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. Shvechkin is supported; the influence of the acoustic and speech motor analyzers 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 analyzers on the development of the phonetic hearing. The stages of phonemic hearing development were revealed by N.H. Shvechkin /1/. The drawbacks in the methods used were criticized by O. Gernica 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/or auditory analyzers 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 analyzer /6/. 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. 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 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 lengths 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. Shvechkin. 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 conclusion paragraphs of the following problems were under investiga-
tion: 1) the ability to differentiate phonemes by speaking and non-speaking ins-
tants to follow the role played by motor and hearing analysis in phonemic hearing: the succession of phoneme differentiation in the groups 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 differen-
tiation.

We supposed (according to N.K. Shchuchkin's theory) that the last stage of articulation differentiation of one and the same phoneme by different children may be based either on the acoustic or on the motor analyser depending upon the individual degree of its development. But there may be some regularities in the interaction of both analysers that depend upon phonemic features in the pro-
unciation or recognition of different sound groups. In order to define these regularities we supposed that three se-
quences should be compared: 1) the sequence of phoneme differentiation (/), 2) the sequence of articulatory differentiation which is obtained from the observation of the children's articulation and pronunciation acquisition (Groups); 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 (/).

The sequence of acoustic and motor difference was determined by the order of sound appearance in the pronunciation of the children or by the order of its recogni-
tion. This was done in 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 it (acoustic or motor) of the pair of sounds for the next test. The relative order percentage of phoneme, acoustic and motor differentiation acquisition of the same pairs of sounds is shown in diagram (p. 3). 

Judging from the data in the diagram, some interesting conclusions can be drawn about the interaction of acoustic and motor differ-
entiating systems in the formation of the phonemic ear.

The results were: "Point differentials c, c', c", w/the articulatory differentiation lags behind auditory very considerably. This means that these phoneme differen-
tiations may be based on some acoustic differences in the sounds which were forth-

1. The acoustic qualities of the sound include only phonemic but all other characteristics.

Diagram

\[ \begin{align*}
\text{Diagram} & \\
\text{motor differen} & \quad \text{acoustic differen} & \quad \text{phonemic differen} \\
\text{tiation} & \quad \text{tiation} & \quad \text{tiation}
\end{align*} \]

6 = relative order N = phonemic, acoustic, percentage of motor phonemic, acoustic, differentiations.

into account. We supposed that the figures showing the ratio of the number of the sub-
jects' correct choices to the number of all the choices which define the degree phonemic differentiation can also be taken into account.

Diagram (p. 4) shows the dependence of the probability of correct choices by every subject on the stages of Shchuchkin'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. sub-
jects is shown on the same upper curve A of a monochromatic character. The results show that the success of the first 8 po-
ints of phonemic differentiation close to 95% and 85% from the 9th point an almost linear increase of the differenti-
ation of the given phonemes is observed.

The same held true for vowel-capitalism. This proves Shchuchkin's scheme of phonemic development. The results also show that three non-speaking subjects differ-
entiated 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 pos-
exyphal character, with periodic rises

Se 34.4.2

Se 34.4.3
and falls in the distinguishing of some
phenomes.
The Spearman correlation rank coefficient
between the probability of phoneme differ-
erentiation and the order of acoustic (CA)
and motor (CM) differentiation was calcu-
lated. CA(CM) = correlation is statistically
meaningful, CA(CM) = correlation is
statistically non-meaningful, it means that the better
is the recognition of the most difficult
sound of a pair, the higher is the proba-
bility 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 sub-
jects about the time they began to speak.
We calculated the Spearman coefficient be-
tween the children level of phonemic differ-
erentiation 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 be-
ting investigation the following conclusions
can be drawn: before being able to dif-
erentiate the phonemes the child can rec-
ognize the words properly, this recogni-
tion is evidently based on non-phonemic
semantic features of the word; the most im-
portant 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 discov-
ered by N.K. Shveckikh; 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 taking
use of acoustic and not motor characteris-
tics of the phonemes; the time necessary
for non-speaking children to master the
pronunciation of the first words is posi-
vately correlated with the level of phoneme
differentiation, that is one can see the
positive influence of phoneme differentiation
over the articulation of non-speaking
children.

That is why we can say that the develop-
ment of hearing and speech motor analyses
is of a heuristic character. The part these
analyses play in the formation of phonemic
hearing changes in connection with
what plays the leading part (develops fa-
ter) in the individual development of the
child: his articulation or phoneme differ-
erentiation. If the hearing and motor anal-
yses develop simultaneously, the develop-
ment of the phonemic hearing may depend
on the difficulties in motor and acoustic
differentiations of sounds.

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