

---

## SIGNIFICANCE OF ELECTROACOUSTIC AIDS IN DEVELOPMENT AND PERCEPTION OF LINGUAL SIGNALS IN THE YOUNG DEAF CHILD

DANUTA BORKOWSKA—GAERTIG\*—JANUSZ NOWOSIELSKI\*  
BOŻENA WIERZCHOWSKA

The development of speech in the deaf child should have a similar course to that of a healthy and normally hearing one, in whom always first appears the period of perceiving auditory notions unrelated to speech, next comes speech-perception, and then only appears the spontaneous speech-production. The method of speech formation in the young deaf child has to be based on the transmission of verbal information about the world it lives in, on rousing interest in it, this method must also tend to develop the child's communicativeness with the world of the hearing and speaking.

In order to afford speech-development to the socially deaf child, it has first of all to be taught to employ the possibilities of its own impaired hearing organ, and this should be done with the use of an amplifier—hearing aid and other acoustic devices.

### *AUDIOLOGICAL PROCEEDINGS AND AUDITORY REHABILITATION*

At the Otolaryngology Clinic of the Institute of Mother and Child, there has been introduced a trial hearing aid for every child with auditory impairment, thus taking account of both children not responding to acoustic stimuli and those responding merely to loud sounds.

Children lacking auditory response proper to their age, are not considered totally deaf, but retarded in auditory development, or socially deaf, thus not supplied with sufficient information by means of hearing.

With patients at the age 1, 2 and 3, responding to acoustic stimuli, the threshold of pain reaction is checked at the initial period, and with older children 2 audiometric curves are drawn initially without, and subsequently with, a hearing aid. The aim is to use binaural hearing aids for the whole day, and for that purpose has been elaborated the scheme (Borkowska-Gaertig) of auditory development. This scheme is divided into 2 periods:

---

\* Institute of Mother and Child (Director: Prof. B. Górnicki, M.D.), Clinic of Pediatric Otolaryngology (Chief: D. Borkowska—Gaertig, M. D.), Scientific Consultant: Prof. I. Cichocka—Szumilin, M.D.

I. — passive i.e. coding auditory notions, unconsciously and consciously. II. — active reproduction of coded auditory concepts.

Within the first period (1) the child is helped to cognize and code, through its subcerebellar and cerebellar centres, human and animal voices, sounds of toys and objects of everyday use, and noises of the immediate environment, (2) next the child is being trained in association processes connected with auditory stimuli, the differentiation of voices and noises from the environment, sounds of various musical instruments, sounds of different rhythms, etc.

II. — After the aforesaid training exercises the reproduction of the coded concepts may be commenced, for inst.: (1) reproduction of rhythm with the use of toys-noisemakers, instruments, a tape recorder, gramophone, and the child's own motoric organs, and its own voice, (2) reproduction of resonance vibration (by sense of touch) of objects emitting sounds (acoustic pressure), instruments, radio, etc., reproduction with its own larynx and "mask" (base) the vibration of the osso-cartilaginous system, (3) reproduction of intensities by modulating the wireless set's dial, tape recorder, amplifying device for auditory rehabilitation, by means of its own voice, (4) reproduction of frequencies with the use of noisemakers, etc., its own voice, and (5) reproduction of sounds from the environment, animal and human voices, such as laughter, crying, shouting and speech.

These preliminary exercises conducted over a period of 1, 2 or 3 years, with regards to the age and developmental possibilities of the particular child, teaches it to differentiate lingual signals from other sounds of the environment, and also prepares for creating spontaneous tendencies of reproducing verbal signals.

