

SYMMETRY AND ASYMMETRY IN MULTI-DIMENSIONAL PROSODIC SYSTEM AS CUES OF TEXTUAL EXPRESSIVENESS

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ABSTRACT

The paper presents the results of experimental phonetic research carried out with the purpose to examine symmetry and asymmetry in the multi-dimensional prosodic structure of expressive texts.

Symmetry is understood here as the general feature of material world reflecting the symmetrical arrangement of the parts of the structure, balanced proportions, correspondence in size, shape, and relative position.

Asymmetry is the opposite of symmetry. However, it is important to understand that the one cannot exist without the other. This is so because in every existing object, during its growth the balance of its parts is violated.

The present paper discusses some new aspects of intonational theory: symmetric and asymmetric features of multi-dimensional prosodic system are explored.

2. SPEECH MATERIAL AND SUBJECTS

Textual prosody was studied here on the statistic data obtained from phonetic experimental investigation of more than 100 expressive and corresponding neutral texts recorded by 20 subjects who were native speakers of English, Russian and Ukrainian. These texts expressed the fourteen most frequently observed positive and negative emotions: joy, sorrow, anger, fear, despair, threat, surprise,

shame, offence, contempt, suspicion, irony, approval, rebuke. The original speech signal was instrumentally analyzed with the help of the Visi-Pitch and IBM speech program, Sena-Graph of the Kay Elemetrics Corporation. For evaluating the average data standard methods of mathematical statistics were applied (t ratio, Student's t and correlation coefficients; calculations were done with the help of IBM program "Lotus"

3. DATA ANALYSIS AND RESULTS

This report generalizes from the results of a long-term investigation carried on by the author. Our previous investigation /1/ proved that information about emotions comes over multiple channels: by lexical cues, grammatical structures and prosodic indicators. These levels of linguistic analysis are closely interconnected. Expressive speech prosody is described as multi-dimensional system characterized in terms of symmetry and asymmetry of its variable components: fundamental frequency, intensity, duration and spectral composition.

The statistical analysis of these main acoustic characteristics shows that a greater symmetry is observed within a temporal framework of the given texts. An act of speech is regularly time-oriented. Speech arrangement in time is related to the specifically regulated nature of acoustic signals. The regular symmetric feature of the temporal structure of expressive texts can be observed in the equality of the mean

syllabic duration of opening and final phrases (see table 1).

Table 1

The mean syllabic duration of opening and final phrases in expressive texts in English

Emotions expressed in the texts	Mean syllabic duration of opening phrases (ms)	Mean syllabic duration of final phrases (ms)
joy	230	225
sorrow	240	225
anger	159	151
fear	221	228
despair	203	193
threat	273	264
surprise	230	225
shame	198	188
offence	185	200
contempt	221	239
suspicion	230	240
irony	254	242
approval	236	241
rebuke	246	256

This regularity is broken in highly emotional texts. For example, the mean syllabic duration of an opening phrase, expressing high degree of despair is 357 ms while in all the other phrases it varies from 150 to 240 ms.

Symmetry of the temporal structure of the text can also be found in the proportion between total text duration and pauses. Table 2 presents the volume of pauses in % in the texts expressing the above-mentioned 14 emotions and the corresponding neutral ones.

Table 2
The volume of pauses (%) in expressive and corresponding neutral texts

Emotions expressed in the texts	Volume of pauses (%)	
	emotion- texts	neutral texts
joy	42	40
sorrow	42	40
anger	48	33
fear	45	36
despair	46	41
threat	41	27
surprise	41	39
shame	38	14
offence	49	41
contempt	44	14
suspicion	47	28
irony	45	30
approval	41	32
rebuke	43	33

The figures in the table show that the regular symmetric feature of expressive texts can be also observed in the equality of the volume of pauses. The corresponding neutral texts do not reveal such symmetry.

The obtained data suggest that there is a principle of symmetric compensation in speech prosody: when the degree of symmetry decreases on one structural level it increases on another. Spectrographic measurements of formant frequencies support this principle. A shift of F_2 , F_3 , and F_4 into higher regions along with the more complicated structure of their harmonics, a constant increase of the total formant energy of the nuclear vowel occurs at the expense of the decrease of formant energy of unstressed syllables. Spectre-

grams of neutral texts revealed more symmetric regularities: well-defined formant structure during the vowels was observed.

The quantitative analysis of the intensity of expressive text prosody demonstrates this principle too: a decrease of energy in one section of the text is accompanied by an increase in another. These changes of energy in expressive texts are closely connected with the changes in the degree of emotional tension. A gradual increase of the total energy to the end is observed in the texts, expressing active emotions, i.e. anger, threat, irony, suspicion, rebuke. For example, in the emotional text expressing all shades of anger - from irritation to rage - the relative intensity of the utterances is: 1,24; 1,39; 1,83; 2,06; 2,41. The decrease of total energy occurs in the texts expressing passive emotions, i.e. sorrow, offence, shame. It appears probable that the asymmetric distribution of energy in expressive texts have to be often specified for certain changes of emotions in them. In contrast, the unexpressive texts are characterized by symmetric distribution of energy.

The symmetry of the melodic structure of expressive texts is found in the similarity of its shapes. However, in highly emotional texts numerous asymmetrically arranged variants are observed. This is due to the dynamic changes of emotional tension, which in turn lead to changes in pitch movement.

CONCLUSIONS

The textual level of analysis has revealed the multi-dimensional nature of the symmetric prosodic space in which the compensatory distribution of prosodic features is taking place. However, the obtained results seem to demonstrate that symmetry of the multi-dimensional prosodic system is no more than an ideal form of the actual asymmetric acoustic features.

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