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Speech perception by left-handed preschoolers with different types of hemispheric laterality

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Abstract

The aim of the study was to examine the characteristics of speech perception while teaching a foreign language to left-handed preschoolers. The relevance of the study is based on the insufficient state of knowledge of the issue and a new approach to the issue of left-handedness. Currently, left-handed children are no longer retrained and that was the reason for creation of different educational technologies. The study used interesting methods of speech study: the differential hearing sensitivity determination technique by J.A. Vedenyapina, the dichotic listening technique by D. Kimura adapted by B.S. Kotik. Conclusively significant differences were found when we compared most of the indicators in the group of left-handed preschoolers with different types of Functional Brain Asymmetry (FBA). There were conclusively significant differences identified by comparing the left-handed and right-handed preschoolers with strong right hemispheric laterality at all levels of differential hearing sensitivity. The results can be used by teachers of various types of educational institutions, as well as the parents of left-handed children.

Keywords: speech perception, hemispheric laterality, left-handedness, foreign language speech

1. Introduction

Children with special needs fall within the area of special attention under the conditions of innovative transformations in the sphere of education. Left-handed children, too, belong to this group. Currently we are increasingly often seeing unretrained left-handed preschoolers while ambidexters are rare, too.

For the purpose of a child’s compliance with certain standards of education his parents forcibly retrained him to write and work with his right hand, which almost always became a psychotraumatic situation for the

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child. In addition to the focus on some dissimilarity to other children, retraining itself resulted in psychoemotional and cognitive stress.

Due to the actualization of this issue, the majority of teachers and parents have shifted their position from retraining a left-handed child to accepting his nature and offering educational technologies that are comfortable and ergonomic for him, taking into account his view of life and reflection of the environment.

A child’s left-handedness does not mean trivial actions with the left hand, left-handedness means a cerebral organization of cognitive functions completely different from that of the right-handed, which must be considered in education and training [1]. The study of left-handedness issues by national and foreign scholars is presented from the viewpoint of the brain functional laterality, characteristics of the cognitive sphere, attempts have been made to study the causes of left-handedness [1].

However, the issue remains open to research. There are practically no studies on left-handedness in the preschool period of a child's life [1]. In connection with the above, special significance is given to study of the cognitive sphere of a left-handed child, in particular to speech as a basis of the cognitive activity of a person. Speech and language are complex cognitive-perceptual systems, which include the development and functioning of all cognitive processes. Currently, this is reflected in the integrative theory of speech which, in our opinion, is an innovative step not only in psychological science, but also in linguodidactics and linguoeducational psychology [2].

Of particular interest is the relationship between qualitative and quantitative indicators of speech development and attentive-mnestic characteristics, especially in foreign language acquisition. Qualitatively formed attentive characteristics are the key to a highly productive and efficient mnestic activity of a student.

In our view, innovative methods of formation and development of the cognitive sphere consist of rehabilitation of traditional auditory-verbal learning technologies: storytelling, retelling, listening tasks with different kinds of information presentation. This, in turn, encourages concentration, perseverance, discipline and obedience [3].

2. Method

Analysis of the relevance of the study and definition of the objective prerequisites allowed us to formulate the aim of this research - to study the characteristics of speech perception by left-handed preschoolers with different types of functional laterality.

To implement the study we used the differential hearing sensitivity determination technique by J.A. Vedenyapina (1979) and the dichotic listening technique by D. Kimura adapted by B.S. Kotik. Participating in our study were 20 left-handed preschoolers. They formed the control sample. The subject was the cognitive sphere (speech perception) of left-handed preschoolers with different types of functional laterality (FL).

At the first stage, the subjects were offered dichotic listening technique by D. Kimura adapted by B.S. Kotik [4]. In contrast to the differential hearing sensitivity determination technique (DHS), this technique interested us in terms of the indicator of sensitivity to the articulatory aspect of speech, i.e. phonemic. The indicator, which can give such information - ER (efficiency ratio) represents the number of correctly reproduced words.

As a result of playing dichotic verbal series we determine the right ear coefficient (REC) using the formula: \(REC = (R - L)/(R + L) \times 100\%\) where R is the total number of correctly reproduced words using the right ear, L is the total number of correctly reproduced words using the left ear. Basically, REC may vary from +100% (stimuli are reproduced only using the right ear) to -100% (stimuli are reproduced only using the left ear). REC positive values determine a relative prevalence in reproduction of the units, presented to the right ear. The indicator P (productivity) means the number of all correctly reproduced words using both sides, that is R + L. The efficiency ratio \(ER = (P-E)/(P+E) \times 100\%\), where E is the number of errors made, i.e.,
incorrectly reproduced words. Thus, applying the technique, one can use all three indicators for the interpretation of the results.

