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Analysis of Infant Cry as an Indicatory Function

By

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The possibility of an objective acoustic analysis of the cry of infants has been studied. The aim was to prove that cyring is an information-carrying signalling system analogous to speech, and to gain data by the elaboration of cry-standards characteristic of single age groups and for normal and pathological conditions. Importance is attached to be findings from the point of view of developmental psychology, provided it could be proved that crying, as the pre-phase of speech, is a complex signalling system situated between the vegetative and motor reaction and babbling, on the one hand, and abstract speech, on the other. Differentiation of characteristic types might be utilized diagnostically as well as in medical education.

Infant cry as one of the indicatory functions of the very young human personality has been studied by us for several years in order to gain data for the differentiation of the types of crying and to work out a reliable method for its objective identification.* Not only paediatricians, but experienced nurses and even carefully observing mothers are able to distinguish between the cry of sleepiness, the cry of hunger, the cry caused by soiled diapers, or that caused by colics, the interrupted cry due to otitis, the apnoeic, whining cry uttered by infants with intrathoracic conditions such as a pleurisy or pneumothorax, the crying associated with coughs of the baby ill with bronchitis, bronchiolitis or pneumonia, the cephalic cry, etc., and to differentiate these from crying due to the baby's desire to draw the mother's attention. Some authors have attempted to systematize the above types of crying. Thus, ILLINGWORTH [2] differentiated the hoarse cry characteristic of cretins, the screaming-like cry of hydrocephalic infants, the rattling-like one of the pneumonic infant and the weak cry of those suffering from amyotonia. He also differentiated the types of cry most characteristic for the single age groups. Thus, during the first 3 months of life, the hunger-cry would dominate and the prolonged night or dawn-cry due to a conditioning of a rigid feeding scheme. Crying in this period may also be due to a humid, cold, biting napkin, to lonelines, *i.e.* the feeling of being left alone, the desire of being taken up, or to sudden

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sound or light stimuli. In infants older than 3 months the hunger cry is less frequent and the main causes of crying are boredom, tiredness, an unusual environment and, during the night, the desire for the mother's company. Thus, in ILLINGWORTH's classification, normal states of crying are mixed with pathological ones.

TRUBY and LIND [3] studied 30 newborn infants up to the age of 12 days; crying was elicited by pinching and recorded on tape. The graphically fixed oscillations of sound were analysed as to their strength, colour and pitch. It was concluded that the cry pattern is as characteristic for the infant as its fingerprint and it was assumed that the acoustic analysis of a baby's crying will reveal reliable information concerning its neurological state. In our opinion, the above investigation was unfavourably influenced by two factors. First, the cry had been elicited by pinching so that only a cry caused by pain could be observed. Second, the microphone was fixed above the larynx, thus air conduction of the sounds must have been distorted.

According to VALANNE et al. [4], crying is a specific characteristic of the individual. These authors set the task to 35 mothers to recognize their own baby's cry recorded on tape and the further task to tell whether the baby cried owing to hunger or for some other reason, by distinguishing between cries recorded before and after meals. The majority of the mothers gave a correct answer after two postnatal days.

Apart from offering practical data, our studies have been expected to yield some theoretical information. Crying is the first signal of acoustic character in extrauterine life; it may thus be considered the ancestor of speech. It was therefore deemed essential to clarify the course starting with crying, then whining and later babbling, and ending with the most developed acoustic signal, human speech. A further aim was to study what remains from crying as a signalling function during later childhood when speech and its understanding already fulfils the task of communication. Thus, it was deemed necessary to investigate the different types of crying according to age, under normal somatic and psychic conditions, and under pathological conditions.

Material and Method

For attaining to above aim, a new method has been worked out for the recording of crying and its comparative analysis. First of all, in 30 neonates at the age of one day, 4 months, and 8 months, crying was registered on tape and analysed for pitch, strength, and colouring.

