

UDK 159.922.73:376.37

BBK IO972.7+Ч457

GSNTI 14.29.29

Code VAK 13.00.03

**T. G. Wiesel**

Barnaul, Russia

### **ARTICULATION AND ITS DISORDERS (A THEORETICAL STUDY FROM THE POSITION OF NEUROPSYCHOLOGY)**

**Abstract.** The article analyzes the causes of differences in acquisition of articulate speech in preschool children (aged from 1 to 6 years). The analysis has been performed from the positions of neuropsychology on the basis of generalization of the data from the literature on the topic and the author's own experience of many years. It is shown that rearticulation and spontaneous articulation are different kinds of speech. The author stresses that articulation is effected by different levels of brain structure. Rearticulation is realized by the secondary (gnostic-praxic) cortex of the brain, and spontaneous articulation — by the tertiary (symbolic, linguistic) one. Accordingly, the first kind of articulation refers to the phonetic level of the speech functional system, the second one — to the phonemic (phonological) level. The article shows that the levels of acquisition of phonetic and phonemic articulation do not always coincide. Consequently, we may observe dissociations: the child is able to repeat words, and cannot articulate them spontaneously. Reverse cases, when the child is able to produce spontaneous articulation but cannot repeat words, are possible but less typical. However, they are less common. The suggested approach made it possible to arrive at the following conclusions: a) about the specificity of development of articulation skills and about the peculiar character of the children's expressive speech; b) about the main algorithms of speech acquisition at different stages of speech development. The article includes illustrative material in the form of clinical observations. They carry the main anamnestic information, describe the behavior of the child during consultation, and the general state of their speech and articulation skills. The article contains analyses of clinical statuses of children and their speech diagnoses.

**Keywords:** children's speech; speech absence; preschool logopedics; preschool children; articulation; spontaneous articulation; neuropsychology; articulate speech.

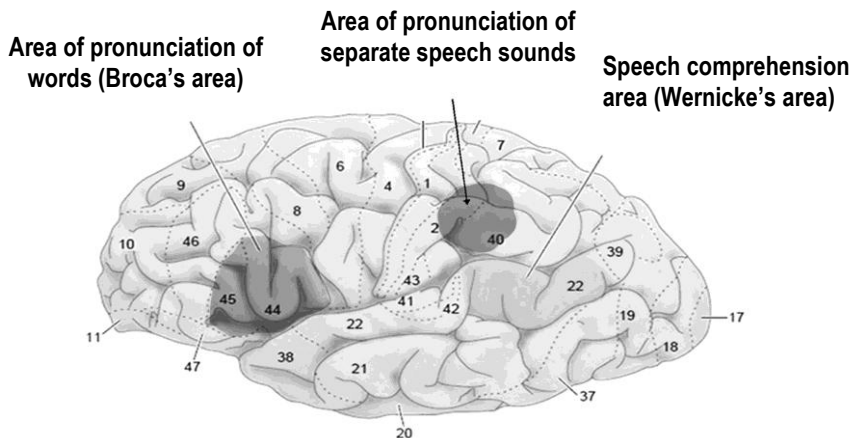
**About the author:** Wiesel Tat'yana Grigor'yevna, Doctor of Psychology.

*Place of employment:* Professor of Department of Special Pedagogy and Psychology, Altai State Pedagogical University, Barnaul, Russia.

*E-mail:* vizel@list.ru.

**Problem statement.** Within the framework of traditional neurology, the notion of praxis formulated by H. Liepmann [15] is widespread. Further developing the theory of H. Liepmann, A. R. Luriya [9] singled out two kinds of articulation praxis: afferent praxis and efferent praxis.

Afferent articulation praxis (AAP) is associated with the secondary areas of the *parietal* cortex of the left hemisphere; efferent articulation praxis – with the secondary areas of the *premotor* cortex of the same hemisphere (Fig. 1).



**Figure 1.** Main brain regions involved in language processing

In spite of the fact that the abovementioned functions have been studied well enough, special literature *does not give proper attention* to the idea that utterance articulation is effected on two different levels of speech, and specifically on the level of *rearticulation* and the level of *spontaneous* speech. Essential differences between their linguistic specificity and brain organization are not emphasized in literature. Meanwhile, it is beyond doubt that there is principal distinction between linguistic and neuropsychological essence of rearticulation and spontaneous speech and, respectively, between the brain mechanisms involved in their realization.

