪ	ɔɪ	əʊ	aʊ	ɪə	eə	ʊə
[syll]	+	+	+	+	+	+	+	+
[cons]	-	-	-	-	-	-	-	-
[son]	+	+	+	+	+	+	+	+
[cont]	+	+	+	+	+	+	+	+
[pure]	-	-	-	-	-	-	-	-
[high]	-	-	-	-	-	+	-	+
[low]	-	+	-	-	+	-	-	-
[central]	-	-	-	+	-	-	-	-
[back]	-	-	+	-	-	-	-	+
[round]	-	-	+	-	-	-	-	+
[tense]	+	+	+	+	+	+	+	+
[gliding to /ʊ/]	+	+	+	+	+	-	-	-

**Table 6.** Feature specification of English diphthongs

### 8.1.2 CONSONANT FEATURES

The distinctive features commonly used for the delimitation of English consonant phonemes are:

- [coronal] – sounds produced with the tongue’s tip raised toward the teeth or the hard palate,
- [anterior] – a consonant is [+anterior] when it is produced in front of the palate-alveolar region (i.e., bilabial, labio-dental, dental and alveolar sounds),
- [strident] – acoustically, strident sounds are characterised by great noise,
- [voice] – voiced sounds are articulated with the active participation of vocal cords,
- [tense] – all voiceless obstruents are fortis, that is, [-tense],
- [nasal] – sounds produced with a lowered velum so the air escapes not only through the mouth but also through the nose,
- [lateral] – sounds where the tip of the tongue forms a closure but the air is still allowed to escape on one or both sides of the tongue.

The vowel features [round], [high], [low], and [back] are applied to the consonant system, too. A complete matrix of the feature specification of English consonants is presented in Table 7 (see note 10 for symbol 0).

	p	b	m	w	f	v	θ	ð	t	d	n	l	s	z	ʃ	ʒ	tʃ	dʒ	r	j	k	g	ŋ	h
[syll]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[cons]	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+
[son]	-	-	+	+	-	-	-	-	-	+	+	-	-	-	-	-	-	+	+	+	-	-	+	-
[cont]	-	-	-	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	+
[delrel]	-	-	0	0	0	0	0	0	-	-	0	0	0	0	0	0	+	+	0	0	-	-	0	0
[coronal]	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
[anterior]	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
[strident]	-	-	-	-	+	+	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-
[round]	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[high]	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	+	+	+	+	-
[low]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
[back]	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-
[voice]	-	+	+	+	-	+	-	+	-	+	+	+	+	-	+	-	+	+	+	+	-	+	+	+
[tense]	+	-	0	0	+	-	+	-	+	-	0	0	+	-	+	-	+	-	0	0	+	-	0	-
[nasal]	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+
[lateral]	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 7. Feature specification of English consonants

## 8.2 DISTINCTIVE FEATURES OF SLOVAK PHONEMES

The most complex account of the distinctive features of Slovak phonemes can be found in Sabol's work (Ondruš & Sabol 1987; Král and Sabol 1989; Sabol 1989). The author – following the fundamental work of Jakobson and Halle (1956) mentioned above – delimits the distinctive features of phonemes on the basis of their articulatory, acoustic and perceptual correlates. First, two distinctive features (two phonological oppositions) are applied to all phonemes in a language to make a substantial difference between two functionally different categories of sounds – vowels and consonants. The features are **consonantal (C)–non-consonantal (C<sup>0</sup>)** and **vocalic (V)–non-vocalic (V<sup>0</sup>)**. In accordance with Jakobson and Halle, these two pairs of phonological relations delimit four classes of phonemes: sonorants – CV, obstruents – CV<sup>0</sup>, vowels – C<sup>0</sup>V, and glides – C<sup>0</sup>V<sup>0</sup>. In Standard Slovak, there are no glides. Consequently, Sabol (1989) delimits a set of distinctive features for vowels (monophthongs and diphthongs) and a set of features for consonants (sonorants and obstruents).

## 8.2.1 VOWEL FEATURES

The acoustic characteristics (depending on articulation) of vowels function as the source of the relevant information necessary for the delimitation of the distinctive features of those sounds. Sabol (Ondruš & Sabol 1987; Král' & Sabol 1989; Sabol 1989) defines Slovak monophthongs and diphthongs using six distinctive features:

1. diffuse (D)–non-diffuse ( $D^0$ ), compact: diffuse vowels (i, e, í, é, ie) are characterised by a high degree of difference between the first and second formants ( $F_2 - F_1$ )<sup>13</sup>;
2. concentrated (Cc)–non-concentrated ( $Cc^0$ ): the property of concentration is given by the proportion of the second formant to the first ( $F_2:F_1$ ). The feature  $Cc^0$  is typical of the phonemes /i, e, í, é, ie/;
3. narrow (Nr)–non-narrow ( $Nr^0$ ): narrowness characterises vowels with a low first formant ( $F_1$ ); these are high vowels (i, u, í, ú, iu);
4. labial (Lb)–non-labial ( $Lb^0$ ): labialised vowels (o, u, ó, ú, uo, iu) are produced with rounded lips, which has its reflection in a low spectral focus (calculated according to the formula  $(F_1 + F_2) : 2$ );
5. quantitative (Lg)–non-quantitative ( $Lg^0$ ): quantitateness is a feature of the phonemes that function as long syllable centres (í, é, á, ó, ú, ia, ie, iu, uo); and
6. glide (G)–non-glide ( $G^0$ ): the glide feature is typical of diphthongs (ia, ie, iu, uo) (Král' & Sabol 1989: 276–279).

The overall configuration of distinctive features delimiting Slovak vowel phonemes is captured in Table 8.

