SOME ASPECTS OF INTONATION IN MODERN STANDARD RUSSIAN (ANALYSIS–SYNTHESIS–ANALYSIS)

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ABSTRACT

In modern standard Russian speech intonation is interpreted in three types of utterances: terminal declarative, non-terminal declarative and interrogative (variable). This paper focuses on the acoustical characteristics (fundamental frequency $F_0$, duration $t$, intensity $I$) of this types of the utterances and concerns with the system of intonation invariants of the Russian standard language.

INTRODUCTION

In speech communication all spheres (prosody, prosodics, prosodemics and intonation) are inseparable linked with each other. A speaker cannot pronounce a syllable without an intonation. At the same time none of the members of intonation system of a language can exclude prosodic ingredients of speech. Any realization of speech communication is a complex structural unity of a substance (prosodic characteristics) and a function (prosodics, prosodemics, intonation). Presence or absence of semiological factors and presence or absence of definite phonological system of oppositions are main factors for differentiating in functional sphere. This point of view is affirmed by many researchers. In the studies of standard Russian there are different opinions concerning linguistic meaning expressed by intonation. Some scientists say about the system of intonation contours, characterizing communicative types, aspects and subaspects of sentences. Other researchers limit all variety of members of intonation system of Russian languages to limited number of intonation forms, models, units. The present paper concerns with the system of intonation invariants of the Russian standard language.

Results are obtained during the experiment using auditory, acoustical, statistical and algorithmical methods of analysis with subsequent verification by "analysis–synthesis–analysis" method.

PROCEDURE

The main aim of this experiment was to establish the role and significance of the components of prosody (fundamental frequency $F_0$, duration $t$ and intensity $I$) in the structure of an intonational invariant in the opposition of meanings: terminal declarative–non-terminal declarative, terminal declarative–interrogative, non-terminal–interrogative.

The experimental data consisted of a number of sentences in Russian, in which some parameters were subject to variation: the number of syllables ($n=5–11$); shifting the logical (sentence) stress within the
last rhythmic group of the sentence; changing the types of rhythmic structures; changing the types of syllables within rhythmic structures ( CV, CCV, CVV, CVC and so on). We took into account the fact that the most frequent type of syllable in Russian is the open syllable ( CCC...). This type is relevant for the description of the intonation system of Russian. These syllable types are partially predictable from the sequence of phonemes and morphemes.

The recording was made in a sound-proof room with microphone MK-5 and a tape recorder MRS-62. All the experimental tape recordings were played at random to listeners (n=5). The listeners were to identify all types of the intonation. The utterances were then recorded by an intonograph - a device which makes it possible to analyse the fundamental frequency \( F_0 \) (Hz), the amplitude of intensity \( I \) (dB) and duration \( t \) (msec). The results of the analysis are registered in curves, which convey oscillograms of speech signal, the level of a sound pressure, fundamental frequency and time marking ( \( h=5,10\text{msec and }20\text{msec} \)).

All parameters were normalized ( \( F_{0\text{min}}, F_{0\text{max}}, F_0, t_1, I_{1\text{max}} \text{ et c.} \)). As the next step of processing the data with computer were analysed. Results of the acoustic analysis were compared with the data of the auditory analysis. Prosodic features as \( F_0, t, I \) were material means for synthesis. These means serve to show individual and invariant parameters of speech on the level of prosody.

**DISCUSSION**

Having analysed the change of \( F_0 \) in the utterances with the help of the instrumental and mathematical - statistical analyses we obtained the following results. The syllables that are characterized by systematic \( F_0 \) differences in the above-mentioned types of intonation are usually located in the part of the sentence preceding the syllable with sentence stress, in the syllable with sentence stress and in the syllable which follow the syllable with sentence stress.

The opposition "terminal declarative utterance - non-terminal declarative utterance" is characterized by the following distinctive features for the \( F_0 \): greater \( F_0 \) values in pretonic syllables in the case of terminal utterance; different \( F_0 \) of the syllable with the sentence stress; the lowest \( F_0 \) on the syllable with sentence stress; different \( F_0 \)-intervals both between the pretonic and tonic syllables, tonic and posttonic syllables.

The opposition "terminal declarative utterance - interrogative utterance" has the following characteristics: lower \( F_0 \) values of the syllable with sentence stress in terminal declarative sentence in comparison with interrogative sentence; different \( F_0 \)-interval between the syllables, preceding the syllable with sentence stress and the primary stressed syllable.