The idea of the study is to get results for intonational and phonemic hearing sensitivity, which will allow us to determine the quality of language acquisition through listening and the quality of subsequent reproduction. The technique can be used to determine the quality of native language acquisition, and the ability of foreign language acquisition [4].

At the second stage of the study, the subjects were offered the differential hearing sensitivity determination technique by J.A. Vedenyapina [4]. They were asked to listen to ten sentences in a language they didn’t know (Spanish) with the intonation either changing or remaining unchanged. The child had to determine whether the intonation had changed. The high level of differential hearing sensitivity is determined in case of 90-100% of correct answers, the medium level is in case of 60-80%, the low one is in case of 50% or less. This test provides an indicator of the intonation type of hearing sensitivity. Presumably, left-handed preschoolers must have high indicators, because the right hemisphere dominant for speech in case of left-handedness is responsible for the intonational aspect of speech.

At the third stage we computed the results using the F-test.

3. Results and discussion

At the first stage of the study, according to the results of the dichotic listening technique, our subjects, both left- and right-handed, were distributed across several sub-groups according to the type of the dominant hemisphere for speech. At the second stage, we received the results for differential hearing sensitivity in these subgroups, and provided data in Tables 1 and 2.

<table>
<thead>
<tr>
<th>Table 1. The results of the Vedenyapina technique (DHS) and the Kimura technique (dichotic listening) in the group of left-handed preschoolers (%)</th>
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<td><strong>Left-handed with different type</strong></td>
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<td>of FL</td>
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<tr>
<td>Right hemispheric Strong REC less than -15% (3%)</td>
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<td>Right hemispheric REC less than -5% (10%)</td>
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<tr>
<td>Lack of laterality -5% to +5% (80%)</td>
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<tr>
<td>Left hemispheric strong REC more than 15% (7%)</td>
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In Table 1 we can see that high DHS prevails among the left-handed respondents with a lack of laterality and the respondents with a predominance of the FBA hemispheric type. Left hemispheric ones do not have a high level of DHS in our sample, and are distributed between medium and low levels. The biggest indicator of low level of DHS is in this subgroup. This can be explained by the fact that the right hemisphere is responsible for the differentiation of intonational-rhythmic aspects of speech and the left hemisphere is responsible for semantics and word formation, speech production proper. Preschoolers with the left hemispheric FBA are less sensitive to the tone of the speech at the first stage of acquaintance with a language than right hemispheric kids regardless of their dominant hand.

In addition to the classic preferences of the left hemisphere for speech, left-handed preschoolers are dominated mainly by the right hemisphere due to the dynamic motor activity of the left hand. Thus, we can talk about bilateralism of the hemispheres for speech. And the bilateralization of the hemispheres for speech suggests, in turn, the presence of flexible styles of foreign language acquisition. On the one hand, it is a good adjustment to grammar-translation style and a style, closer to the natural type of speech acquisition, emotionally and expressively, when the intonational-rhythmic aspect of speech comes to the fore. Flexibility of acquisition
strategies for both native and foreign language is higher, when the two hemispheres of the brain are more developed and respond to different language teaching methods. In this case, the child uses equally both representational systems - visual and auditory.

As for the right-handed preschoolers, the results in the subgroups are as follows.

Table 2. The results of Vedenyapina’s technique (DHS) and Kimura’s technique (dichotic listening) in the group of right-handed preschoolers

<table>
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<th>Right-handed with different type of FBA (%)</th>
<th>DHS indicators</th>
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<tr>
<td></td>
<td>High (90-100)</td>
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<tr>
<td>Right hemispheric Strong REC less than -15% (10%)</td>
<td>4%</td>
</tr>
<tr>
<td>Right hemispheric REC less than -5% (10%)</td>
<td>56%</td>
</tr>
<tr>
<td>Lack of laterality -5% to +5% (60%)</td>
<td>65%</td>
</tr>
<tr>
<td>Left hemispheric strong REC more than 15% (20%)</td>
<td>-</td>
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</tbody>
</table>

The medium and low DHS levels are characteristic of right-handed preschoolers with strong hemispheric laterality and both high and medium DHS levels are equally characteristic of respondents with moderate hemispheric laterality and the lack of laterality. Right-handed preschoolers with strong left hemispheric laterality are characterized by the medium DHS level.

