

6.5. ACOUSTIC NATURE OF WORD STRESS IN UKRAINIAN

The list of experimental material for the investigation of nature of word stress in Ukrainian included minimal word-pairs with initial or final stressed syllables pronounced isolatedly as vocabulary units and in one-word and extended phrases by 20 speakers – 10 male voices and 10 female voices.

Examples:

бра́ти	брати́;
се́стри	сестри́;
ві́кна	вікна́;
му́зика	музи́ка.

Each speaker read the experimental utterances preserving the following conditions:

1. Isolated words were read twice: (a) as vocabulary units and (b) as one-word statements.
2. 10 words were read as one-word interrogative phrases – general questions.
3. The same words were included into simple extended phrases, e.g. declarative and interrogative phrases – general questions.

Examples:

Не треба цього бра́ти.	Чи треба це бра́ти?
Це великі ві́кна.	Це великі ві́кна?
Це мої се́стри.	Це мої се́стри?
Це гарна му́зика.	Це гарна му́зика?
Це твої брата́.	Це твої брата́?
Не бачу цього ві́кна.	Не бачиш цього ві́кна?
Немає твоєї сестри́.	Немає твоєї сестри́?
Він гарний музи́ка.	Він гарний музи́ка?

The investigation of the data of approximately 1500 Ukrainian one-word and extended phrases showed that absolute and relative characteristics of total acoustic energy of the stressed syllables were nearly twice bigger than those of the unstressed syllables. The coefficients showing the relation of the total energy of the stressed syllables to the total energy of the unstressed syllables was 1.96 rel. units in one word phrases.

The relative average total energy of the stressed syllables of extended sentences was big enough but not so big as in one-word phrases. The coefficient showing the relation between the total energy of the stressed and the unstressed syllables in extended sentences was 1.79 rel. units (table 6.9).

It may be assumed that in Ukrainian, as well as in English, the influence of sentence stress and other prosodic characteristics is stronger in more complicated extended phrases than in one-word phrases.

Table 6.9

Average absolute and relative characteristics of total acoustic energy of Ukrainian stressed and unstressed syllables in one-word and extended phrases

Speakers	One-word phrases			Extended phrases		
	Absolute meaning of total energy (conv. units)		Relative characteristics of total energy (rel. units)	Absolute characteristics of total energy (conv. units)		Relative characteristics of total energy (rel. units)
	Stressed syllables	Unstressed syllables		Stressed syllables	Unstressed syllables	
Male voices	431	237	1.97	256	154	1.66
Female voices	455	235	1.94	310	192	1.61
Total	443	236	1.96	285	179	1.64

The total acoustic energy of stressed and unstressed syllables in Ukrainian has been analysed under different conditions of pronunciation.

The results of the analysis showed that energetic characteristics of the stressed syllables did not depend upon the position of the syllable in the word. The coefficients of the relation of total energy between the stressed and the corresponding unstressed syllables in initial and final syllables were more than two rel. units.

No significant difference was observed in two- and three-syllable words. Under all the conditions of pronunciation the average total energy was big enough to assert that total energy is the main physical characteristic feature of word stress in Ukrainian as well as in English (table 6.10).

Table 6.10

Average absolute and relative characteristics of total acoustic energy of Ukrainian stressed and unstressed syllables under different conditions of pronunciation

Conditions of pronunciation of stressed and unstressed syllables		Absolute characteristics of acoustic energy (conv. units)		Relative characteristics of acoustic energy (rel. units)
		Stressed syllables	Unstressed syllables	
Position of the syllables in the word	initial	194	165	1.18
	final	202	160	1.26
Syllabic structure of the word	two-syllable words	190	160	1.19
	three-syllable words	196	178	1.10

The results of the experimental analysis showed that the intensity of stressed syllables prevailed over the intensity of the corresponding unstressed syllables but considerably less than that of the total acoustic energy. The coefficients showing the relating of the intensity between stressed and unstressed syllables were smaller than the corresponding coefficients in English. The coefficients of correlation between Ukrainian stressed and unstressed syllables were equally low both in one-word and extended phrases.

The results illustrate that the share of intensity as a component of the main characteristic feature of word stress – total acoustic energy, is not so important in Ukrainian as in English (table 6.11).

The intensity of stressed and unstressed syllables in Ukrainian was analysed under different conditions of pronunciation.

