PERCEPTIVE AND ACOUSTIC CHARACTERISTICS OF EMOTIONS: A Typological Research Based on the Material of Languages with Different Structures

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ABSTRACT
The present paper offers results of experimental phonetic research carried out with the purpose to solve some problems of describing different emotional states from the point of view of their phonetic expression in different linguistically structured languages. With the help of complex techniques of auditory and acoustic analysis the main types of emotions relevant for speech communication and their phonetic parameters are determined.

INTRODUCTION
At present considerable interest is taken in the problems of phonetic expression of different emotional states, which is determined both by the development of fundamental linguistics (mainly in the direction of communicative linguistics) and by the need to solve a number of most important applied problems, such as diagnosing, the emotional state of the speaker and listener by speech, normal and pathological; the types of emotions, identification of a person, as well as using automatic speech synthesis and analysis. However, despite considerable success in the study of psychology and physiology of a person's emotional state, there has been produced no linguistic levels of the fundamentals of the phonetic expression of emotions in different languages, as well as so far, which would describe and explain on all linguistic levels the interrelation of the phonetic and acoustic parameters of the emotional states. In this case the results of the phonetic and acoustic analysis of the emotional states correlated with the psychological and emotional states have been obtained. The main types of emotions have been considered: anger, disgust, despair, distress, fear, irritation, joy, sadness, surprise, terror, surprise. The results have been obtained from the phonetic and acoustic analysis of the emotional states.

1. MATERIAL AND TECHNIQUES OF OBTAINING RECORDS
The study of Russian plays and especially of stage directions which contain lexical designation of an emotion, has revealed the most frequent emotional states, seventeen of which have been selected as having the maximum frequency coefficients. Together with the neutral emotional state they have made up the initial list of emotional states to be analyzed, i.e., neutral, pleasure, joy-delight-admiration, disgust-anger, indignation, anger, malice, hatred, irritation, contempt, rage, iron, sadness, reproach, fear, fright, extreme, despair, distress-bitterness, surprise between these emotions by means of modeling an appropriate situation the word "gogorom" (gargling) has been uttered by four native speakers as a professional vocal teacher. The emotional characteristics of the words as well as the emotions have been described in detail.

2. AUDITIVE AND PERCEPTIVE EXPERIMENTS
The records have been offered for auditory analysis to both native speakers of Russian (25-40 persons) and native speakers of other languages (5 persons for each language). As a phonetic experiment it was necessary to identify the emotion as one or two from the list. At the second - to judge whether the emotions caused correspond to the implied emotion or not. The group of expert listeners (6 persons) were asked to state the level of difference of all possible emotional states of a neutral state. Another group (16 persons) were asked to state the subjectivity or dissimilarity of the emotions under analysis on the basis of the pairs of emotional states given to them.

3. ACOUSTIC ANALYSIS
The graphs of speech-acoustic parameters (frequency range - up to 4 kHz) of emotions (intensity variations) have been made. The length of segments, changes of the voice pitch on the vowel segment and the mean values of segments' intensity have been calculated.

4. LABORATORY ANALYSIS OF EMOTIONS
Vocalizations of all emotions produced by native Russian speakers and presented as margarine without indication of the emotive state of the speaker have been offered to 100 non-musicians with the task to state the number of these realizations according to certain features chosen by the experimenter. The teachers have chosen and the classes they gave were registered in protocol.

5. RESULTS
The results of the auditory and auditive analysis for the Russian language have been compared with the results of other languages with different degree of concordance. Among the speakers who are the most skilled in the recognition of the emotional realizaions were the authors' opinion the easier the identification. As a result has also the least difficulty in the subjective estimation of the emotional states under analysis. The subjective space of the emotions is question has been defined as the result of the analysis of the emotional states and to one another. The relative importance of the types of emotions is shown below the results of the analysis of the emotional states and to one another. The relative importance of the types of emotions is shown below in the diagram 1, the subjective space of the emotions in question has been defined as the result of the analysis of the emotional states and to one another. The relative importance of the types of emotions is shown below in the diagram 1.

The identification of emotional states by the phonetic and auditive parameters of the phonetic experiment has yielded the following results: degrees of correct identification of the emotions produced by the recordings are as follows: neutral (60%), correct identification 60%, anger (65%), sad (65%), surprise (60%), fear (60%), irritation (65%), terror (65%), anger (65%), joy (65%), sadness (65%), surprise (65%). Statistically relevant differences in the subjective estimation of the emotional states are given below in the diagram 1 (it is noteworthy that these pairs of emotions, realizations were found similar in their phonetic form).

Diagram 1. Graph of confusions between emotional states in their diagnosis in speech
- displeasure - context
- joy - anger
- surprise - irritation

Diagram 2. Emotions
- anger - distress
- reproach - despair
- irritation - entertainment

When estimating the recognizability of stimuli carried by the voices of the auditors found all stimuli natural for the given speaker except the emotion of reproach. Thus, it is clearly seen that not all differences in the stimuli can be perceived by ear are of equal importance for the emotions' identification. Therefore, the question of relevant and irrelevant differences in the phonetic expression of emotions is closely connected with the subjective estimation of the emotional states under analysis. The subjective space of the emotions in question is the result of the recognition of the emotional states and to one another. The relative importance of the types of emotions is shown below in the diagram 2.

The correlation of the subjective estimation of the distance between the emotions has been observed. The data obtained as a result of perceptive analysis make it possible to group the results of the instrumental analysis of the emotional states and do not vary significantly with the individual peculiarities connected with the individual-manner of the speaker and other channel manner of the speaker.

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Po 2.6.2 219
Environments that are intentionally marked and for this reason are easily and correctly identifiable, are taken in a framework: Voice Pitch. It seems convenient to begin the presentation of the results of the instrumental acoustic analysis of the Vol- ce Pitch. Pitch range and the average value of P0, proved to be rather significant for the differentiation of emotions. Fig.1 shows the pitch range of all emotions. 1 — being neutral utterance, 2 — pleasure, 3 — joy-unlight-satisfaction, 4 — displeasure, 5 — indiscipline, 6 — anger, 7 — nausea, 8 — irritation, 9 — contempt, 10 — rage, 11 — irony, 12 — menace, 13 — reproach, 14 — fear, fright, 15 — anxiety, 16 — despair, 17 — distress-bitterness, 18 — surprise.

Fig.1 Pitch range of emotional utterances.

The emotional states with marked Pitch range are: pleasure, displeasure, malice, irritation, despair (minimum range of P0). On the other hand, emotions which show an average Pitch range of all emotions except those with marked minimum range, are: joy, fright, contempt, distress, anger, surprise and irony (though in a lesser degree). Displeasure, it is noted, is more attractively emphasized in the average Pitch range of all emotions, which shows a lower than neutral, while joy, contempt and iron are higher than neutral.

According to the form of P0, two types of the contour are important for the expression of different emotions: level contour (level-falling) and rising (rise-falling). It is noteworthy that the form of P0 contour influences also the tempo deformations of emotional word structures, i.e., anger and rage.

The form contour is an important parameter for the expression of different emotions (level-falling), contempt (level-falling), malice (level-falling), sadness (rising), irritation (rising). This parameter is especially significant for the realization of surprise and irony in one of its phonetic variants: it is rising and rising-falling in these cases.

Intensity. The overall range of intensity changes is not very informative; on the whole for all emotions it is larger than for a neutral utterance (except displeasure and irritation). See Fig.2.

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