

Neuropsychological and Psychophysiological Studies in Logopsychotherapy: In Memory of J. M. Glzman

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Нейропсихологические и психофизиологические исследования в логопсихотерапии: памяти Ж. М. Глозман

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Abstract. The article is devoted to research in logopsychotherapy related to J. M. Gluzman. Logoneurosis is a disease that affects 1–2.5 % of the population according to various sources, which is why effective methods of rehabilitation are so important. One of the effective methods is group logopsychotherapy, a technique developed for adults and adolescents by Yu. B. Nekrasova in the 1960s and subsequently monogamously improved. A special stage in scientific research in the system of family group speech therapy began with the arrival of J. M. Gluzman. In the groups of family logopsychotherapy, A. A. Kisel'nikov conducted a systematic inter- and multidisciplinary study of the brain mechanisms of stuttering under the guidance of J. M. Gluzman and V. A. Vartanov in 2004–2006, showing the determinacy of this speech disorder by many psychological variables. It has been shown that the disintegration of left-right hemisphere interactions in the realization of mental activity can be one of the mechanisms of stuttering. It was revealed that stuttering is not an isolated (purely peripheral) speech disorder, but occurs in a syndrome of specific mnestic, neurodynamic and motor defects reflecting dysfunction of the posterior and median structures of the brain (functional blocks I and III, according to A. R. Luria (1973)), and the symptoms of dysfunction decrease during complex speech therapy. In the course of 2015–2020 studies supported by the RGNF and RFBR, which were conducted with groups of stuttering people, as well as at the Neurocorrection Center with children with learning difficulties (Gluzman, Karpova, Cheburashkin-Antipov, 2018b), it was also shown that inadequate methods of psychological protection in case of violations or lack of communication skills may be associated with defects the image of verbal communication. It has been shown that the appearance of stuttering is facilitated if the child has the phenomenon of crosslaterality. Psychophysiological studies have also shown the role of functional asymmetry of the brain in the formation of the disease, and the effectiveness of logopsychotherapy for the correction of logoneurosis has also been confirmed.

Keywords: *psychophysiology of stuttering; speech; personality; neurodiagnostics; family group speech therapy; the go/go paradigm; handedness; left-handedness*

Аннотация. Статья посвящена исследованиям в логопсихотерапии, связанным с работой Ж. М. Глозман. Логоневроз — заболевание, которым страдает, по разным источникам, 1–2.5 % населения, поэтому так важны эффективные методы реабилитации. Одним из эффективных методов является групповая логопсихотерапия — методика, разработанная для взрослых и подростков Ю. Б. Некрасовой в 1960-е гг. и в дальнейшем многократно усовершенствованная. Особый этап в научных исследованиях в системе семейной групповой логопсихотерапии начался с приходом Ж. М. Глозман. В группах семейной логопсихотерапии системное меж- и мультидисциплинарное исследование мозговых механизмов заикания под руководством Ж. М. Глозман и В. А. Вартанова в 2004–2006 гг. провел А. А. Кисельников, показав детерминированность данного

речевого расстройства многими психологическими переменными. Было установлено, что дезинтеграция лево- и правополушарных взаимодействий в реализации психической активности может быть одним из механизмов заикания. Выявлено, что заикание не является изолированным (чисто периферическим) речевым нарушением, а сочетается с синдромом специфических мнестических, нейродинамических и двигательных дефектов, отражающих дисфункцию заднеобных и срединных структур мозга (I и III функциональные блоки, по А. Р. Лурия), симптомы дисфункции уменьшаются в процессе комплексной логопсихотерапии. В ходе исследований 2015–2020 гг., подержанных РГНФ и РФФИ, которые проводились с группами заикающихся, а также в Центре нейрокоррекции с детьми, имеющими трудности обучения (Glozman, Karpova, Cheburashkin-Antipov, 2018b), было обнаружено, что неадекватные способы психологической защиты при нарушениях или несформированности навыков коммуникации могут быть связаны с дефектами образа вербальной коммуникации. Было установлено, что заикание может выражаться сильнее в том случае, если у ребенка отмечается кросс-латеральность. Психофизиологические исследования показали роль функциональной асимметрии мозга в формировании заболевания, а также была подтверждена эффективность логопсихотерапии для коррекции логоневроза.