Table 6.11

Average absolute and relative intensity of Ukrainian stressed and unstressed syllables in one-word and extended phrases

Speakers	One-word phrases			Extended phrases		
	Absolute meanings of intensity (conv. units)		Relative characteristics of intensity (rel. units)	Absolute meanings of intensity (conv. units)		Relative characteristics of intensity (rel. units)
	Stressed syllables	Unstressed syllables		Stressed syllables	Unstressed syllables	
Male voices	15.4	12.5	1.23	13.6	10.6	1.28

Female voices	13.7	11.0	1.24	12.5	10.2	1.23
Total	14.6	11.8	1.24	12.4	9.6	1.26

The indices of relative characteristics of intensity of stressed syllables under different conditions of pronunciations were considerably smaller than those of the total energy and didn't differ considerably between stressed and unstressed syllables. The relative characteristics of intensity were stable in different syllabic structures of the word. Under other conditions of pronunciation the indices of relative characteristics of intensity were not so stable either, and the relative intensity of the initial syllable was lower than that of the final syllables (table 6.12).

Table 6.12

Average absolute and relative characteristics of intensity of Ukrainian stressed and unstressed syllables under different conditions of pronunciation

Conditions of pronunciation		One-word statement		
		Absolute characteristics of intensity (conv. units)		Relative characteristics of intensity (rel. units)
		Stressed syllables	Unstressed syllables	
Position of the syllables in the word	initial	15.1	13.6	1.11
	final	14.0	11.7	1.20
Syllabic structure of the word	two-syllable words	15.2	12.0	1.26
	three-syllable words	1.18	9.6	1.23

A bigger average intensity of the stressed syllables than of the unstressed ones makes it possible to assure that intensity is one of the characteristic features of word stress in Ukrainian and a more important component of total energy than duration.

However, considerably smaller average indices of intensity than those of total energy and the dependence of intensity of conditions of pronunciation support the idea that intensity is not an independent characteristic feature of word stress but is a component of total acoustic energy.

The results of the experimental analysis showed that the duration of the stressed syllables in Ukrainian was considerably longer than in the corresponding

unstressed ones in one-word and in extended phrases, which is explained by the influence of prosodic suprasegmental characteristics on the characteristics of the word stress.

The difference in duration between the stressed and unstressed syllables was much bigger than, the difference between the intensity of stressed and unstressed syllables in Ukrainian.

The average coefficients showing the relation of the duration of stressed syllables to the duration of the unstressed syllables in one word phrases in Ukrainian were bigger than in extended phrases (table 6.13).

Table 6.13

Average absolute and relative duration stressed and unstressed syllables in one-word and extended Ukrainian phrases

Speakers	One-word phrases			Extended phrases		
	Absolute duration (msec)		Relative durations (rel. units)	Absolute duration (msec)		Relative durations (rel. units)
	Stressed syllables	Unstressed syllables		Stressed syllables	Unstressed syllables	
Male voices	229	142	1.46	157	114	1.38
Female voices	202	126	1.60	160	105	1.47
Total	205	134	1.56	159	112	1.43

The duration of stressed and unstressed syllables in Ukrainian was analysed under different conditions of pronunciation.

The results of the analysis showed that the coefficients characterizing the relation of the duration of stressed syllables to that of the corresponding unstressed syllables were not so big as those of the total acoustic energy, but considerably bigger than those of the relative intensity.

Some variations in the indices of the coefficients of the relative duration of stressed syllables under different conditions of pronunciation were observed. The average relative duration of initial stressed syllables was shorter than that of final

stressed syllables. The average relative duration of stressed syllables in statements and questions was rather stable (table 6.14).

Table 6.14

Average absolute and relative characteristics of duration of Ukrainian stressed and unstressed syllables under different conditions of pronunciation

Conditions of pronunciation		One-word statement		
		Absolute characteristics of duration (msec)		Relative characteristics of duration (rel. units)
		Stressed syllables	Unstressed syllables	
Position of the syllables in the word	initial	147	110	1.34
	final	169	118	1.43
Syllabic structure of the word	two-syllable words	212	138	1.59
	three-syllable words	182	121	1.50

The importance of the two components of the acoustic energy – intensity and duration is not equal in Ukrainian.

