
RELATIONS BETWEEN THE ACOUSTIC, ARTICULATORY AND PSYCHOLOGICAL PARAMETERS OF THE EMOTIONAL EXPRESSIONS IN SPEECH

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In our study published in *Folia Phoniatrica* in 1963 (15: 89—98) we tried to demonstrate that the expression of joy or grief is closely related to the mean pitch of the phrase. Our supplementary revision of the same material has proved that the correlation index according to the test of Kendall is $+0,66$ which is the value significant on the level of 1 %.

Such definite correlations do not occur very often. The constant melodic or melodico-rhythmical patterns are much less frequent. Complicated vectors of acoustic parameters are usually at play.

When studying these vectors we have to be aware of the fact that the speaker communicating emotions is not able to control immediately the acoustic parameters such as the upper limit of the spectrum, that is the highest partial component of the sound, or the frequency and the intensity of the formants. But what he does control are the basic physiological or as the case may be psychological intentions, or let us say instructions, from which in our opinion the most important are: brightness or darkness of the voice, softness or harshness of the articulation, purity or hoarseness of the voice, liveliness or monotony of the melodic or rhythmical movement, smiling or weeping voice etc.

At first the correlations between these instructions and the expression of joy or grief and love or anger were established on the basis of several groups of observers who registered their subjective feelings which were evoked by 23 different recitations of two sentences. Figure 1 demonstrates the positive correlation of the rank-order JOY-GRIEF with the rank-order BRIGHTNESS-DARKNESS of the voice. The correlation index $t = +0,65$ is significant on the 1 % level. A similar positive correlation exists between JOY-GRIEF and PURITY-HOARSENESS of the voice, the coefficient of the correlation being $+0,45$ (equally significant on the 1 % level).

On the contrary the rank-order LOVE—ANGER is not correlated either with BRIGHTNESS—DARKNESS, or PURITY—HOARSENESS of the voice. There exists however a negative correlation between the rank-order LOVE—ANGER and the rank-order SOFTNESS—HARSHNESS ($t = -0,49$ significant on the 1 % level). No further correlations of this rank-order with the physiological instructions have been found.

Our second task was to try to define the physiological or psychological instructions

in terms of acoustic parameters. We communicate to-day only some of the positive findings of our rather extensive investigations.

First of all we have to emphasize that in accordance with our earlier investigations which we have mentioned, the most important factor is the mean pitch of the voice. To a certain extent, all physiological or psychological instructions we have studied are somehow related to this parameter. A very close correlation exists between the mean pitch and the rank-order BRIGHTNESS—DARKNESS ($t = +0,676$ which is significant on the 1 % level). Among other acoustic factors 3 parameters characterizing the spectrum of the voice are very important, namely: the relative intensity of the higher components of the voice, the upper limit of the spectrum and the factor, we call the upper limit of the periodicity, that is the highest harmonic (periodic) tone.

As far as the intensity of the higher components of the voice spectrum is concerned, the positive correlation of this parameter with the rank-order SOFTNESS—HARSHNESS has been established. For this purpose, the intensity of the 3rd and 4th formant was taken into consideration with the result of $t = +0,328$ for the 3rd formant and $t = +0,359$ for the 4th formant, both significant on the 5 % level.

The material we have chosen for the present communication enables us to differentiate between the instructions of BRIGHTNESS—DARKNESS and SOFTNESS—HARSHNESS. The respective results are demonstrated on the table. The rank-order BRIGHTNESS—DARKNESS shows the positive correlation with the pitch, with the upper limit of the spectrum and the upper limit of the periodicity. No correlation has been found in the intensity of high components. On the contrary, the rank-order SOFTNESS—HARSHNESS is characterized by the negative correlation with the intensity of the higher sound components and the negative correlation of the upper limit of the periodicity, whereas the remaining acoustic parameters are without any correlation. The results obtained are in accordance with our suppositions as to the phonatory mechanisms. We assumed we would find a higher positive correlation between the rank-order PURITY—HOARSENESS and the upper limit of the periodicity which we could not demonstrate on the basis of this material because of the absence of hoarse voices. But we have discovered this dependence in another group of our experiments containing phrases with the expression of FEAR.

These conclusions are naturally valid for the present material only; generalization will be possible only on the basis of more extensive experiments connected with statistical factor analysis. Nevertheless, in our opinion the possibility of defining the emotional expression of speech by means of the acoustic parameter has been thus demonstrated.