

6.4. ACOUSTIC NATURE OF WORD STRESS IN ENGLISH

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

Examples:

'conflict con'flict;
'protest pro'test;
'contract con'tract;
'integral in'tegral, etc.

Each speaker read the experimental utterances observing the following conditions:

1. isolated words were read twice: a) as vocabulary units and b) as one-word statements;
2. 10 one-word sentences were read as interrogative phrases – general questions;
3. the same words were included into simple declarative phrases and the corresponding interrogative phrases.

Examples:

That's a 'conflict.	Did they con'flict?
That's a 'protest.	Did they pro'test?
That's a 'contrast.	Did they con'trast?
That's an 'integral.	Is that in'tegral?
They didn't con'flict.	Didn't they con'flict?
They didn't pro'test.	Didn't they pro'test?
They didn't con'trast.	Didn't they con'trast?
That isn't in'tegral.	Isn't that in'tegral?

The investigation of the data of approximately 1500 English one-word and extended phrases showed that in all the cases the total energy of the stressed syllables was much bigger than the total energy of the corresponding unstressed syllables. Some variations of characteristics of absolute acoustic energy observed from speaker to speaker and the difference between male and female voices could be explained by the individual physiological and gender peculiarities of the speakers. It's important to

note that relative acoustic characteristics of word stress remained stable and did not differ essentially within each group of experimental material.

Examination of the data, presented in table 6.1, shows that the total energy of the stressed syllables in one-word phrases in English was more than twice as big as that of the unstressed syllables.

Despite the differences between the results of absolute meanings of acoustic characteristics of stressed syllables in speech of the same speaker and the characteristics of different speakers, in phrases read by male or female voices, relative acoustic characteristics remained stable and illustrated the relevant difference between stressed and unstressed syllables. Thus, the examination of the data presented in table 6.1 showed that the average total energy of stressed syllables prevailed over the energy of the corresponding unstressed syllables.

The average coefficients denoting the relation of total energy of the stressed syllables to the total energy of the corresponding unstressed syllables in one-word phrases were considerably big. The average total energy of stressed syllables in extended phrases was big enough but not as big as in one-word sentences.

Coefficients, denoting the relation of the acoustic characteristics of the stressed syllables to that of the unstressed ones, were measured in relative units. It's possible to assert that stressed syllables were characterised by a bigger total energy both in one-word and in extended phrases in English (table 6.1).

Table 6.1

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

Speakers	One-word phrases			Extended phrases		
	Absolute meanings of acoustic energy (conv. units)		Relative meanings of energy (rel. units)	Absolute meanings of acoustic energy (conv. units)		Relative meanings of acoustic energy (rel. units)
	Stressed syllables	Unstressed syllables		Stressed syllables	Unstressed syllables	
Male voice	297	147	2.02	236	145	1.63
Female voice	200	95	2.11	209	122	1.71
Total	249	121	2.06	223	134	1.67

It seems reasonable to assume that the role of total acoustic energy as a characteristic feature of word stress is more vivid in isolated words pronounced as vocabulary units which are more simple than that of extended phrases, the structure of which is more complicated.

The total acoustic energy of stressed and unstressed syllables in English was analysed under different conditions of pronunciation.

The results of the analysis showed that the energetic characteristics of the stressed syllables did not depend upon the position of the syllable in the word. The coefficients showing the relation of the total energy of the stressed syllables to the total energy of the corresponding unstressed syllables in initial and in final syllables were more than 2 rel. units.

No significant difference between two relative characteristics of the total acoustic energy was observed between two- and three-syllable words, though the amount of absolute energy was bigger in two-syllable words. The coefficients showing the difference between the total energy of stressed and unstressed syllables varied from 1.93 to 2.25 rel. units (table 6.2).

Table 6.2

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

Conditions of pronunciation of stressed and unstressed syllables		One-word phrases		
		Absolute characteristics of acoustic energy (conv. units)		Relative characteristics of acoustic energy (rel. units)
		Stressed syllables	Unstressed syllables	
Position of the syllables in the words	initial	251	123	2.04
	final	227	101	2.25
Syllabic structure of the word	two-syllable words	278	144	1.93
	four-syllable words	227	101	2.25

The results of the experimental analysis showed that the relative acoustic characteristics of the total acoustic energy in English remained stable under different conditions of pronunciation corroborating the theory of the leading role of total acoustic energy in creating the effect of word stress.

As it has been asserted in Chapter 5 total acoustic energy – the main physical characteristic feature of word stress – is a complex acoustic parameter, created by two components – intensity and duration. The results of the experimental analysis showed that the intensity of the stressed syllables prevails over that of the corresponding unstressed syllables in English, but not so much as the total acoustic energy. The coefficients showing the relation of the intensity of the stressed syllables to the intensity of the unstressed syllables are considerably smaller than those of total acoustic energy. The coefficients showing the relation of the intensity of the stressed syllables to the intensity of the unstressed syllables are considerably smaller than those of the total acoustic energy. A sharp decrease of intensity in extended phrases reveal the subordinate role of intensity as a component of the total acoustic energy in English (table 6.3).

Table 6.3

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

Speakers	One-word phrases			Extended phrases		
	Absolute characteristics of intensity (conv. units)		Relative characteristics of intensity (rel. units)	Absolute meanings of intensity (conv. units)		Relative meanings of intensity (rel. units)
	Stressed syllables	Unstressed syllables		Stressed syllables	Unstressed syllables	
Male voices	13.8	8.7	1.53	11.1	8.8	1.26
Female voices	10.7	6.6	1.62	9.5	7.0	1.36
Total	12.5	7.9	1.58	10.3	7.9	1.31

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

The results of the analyses showed that the intensity of the stressed syllables was rather big and did not depend upon the position of the syllable in the word. The coefficients showing the relation of intensity of the stressed syllables to the intensity of the corresponding unstressed syllables did not differ considerably and were as big.