#### *SPEECH FORMATION*

Speech in the young deaf child is developed with the use of specially elaborated texts (Wierzchowska) for 2, 3 and 4 years old children. The vocabulary of these texts is limited to notions necessary in understanding and in contacts with the environment. For inst., for the 2 and 3 years old have been selected about 100 words, whereas the hearing child uses about 600. These texts are meant for everyday conversations, in the same form as used in contacts with the hearing youngster. Every sentence and each expression is to be used in a relating situation. That is, sentences relating to food are to be used at meals, etc. With children of 2 and older, there may and ought to be used not only actual objects, but also pictures illustrating them, models as well as toys. It is recommended that particular sets of texts ought to be repeated in their original form and as many times as needed for the child to remember and understand them. The criterium for whether the child understands the phrase before it can pronounce it, is the correct response to a message.

#### *ELECTRONIC APPARATUSES FOR SPEECH AND HEARING REHABILITATION*

With the purpose of providing for the auditory rehabilitation of children with hearing impairment and lacking speaking skills, there have been constructed (Nowosielski) 2 prototype devices: 1. the transistor amplifier with earphones, 2. the vibration device—an analyzer of the pitch of lingual sounds transposed to sensory vibration.

Ad 1. This amplifying device through microphones receives human voices, music, and other acoustic signals, then after amplification relays them to both earphones. This set is furnished with two microphones: an internal one for self-control, and a second one for the assistant conducting the auditory training. The voice volume control is separate for each earphone in the range of 0—110 dB, that allows of leveling the loudness between both ears. A special output socket and set of small cables provide for connecting it to any wireless set, TV set, or tape recorder. The characteristics of transmitted sounds can be flat in the range of 100—10 000 Hz, or separately controlled for low and high tones. With this amplifier may be used any dynamic earphones, headearphones, or miniature ones with individual ear inserts of a suitable transmitting characteristic in the range of 200 to 6 000 Hz. The resistance of the earphones can be enclosed within the limit of 8 to 60 Hz. This apparatus avails to children and adults with auditory impairment the rehabilitation of hearing and speech, correction of pronunciation defects, cognition of sounds from the environment, and the enjoyment of radio, TV, records, and magnetic tapes.

Ad 2. The vibration unit provides for initiation and correction of speech through sound reception by means of sensing the digital mechanical vibrators. Occurrence of vibrations and their amplitude depend on the volume of high and low frequencies of the tone's components in the voiced sonants of a particular word or syllable. This unit is furnished with a microphone connected to the microphonic amplifier operating with AVC (automatic volume control) compression. The signal of the AVC amplifier's output is transmitted to an 8-channel frequency analyzer containing LC filters. The voltage outputs of the analyzer after detection cause—each in its channel—the power to begin to be amplified and the occurrence of oscillation in the vibrators with a fixed frequency of about 300 Hz. The frequency band for each analyzer's channel, and the appropriate selectivity of the filters, have been selected with particular regard to the phonetic structure properties of the Polish language. The unit is furnished with 8 vibrators, 4 for the left and 4 for the right hand, placed in such a manner that both hands rest similarly to the position on a piano keyboard. The analyzed frequencies increase from the left to the right hand. The aforesaid device enables people with hearing losses ranging on bands of higher frequencies, to differentiate soft consonants such as *ś*, and hard ones like *s* (and also the so called buzzing consonants *s*, *z*, sibilants).

*EFFECT OF USING ELECTRONIC DEVICES IN DEVELOPMENT  
OF HEARING AND SPEECH*

After extending the general scheme of consultation for all children with auditory impairment in the country, which has been arranged by the Polish Association for the Deaf, and the Institute of Mother and Child in Warsaw, children from their infancy up to 4 years of age have been the centre of special care. Data compiled in 1967, show that about 75 percent of preschool children with auditory impairment have been supplied with hearing aids, within this number about 45 percent in training to speaking skills, benefit from the assistance of a logopedist, and the rest are subjects to auditory autorehabilitation. The reproduction and understanding of lingual signals in young preschool children have begun to be formed thanks to the earlier development of their auditory perception and cognition of sounds from the surrounding world.

From our initial experience it is deduced, that the early introduction of early acoustic rehabilitation of hearing before the development of speaking skills, forms the foundation for the developmental and intergrational processes of human speech.