Ключевые слова: психофизиология заикания; речь; личность; нейродиагностика; семейная групповая психологическая терапия; парадигма go/go; рукоуть; леворукость

Introduction

Logoneurosis — develops, which is based on natural heredity (Drayna & Kang, 2011; Grigorenko, 2009) and psychophysiological factors (Bishop, 2013), as well as a violation of communication processes (Grebelsky-Lichtman, 2014), primarily within the scheme (Collins, Madsen, & Susman-Stillman, 2002). Speech is a lateralized function, then its development, both in the norm and in consideration, has always been considered aspects of the functional totality of the brain or lateral preferences (Büchel & Sommer, 2004), there are also genetic features and psychophysiological signs in massiveness (Nikolaeva & Karpova, 2021; Perani et al., 2011).

That is why the process of correcting the disease should have a complex character, which is what happens in the method of group logopsychotherapy — one of the directions for correcting logoneurosis, developed in the 1960–1980s by Yu. N. Nekrasova for stuttering older teenagers and adults 14–40 years old. Since the early 1990s the technique is being developed by N. L. Karpova for stuttering children, adolescents and adults aged 7–45 years with the active involvement of their parents and relatives in the logopsychotherapeutic process.

In the framework of this study, we will consider that aspect of logopsychotherapy that is associated with the neuropsychological research of J. M. Glozman. Zhanna Markovna applied her neuropsychological knowledge to evaluate the effectiveness of logopsychotherapy, paying special attention to the phenomenon of crosslaterality, which,

according to her hypothesis, is the genetic and neuropsychological basis that contributes to the onset of the disease if the child develops in a dysfunctional, from the point of view of communication, family environment.

To show the contribution of J. M. Glozman in understanding the mechanisms of stuttering, we will begin the presentation with the history of the creation of the method of group logopsychotherapy, and then present the results obtained with the participation of J. M. Glozman in the system of family group logopsychotherapy in order to prove the effectiveness of this method.

Research in Group Speech Therapy in 1960–2000

Despite the large number of scientific papers on the problem of stuttering (according to various sources, 1–2.5 % of the population suffers from this disease), as well as on many proposed methods for the rehabilitation of stutterers in our country and abroad, the need for effective methods that ensure stable consolidation of positive results remains.

One of the examples of effective work is the method of group logopsychotherapy — the correction of stuttering (logoneurosis) for adults and adolescents, developed by Yu. B. Nekrasova in the 1960s (Nekrasova, 1968) and further improved (Nekrasova, 1992, 2006). This technique was based on the method of emotional-stress psychotherapy by the psychotherapist K. M. Dubrovsky (1966), who turned to the inner potential of the patient to relieve neuroses.

Also, in continuation of N. I. Zhinkin about stuttering as a violation of the communicative function of speech, first of all, a violation of the communication system, leading to changes in the personality of a stutterer (Zhinkin, 1958), Yu. B. Nekrasova built a logopsychotherapeutic process of sociorehabilitation of stutterers on the dynamics of mental states that contribute to the patient's speech and personal health.

The methodology of group logopsychotherapy consisted of 3 main stages: (a) preparatory-diagnostic, contributing to the beginning of the restructuring of the attitude of a stutterer to his illness and active involvement in the treatment of the patient himself, which is the beginning of the “setting for recovery”; (b) a session of “stuttering removal” according to K. M. Dubrovsky (1966), who mobilizes and strengthens the patient's will to health; (c) the main restorative work in the course of group logopsychotherapy sessions.

All experimental studies of the process of social rehabilitation of stutterers, conducted by Yu. B. Nekrasova, can be divided into three stages:

I (1966–1976) — along with speech therapy studies of stutterers and the inclusion of psychotherapeutic methods in the work of groups, also at the Department of VND of Moscow State University. M. V. Lomonosov together with L. G. Voronin and V. M. Vasilyeva conducted a polygraphic electrophysiological study of the speech process of stutterers using electrophysiological recording methods (electroencephalogram — EEG, galvanic skin reaction — GSR, electromyogram — EMG, phonogram FG and breathing).

