

DEVELOPMENT OF CHILD SPEECH HEARING AT THE ONSET OF SPEECH

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Abstract

The results of the investigation of speech hearing indicated the ability of children aged from 18 to 4 months to recognize the words before they are able to differentiate the phonemes; the general tendency of phoneme differentiation revealed by N.H. Shvachkin is supported; the influence of the acoustic and speech motor analysers over the formation of phonemic hearing depends on individual differences in the development of one of them in the child.

Introduction

There are two important problems in the investigation of child speech hearing at the onset of speech: the order of phoneme differentiation and the influence of the speech-motor and/or acoustic analysers on the development of the phonetic hearing.

The stages of phonemic hearing development were revealed by N.H. Shvachkin /7/. The drawbacks in the methods used were criticized by O. Garnica and the results were partially confirmed in the experiments of M.G. Edwards /9/. That is why the problem was open to investigation. There are three points of view regarding the influence of speech motor and auditory analysers on the development of phonemic hearing. The adherents of the acoustic theory of speech perception suppose the phonemic hearing development to be based on the operations of the auditory analyser /8/. The supporters of the motor theory believe the formation of the phonemic hearing is impossible without the activity of articulatory organs /1/. Some scholars believe that only the interaction of hearing and articulation define the formation of phonemic hearing /7/. Before describing our experiments devoted to these two problems it is necessary to define the concept "speech hearing" differentiating it from the concept "phoneme differentiation" or "phonemic hearing". Speech hearing includes: 1. phoneme differentiation ability, 2. speech recognition. The mechanisms of differentiation and recognition that underlie these abilities in adults were investigated by N.I. Zinina /3/.

and E. Esenina /4/. While differentiating one singles out all the differential features of an object (the phonemes of the word, for ex.), the relations between them and in this way the image of an object is formed. The process of recognition is based on the image which has been already formed and "makes use" of some features referring to an object as a whole (the word structure features, length, different features of some phonemes).

Experiments

In our first preliminary experiment /6/ the general problems of child phoneme differentiation and recognition were investigated. The problems were: to find adequate methods of infant speech hearing investigation; to find out the relation between child phoneme differentiation and word recognition; to find out what sounds in the words of different length are the most informative for recognition. Two groups of children: (3 children in each group), speaking and non-speaking at the age from 1,8 to 2 years took part in the experiment.

The results pointed to the absence of difference in compared groups both in the number of phonemes differentiated and in the number of words recognized. The features used in recognition changed according to the word context. The words had been recognized before all the phoneme differentiations were achieved. The most informative for the recognition were: the stressed vowel, the vowel after the stressed syllable, the first sound. (The same results were obtained with the grown-ups /5/.

In our next preliminary experiment /6/ the succession of phoneme differentiation and the recognition process were under investigation. The subjects were 4 non-speaking children and 5 speaking children at the age of about 2 years old. The experiments confirmed the succession of phoneme differentiation achieved by N.H. Shvachkin. The experiment also suggested that non-speaking children could achieve the same level of phoneme differentiation as speaking children. While not being

able to differentiate phonemes the children used acoustic features in the recognition of 49 names of objects. In the concluding experiments /6/ the following problems were under investigation: the ability to differentiate phonemes by speaking and non-speaking infants to follow the role played by motor and hearing analysers in phonemic hearing; the succession of phoneme differentiation in the groups of speaking and non-speaking infants. We also wanted to find out whether the time of the first word of non-speaking infants depended on the previous success with phoneme differentiation.

We supposed (according to N.H. Shvachkin /7/) that the differentiation of one and the same phoneme by different children may be based either on the acoustic or upon the motor analyser depending upon the individual degree of its development. But there may be some regularities of the interaction of both analysers that depend upon non equal difficulties in the pronunciation or recognition of different sound groups. In order to define these regularities we supposed that three sequences should be compared: 1) the sequence of phoneme differentiation /7/; 2) the sequence of articulatory differentiation which is obtained from the observation of the children's sound pronunciation acquisition /1/; 3) the sequence of the recognition of the same pairs of sounds by speaking children which was obtained in the experiments with some noise interference /1/.

The sequence of acoustic and motor differentiations was defined by the order of sound appearance in the pronunciation of the child or by the order of its recognition. This was done on the supposition that after the given child had mastered the pronunciation of the latest sound in the pair, or had recognized it we would take the differentiation (acoustical or motor) of this pair of sounds for granted. The relative order percentage of phonemic, acoustic and motor differentiation acquisition of the same pairs of sounds is reflected in diagram N 1. (p. 3). Judging from the data in the diagram, some conclusions can be drawn about the interaction of acoustic and motor differentiations which influence the formation of the phonemic ear.

1. In the case of phonemes [p, c, 3, u, x] the articulatory differentiation lags behind the auditory very considerably. That means that this phoneme differentiation may be based on some acoustic differences in the sounds which calls forth

7. The acoustic qualities of the sound include not only phonemic but all other characteristics.

some articulatory changes leading to the articulatory differentiation of these sounds. In other cases difficulties in the pronunciation lead to a lag in phoneme differentiation of soft and hard sibilants (in Russian), sonorants and non-articulatory voiceless sounds.

