

ON SPECTRAL DIFFERENCES IN THE CRY OF NEWBORNS OF DIFFERENT NATIONALITIES

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ABSTRACT

A statistically reliable difference in the cry of newborns of different nationalities is revealed. This is observed both auditorily and through a spectrum analysis and is assumed by the authors to be connected with the specificity of the mother tongue of ancestors. Newborns are supposed to be inheriting certain features of the articulatory basis of this tongue.

Experiments on perception revealed a statistically reliable difference in the cry of newborns of different nationalities. The Georgian auditors were to listen in pairs to the cry of the Georgian and Russian newborns and asked to mark which - the first or the second - of the two stimuli (an isolated cry) was closer to the Georgian vowel a.

Similar experiments showed that the auditors could be assigned (with necessary breaks) to make not more than 100 comparisons. Therefore two groups of stimuli for two different series were made with 100 oppositions of the cry of newborn children of the same sex but of different nationalities. In order to reduce the influence caused by the position of stimuli in pairs on perception of similarity, in 50 cases of each series first on the list came the cry of a newborn of one nationality while in 50 other cases that of other nationality. Naturally the auditors would not know the cries of which - Russian or Georgian - newborns they were to assess.

The study of the auditors' records (6400 assessments) revealed that the auditors had more often found the cry of the Georgian newborns closer to the Georgian vowel a than that of the Russian newborns. This was noted in the cry of both boys (36 auditors) and girls (28 auditors). None of the auditors found the cry of the Russian newborns closer to the standard vowel more often than that of the Georgian newborns. The cry of the latter was considered to be closer to the standard

vowel in 76 cases out of 100 on the average and 81-82 cases with individual auditors. Such a constantly one-way deviation being several times greater than the standard deviation of ± 5 allows to assert with a high degree of reliability that there is a considerable nonrandom difference (/1/, at greater length /2/) in the studied stimuli of the Georgian newborns in one aspect and those of the Russian newborns in another aspect.

However, the actual picture might have been slightly changed in the assessment of the auditors due to their tiredness, distraction, illusive perception or other factors that occur when an analysis is carried out not by a machine but by a man. The aim of the present investigation was the instrumental study of the spectral structure of the sounds under review and matching up of the revealed differences with the picture of their perception and formation. For this purpose a band-pass spectrum analysis of newborn cries through 30 band-pass filters over the range of 80 to 8300 Hz was carried out. Over 1000 Hz the spectrum constituents were boosted by 6 dB per octave as is usually done in phonetic investigations. As is known, a negligible base frequency difference between sounds in a band-pass spectrum analysis may lead to considerable amplitude discrepancies on band-pass filter outlets. To avoid this the spectrum was smoothed out with the given frequency band range substituted by the arithmetic mean of the given and several neighboring values. Account of values from 7 adjacent channels turned out to be optimum for coping with the task: the values of the given band and three lower and three higher bands were taken account of. In the case of the first and last three bands the arithmetic mean could be naturally deduced only from the smaller number of the bands.

Prior to statistical data processing the intensity of every cry had been brought to one and the same value and computed as a sum of square values from each frequency band without boosting by 6 dB per oct.

A total of 322 cries was analyzed out of which 173 cries belonged to the Russian newborns and 149 cries to the Georgian ones.

By use of Willcockson's criterion which is applicable to any kind of distribution a difference between the compared groups was elucidated and rated on statistical reliability.

The analysis allowed to assert with a degree of reliability of 0.99 that there is a nonrandom difference between these groups (i.e. the cries of the Russian newborns on the one hand and those of the Georgian newborns on the other hand) in a number of bands. Namely such a difference was observed in frequency ranges 80-100 Hz, 300-1500 Hz, 1900-2700 Hz, 5200-8300 Hz. Out of these in the first and third ranges the expectations were greater in the cries of the Georgian newborns while in the second and fourth ranges they were greater in the cries of the Russian newborns.

Such a picture complies sufficiently well with the perception data described above. The two separated (second and fourth) frequency ranges 300-1500 Hz and 5200-8300 Hz in which the values were greater in the cries of the Russian newborns revealed a definite similarity to the first two formants of the diffusive vowels e, i. As to the spectrum of the cries of the Georgian newborns, it has greater values in the middle third range and is closer not to the diffusive but, on the contrary, to the compact vowel a (in comparison with the cries of the Russian newborns).

The difference in the low-frequency range band 80-100 Hz deserves a special mention. This band is situated lower than the base frequency of the stimuli and its vibrations cannot, at first glance, be related with the cry of newborns. However, the spectrum constituents of different intensity in this band observed in the cries of newborns both nationalities are supposedly related with the formation of sound vibrations in the back of the oral resonator: with a friction noise in the narrowed passage in the velar and laryngeal regions and with low-frequency vibrations of the soft palate and the uvula. The most favourable conditions for such vibrations are created through a rather backward placement of the tongue that is permissible for the Georgian newborns. A possible influence of glottalization should also be considered.

The above-mentioned assumption is connected with our earlier suggestion that individual features of the articulatory basis (articulatory habits) of mother tongue is somehow transmitted to newborns. At least by the moment of birth they are observed to possess certain features of

such a "starting placement" of the speech organs that is convenient for passing in the acts of speech to the pronunciation of the sounds of the given language /1/, /2/. But what "starting placement" of the speech organs may be characteristic for the Russian and Georgian languages? A great functional load of the contrast-d distinction of soft and hard consonants in Russian and its absence in Georgian, and the realization of more advanced and raised vowels in Russian in comparison with the Georgian ones make different starting placements more convenient for the Russian and the Georgian speakers: a more advanced and raised placement of the tongue for the Russians and a more retracted and lowered placement of the tongue for the Georgians. Such a difference in placements of the speech organs in the cry of newborns might lead to a greater similarity of the cry of the Georgian newborns to the a-type vowel, i.e. to the difference ascertained both in the spectrum of the stimuli and in their perception /1/, /2/.

It is not quite clear how could the features of the starting placement of the speech organs be transmitted to newborns. This requires further investigations. But it should also be noted that the difference in the cry of newborns of different nationalities cannot so far be satisfactorily linked with any other nonlinguistic factor. The assumption that this difference could be related to the anatomical difference in the structure of the speech tract was not confirmed by specialist investigations. The anatomical difference could but cause a converse effect: the cry of the Russian newborns should have been closer to the vowel a but not that of the Georgian ones /3/.

The obtained results of the investigation allow to assert with certainty a timbral difference in the cry of newborns of different nationalities. This is confirmed by data of both auditory and spectrum analyses and may be related, as stated above, to the phonetic specificity of the mother tongue of ancestors of the newborns.

/1/ Z.N.Japaridze, Y.A.Strelnikov, On Linguistic Characteristics of the Cry of Newborns. XXIV Scientific session of the Institute of Linguistics. Working plan and report theses (in Georgian), Tbilisi, 1978.

/2/ З.Н.Джапаридзе, Ю.А.Стрельников, О различиях в плаче новорожденных разной национальности и пола, Сб.Экспериментально-фонетический анализ речи, Ленинград, 1984.

/3/ М.Г.Абдушлишвили, З.Н.Джапаридзе, Ю.А.Стрельников, К оценке влияния антропологических факторов на характеристики плача новорожденных, Сб.Проблемы фонетики и фонологии. Материалы всесоюзного совещания (ноябрь 1986 г.) Москва - 1986.