This made it possible to deepen the characterization of the disturbed speech process and became a means of additional objective monitoring of changes in the speech components of stutterers before treatment, during and after the course of rehabilitation, as well as during the period of observation of individual results.

II (1977–1988) — the work was carried out at the Research Institute of General and Pedagogical Psychology of the USSR APS. The possibilities of diagnosing a number of personal characteristics of stutterers and their dynamics during the logopsychotherapeutic process were investigated. The task of the experiment conducted under the guidance of F. D. Gorbov (1971) with the participation of E. Yu. Rau, consisted in substantiating and finding the leading factor that could form the basis of experimental methods for studying the personality of stutterers.

They were the frustration factor (frustration in stuttering is a deprivation in meeting the need for communication). The research method was the *Rosenzweig Frustration test*. The test indicators were compared with the results obtained using the F. D. Gorbov homeostat method, as well as with anamnesis data, questionnaires and diary entries test subjects.

Before treatment, stutterers showed increased indicators of outward-directed aggression, a pronounced fixation on an obstacle, and a way out of problem situations at the expense of another. The dynamics of the identified features during the course of rehabilitation using the same methods at the end of treatment showed a significant change in the attitude of the subjects to the frustrating effect, a 16 % decrease in the state of frustration, and an increase by 31 % in the number of reactions aimed at resolving problems on their own. The data obtained showed the possibility and effectiveness of using the *Rosenzweig Frustration test* for examining stuttering patients, making a prognosis for the treatment of each of them, and evaluating the effectiveness of the course of logopsychotherapy.

During the same period, the mental states of the subjects were identified and described as a feedback on the influence of the psychotherapist within the model of an emotional-stress psychotherapy session using the *Rix-Wessman test*. 9 main mental states were identified that the participants in the session experienced, and it was shown that all the identified states are a continuum built by the psychotherapist using special techniques strictly in sequence, but not in duration of each of them. Also, *The Effect of Parallel Empathy of the Audience* — the feelings of the audience — was identified and described. To record and measure mental states during the course, the *Rix-Wessman test* was used in combination with anamnestic data, diary entries and self-characteristics of patients. The data obtained showed a significant decrease (up to 50 %) of anxiety in the subjects, noticeable shifts towards an increase in the states of cheerfulness, elation, and self-confidence.

Based on all the studies in these years, Yu. B. Nekrasova (1991, 1992) developed dynamic psychotherapeutic diagnostics, which is an important part of the entire system of group logopsychotherapy (Karpova & Golzitskaya, 2021).

III (1989–1992) — studies were carried out at the Research Institute of General and Pedagogical Psychology of the Academy of Pedagogical Sciences of the USSR. The aim of the study (with the participation of N. N. Skuratovskaya) was to analyze the relationship between the sound-speech and personality characteristics of stutterers in various states of mental tension. Modeling of emotional tension in the subjects was carried out by changing situations, sound-speech characteristics were measured by speech spectrum analysis, in the study of personal characteristics, the *tests of Rosenzweig, Rix-Wessman, Eysenck, Taylor* were used.

The revealed dependence of the intonational features of the speech of stutterers on their personal characteristics was revealed as a kind of behavior, emotional state of stutterers in situations of difficult, meaningful communication for them. This behavior has been called *avoidance tactics* and *coping tactics*. The study of the dynamics of sound-speech and personal characteristics, as well as their relationship before and after logopsychotherapeutic exposure, showed significant shifts towards their optimization (more than 55 %), in particular, the disappearance of obvious manifestations of one of the rigid “tactics,” increased flexibility and diversity of mental states of former stutterers.

In the same years and subsequent ones (1988–1998), on the basis of the method of group logopsychotherapy, Yu. B. Nekrasova, which had already been formed as an integral system of social rehabilitation of stuttering adolescents and adults aged 14–40, the development of a new method of family group logopsychotherapy by Yu. B. Nekrasova and N. L. Karpova. This system already consisted of 4 stages, including the control and maintenance, which was carried out 4–6 months after the main stage.