In view of the above, it is necessary to specify that the child acquires articulation as the necessary component of any oral speech both on the basis of verbal auditory gnosis (*rearticulation*) and on the basis of phonemic competence, in neuropsychology referred to as phonemic awareness (*spontaneous* speech). It is quite clear that these are different phenomena. In order to repeat a speech sound or a word, even without understanding it, it is enough to hear it (distinctly) and then to translate it into articulatory movements. But in order to pronounce a word spontaneously, without repeating it after somebody else, it is necessary to have a certain idea about its phonemic composition. Each articu-

leme in the word pronounced spontaneously plays a certain semantic role, and is, therefore, an equivalent of a phoneme. The phoneme can be translated into a letter, if the word is realized in the written variant of speech, and not in the oral one. A letter is also an equivalent of a phoneme. This allows stating the following: in word rearticulating, articulemes are phonetic units (provisionally – units of speech), and in pronouncing the word spontaneously, articulemes are phonemic units (provisionally – units of language).

Based on what has been said above, it seems important to note the following. The child acquires speech by ear, but in an unconscious and conscious utterances hearing plays different roles. Articulation without the auditory images of speech sounds and words, i.e. in utterances produced on one's own, are more likely to be called spontaneous articulation (SpArt). Such consideration “distracts” from the purely praxical essence of the speech motor act, which goes beyond the frames of articulatory movements proper and serves the task of transfer of the *sense* of the pronounced entity.

Without taking into account the differences between articulation operations in these kinds of speech, it is impossible to understand the specificity of various articulation disorders, and specifically why in clinical practice we come across: a)

children who understand words and repeat them, but cannot pronounce words spontaneously; b) children who understand words, can say some of them on their own, but cannot repeat them (seldom!).

This fact is paid no attention to in literature, and it is only natural that the question about the causes of the discussed *dissociations* in acquisition of articulation skills is left beyond the scope of special research. Meanwhile, their discovery is of prime importance both for neuropsychological and neurolinguistic understanding of the phenomenon of articulation as a kind of speech and its disorders. It is equally significant for the choice of ways of correction of articulation defects.

### **Peculiarities of brain organization of the aspect of speech articulation.**

According to N. A. Bernstein [1], higher psychological functions (HPF) are governed by two levels of brain organizations, which he called gnostic-praxical (level D) and symbolical (linguistic – level E). Such functional differentiation of the given levels is also supported by the founder of neuropsychology A. R. Luriya [9]. As follows from the terms themselves and their generally accepted interpretations, speech on the gnostic-praxical level (rearticulation) is limited to perception and reproduction of speech acts and does not spread upon their se-

mantic component; on the symbolic, linguistic level speech acts (spontaneous speech) are performed in order to extract *meaning* from the utterance perceived or to express though in the word. In her book “Developmental Phonetics” [6], E. N. Vinarskaya writes: “... it is desirable to have “two sciences about sounds”; one of them would focus on speech, the other – on language. This corresponds to the view of speech sounds as phonetic and phonemic units by the founders of phonology S. V. Knyazev [8] and N. S. Trubetskoy [13]. Keeping in mind periodization of child development, this position should be complimented by the assumption that *in each developmental period there is its own phonetics and its own phonology*” [6, p. 8]. As we see, E. N. Vinarskaya, the same as many contemporary linguists, correlates phonetic system with *speech*, and phonemic system – with *language*.

The suggested division of articulation skills as belonging to rearticulation and spontaneous speech seems to be absolutely imperative and highlighting many previously fuzzy phenomena of speech disorders, and not only in children but also in adults with aphasia. This idea was expressed by the author in her earlier publications [4; 3; 2].

**Articulate speech disorders and their brain mechanisms.** Articulation disorders have different manifestations at each stage of on-

togenesis. Articulate speech development periodization used in the given paper is based on the literature on speech ontogenesis [7; 10; 14; 12], as well as on the assumption that the child must have a well-formed functional basis of speech (thinking, memory, attention). This has been shown in another work written in co-authorship with O. Yu. Tsvirko [5]. It is quite evident that pathological conditions of the vocal apparatus muscles (paralyses, pareses) should be also excluded.

The results of our observations show that the inability to articulate in children of different ages acquiring speech can be *primary* and can belong to the following kinds:

- total absence of articulate speech;
- partial presence of rearticulation with absence of ability to speak on one's own;
- dissociated state of articulate speech, when rearticulation is impossible, and fragments of independent (spontaneous) speech may be present.

As a result of our search for the reasons of these variants of disorders we have found out that they might be attributed to two main factors: 1) poor formation of the primary functions, specific for the ability to articulate – auditory verbal gnosis and phonemic awareness; 2) disruption of *ties* between the areas which should be specialized in the given period of verbal speech development. Below, these two causes will be dealt with in detail with relation to each variant, including the ties between brain hemispheres.