To see the characteristics of speech perception by left-handed preschoolers it is necessary to compare their indicators with those obtained in the group of right-handed preschoolers. Right-handed preschoolers, who use the right hand when writing as well, differ from each other by the FBA type. The most successful in foreign language speech acquisition are those with a lack of laterality, that is, the opportunity of flexible information acquisition and orientation to the methodological characteristics of teaching. At the early stages of language exploration, during the immersion in the language environment, the differential hearing sensitivity of the speech comes to the forefront that is the opportunity for a keen distinction of the intonational-rhythmic aspect. Accordingly, at the first stage of language acquisition, the preference is given to the right hemisphere, then the left hemisphere steps in with the comprehension of the vocabulary and semantics of words, concepts, semantic context of speech is captured. The subtle distinction between the emotions, intonations, age and gender nuances of speech - this is the responsibility of the right hemisphere. Left-handed preschoolers form pronunciation successfully; they quickly catch the nonverbal intonation characteristic, which contributes to a minimum accent in the foreign language.

The result of the mathematical data processing indicates the presence of conclusively significant differences when comparing the left-handed and right-handed preschoolers with strong right hemispheric laterality (REC less than -15%) for all levels of differential hearing sensitivity: the high level of differential hearing sensitivity us \( \varphi = 4.44 \) with \( p = 0.01 \), the medium DHS level is \( \varphi = 2.48 \) with \( p = 0.01 \) and the low DHS level is \( \varphi = 4.61 \) with \( p = 0.01 \). Therefore, we can say that the medium and low DHS levels are characteristic of right-handed preschoolers with strong right hemispheric laterality, and the high DHS level is typical of left-handed preschoolers with strong right hemispheric laterality.

To make the analysis of left-handed preschoolers’ speech perception characteristics complete, we paid attention to the productivity and efficiency of speech perception and the main speech acquisition indicators at different stages. Efficiency and productivity are based on such mental processes as attention and memory. First of all, speech itself includes memory mechanisms. On the one hand, it is symbolic, and, on the other, it is imaginative. Verbal symbol codes, word images exist on the basis of memory. Memory is always involved in the process of speech production, but memory itself can have a linguistic nature by functioning in verbal codes and images.

In order to identify significant differences in the representation of different levels of productivity and efficiency between left-handed and right-handed preschoolers, the statistical data was processed using the F-test. No
conclusively significant differences in the given indicators of efficiency and productivity of left- and right-handed preschoolers were identified. This can be explained by the age characteristics. The level of memory and attention is not sufficiently formed at the primary school age of 10-11. Productivity and efficiency of memorizing can be affected by various factors - individual characteristics, the volume of short-term auditory-verbal memory. Despite this, left-handed preschoolers showed a more subtle differential hearing sensitivity due to the functional laterality of the hemispheres. As it was shown in the theoretical part of the work, left-handed preschoolers have a different organization of hemispheric interaction and due to the activity of the left hand the right hemisphere functions vigorously and actively, especially in the formation and development of cognitive processes.

Firstly, the right hemisphere is responsible for the intonational-rhythmic aspect of speech, and in the case of left-handedness it is more susceptible to stress due to the transfer of the functional center of gravity.

Secondly, it is commonly known that fine motor skills develop certain brain structures responsible for integrative cognitive processes, such as speech. And accordingly, a constant use of the left hand develops the right hemisphere more actively in left-handed rather than in right-handed preschoolers.

4. Conclusion

As a result of the psychological and mathematical data analysis, the following conclusions were reached:

1. 80% of the left-handed preschoolers made it into a favorable range for foreign language speech acquisition. It matches high DHS indicators as bilateralization of the hemispheres for speech requires flexible styles of foreign language acquisition. On the one hand, it is a good adjustment to the grammar-translation style and a style closer to the natural type of speech acquisition, emotionally and expressively, when the intonational-rhythmic aspect of speech comes to the fore.

2. Conclusively significant differences were found when comparing most of the indicators in the group of left-handed preschoolers with different FBA types. We can say that for the left-handed preschoolers with the right hemispheric type of laterality (strong and REC is less than -5%) and the lack of laterality is characterized by high differential hearing sensitivity. The medium level of differential hearing sensitivity is characteristic of left-handed preschoolers with the left hemispheric strong FBA type (REC is more than 15%).

3. We conclusively identified significant differences when comparing the left- and right-handed preschoolers with strong right hemispheric laterality (REC is less than -15%) for all levels of differential hearing sensitivity. The medium and low DHS levels are characteristic of right-handed preschoolers with strong right hemispheric laterality, and the high level is characteristic of left-handed preschoolers with strong right hemispheric laterality.

Thus, we can say that the speech perception of left-handed preschoolers is different from that of right-handed preschoolers. They have more subtle differential hearing sensitivity, because of the considerable speech development of the right hemisphere, which is responsible for the perception of the intonational-rhythmic pattern of speech. The dichotic listening test confirmed our assumption that the left-handed preschoolers get to the favorable range by the quality of perception of foreign language speech.

The results can be used by teachers at various types of educational institutions, as well as by the parents of left-handed children.

References