2. In the case of phonemes [п, т, к, д, л, г, в, с, ш, ж, х, ф, м] the development of the phonemic ear is based upon their articulation, with acoustic differentiation following it. It should be born in mind that these tendencies are likely to change under the influence of the child acoustic and motor individual development. For the purpose of testing some of these suppositions, the following experiment has been carried out.

Subjects. 17 children aged from 1 year 5 months to 1 year 9 months. Four from 5 speaking children of the control group could produce sentences. The experimental group consisted of 12 non-speaking children who could pronounce only: "МАМА ПАПА, БАХ, БУ-БУ, ДА-ДА". All the children had parents speaking only one language (Russian). Their hearing was normal. They were on the 6th stage of sensory-motor intellectual development (according to Piaget). Their ability to understand speech and to speak was checked up. Our hypothesis was that the group of non-speaking children bases their phoneme differentiation on the acoustic properties of the speech sounds given in diagram N 1. The experiment lasted for two and a half months.

Material. In the experiment 35 control cards and 28 experimental cards were used. The control cards presented pictures of objects familiar to the children. The exp. cards presented objects having monosyllabic names and differing only in one phoneme. They reflected the 9 stages of phonemic development given by N.H. Shvachkin /7/.

Procedure. First, the Exp. taught the children to recognize and differentiate the control cards shown to the child in chance order (3 or 4 at a time) until they all could recognize and point to the card (when asked) very quickly and without any mistakes. After this the Exp. passed to presenting control pairs of cards. A pair of cards differing in one phoneme was put before the subject. Four commands had to be fulfilled with each word. The commands were: "Point to..., give it, put it into the box, take it out of the box". Each pair was presented 8 times. Every subject had to differentiate 4 or 5 pairs of words at each experiment. Every child participated in the experiment once a day for 20 minutes, five times a week.

Discussion of the Results. In O.K. Garnica's experiments /10/ only the fact of the differentiation on non-differentiation of the phonemes of the pair was

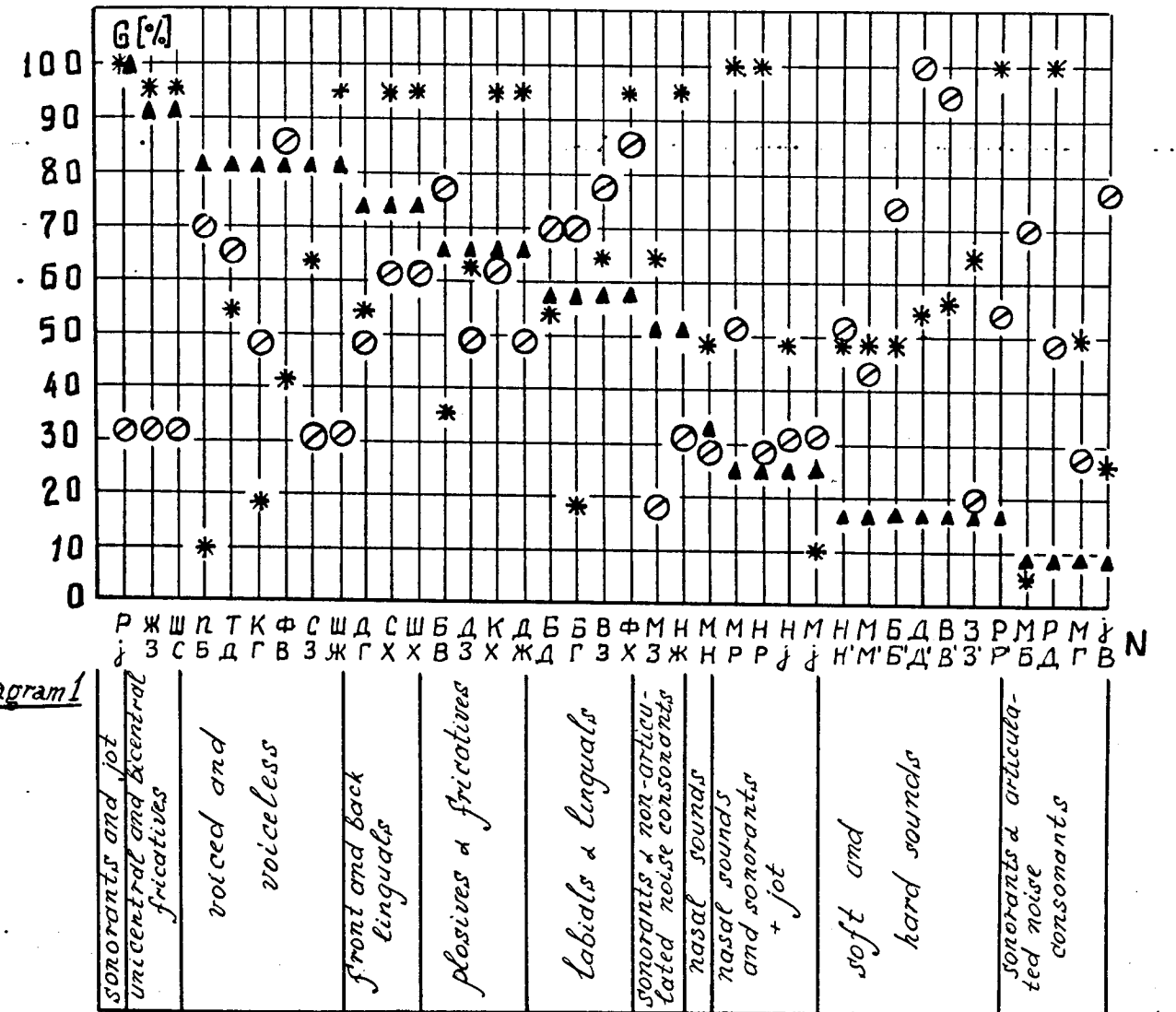
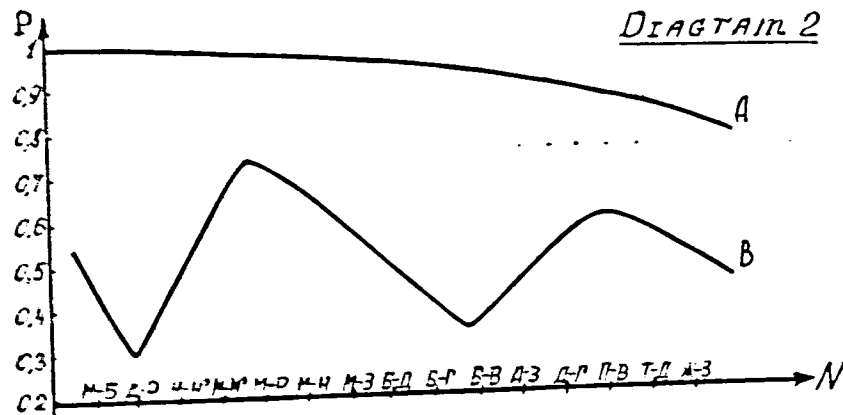