The table indicates the stages of expressive speech development and includes disorders characteristic of each of them.

The table shows that four stages of speech development are supported by the gnostic-praxical level of brain organization of speech function, and the fifth level – by the higher symbolic (linguistic) level.

Let us dwell in more detail on most informative clinical variants of expressive absence of speech.

Table.

## Kinds of “expressive” absence of speech

Stage of speech development	Kind of articulate speech disorder	Disorder variants and their brain mechanisms
I. Beginning with 5-6 months	Absence of cooing, babbling	Poor state of reflective sphere (cooing) and ability to listen to the speech of surrounding people (babbling)
II. By 9-11 months	Absence of onomatopoeias	First — non-verbal auditory agnosia; second — inadequacy of interzonal ties between the auditory area of the right hemisphere and the speech motor secondary parietal cortex of the left hemisphere
III. (about 1 year)	Absence of onomatopoeic words	First — verbal auditory agnosia; second — inadequacy of interzonal ties between the secondary temporal auditory area of the hemisphere and the speech motor secondary parietal cortex of the left hemisphere
IV. Beginning with year 1	Absence of ability to repeat words	First — verbal auditory agnosia — 2; second — inadequacy of interzonal ties between the second temporal auditory area of the hemisphere and the speech premotor cortex of the left hemisphere
V. Beginning with year 1.5	Absence of ability to say words spontaneously	First — inadequate level of formation of phonemic awareness; second — inadequacy of ties between the <i>tertiary</i> temporal cortex and speech premotor area of the left hemisphere

**Variant 1. Total inability to articulate**

Clinical example1: Boy G. 4.5 years of age. Complaints: absence of speech with ability to understand it.

**Anamnesis.** The data about the perinatal period contain separate records about mild symptoms of intracranial hypertension.

According to the parents, in infancy there were no significant deviations in motor development and non-verbal sphere, but own articulate speech did not emerge in due time. Speech comprehension developed without deviations.

**At the consultation.** The child has well-balanced body build, is flexible and active. Gets in productive contact: performs tasks connected with constructing and other

non-verbal actions on the object-oriented level quickly and correctly. Points at objects named. He does everything without verbal comment. Does not answer questions, even the simplest ones. He is rather active in non-verbal occupations: easily passes from one game to another without losing interest in what he is doing and making actions look complete.

The specific feature of the case is the child's inability to arbitrarily perform any tasks referring to the sphere of praxis. The simplest communicative and semantic gestures have not been formed in the hand and finger praxis: the child cannot reproduce the needed postures even by imitating. He ignores them completely, the same as verbal comment, even onomatopoeic one. Lately, we have noticed only humble attempts to imitate the "voices" of some animals. Enhanced, expressive stimulation of production of visual and acoustic images of gestures (mimetic actions) by the experimenter is, as a rule, unsuccessful. It was impossible to make the child produce even a pointing gesture during examination.

A similar picture was observed in oral praxis: arbitrary control of oral organs is absolutely absent (with the necessary muscular potential present). The child cannot even perform the task of blowing a piece of paper off the palm.

**Analysis.** The total amount of the symptoms revealed allows us to come to the conclusion that the child suffers from severe expressive absence of speech demonstrated on the background of a "break" in ontogenetic development of the gestural-mimetic and intonational-prosodic phase of communication with the surrounding people. Inadequacy of conducting systems connecting the acoustic (secondary temporal) cortex and the articulatory (secondary speech motor) cortex, both afferent and efferent ones, is, evidently, the brain mechanism causing the expressive speech disorder.

### **Variant 2. Rearticulation is present, spontaneous articulation is not observed**

These children do not understand speech addressed to them (or understand it to a very limited degree), but rearticulate extremely easily in the form of echolalias. Inability to express thoughts verbally and, consequently, inability to take part in verbal communication acts made us refer them to the category of non-speaking children.

Clinical example 2: Boy M., 3.5 years of age, consulted in connection with complaints on absence of speech.

**Anamnesis.** Pregnancy without complications. Birth by planned caesarean section. The child was born with anal atresia and had sur-

gery on the third day. Later he had three more operations for the same condition (the last one at 7 months of age). Troublesome. Infancy was characterized by delay of psycho-verbal development noticeable to the parents. At present, the child attends the development center for children with autism spectrum disorder (ASD). The parents report improvement of his behavior: he

has become interested in cartoons, pictures in books, etc.