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<sup>13</sup> See note 21 for the delimitation of a formant.

	i	í	E	é	ie	ä	a	á	ia	o	ó	uo	u	ú	iu
<b>V</b>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<b>C</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>D</b>	+	+	+	+	+	+	-	-	+	-	-	-	-	-	-
<b>Cc</b>	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+
<b>Nr</b>	+	+	-	-	-	-	-	-	-	-	-	-	+	+	+
<b>Lb</b>	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+
<b>Lg</b>	-	+	-	+	+	-	-	+	+	-	+	+	-	+	+
<b>G</b>	-	-	-	-	+	-	-	-	+	-	-	+	-	-	+

**Table 8.** Matrix of distinctive features of Slovak vowel phonemes  
(Kráľ & Sabol 1989: 279)

### 8.2.2 CONSONANT FEATURES

Two distinctive features of consonant phonemes depend on the place of articulation:

1. diffuse (D)–non-diffuse (D<sup>0</sup>): diffuse sounds are articulated in the front part of the oral cavity (i.e. bilabial, labiodental, and pre-alveolar places of articulation);
2. acute (A)–non-acute (A<sup>0</sup>): articulation in the middle of the oral cavity (alveolar and palatal sounds) is reflected in the feature acute (A).

The type of obstacle gives the feature

3. occlusive (O)–non-occlusive (O<sup>0</sup>): semi-occlusives are treated as occlusives too. This feature is irrelevant for sonorants.

The lateral articulated is captured in the feature

4. lateral (Lt)–non-lateral (Lt<sup>0</sup>): the feature Lt delimits /l/ opposite to /r/, that is, Lt<sup>0</sup>, and /l/ opposite to Lt<sup>0</sup> /j/. Lt is irrelevant for all other phonemes.

The auditive impression of a strong sibilant acoustic effect results in the feature

5. strident (S)–non-strident (S<sup>0</sup>): the feature S is phonologically relevant for the phonemes /s, z, š, ž, c, ʒ, č, ǰ/ as opposed to the phonemes /t, d, t', d'/ that have the feature S<sup>0</sup>.

Obstruents are characterised by the feature:

6. voice (Vc)–non-voice (Vc<sup>0</sup>): the phonemes /b, d, d', g, ʒ, ž, z, ž, h, v/ are Vc, and the phonemes /p, t, t', k, c, č, s, č, x, f/ have the feature Vc<sup>0</sup>.

The articulation with lowered velum results in the feature

7. nasal (N)–non-nasal (N<sup>0</sup>): in Standard Slovak, only the phonemes /m, n, ň/ are nasal (ibid. 283–285).

Table 9 summarises the feature specification of sonorants. The feature specification of Slovak obstruents can be found in Table 10.

	r	l	ʀ	m	n	ň	j	v
V	+	+	+	+	+	+	+	+
C	+	+	+	+	+	+	+	+
D	+	+	-	+	+	-	-	+
A	+	+	+	-	+	+	+	-
Lt	-	+	+	0 <sup>14</sup>	0	0	-	+
N	-	-	-	+	+	+	-	-

**Table 9.** Distinctive features of Slovak sonorants (Kráľ & Sabol 1989: 286)

	p	b	f	v <sup>15</sup>	t	d	s	z	c	ʒ	š	ž	č	ž	tʰ	dʰ	k	g	x	h
V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
D	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
A	-	-	-	-	+	+	-	-	+	+	+	+	+	+	+	+	-	-	-	-
O	+	+	-	-	+	+	-	+	+	+	-	-	+	+	+	+	+	+	-	-
S	0	0	0	0	-	-	+	+	+	+	+	+	+	+	-	-	0	0	0	0
Vc	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+

**Table 10.** Distinctive features of Slovak obstruents (Kráľ & Sabol 1989: 287)

## SUGGESTIONS FOR FURTHER READING

For details about the general theory of distinctive features, see Jakobson and Halle (1956), the book cited earlier, but also Jakobson et al. (1961), Chomsky and Halle (1968) or Katamba (1989: 35–59), who summarises the Jakobsonian features and the *SPE* system of distinctive features. On distinctive features theory for English phonemes, see especially Giegerich (1992: 89–129) and McMahon (2002: 36–50), which may be very helpful for first-year students. On distinctive features theories for Slovak phonemes, see the fundamental work on the phonology of contemporary Standard

<sup>14</sup> See note 11.

<sup>15</sup> In Standard Slovak, the phoneme /v/ behaves as a sonorant but also as an obstruent.

Slovak by Sabol (1989: 79–104). Horecký (1975: 18–26), whose work is the first generative account of the phonological system of Standard Slovak, and Pauliny (1979: 107–128) may also be very inspiring for students interested in Slovak phonology.

## EXERCISES

**1. Match the appropriate number with the space on the left of the following sentences:**

- (1) Proportional oppositions                      (2) Unidimensional oppositions  
(3) Isolated oppositions                          (4) Multidimensional oppositions

- a) \_\_\_\_\_ : the base common for both phonemes in opposition does not occur in other pairs of phonemes  
b) \_\_\_\_\_ : the common base occurs in more than two phonemes  
c) \_\_\_\_\_ : the relation between two phonemes occurs in several phonemes  
d) \_\_\_\_\_ : the given relation between two phonemes does not occur elsewhere

**2.** The difference between the phonemes in **privative opposition** is based on the \_\_\_\_\_ vs. \_\_\_\_\_ of a particular distinctive feature.