The opposition "interrogative utterance - non-terminal declarative utterance" has different \( F_0 \) data for post-tonic syllables.
following the primary - stressed syllable, a higher $F_0$ level in non-terminal declarative utterances.

A special programme for computer was worked out which took into account $F_0$ changes for the initial and final part of a vowel, a sonant and a voiced consonant of each syllable in the sentence. The algorithm included computation of normalized $F_0$ parameters, which were obtained by division of the measured values. The estimation of the reliability of divergences was verified with t-criterion.

The analysis of the intrasyllabic $F_0$ showed that in the realization of the above types of utterances the data concerning the intrasyllabic $F_0$ changes have additional information about the changes of the pitch contour.

The results of the analysis and synthesis for the intra- and intersyllabic fundamental frequency $F_0$ showed that in the realization of the sentence intonation the data are different. In terminal declarative utterance rising direction of $F_0$ is characteristic of the intrasyllabic $F_0$ changes. For non-terminal and interrogative utterances falling direction is characteristic. In the opposition "non-terminal declarative utterance - interrogative utterance" we observed systematic divergences in intrasyllabic $F_0$ changes in unstressed syllables which are between the stressed syllable of the first phonetic word of the sentence and the syllable with sentence stress. Unstressed syllables in non-terminal declarative utterances are characterised as a rule by falling $F_0$, unstressed syllables in interrogative utterances - by rising.

The study of temporal characteristics was aimed at the singling out of such parts of the temporal contours of a sentence which could be correlated with the intonation of statement and question. It was necessary to find out the role of temporal characteristics of vowels with phrase stress to differentiate three types of intonation; to measure the degree of the change in duration for qualitatively similar vowels, which differ only in the degree of stress, to compare the duration of stressed and unstressed vowels. Further investigation (1, 2, 3) showed that we can use both data on the duration of vowels with first sentence stress and the duration of final vowels in sentences for a reliable differentiation of the utterances in the analysed oppositions. The hypothesis that the whole temporal contour of the vowels in a sentence is relevant for the determination of the intonation type was not corroborated. The duration of sounds in sentences similar in sound composition does not change with the type of intonation.

But it does not apply to the final position in the sentence and the syllable with the sentence (or phrase) stress. The main differences in the duration are observed in final unstressed vowels in a open syllable (CV) in the opposition "terminal declarative utterance - non-terminal declarative utterance". The temporal pattern of utterance depends on the functioning of a number of variables such as the total length of the utter-
rance, its rhythmic pattern, the distribution of rhythmic patterns in the utterance, the distribution of stressed and unstressed syllables within each rhythmic structure, the distribution of the stress types, the position of the tonisyllable, the structure of the syllables constituting the utterance (CV,CVC,V,VC etc), the proper duration of vowels.

The results of the analysis of the intensity level have shown a major coincidence of the mean intensity values of vowel sounds in terminal and non-terminal statements and in questions. It does not apply to the intensity of a vowel of the final syllable. The synthesis showed that there are regular divergences in the mean intensity values of the vowel of the final syllable in the sentences for the opposition "terminal declarative utterance - non-terminal declarative utterance". But the oppositions "non-terminal declarative utterance - interrogative utterance" and "terminal declarative utterance - interrogative utterance" are characterized by irregular divergences.

CONCLUSION

The obtained results make it possible to draw the following conclusions:

a) the most important values for the intonation invariant of every member of the opposition are not the absolute, but relative values of all the analysed prosodic characteristics;

b) the intensity level is the least dependent parameter on the type of intonation;

c) the duration is more dependent on it;

d) the fundamental frequency is the most reliable parameter for distinguishing the types of intonation. All the variability of intonation contours of the Russian language can be expressed through combination (scale) of prosodic features. The acoustical characteristics $F_0$, $t$, $I$ are substance for conveying of functional relations in the intonation system of the language.

Constituents units and their number can vary. But for the intonation system units of the invariant level are mainly chosen, because the system consists of a limited number of constituents whose information load must be maximum to make speech communication possible.

REFERENCES


(2) R.K. Potapova, "O vremennych parametrah sinteza russkoy rechi", Proc. of 14 Conf. on Acoustics, pp. 177-180: 1976