For establishing the standard pitch, the tape was played back, the breathing intervals were cut out and the remaining sections of tape carrying the crying were rerecorded on a single track which thus carried the record of the cries of several healthy infants of the same age group. After having established the standard cry of normal babies of a certain age the next step was to analyse the different types of cry characterteristic of different pathological states, and to determine the extent and type of deviations by comparing the recordings to the normal standard.

Discussion

The soundness of our method of recording and analysis was soon supported by experience. For instance, the crying of one of the neonates differed discernibly from the types recorded up to then. In view of this fact the neonate was repeatedly examined with special care, but nothing abnormal was revealed. Soon thereafter we understood that the mother and the grandmother of the baby are both deafmutes. This observation might eventually lead to a new method for the early diagnosis of deafness. The possibility has namely to be taken into consideration that if the own cry of an infant is recorded on tape and this is played back at phase-shift when the baby is crying, it will change the rhythm of its crying, whereas this reaction cannot be elicited if the baby is deaf.

Establishing normal and certain pathological crying standards may serve a double practical aim. On the one hand, it may facilitate the early diagnosis of certain pathologic states and on the other, it may help in improving the practical of medical students.

Apart from practical purposes, the investigation may lead to new results which might be important theoretically, especially from the point of view of developmental psychology. It is well-known that the vegetative and motor reactions of the infant can be regarded as part of a complex signal system by which the infant expresses its somatic and psychic state. This earliest signalizing function of the personality is maintained up to the period of the development of speech. It seems, however, that the complex signalizing function of crying which is considered the archaic pre-phase of speech is so-to-say connecting the vegetative-motor reactions and the development of speech, the asbtract signalling function. This assumption is supported by Truby's above mentioned statement according to which from the analysis of the cry conclusions can be drawn as to the features of the future formation of speech. If we succeed to prove the signalling role of the cry, this might represent an important link for research in the field of developmental psychology. For this end it must be proved that crying as an acoustic signal is the archaic information carrier, analogous to speech.

Cherry [1] has shown that the understanding of articulated speech is resistant against distortions of the oscillation amplitude of speech. In spite of considerable distortions of the amplitude, the spoken words are nevertheless recognizable, they remain distinct. From the point of view of understanding, changes in the amplitude of speech are therefore of negligible importance. The more important part of distinctness is the phase-modulation of speech. Phase-modulation means the rhythmic changes during speech as related to zero point. It has been proved experimentally that distinctress is maintained even in the case of a considerable transformation of speech frequency,

the so-called destructive transformation. This can clearly be proved by the so-called sound clipping method. The essence of clipping of a significant

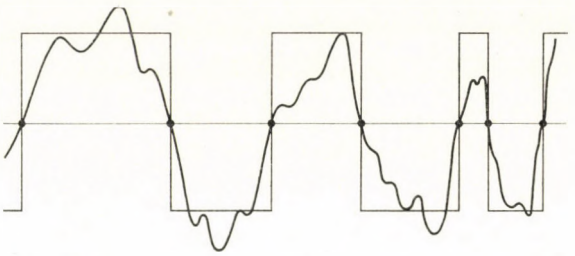

FIG. 1. Oscillographic form of normal speech-wave and its clipped variation

destructive transformation is seen in the following diagram (See Fig. 1).

In sound squaring, distortion is of such a degree that the speech amplitudes on the oscillogram disappear entirely and what remains is only an irregular square wave. If the zero transitions of this square-wave correspond to those of the original speech-sound, the speech is recognizable, it remains distinct. Zero transitions must thus be regarded as the genuine carriers of information of the contents of the communication (see Fig. 1).

The recorded cries were thus clipped by maintaining the original zero transitions. This was controlled by subjects trained to differentiate between the types of crying characteristic for two different age groups. If the subject will be able to differentiate the cries after squaring transformation, this will prove that the cry is an information carrier system analogous to that of speech.

The present investigations are still in the initial stage. All we have attempted now was to give an account of the method and to direct attention to the possibilities and significance of the objective analysis of infant cry, partly for the purposes of paediatric practice, and partly for those of developmental psychology.

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