**3.** The members of \_\_\_\_\_ **opposition** differ by the different degrees of a feature.

4. The members of a pair in **equipollent opposition** differ in \_\_\_\_\_ features.

5. Match the appropriate number with the space on the left of the following sentences:

1 [Sonorant]                      2 [Continuant]                      3 [Consonantal]

- a) \_\_\_\_\_ : a sound where the air stream is not blocked in the oral cavity during its production
- b) \_\_\_\_\_ : a sound produced with a radical obstruction in the vocal tract
- c) \_\_\_\_\_ : a sound whose phonetic content is predominantly made up of the sound waves associated with voicing

6. [Sonorant], [Continuant] and [Consonantal] are called \_\_\_\_\_ features.

7. Following **Giegerich's theory** of distinctive features (1992), name the classes characterised by the following bundles of distinctive features:

- [-sonorant, -continuant, +consonantal] \_\_\_\_\_
- [+sonorant, +continuant, -consonantal] \_\_\_\_\_
- [+sonorant, -continuant, +consonantal] \_\_\_\_\_
- [+sonorant, +continuant, +consonantal] \_\_\_\_\_
- [-sonorant, +continuant, +consonantal] \_\_\_\_\_

8. Name **the feature** that characterises

- sounds produced by retracting the body of the tongue from the neutral position [\_\_\_\_\_]
- sounds produced without the narrowing of a lip orifice [\_\_\_\_\_]
- sounds produced by lowering the body of the tongue below the level that it occupies in the neutral position [\_\_\_\_\_]
- sounds produced without a rising of the tongue's body above the level it occupies in the neutral position [\_\_\_\_\_]

9. **Long vowels** are \_\_\_\_\_ ([+tense]/[-tense]), that is, they are produced \_\_\_\_\_ (with/without) considerable muscular effort.

10. Name the **feature** that characterises

- sounds produced with an obstruction located in front of the palato-alveolar region of the mouth [\_\_\_\_\_]
- sounds produced by lowering the mid-section of the tongue at one or both sides, thus allowing the air to flow out of the mouth [\_\_\_\_\_]
- sounds produced with the tip of the tongue raised above its neutral position [\_\_\_\_\_]
- sounds produced without vocal cords' vibration [\_\_\_\_\_]

- sounds marked acoustically by a great amount of noise  
[\_\_\_\_\_]
- sounds produced with a lowered velum [\_\_\_\_\_]

11. Voiceless consonants are \_\_\_\_\_ (fortis/lenis), that is, \_\_\_\_\_ ([+tense]/[-tense]).

12. Name the phonemes with the feature [+nasal]: \_\_\_\_\_

13. Name the phonemes with the feature [+lateral]: \_\_\_\_\_

14. The feature [+anterior] is a covering term for \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ places of articulation.

15. Find **minimal pairs** for the following contrasts:

/i:/ – /ɪ/ \_\_\_\_\_

/f/ – /v/ \_\_\_\_\_

/m/ – /ŋ/ \_\_\_\_\_

/s/ – /ʃ/ \_\_\_\_\_

/w/ – /j/ \_\_\_\_\_

/ð/ – /d/ \_\_\_\_\_

/ʒ:/ – /e/ \_\_\_\_\_

16. Specify the **phonetic environments** in which the sounds [n] and [ŋ] appear. Are these two sounds in complementary or in parallel distribution? Explain.

17. Which **distinctive feature(s)** distinguish(es) the following pairs of sounds:

- [ð] – [θ] \_\_\_\_\_  
[s] – [ʃ] \_\_\_\_\_  
[i] – [e] \_\_\_\_\_  
[b] – [m] \_\_\_\_\_

18. Consider the following sounds:

m, w, f, v, t, d, n, s, ʃ, dʒ, k, g

For each phoneme, give the appropriate features:

1. [+anterior, +strident] \_\_\_\_\_ 4. [+back] \_\_\_\_\_  
2. [-coronal, +round] \_\_\_\_\_ 5. [+voice, +nasal] \_\_\_\_\_  
3. [+coronal, +anterior] \_\_\_\_\_ 6. [+delrel] \_\_\_\_\_

19. Consider **Sabol's theory of distinctive features** (Kráľ & Sabol 1989) and answer the following questions:

- a) Why is the feature voiced–non-voiced phonologically irrelevant for sonorants?
- b) For which consonants is the feature strident–non-strident important?
- c) What is the purpose of the vocalic opposition glide–non-glide?

## 9 THE SYLLABLE

The **syllable** is the basic sound-rhythmical unit of a language. Although language users can usually intuitively count the number of syllables in a word or in a word form in their mother tongue, in linguistics, there is no general agreement on the syllable in terms of its structure and function.

Phonetically speaking, the syllable is the sound unit whose centre creates the most sonorous sound (Jespersen 1904). **Sonority** is the relative loudness of a sound made by the function of the vocal cords and the opening of the supraglottic cavities during its articulation. Following on from this, **vowels** are the segments with the highest degree of sonority, and they form the centre of the syllable. The syllable centre can also be formed by **liquids** /r, l/ and **nasals**, e.g., (/m, n/), which have a relatively high degree of sonority too due to their voicing. Other consonants occupy only a marginal position in the syllable structure. Segments that are classified as consonants in phonetics and can function as vowels, that is, as the syllable centre, are called **syllabic consonants**.

In phonology, the syllable is seen as the basic unit of **phonotactic analysis**. **Phonotactics** is a discipline dealing with the possible combinations of sounds/phonemes. For example, the well-known fact that the occurrence in languages of the velar nasal /[ŋ]/<sup>16</sup> is limited to the position before velar consonants /k, g/, as, for example, in the English word *king* /kɪŋ/, is the result of phonotactic analysis.