Diagram 1

* - motor differentiations
 ▲ - phonemic differentiations
 ○ - acoustic differentiations
 G - relative order percentage of phonemic, acoustic, motor differentiations
 N - phonemic, acoustic and motor differentiations

into account. We supposed that the figures showing the ratio of the number of the subjects' correct choices to the number of all the choices which define the degree of phonemic differentiation can also be taken into account. Diagram N2 (p.4) shows the dependence of the probability of correct choices by every subject on the stages of Shvachkin's scheme of phonemic development (19 pairs). According to their results all the subjects were divided into two groups: with low probability of correct choices (less than 50% - nine subjects of the exp. group; and with high probability of correct choices (more than 50%) - 8 subjects, 3 from exp. group and 5 from contr. group. The data of

three experimental and five contr. subjects is shown on the same upper curve A of a monotonous character. The results show that the success of the first 8 points of phonemic differentiation come close to 95%-100%. From the 9th point an almost linear lessening of the differentiation of the given phonemes is observed. The same held true for vowel-phonemes. This proves Shvachkin's scheme of phonemic development. The results also show that three non-speaking subjects differentiated all the given pairs of phonemes as well as all the speaking subjects. For the other 9 subjects of the exp. group, the curve of differentiation -B has a polyextremal character, with periodic rises



and falls in the distinguishing of some phonemes.

The Spearman correlation range coefficient between the probability of phoneme differentiation and the order of acoustic (CKA) and motor (СМ) differentiating was calculated. CKA=0,54 - correlation is statistically meaningful. СМ=0,01 (statistically non-meaningful). That means that the better is the recognition of the most difficult sounds of a pair, the higher is the probability of phoneme differentiation of this sound for the given non-speaking subject.

In some months after the experiment we asked the parents of our non-speaking subjects about the time they began to speak. We calculated the Spearman coefficient between the children level of phonemic differentiation and the number of months which were necessary for them to begin speaking. It appeared to be 0,72 - the correlation was statistically evident.

Conclusion

Summing up our results of child speech hearing investigation the following conclusions can be drawn: before being able to differentiate the phonemes the child can recognize the words properly, this recognition is evidently based on non-phonemic acoustic features of the word; the most informative for recognition elements are: the stressed vowel, the vowel after the stressed syllable and the first sound of the word; the general tendency of phoneme differentiation coincides with that discovered by W.H. Orvaschel; speaking children can differentiate phonemes better than non-speaking ones, it points to the positive influence of articulation over phoneme differentiation; non-speaking children can differentiate phonemes quite well using use of acoustic but not motor characteristics of the phonemes; the time necessary for non-speaking children to master the recognition of the first words is positively correlated with the level of phoneme differentiation; that is one can see the positive influence of phoneme differentiation over the mastering of non-speaking children.

That is why we can say that the development of hearing and speech motor analysers is of euristic character. The part these analysers play in the formation of phonemic hearing changes in connection with what plays the leading part (develops faster) in the individual development of the child: his articulation or phoneme differentiation. If the hearing and motor analysers develop simultaneously, the development of the phonemic hearing may depend on the difficulties in motor and acoustic differentiations of sounds.

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