A study was made of the phenomenon of motivational involvement of adult stuttering teenagers in the process of social rehabilitation and the problem of active involvement of their immediate environment in logopsychotherapy (Karpova, 2003). On the basis of psychotherapeutic diagnostics for patients, a diagnostic block was developed for their parents and relatives, which confirmed the basic principle of the methodology, according to which diagnostics can become therapy at the same time. In 1993, the work of the first group of family logopsychotherapy was carried out.

As can be seen from the above, in the study of stuttering in the 1960–1990 within the framework of group logopsychotherapy, and then family group logopsychotherapy, a multilateral analysis of the process of sociorehabilitation of stutterers was carried out in order to identify the main psychological and psychophysiological mechanisms of therapeutic re-education of patients and substantiate the effectiveness of the diagnostic and formative methods used. It has been shown that the assessment of the effectiveness of the process of logopsychotherapy is determined by the transition of the continuum of sanogenic mental states into new formations of personality (Karpova, 2003; Nekrasova, 1992, 2006).

Neuropsychological Research in Logopsychotherapy in 2000–2020

A new stage in scientific research, already in the system of family group logopsychotherapy, began together with J. M. Glozman.

A Systemic Inter- and Multidisciplinary Study of the Brain Mechanisms of Stuttering

In the groups of family logopsychotherapy, a systemic inter- and multidisciplinary study of the brain mechanisms of stuttering under the guidance of J. M. Glozman and V. A. Vartanov in 2004–2006 conducted by A. A. Kisel'nikov, showing the determinism of this speech disorder by many psychological variables.

The conclusions of neuropsychologists, psychophysicists and neurophysiologists who studied the issues of inter- and intrahemispheric interaction in the implementation of speech activity during stuttering were also confirmed: it is the disintegration of left-right hemispheric interactions in the implementation of mental activity that can be one of the mechanisms of stuttering (Kisel'nikov, 2006; Vartanov, Glozman, Kisel'nikov, & Karpova, 2005).

This complex psychophysiological and neuropsychological study showed: (a) stuttering is not an isolated (purely peripheral) speech disorder, but occurs in a syndrome of specific mnemonic, neurodynamic and motor defects, reflecting dysfunction of the posterior frontal and median structures of the brain (functional blocks I and III, according to A. R. Luria (1973)); (b) symptoms of dysfunction decrease in the process of complex logopsychotherapy (Kisel'nikov, 2006).

A comprehensive psychophysiological and neuropsychological study of the dynamics of stuttering in the process of family group logopsychotherapy was continued in 2014–2020, which makes it possible to more deeply and comprehensively study this speech disorder and the process of its correction.

Let us present the results of psychological and neuropsychological studies of recent years.

During the 2015–2020 studies supported by the Russian Humanitarian Foundation and the Russian Foundation of Basic Research, which were conducted with groups of stutterers, as well as in the Center for Neurocorrection with children with learning difficulties (Glozman, Karpova, Cheburashkin-Antipov, 2018b), it was also shown that inadequate methods of psychological defense in case of violations or unformed communication skills may be associated with defects in the image of verbal communication. The method of projective drawing “Me and my Speech” was used before and after the course of social rehabilitation. The subject was asked to draw 2 circles on a sheet of paper, one of which would mean “I,” and the other “My Speech,” then comment on his drawing.

The mutual size of the circles, their mutual position (intersection, separation or one inside the other), as well as the positive or negative emotional background of the comments on the drawing were evaluated. The subjects were also asked to make a free drawing on the theme “Me and my Speech.” All subjects also underwent a neuropsychological

examination of cognitive, speech and neurodynamic functions using the Lurian methods of neuropsychological examination with a quantitative (point) assessment of the severity of defects.