Nevertheless, in the case of medial consonant clusters, neither phonetics nor phonology gives precise information about the syllable boundary. In such a situation, the higher-level unit, the **morpheme**, helps us find the borderline between the syllables. The

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<sup>16</sup> The velar sound ŋ is either a phoneme or only a phone, depending on the phonological subsystem of a language.

discipline focusing on the interaction between phonology (and phonetics) and morphology is called **morphophonology**.

Consider, for instance, the English word *extra* /ekstrə/. Phonetics identifies the number of syllables in this word: there are two vowels and, consequently, there are two syllables. The word *extra* is disyllabic. But where is the boundary between these two syllables? Theoretically, there are five possibilities:

- 1) e-kstrə
- 2) ek-strə
- 3) eks-trə
- 4) ekst-rə
- 5) ekstr-ə

Version (1) e-kstrə can be excluded because it violates the maximum phonological structure of the English syllable (see 9.1), which says that, in English, there can be a maximum of three consonants at the beginning of the syllable, that is, at the beginning of the word<sup>17</sup>. Version (5) ekstr-ə can be rejected too. This is against the so-called **right-hand rule**, which suggests that if two syllables are to be divided, there must be at least one consonant between them that is a member of the right-hand syllable. Perceptually, the syllable is better perceived the better its beginning (that is, onset) is created. This means that the sounds with the lower (lowest) degree of sonority are more suitable for forming the syllable onset than more sonorous sounds. Taking into account the phonetic properties of the consonants in the cluster /kstr/ and the perceptual evaluation of the syllable, syllabification version (4) ekst-rə is not very apt: /t/ is the consonant with the relatively higher degree of sonority compared to the sounds /k, s, t/. Two syllabifications thus remain: (2) ek-strə and (3) eks-trə. Phonologically speaking, both can be considered good: the

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<sup>17</sup> The idea that the beginning of the word is at the same time the beginning of the first syllable of this word and that the end of the word is identical with the end of the last syllable is known as the **Kuryłowicz rule** (Gregová 2016).

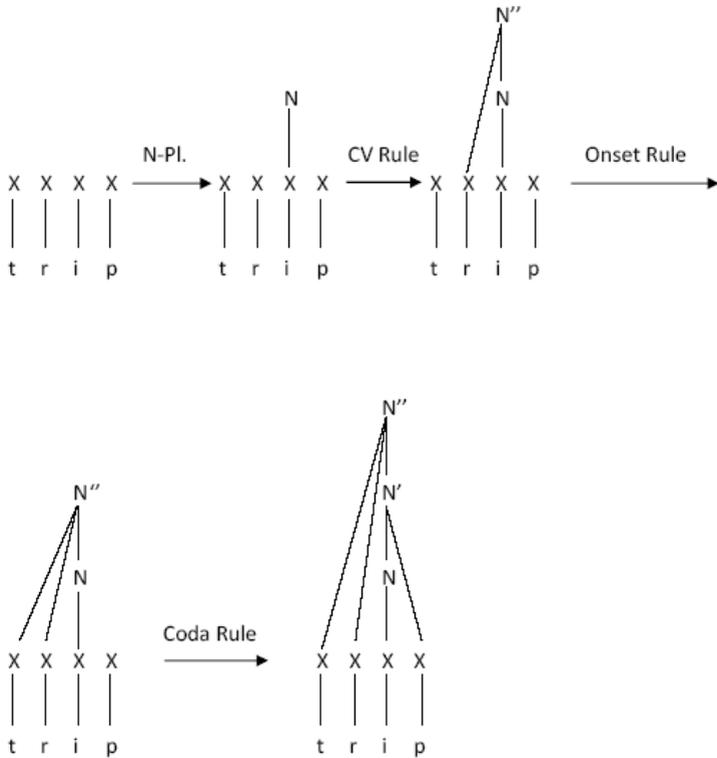
relationship between /k/ and /s/ is the same as the relationship between /s/ and /t/ – it is the relationship between a voiceless plosive and a voiceless fricative. Thus, which of these two syllabifications is the best? Morphophonology gives us the answer: if possible, the boundary of the syllable as a sound unit should be at the place of the boundary of the morpheme as a unit of meaning (Sabol 1994). In English, there is the prefix *ex-* /eks-/. There is no prefix in the word *extra*, but the initial part /eks-/ can be treated as a prefix-like element (see Duanmu 2009). The best syllabification of the word *extra* /ekstrə/ is thus (3) eks-trə.

## 9.1 THE SYLLABLE IN LEXICAL PHONOLOGY

In lexical phonology, words are decomposed into syllables on the basis of the set of rules known as **the Syllable Structure Algorithm (SSA)**. The SSA encompasses two language-universal rules, the **N Placement** and the **CV Rule**, and language-specific rules whose purpose is to delimit the syllable onsets and codas. These are the **Onset Rule**, the **Coda Rule** and the **Complex Coda Rule**. The **N Placement** specifies the centre of the syllable, its nucleus (N), which is the most sonorous segment. The **CV Rule** is identical to the right-hand rule (see above), that is, it syllabifies the sequence VCV as V-CV. The **Onset Rule** and the **Coda Rule** insert the so-called ‘rhyme node’ (N’) between the N and the N’<sup>18</sup>. The **Onset Rule** connects the consonant immediately preceding the already created CV combination to this structure. The **Coda Rule** connects the consonant immediately following the CV combination to the given CV structure. The **Complex Coda Rule** is applied in languages with more than one consonant in codas (Rubach 1993). Consider, for example, the syllabification of the word *trip*:

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<sup>18</sup> In lexical phonology, N’ stands for a syllable node that is sometimes abbreviated as the sigma sign  $\sigma$ .