*At the consultation.* Visually registered strabismus and skull deformation: excessive thickness of temporal bones and expansion of parietal bones, and flat occiput. The latter is attributed by the parents to lying much on the back in the postsurgery periods.



**Figure 2.** Inability to rearticulate (repeat) words



**Figure 3.** Inability to articulate words spontaneously (on one's own)



The boy's behavior at the consultation is adequate. Gets in productive contact. Shows interest in tasks. Interacts with the specialist. His movements are clumsy. Can hardly hold a pencil in his hand.

Conduct of diagnostics of psychological development is complicated. We could only state that he understands familiar words well (points at pictures when hears a word). This allows us to suppose primary safety of verbal thinking.

Independent speech is characterized by babbling. Speech activity is reduced. Systemic kinesthetic apraxia is revealed: oral, hand, and finger. Absence of onomatopoeias may be due to articulation apraxia.

*Analysis.* Considerable delay of general motor and speech development based on severe systemic apraxia. Secondary disorder of psychological development.

**Variant 3. Rearticulation is absent, spontaneous speech is partially present**

Speech comprehension in the children of this group is partially limited. They cannot repeat speech sounds and words, but try actively to produce spontaneous speech. The latter mostly consists of words incomprehensible to other people ("own lingo"), having peculiar intonation, and granting no chance to express thought verbally. All this, the same as absence of speech in variant 2, prevents the children

from verbal communication and serves as a basis for referring them to the category of non-speaking children.

This variant of speech absence is the rarest one. It refers to the group of dissociated according to the peculiarities of speech development. It may be explained by the phenomenon of hypercompensation due to which the processes of spontaneous rehabilitation of the speech defect take the child up to a higher hierarchical level of brain organization of speech. As a result, the symbolic (linguistic) level is included in speech bypassing the gnostic-praxical level typical of gradual speech acquisition. Inadequacy of the processes of speech and word gnosis, which is manifested by inability to repeat verbal stimuli, prevents children from finding the articulemes equivalent to the sounds pronounced, and they try to "invent" their own ones. Practice shows that the children of this group are quick-witted and active, especially in their verbal behavior.

Due to a change of views on the brain mechanisms of various forms of aphasia undertaken by the author lately [13; 10, p. 36-46; 14, p. 1316], the given variant of speech absence may be correlated with aphasia which is part of the classical neurological classification of Lichtgaim-Wernicke and is called "conduction aphasia" in it.

Clinical example 3: Boy A., 4 years of age, consulted in connection with complaints on developmental speech disorder. Family left-handedness (mother is left-handed), but the dominant eye is the right one.

**Anamnesis (according to mother).** Pregnancy and birth without complications. Number of points on the Apgar score is 8/9. He gave his first cry on time, feeding was active. Infancy: cooing and babbling on time. Speech developed according to the norm up to one year. At the age of one he got a terrible fright, and speech stopped developing. Before this consultation, the neurological diagnosis was: disorder of psychological development. He undergoes cortexin therapy regularly once every three months.

**At the consultation.** The boy is active; the behavior is adequate. Gets in productive contact. Smiles often. Assembles frames and stacking toy according to his age. Judging by these skills and other non-verbal actions, his cognitive development, and specifically thinking, is primarily intact.

The child comprehends speech and performs oral instructions.

He points at object-based pictures but does not name the objects shown in them. His own speech is presented by separate specific sound complexes resembling Russian words in their general prosodic pattern ("own lingo"). Some of

them can be related with certain objects. The child's utterances are accompanied by adequate gestural-mimetic actions.

Oral praxis is severely disabled. The same as articulatory praxis. In addition, there are disorders of hand and fingers kinesthetic praxis. Can produce onomatopoeias. The boy performs rhythm reproduction tests. He comprehends the meaning of plot-driven pictures.

**Analysis.** Expressive alalia based on systemic disorders of praxical articulation sphere. The specificity of the case consists in hypercompensation of the speech defect by inclusion of the symbolic (linguistic) level of the brain organization of speech.

The examples described do not make up a complete list of variants of articulation disorders, but are the most illustrative ones in terms of theory and practice of the study of children's speech development.