The experiment involved 3 groups of subjects. *A group of stutterers*: 12 people aged 7 to 35 years (3 women and 9 men, which corresponds to the gender distribution of stuttering in the whole population); the degree of speech and personality disorders was assessed in points by an expert method. *A group of children with learning and behavioral difficulties at school due to lack of communication skills*: 6 girls and 4 boys aged 6 to 10 years. *A control group* of 10 healthy subjects, age-matched with the experimental group.

It is worth noting that, although there were no left-handers in both experimental groups, the majority of subjects in both experimental groups had cross-laterality: a combination of right-handedness in the hand with a dominant left eye, ear or foot.

Results

An analysis of the projective drawings showed that 70 % of the subjects without speech disorders (the control group) placed the “speech” circle in the drawing inside the “I” circle or intersecting with it, i. e. speech is perceived as an integral part of the “I.” Most of the comments on the drawing, according to experts, were emotionally positive. Only 2 subjects from the group of stutterers and none of the group with poor communication skills placed the “speech” circle inside the “I” circle. Only 13 % of comments on drawings in both experimental groups were emotionally positive. As a rule, the “speech” circle was much larger than the “I” circle with the corresponding comment: “I consist of speech that is 2 times larger than me.”

The reflection of speech difficulties in the internal image of verbal communication in patients with stuttering was the phenomenon of adding dots and dashes between circles to the drawing, denoting obstacles and breaks in communication, which was confirmed by the comments to the drawing: “When I recover, I will not have breaks.” Both in this and in the free drawing there were many circles and shadings, reflecting the increased anxiety of the subjects.

A significant correlation was found between the degree of stuttering/personality problems and the total score of the neuropsychological examination and with the score of speech defects. The degree of personality problems (according to expert assessment) significantly correlates with the score for praxis, memory, gnosis and intelligence in neuropsychological examination

All subjects with stuttering underwent a course of family group logopsychotherapy for six months. After the end of the course, a repeated expert assessment of speech and personality problems and a repeated neuropsychological examination were carried out. Subjects with learning and behavioral difficulties at school underwent a group psychotherapy course for six months, aimed at developing communication skills. The methods of play therapy, psychodrama, art therapy were used.

An expert assessment showed a pronounced decrease in speech and personality problems after a course of group logopsychotherapy (*Tab. 1*).

Table 1

Dynamics of speech and personality problems in patients with stuttering after a course of group family logopsychotherapy

Severity of speech and personality problems (scores)	Patients in the group before rehabilitation, %	Patients in the group after rehabilitation, %
Without speech problems (score 0)	0	33
With mild speech problems (scores 0.5–1)	25	50
With middle speech problems (scores 1.5–2)	42	17
With severe speech disorders (scores 2.5–3)	33	0
Without personnel problems (score 0)	0	0
With mild personnel problems (score 0.5–1)	25	83
With middle personnel problems (scores 1.5–2)	8	17
With severe personality disorders (scores 2.5–3)	67	0

This correlated with a decrease in the scores of cognitive and speech disorders during repeated neuropsychological examination (*Tab. 2*).

Table 2

Dynamics of neuropsychological examination scores in patients with stuttering after a course of group family logopsychotherapy

Penalty score	Before rehabilitation	After rehabilitation
Sum	1.39	.90
For speech function	.33	.16
For the neurodynamics	.80	.40

Statistical analysis of the data using the non-parametric *Wilcoxon signed rank test* for dependent samples showed a non-random nature of a downward shift in the score for speech after therapy at a significance level of $p < .01$ ($T_{emp} = 5 < T_{cr} = 7$, $n = 11$). Similarly, the nature of the decrease in the total score for three indicators (neurodynamics, memory, speech) at a significance level of $p < .05$ ($T_{emp} = 12 < T_{cr} = 13$, $n = 11$) is not accidental.

Thus, it was shown that the improvement of communication capabilities is reflected not only at the external (speech) level, but also at the level of consciousness and internal representation of speech activity (Glozman, Karpova, & Cheburashkin-Antipov, 2021).