**Figure 10.** The Syllable Structure Algorithm (Rubach 1993: 23)

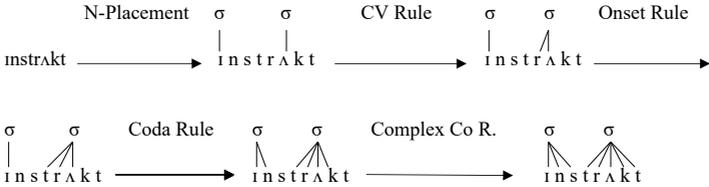
The sequence of the language-specific rules varies, depending on the phonological structure of the syllable in the given language, as illustrated in 9.1.1 and 9.1.2.

### 9.1.1 THE SYLLABLE IN ENGLISH

The maximum phonological structure of the English syllable is three consonants in onset, as, for example, in the word *strip* /stri:p/ and four

consonants in coda, as, for instance, at the end of the monosyllabic word *texts* /teksts/. No word (syllable) in English begins with more than three consonants, and no word (syllable) in English ends with more than four consonants. The centre of the syllable can be a vowel (monophthong, diphthong or triphthong) or a syllabic consonant. The **syllabic consonants** in English are [l] – *bottle* [bɒtl̩] and [ŋ] – *threaten* [θreɪt̩ŋ]. The segments [m] and [ŋ] can become the syllable’s centre as the result of elision in colloquial speech: *blossom* [blɒsəm], *broken key* [brəʊkɪ ki:]. In rhotic accents, [r] can be syllabic, too, as, for example, in *particular*, pronounced as /pɑːtɪkjələɹ/ in American English.

The **SSA for English** is as follows: the N Placement, the CV Rule, the Onset Rule, the Coda Rule, and the Complex Coda Rule. The application of the SSA to the word *instruct* /ɪnstrʌkt/ with the four-consonant cluster in the medial position leads to the syllabification /ɪns-trʌkt/, as illustrated in Figure 11.

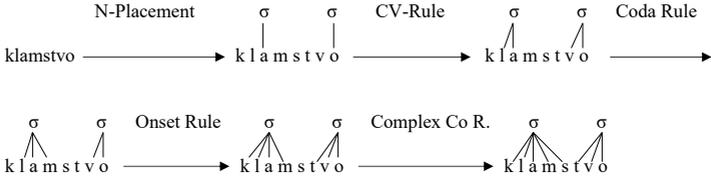


**Figure 11.** The syllabification of the word *instruct* /ɪnstrʌkt/

### 9.1.2 THE SYLLABLE IN SLOVAK

In Slovak, the maximum number of consonants in the initial position of a syllable (word) is four, as, for example, in *pstruh* /pstrux/ ‘trout’, and the maximum number of consonant segments in the final position of the syllable (word) is three, as, for example, in *vojsk* /vojsk/ ‘of the armed forces’. The centre of the syllable can be a short monophthong,

a long monophthong, a diphthong, or a syllabic consonant [r], [ʃ], [l] or [ʃ]. The basic **SSA for Slovak** is the N Placement, the CV Rule, the Coda Rule, the Onset Rule, and the Complex Coda Rule, as illustrated by the syllabification of the word *kľamstvo* /kľamstvo/ ‘falsehood’ in Figure 12.



**Figure 12.** The syllabification of the word *kľamstvo* /kľamstvo/ ‘falsehood’

## SUGGESTIONS FOR FURTHER READING

More about various phonetic/phonemic syllable theories, as well as about the structure of the English syllable, can be found in Giegerich (1992: 130–178), who emphasises the syllable as the unit of phonotactic analysis. Roach (2000: 70–92) provides details about the phonological structure of the English syllable. Sabol (in Sabol & Zimmermann 2014: 57–67) concentrates on the rules for the delimitation of the syllable boundaries and offers the complex definition of the syllable (Sabol 1994). Gregová (2016) is useful for the mutual comparison of the structure of English and Slovak syllables on the basis of two different approaches to language – generativism and structuralism.

## EXERCISES

1. What is the **syllable**?
2. Comment on the following **functions of the syllable**:
  - a) The syllable as the basic sound rhythmical unit
  - b) The syllable as the basic unit of phonotactic analysis
  - c) The syllable as the bearer of prosodic features
3. Rank the following sounds according to their degree of **sonority**:

u:, k, p, w, j, s, ʌ, v, θ, l, z, dʒ, r

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4. Explain the role of **sonority** in the **syllable structure**.
5. Analyse the **syllable structure** of the following words, and identify **strong and weak** syllables and **open and closed** syllables:

twelfths  
glimpsed  
streamlet  
alone

6. Explain the difference between the phonetic and the phonemic understanding of the so-called **syllabic consonants**.

7. Draw the **'tree structure'** of the syllable(s) in the following words:

diving  
hierarchy

bottle

**8.** Compare **syllabic consonants** in English and in Slovak.

**9.** Following the **Syllable Structure Algorithm** as specified for English and for Slovak, syllabify the following words:

English:	hundred	upstairs	extraordinary
Slovak:	mastný	horstvo	hospodársky

## 10 PROSODIC FEATURES

**Prosodic features** are sound phenomena resulting from the miscellaneous modulations of the articulatory air stream in speech. Four types of modulation are possible:

- (1) **temporal modulation** (the length and the ending of the articulatory air stream) that gives rise to the **length, pause, speed of the utterance** (tempo, pace) and its **rhythm**;
- (2) **force modulation** (the ‘power’ of the human voice), resulting in **voice intensity, word stress, sentence stress, and emphasis**; and
- (3) **tone modulation** (variations in pitch), echoing itself in **voice register** and **melody (tone of the utterance)**;
- (4) **qualitative modulation** perceived as **voice colour (timbre)**.