Both intensity and duration have the smaller average meanings than those of the total acoustic energy. Nevertheless, the share of duration in the formation of the total acoustic energy is bigger than that of intensity. The average relative indices of duration are bigger than those of intensity and thus duration may be considered a more important component of acoustic energy than intensity in Ukrainian (table 6.15).

The difference between pitch characteristics of the stressed and unstressed syllables is very small in Ukrainian, considerably smaller than that of intensity. The coefficients showing the relation of pitch of stressed syllables to the corresponding unstressed ones do not differ essentially in various conditions of pronunciation.

The only exception was the pitch of stressed syllables in different communicative types of phrases. The average relative pitch of stressed syllables was considerably smaller in statements than in general questions. Such a difference may be explained by the cooperation of segmental characteristic of word stress with the suprasegmental characteristics of sentence stress and intonation. It supports the viewpoint that pitch modulations are relevant on the suprasegmental level and not relevant on the level of word stress (tables 6.15, 6.16).

Table 6.15

Average absolute and relative characteristics of pitch of stressed and unstressed syllables in Ukrainian one-word and extended phrases

Speakers	One-word phrases			Extended phrases		
	Absolute characteristic of pitch (cps.)		Relative pitch (rel. units)	Absolute characteristic of pitch (cps.)		Relative pitch (rel. units)
	Stressed syllables	Unstressed syllables		Stressed syllables	Unstressed syllables	
Male voices	190	152	1.25	169	134	1.26
Female voices	303	269	1.13	271	262	1.06
Total	247	211	1.19	225	193	1.16

Table 6.16

Average absolute and relative characteristics of pitch of stressed and unstressed syllables in Ukrainian one word phrases under different conditions of pronunciation

Conditions of pronunciation		Absolute characteristics of pitch (cps.)		Relative characteristics of pitch (rel. units)
		Stressed syllables	Unstressed syllables	
Position of the syllables in the word	initial	254	218	1.17
	final	248	218	1.14

Syllabic structure of the word	two-syllable words	241	207	1.16
	three-syllable words	226	202	1.12
Intonation structure of the phrase	statements	186	158	1.18
	questions (general)	271	202	1.36

Thus, English and Ukrainian word stress is energetic in character. The main physical characteristic feature of word stress distinguishing stressed syllables from the corresponding unstressed syllables is total acoustic energy, which is the result of a joint action of two components – intensity and duration both in English and in Ukrainian.

The share of the two components of the total acoustic energy is not equal in English and Ukrainian.

In the English language intensity is the leading component of the total acoustic energy. It is a more important component of the total energy than duration. The difference in intensity between stressed and unstressed syllables is bigger than that of duration in English.

A less important role of duration on the level of word stress in English may be explained by the phonematic structure of this language in which length of vowels is capable of distinguishing words and thus, is “engaged” on the level of speech sounds in English and is less important on the level of word stress.

In Ukrainian where the length of vowels is not phonematically important duration is the leading component of the main characteristic feature of word stress – total acoustic energy. Intensity is a less important component of total energy than duration in Ukrainian but as it has been mentioned above in English the share of intensity as a component of the main acoustic characteristic feature of word stress is bigger than that of duration.

Frequency characteristics of word stress are not relevant on the level of word stress both in English and in Ukrainian.

Table 6.17

A summarizing table of absolute acoustic characteristics of English and Ukrainian stressed and unstressed syllables

Acoustic characteristics	English		Ukrainian	
	Stressed	Unstressed	Stressed	Unstressed
Total energy (conv. units)	249	121	443	236
Intensity (conv. units)	12,5	7,9	14,6	11,8
Duration (msec)	156	115	205	134
Pitch (cps)	M. 150 W. 264 $\bar{X} = 207$	M. 123 W. 299 $\bar{X} = 211$	M. 190 W. 303 $\bar{X} = 247$	M. 152 W. 269 $\bar{X} = 210$

Table 6.18

A summarizing table of correlation coefficients between acoustic characteristics of stressed and unstressed syllables in English and Ukrainian

Acoustic characteristics	Coefficients of English and Ukrainian	
	English	Ukrainian
Total energy	2.06	1.96
Intensity	1.58	1.24
Duration	1.39	1.56
Pitch	M. 1.24 W. 1.18 $\bar{X} = 1.21$	M. 1.25 W. 1.13 $\bar{X} = 1.19$