Study of the Dynamics of Personality Disorders and Fluency of Speech in the Process of Logopsychotherapy

The study of the dynamics of personality disorders and fluency of speech in the process of logopsychotherapy (Glozman, Karpova, & Cheburashkin-Antipov, 2018a) was carried out in 2 groups before and after the course with the help of an expert assessment of speech and personality problems associated with speech communication, as well as during neuropsychological examination using the Lurian battery of methods. The subjects were 20 people aged 7 to 43 years (5 females and 15 males, which corresponds to the gender distribution of stuttering in the general population) with varying degrees of speech impairment.

A further comparative study of speech and personality changes in the process of logopsychotherapy was carried out in three groups of family logopsychotherapy in 2018–2020, which differed both in composition and in working conditions. In the 2018 group, for the first time in our experience, out of 11 people, 9 had a high degree of speech and personality disorders (the degree of speech and personality disorders was assessed in points by an expert method). The peculiarity of the 2019 group was that out of 9 people for the first time in our practice there were 5 girls; the group of 2020 consisted entirely of 9 schoolchildren and took a treatment and training course at the stages of active family group logopsychotherapy in the online format on the Zoom platform. In total, the study involved 29 stutterers aged 9–32 years, of which 18 were males and 11 were females with varying degrees of speech and personality disorders.

Research procedure

To conduct a comprehensive psychological and neuropsychological study, the diagnostics were carried out 3 times: before and after the main course of active family group logopsychotherapy, and at the end of the control and support stage. The program of the family group logopsychotherapy course was also adapted (note that 26 out of 29 subjects completed the full course of diagnostics).

Psychological diagnostics

A study was made of the severity of speech and personal problems associated with speech communication, as well as the dynamics of situational and personal anxiety, rigidity and self-assessment of emotional states and self-perception of communicative situations among group members before and after a course of family group logopsychotherapy. We used: *questionnaire S. D. Spielberg*, test *Rigidity* by D. N. Levitov, *D. Ricks — A. Wessman test*, the *self-characterization questionnaire*, as well as the analysis of medical documents and the method of independent experts.

Neuropsychological diagnostics

All subjects before the start of active group work underwent a neuropsychological examination of cognitive, speech, and neurodynamic functions. The methods developed by A. R. Luria, with a quantitative (scoring) assessment of the severity of defects (Glozman, 2012).

Results of a comprehensive study

Psychological diagnostics. A hypothesis was tested about the differences in values before and after undergoing family logopsychotherapy groups for participants in the 2018, 2019 and 2020 groups. The groups were compared using the *Wilcoxon test* (Tab. 3).

Significant differences were shown between the values before and after treatment according to the *Rigidity test* in all three groups of participants ($p < .001$), as well as according to the *Ricks-Wessman test* ($p < .0004$). According to the *Spielberger test*, no significant differences were found in terms of situational and personal anxiety.

Comparison of the mean values for the tests in the three groups suggests the absence of significant differences between them and the homogeneity of the sample. Thus, despite the composition of different ages, the different proportions of participants of both sexes, and the different format of holding groups of family logopsychotherapy, in general, the studied characteristics of the subjects coincide. Comparison of the dynamics of values by tests in all three groups deserves special attention (Tab. 3).

Table 3

Comparison of the dynamics of values by questionnaires in 2018, 2019, 2020 groups

Questionnaire/Scales	Means, group 2018	Means, group 2019	Means, group 2020
Rigidity	-.1	-.2	-.1
Self-assessment of emotional states (<i>Ricks-Wessman test</i>)	3.7	8.4	3.9
Situational anxiety (<i>Spielberger test</i>)	-3.4	-5.0	-3.1
Personnel anxiety (<i>Spielberger test</i>)	-10.6	-6.9	-4.3

Comparison of the dynamics of values across questionnaires allows us to talk about some differences. So, for example, in the 2018 group, the strongest dynamics in personal anxiety was observed by the end of the group compared to the 2019 and 2020 groups. compared to other years. Rigidity indicators have similar dynamics in all three groups. Despite the fact that it is impossible to draw a conclusion about the reasons for such data on the basis of such a comparison, we can assume that the severity of speech and personality disorders, as well as the format of the group's work, are of great importance.