The smallest unit necessary for the production and perception of prosodic features is the **syllable**. The syllable is the sound unit consisting of segments of vowels and consonants (see Chapter 9). That is why prosodic features are sometimes called **suprasegments** – they are realised on segments (the Latin prefix *supra-* means ‘above, over’). Another well-known term in connection with prosodic features is **intonation**. However, when speaking of **intonation**, one has to keep in mind that this expression has more than one meaning in linguistics:

- (1) as a catch-all term for all prosodic features,
- (2) as a root term for prosodic features with a grammatical function (see below), that is, pause, word stress and tone, or
- (3) as a synonym for tone (melody), that is, the patterns of pitch levels in utterances.

**Prosodic (suprasegmental) features** bring a kind of ‘additional information’ to speech, meaning that it is not *what* we say (the

meaning of the individual words creating utterances) but *how* we say something that is important. Some suprasegments are **language-universal**, and some are more **language-specific**, depending on the function they fulfil in speech. Language-specific prosodic features are those with the **stylistic function** and the **expressive function**. The **stylistic function** means that the realisation of a suprasegment is linked with the semantic content of the utterance, as with **pause** and **tempo**, and/or that a suprasegment helps build the overall dynamism of the utterances through **voice register** and **voice intensity**. The **expressive function** is connected especially with **emphasis**, that is, with the emotional realisation of stress. Other functions of suprasegments are as follows:

- **phonological-distinctive** – the ability of a prosodic feature to change the meaning of words or word forms (for example, the **length** or **vowel duration** in Standard Slovak and in the standard accent of British English);
- **phonological-delimitative** – the ability of a suprasegment to delimit meaningful parts of utterances (**word stress** in Standard Slovak or **pause** in any language);
- **grammatical function** – the function of prosodic features to indicate a different type of utterance, for example, affirmative statement vs. question, exclamation, etc. This is the function of **word stress**, **pause** and, predominantly, the **tone (melody)** of the sentence.

## 10.1 ON THE PROSODIC STRUCTURE OF ENGLISH WORDS AND SENTENCES

The prosodic structure of English words is shaped predominantly by **word stress** and, in the standard accent of British English, also by the **duration of vowels**, that is, their **length** or **vocalic quantity**.

**Word stress** in English is free in the sense that it can be on any syllable of the word depending on its morphological category (whether the word is simple or complex) or grammatical category (whether the word is a noun, verb, adjective, etc.). The number of syllables also plays a role in the position of the word stress, as well as the phonological structure of the syllables in a word (strong syllables can be stressed or unstressed, weak syllables are always unstressed). The phonological value of the word stress is limited due to its free character: word stress in English indicates the different morphological categories of semantically related words. Consider, for example, *record* ['rekɔ:d]<sub>N</sub>, [rɪ'kɔ:d]<sub>V</sub> or *abstract* ['æbstrækt]<sub>N</sub>, <sub>Adj</sub>, [æb'strækt]<sub>V</sub>.

**Vocalic quantity** (length) goes hand in hand with **vocalic quality** (given by the position of the tongue during articulation; see part 5.1.1). The differences between vowels from the same vocalic type in terms of their length are perceived by speakers of the standard accent only: for example, *march* [mɑ:tʃ] vs. *much* [mʌtʃ]. In other accents, speakers perceive the differences between vowels belonging to the identical vocalic type in terms of their quality: for example, [ɑ:] is open and back, while [ʌ] is central, between half-open and open (see Figure 6).

The prosodic character of sentences in English depends on their **tone** and **rhythm**, which are strongly influenced by the so-called **New English Gradation** (sentence stress). This term was coined by Daniel Jones (1976). **New English Gradation** means the existence of several pronunciation forms of some frequently used words in English. In particular, grammatical words (function words) have one **strong form** (SF), which is stressed and without vowel reduction, and at least one **weak form** (WF), which is unstressed and features vowels that are reduced in terms of their quality and quantity. For example,

*have* – SF ['hæv], WF [həv] or [əv],

*and* – SF ['ænd], WF [ənd] or [ən].

The ability of English vowels to reduce their quality and quantity has its reflection in the **rhythm**. English features the **stressed-time rhythm theory**. This means that the time intervals between two stressed syllables are approximately the same, regardless of how many unstressed syllables there are between them, as, for instance, in the following sentence: *He must wait for the bus* [hi mæs 'weɪt fə ðə 'bʌs].

**The tone of the sentence** can be either **simple** (falling, rising, level) or **complex** (rise-fall or fall-rise). A **falling tone** is typical of **completed statements** (*The sun shines `here.*), **wh-questions** (*What is your `name?*) and **exclamations** (*Dan`ger!*). A **rising tone** is used in **yes/no questions** (*Do you like pízza?*) and in interrupted or incomplete statements. A **level tone** indicates that something is uninteresting or boring: *Do you like it? `Yes.* A **fall-rise** tone creates the impression of a response with reservation: *Do you like it? ^Yes.* A **rise-fall** tone expresses surprise: *I saw her yesterday. ^Yes.*

## 10.2 ON THE PROSODIC STRUCTURE OF SLOVAK WORDS AND SENTENCES

The prosodic character of Slovak words is given by their **vocalic quantity** (length of vowels) and **word stress**. In Standard Slovak, the **length of vowels** has the ability to change the meaning of a word or a word form. This means that it has a very important **phonological-distinctive function**. Consider, for example, the following pairs of words: *sud* 'barrel' – *súd* 'court', *latka* 'pale' – *látka* 'fabric', *baza* 'bountree' – *báza* 'base', etc.