**Conclusion.** The approach to the issue of expressive absence of speech suggested by the author of the given study allows coming closer to the end of the discussion, which has been carried on for years, about the relevance of the term *motor alalia*. The beginning of the discussion can be related to the conception of alalia by V. K. Orfinskaya, who distinguished linguistic alalia alongside gnostic-praxical one [11]. The supporters of exclusively linguistic nature of

alalia and aphasia, whose views have been shared by the author of the given paper until lately, challenge the given theory with conviction arguing that linguistic alalia as a phenomenon of speech disorder cannot have agnostic or apraxical nature. They explain it by the fact that such functions as gnosis and praxis do not belong to a linguistic level, but are sure to have salient prelinguistic significance. Nevertheless, the observations provided in the given paper demonstrate that this statement does not refer to all kinds of articulatory activity. Articulation, consisting in recoding of articulemes into *phonemes* (units of exceptionally linguistic level) can be reasonably referred to linguistic level operations. Thus, the variants of expressive alalia, in which speech comprehension is intact and rearticulation is impaired, may be considered as severe absence of speech (alalia) of the type of articulation apraxia, and the variants in which rearticulation is present but spontaneous speech is absent – as absence of speech (alalia) of linguistic nature.

A similar train of reasoning can be used to resolve the problem of the discussion (by A. R. Luriya and E. N. Vinarskaya) on the subject of legitimacy/illegitimacy of distinction of motor aphasias.

#### References

1. Bernshteyn, N. A. O postroenii dvizheniy / N. A. Bernshteyn. — M. : Medgiz, 1947. — 255 s.

2. Vizeľ, T. G. K voprosu o patogeneze alalii / T. G. Vizeľ // Diagnostika i korektsiya rechevykh narusheniy : (materialy nauch.-prakt. konf. «Tsentral'nye mekhanizmy rechi»), posvyashch. pamyati prof. N. N. Traugott / T. G. Vizeľ. — SPb., 1999.

3. Vizeľ, T. G. Ob «ekspressivnoy alalii», ee mozgovykh mekhanizmakh i preodolenii / T. G. Vizeľ // Defektologiya. — 2018. — № 1.

4. Vizeľ, T. G. Priobretenie i raspad rechi / T. G. Vizeľ. — Barnaul : AltGPU, 2016. — 289 s.

5. Vizeľ, T. G. Logopedicheskiy aspekt neyroreabilitatsii bezrechevogo rebenka / T. G. Vizeľ, O. Yu. Tsvirko // Izbrannye voprosy neyroreabilitatsii : materialy VIII Mezhdunar. kongr. «Neyroreabilitatsiya-2016» (8—10 iyunya 2016 g.). — S. 72—74.

6. Vinarskaya, E. N. Vozrastnaya fonetika : ucheb. posobie dlya studentov / E. N. Vinarskaya, G. M. Bogomazov. — M. : ASTrel', 2005. — 207 c. — (Vysshaya shkola).

7. Kipkhard, E. Y. Kak razvivaetsya vash rebenok? / Ernst Y. Kipkhard ; per. s nem. L. V. Kharinoy. — M. : Terevinf, 2006. — 112 s.

8. Knyazev, S. V. Russkaya razgovornaya rech' v foneticheskikh zadachakh / S. V. Knyazev // Russkiy yazyk v shkole. — 2016. — № 10.

9. Luriya, A. R. Vysshie korkovyie funktsii cheloveka / A. R. Luriya. — M. : MGU, 1969. — 504 s.

10. Makarturovskiy oprosnik (MakArthur CDI). Russkaya versiya. Spetsifika rechevogo i kommunikativnogo razvitiya detey rannego vozrasta / M. B. Eliseeva, E. L. Verzhinina, V. L. Ryskina. — 2007.

11. Orfinskaya, V. K. Printsipy postroeniya differentsirovannoy metodiki obucheniya alalikov na osnove lingvisticheskoy klassifikatsii form alalii / V. K. Orfinskaya // Logopediya. Metod. nasledie. V 5 kn. Kn. 3. Sistemnye narusheniya rechi. Alaliya. Afaziya / V. K. Orfinskaya ; pod red. L. S. Volkovoy ; [k kn. 3] avt.-sost. M. K. Shokhor-Trotskaya, S. N. Shakhovskaya. — M. : Vlados, 2007.

12. Skvortsov, I. A. Issledovanie «profilya razvitiya» psikhonevrologicheskikh funktsiy u detey do 7 let i psikhologicheskaya korektsiya ikh narusheniy : metod. posobie /

I. A. Skvortsov [i dr.]. — M. : Trivola, 2002. — 28 s.

13. Trubetskoy, N. S. Osnovy fonologii / N. S. Trubetskoy. — M, 1960

14. Tseytlin, S. N. Yazyk i rebenok. Osvoenie rebenkom rodnogo yazyka / S. N. Tseytlin. — M., 2017.

15. Liepmann, H. Apraxie. Brugsch's Ergebnisse d. ges. Med. Berlin / H. Liepmann. — Wien, 1920.