No significant difference between the relative characteristics of intensity was observed among two- and three-syllable words.

These observations support the conclusion about the significant but secondary role of intensity as a component of the main acoustic characteristic feature of word stress – total energy in English (table 6.4).

Table 6.4

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

Conditions of pronunciation		One-word phrases		
		Absolute characteristics of intensity (conv. units)		Relative characteristics of intensity (rel. units)
		Stressed syllables	Unstressed syllables	
Position of the syllables in the words	initial	13.0	8.5	1.53
	final	12.2	7.6	1.61
Syllabic structure of the word	two-syllable words	12.7	8.2	1.55
	three-syllable words	12.2	7.5	1.63

The results of the experimental analysis showed that the duration of stressed syllables in English one-word and extended phrases was longer than the duration of the corresponding unstressed syllables. However, the difference was not so big as the difference between the total acoustic energy of stressed and unstressed syllables and considerably smaller than the difference of intensity between stressed and unstressed syllables.

The coefficients showing the relative duration of stressed syllables were smaller than those of the intensity.

A bigger total acoustic energy of stressed syllables may be achieved by means of increase of its components – intensity or duration or both of them.

The results of the experimental investigation made it possible to affirm that the share of duration and intensity in creating the total acoustic energy of a stressed syllable is not equal. The share of duration is not as big as the share of intensity in English (table 6.5).

As it has been mentioned before, the length of vowels is phonematically important in English. As duration is “engaged” on speech sounds level, its role on the level of word stress is diminished.

Table 6.5

Average absolute and relative characteristics of duration of English stressed and unstressed syllables in one-word and extended phrases

Speakers	One-word phrases			Extended phrases		
	Absolute characteristics of durations (msec)		Relative characteristics of duration (rel. units)	Absolute characteristics of duration (msec)		Relative characteristics of intensity (rel. units)
	Stressed syllables	Unstressed syllables		Stressed syllables	Unstressed syllables	
Male voices	153	119	1.38	139	107	1.29
Female voices	158	111	1.33	136	102	1.32
Total	156	115	1.39	133	105	1.31

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

The results of the analysis showed that the coefficients characterizing the relation of duration of stressed syllables to the corresponding unstressed syllables were rather low and didn’t deviate much under different conditions of pronunciation, supporting the idea that the share of duration creating stressed syllables is not so big as the share of intensity in English (table 6.6).

Table 6.6

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

Conditions of pronunciation		Phonetic words		
		Absolute characteristics of duration		Relative characteristics of duration
		Stressed syllables	Unstressed syllables	
Position of the syllables in the word	initial	137	98	1.40
	final	153	118	1.37
Syllabic structure of the word	two-syllable words	160	117	1.38
	three-syllable words	132	98	1.35
Intonation structure of the phrase	statements	150	116	1.29
	questions (general)	162	107	1.51

The results of the experimental analysis of the frequency characteristics of word stress in English showed that the measurements of pitch slightly prevail in stressed syllables over those of the unstressed syllables. The coefficients of relative pitch of the stressed syllables vary in the limits from 1.18 rel. units to 1.23 rel. units, which makes it possible to admit that the frequency is not relevant as a characteristic feature of word stress in English (table 6.7).

Table 6.7

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

Speakers	One-word phrases			Extended phrases		
	Absolute characteristics of pitch (cps.)		Relative pitch (rel. units)	Absolute characteristics of pitch (cps.)		Relative pitch (rel. units)
	Stressed syllables	Unstressed syllables		Stressed syllables	Unstressed syllables	
Male voices	152	123	1.24	167	135	1.24
Female voices	264	222	1.18	261	216	1.21
Total	208	173	1.21	214	176	1.23

Frequency characteristics were analysed under different conditions of pronunciation. The results of the analysis showed that in different positions of the syllables in the words and in different syllabic structures, the pitch of the stressed syllables varied considerably. The relative pitch characteristics of stressed syllables were even smaller than those of duration. The coefficients showing the difference in pitch under various conditions of pronunciation were very small in all the cases and varied from 1.10 rel. unit to 1.26 rel. units.

All the above testify to the conclusion that pitch is not a characteristic feature of word stress in English (table 6.8).

Table 6.8

Average absolute and relative characteristics of pitch of English stressed and unstressed syllables under different conditions of pronunciation

Conditions of pronunciation		Phonetic words		
		Absolute characteristics of pitch (cps.)		Relative characteristics of pitch
		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

As a result of the experimental investigation of word stress in English a conclusion can be made that word stress in English is energetic in nature. The main physical parameter of word stress is total acoustic energy – intensity over time. The main components of total acoustic energy are intensity and duration with the help which the main acoustic characteristic feature of word stress is formed.

The role of intensity and duration is not equal in producing the effect of word stress. Intensity is the main component of total acoustic energy in English. The share of duration is not as big as the share of intensity which is explained by the

phonological structure of the English language, i.e. the “engagement” of duration on the level of speech sounds.

The pitch of voice cannot be considered a characteristic feature of word stress in English. A higher pitch characterises stressed syllables, very seldom. The coefficients showing the average relation of pitch of stressed syllables to the corresponding unstressed ones are very low and do not help to distinguish stressed and unstressed syllables. Pitch characteristics are not stable under different conditions of pronunciation and differentiate various communicative types of phrases on the suprasegmental level.