The **word stress** is fixed on the first syllable of a word, and thus it has a **delimitative function**. In Standard Slovak, the word stress delimits the word "as the basic semantic-rhythmical unit of a language" (Ondruš & Sabol 1987: 141).

The prosodic nature of a Slovak sentence is formed by its **tone (melody)** and the word order as a direct reflection of the **sentence stress**. In Slovak, as a synthetic language, the word order is

free. Taking into account the semantic criterion of the organisation of words in a sentence (words are arranged according to their importance given by the situation or context), the **word order** can be **objective** (the word bringing the new information is at the end of the statement) or **subjective** (the nucleus of the statement, the new information, is at the beginning of the sentence). Compare, for instance, the following sentences: *Môj brat je učiteľ* ‘My brother is a teacher’ vs. *Je učiteľ, môj brat* ‘A teacher, my brother is’.

As for the **tone (melody)** of Slovak sentences, there are three types: (1) **conclusive cadence** (falling tone), which is typical of declarative statements, for example, *Môj brat prišiel včera*. ‘My brother came yesterday’; (2) **anticadence** (rising tone), which characterise yes/no questions, for instance, *Môj brat prišiel včera?* ‘Did my brother come yesterday?’; and (3) **semi-cadence** (slightly level tone of the pre-pause syllables), which occur in unfinished statements, as, for example, in *Môj brat prišiel včera a...* ‘My brother came yesterday and...’.

## SUGGESTIONS FOR FURTHER READING

For further information about word stress, sentence stress, intonation in a broader sense, and intonation as tone, see Roach (2000: 93–120, 150–179). Kavka (2009: 127–132) offers valuable exercises for the practising of strong and weak forms. For English word and sentence stress, I also recommend Ladefoged (2000: 91–103). For more about suprasegments in Slovak, see Ondruš and Sabol (1987: 130–152) or Král’ and Sabol (1989: 357–369) with related data about the phonological interpretation of suprasegments.

## EXERCISES

1. Explain the difference (if any) between **segments** and **suprasegments**.

2. What does the **stylistic function** of prosodic features mean?

3. Explain the **phonological value** of **word stress** in English and in Slovak.

4. Compare **emphasis** in English and in Slovak.

5. What is **New English Gradation**?

6. Transcribe the following words and identify the position of the **stress**:

import (verb) \_\_\_\_\_

protest (verb) \_\_\_\_\_

protest (Noun) \_\_\_\_\_

permit (verb) \_\_\_\_\_

record (Noun) \_\_\_\_\_

conduct (Noun) \_\_\_\_\_

7. Transcribe the following words and identify the position of the **stress**:

half-moon \_\_\_\_\_  
greenhouse \_\_\_\_\_  
open-ended \_\_\_\_\_  
fruitcake \_\_\_\_\_  
information \_\_\_\_\_  
defective \_\_\_\_\_  
old-fashioned \_\_\_\_\_

**8.** Identify the position of the **stress** in the following words and comment on this.

mountain – mountaineer  
refuse – refusal  
humour – humoresque  
advantage – advantageous  
proverb – proverbial  
tranquil – tranquillity  
icon – iconic – iconicity

**9.** Transcribe the following sentences (**phonetic** and **phonemic transcription**):

1. We can wait for the train.

\_\_\_\_\_

2. How do the lights work?

\_\_\_\_\_

3. There are some new books I must read.

---

4. She took her aunt for a drive.

---

5. The basket was full of things to eat.

---

6. He wants to come and see us at home.

---

7. Have you taken them from that box?

---

8. At least we can try and help.

---

9. They wanted to buy some cigarettes.

---

10. Why should a man earn more than a woman?

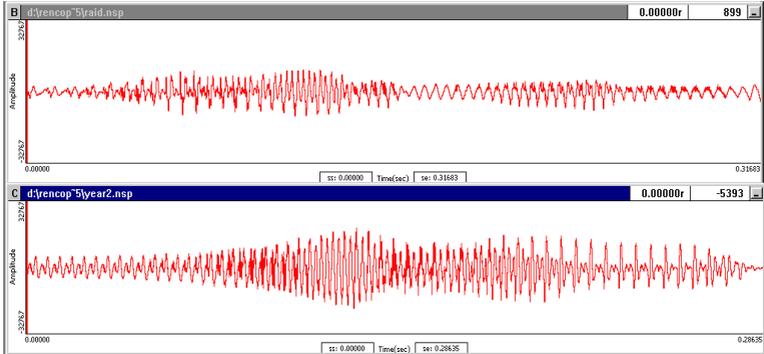
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*(based on Roach 2000)*

## 11 EXPERIMENTAL PHONETICS

**Experimental phonetics** is a term used in connection with “any investigation of speech by means of instruments” (Hayward 2013: 32). The main purpose of those ‘instruments’ is to overcome the fundamental feature of human speech: its transiency. Speech sounds are equal to any other sounds in the world around us; they disappear in time and space. Methods of experimental phonetics capture the sound and visualise it, thus making the investigation of its properties easier. **Experimental phonetics** covers all three branches of phonetics: **articulatory phonetics**, **acoustic phonetics** and **perceptual phonetics**.

There are two basic types of sound visualisation: the waveform (an **oscillogram**) and the **spectrogram**. The **oscillogram** shows two dimensions of a sound (see Chapter 4): **time** and **amplitude**. The **time** dimension is represented by the x-axis, and the y-axis represents the **amplitude**, as can be seen in Figure 13. The oscillogram can visualise a whole sentence (utterance), a phrase, or shorter parts of speech, such as words, syllables, or individual segments. The **oscillogram** is the most reliable device for the segmentation of speech into sounds. The oscillogram also enables us to measure suprasegments given by the **temporal modulation** of the articulatory airstream (see Chapter 10): **quantity**, **pause** and **tempo** (Sabol & Zimmerman 2015: 25–26).

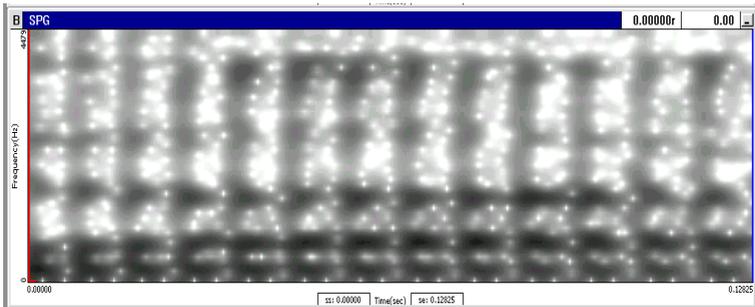


**Figure 13.** Oscillograms of the English words *readers* [ri:dəz] and *year* [jiə]

A **spectrogram** is a three-dimensional graph representing **time** (on the horizontal axis), **frequency** (on the vertical axis) and **intensity** (reflected in the darkness or brightness of the marking) (see Figure 14). Spectrograms are produced by spectrographs. Usually, spectrographs generate so-called **power spectra**<sup>19</sup> or **FFT spectra**<sup>20</sup> that have only two dimensions: frequency (horizontal axis) and amplitude (vertical axis). A spectrogram is not only suitable for the analysis of **formants** and **fundamental frequency**  $F_0$  but also for the parsing of speech into segments (ibid.: 30–31).

<sup>19</sup> A sound spectrum is a visual representation of a sound. A power spectrum displays the distribution of power into frequency components composing the signal.

<sup>20</sup> FFT stands for fast Fourier transform. This is an algorithm converting a signal from its original domain (time, space) to the frequency domain (for details, see Johnson 2003).



**Figure 14.** Spectrogram of the Slovak vowel [a:]

All fundamental techniques in **experimental phonetics** – recording of speech, annotation, fundamental frequency analysis, formant frequency analysis, spectrographic analysis, etc. – can be easily done with the help of computers. In other words, contemporary experimental phonetics is predominantly a computer-based science. There are various pieces of software for speech analysis, synthesis, or any other type of speech processing. The most popular commercial speech tools are:

- Kay Elemetrics Computerized Speech Lab (CSL)  
(<http://www.kayelemetrics.com/>)
- Computerized Speech Research Environment (CSRE)  
(<http://www.avaaz.com/researchresources/csre.htm>)
- SpeechLab (<http://www.media-enterprise.de/engl/speechla/speechla.htm>)
- Laryngograph Speech Studio  
([http://www.laryngograph.com/pr\\_studio.htm](http://www.laryngograph.com/pr_studio.htm))

As for free speech tools packages, these include, for example,

- Praat ([www.praat.org](http://www.praat.org))

- Speech Analyzer (<https://software.sil.org/speech-analyzer/>)
- WASP (<https://www.phon.ucl.ac.uk/resource/sfs/wasp/>)
- Speech Filing System  
(<http://www.phon.ucl.ac.uk/resource/sfs>)

## 11.1. HOW TO ANALYSE SPEECH

In Chapter 5, the speech sounds were divided into two basic categories: **vowels** and **consonants**, which further subdivide into obstruents and sonorants. **Vowels** and **sonorants** are characterised by the tone's **acoustic spectrum**, while **obstruents** are known as **noises**. Acoustically speaking, vowels and sonorants have **periodic waveforms**, and **aperiodic waveforms** are typical of obstruents. Periodic sounds (vowels, sonorants) are sounds with clearly delimited **formants**<sup>21</sup>. The configuration of the individual formants determines the differences in the acoustic structure of vowels. Formants are also useful for the delimitation of the distinctive features (see Chapter 8). Aperiodic sounds (obstruents) are characterised by noise. There is no formant structure in their acoustic spectra that is unequal without significant prominence parts. Obstruents are either voiced or voiceless. This important difference between sounds is reflected in the presence of the dark strip at the bottom of the spectrogram in the case of voiced sounds (Sabot & Zimmermann 2015: 43–58).

## SUGGESTIONS FOR FURTHER READING

Hayward (2000, 2003) provides a reader-friendly guide to experimental phonetics. Ladefoged (2000: 170–197) offers good further reading on the acoustic analysis of English vowels and

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<sup>21</sup> Formants (labelled as F<sub>1</sub>, F<sub>2</sub>, F<sub>3</sub>, etc.) are the resonant frequencies of the vocal tract. They are determined by the length of the vocal tract. Short tubes have higher frequencies than long tubes (Johnson 2003: 96–97). F<sub>1</sub> (resonance of the front cavity) is given by the height of the tongue's body. F<sub>2</sub> (resonance of the back cavity) is the result of the frontness/backness of the tongue's body.

consonants. Sabol and Zimmermann (2015: 23–87) delimit experimental phonetics and provide valuable data about the acoustic structure of segments and suprasegments in Standard Slovak.

## EXERCISES

1. Explain the difference between **periodic** and **aperiodic sounds**.
2. Which speech **sounds** are characterised as **periodic** and which are **aperiodic**?
3. What is an **oscillogram**, and what is a **spectrogram**?
4. Define the scope of **experimental phonetics** research.
5. **Record** one English word and one Slovak word. Go to the website of any of the free speech tools packages listed above, follow the instructions for **speech processing**, and create an **oscillogram** and a **spectrogram** of your recorded words. Comment on these.

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