In addition to a quantitative study of the dynamics of indicators of group members, qualitative methods were used that allow us to see meaningful changes in the representation of a speech problem. Content analysis of self-characteristics of the subjects revealed a general trend towards a decrease in the number of words and categories used in self-assessment after treatment, especially negative ones, in all three groups, which indicates a more adequate self-perception.

Neuropsychological diagnostics. The results of neuropsychological diagnostics are presented on an expanded sample of 34 people — in addition to 29 main participants, data from 5 graduates of previous years were used, who repeatedly participated in the work of experimental groups, helping leaders in working with newcomers. Survey data are presented in *Tab. 4*.

Table 4

Average penalty scores for mental function in stutterers

Age	Neurodynamic		Praxis		Speech		Gnosis	
	before	after	before	after	before	after	before	after
9–19	.55	.5	.48	.21	.37	.15	.79	.34
Before–After	.11		.27		.22		.45	
Before/After	1.24		2.30		2.43		2.31	
21–32	.30	.13	.19	.60	.38	.15	.13	.00
Before–After	.17		.13		.22		.13	
Before/After	2.25		3.30		2.43		–	
Age	Memory		Intelligence		Total			
	Before	After	Before	After	Before	After		
9–19	.39	.09	.34	.20	2.92	1.44		
Before–After	.30		.14		1.48			
Before/After	4.30		1.68		2.02			
21–32	.37	.09	.13	.03	1.50	.47		
Before–After	.28		.10		1.03			
Before/After	4.10		3.99		3.20			

As can be seen from *Tab. 4*, the data allow us to speak about the neuropsychological foundations of speech impairment. At the same time, adult stutterers demonstrate increased activity in the right hemisphere and abnormal coordination between brain regions that plan and perform speech function. Patients of the younger group up to 21 years of age initially have a more pronounced defect (the total score is three times higher than that of the older group) in praxis, gnosis, intelligence, neurodynamics (including large fluctuations in the neurodynamic status), and show less pronounced positive dynamics in the course of therapy for all functions.

Patients over 21 years old are initially characterized by a less pronounced defect, more stable functions (when compared before and after therapy), the absence of negative dynamics and a significantly more pronounced positive dynamics in all functions during therapy, except for speech and memory, where the dynamics are equally high in both subgroups. This picture can be explained by the maturity of the central nervous system in people over 21 years old, and the higher positive dynamics of the older group is a consequence of the developed higher mental functions, which allows the implementation of compensatory mechanisms.

A significant correlation was also found between the degree of stuttering / personality problems and the total score of the neuropsychological examination and with the score of speech defects. The degree of personality problems (according to expert assessment) significantly correlates with the score for praxis, memory, gnosis and intelligence in neuropsychological examination. This connection is substantiated and confirmed by practical experience in working with severe cases of stuttering, but the nature of such a connection has not yet been established. We assume that personality and speech disorders have common factors, and also reinforce each other in ontogenesis.

The study experimentally proved the relationship between the severity of communication defects and the quality of life and mental health indicators in various age and nosological groups. The mobilization of personal resources in the family logopsychotherapy groups contributes to the overall positive dynamics of mental health indicators. This is achieved using a system of creative functional learning in various situations of verbal communication, where new methods of self-regulation and effective communication are purposefully developed, formed and automated (Karpova, Glozman, Danina, Elistratova, & Cheburashkin-Antipov, 2021).

Psychophysiological Research in Logopsychotherapy

One of the first suggestions in the field of psychophysiology regarding the causes of stuttering was the *Cerebral Dominance Theory* proposed by S. T. Orton (1928) and L. E. Travis (1931).

There is no unity among researchers regarding the understanding of the formation of brain asymmetry in ontogeny (Nikolaeva & Vergunov, 2020). Some authors believe that the left hemisphere is dominant in relation to speech from birth, just like in adults (Peña et al., 2003), others argue that bilateral activation to a speech stimulus is initially fixed at birth, and then there is a gradual, during several months, an increase in the specialization of the left hemisphere (Perani et al., 2011).

At the same time, the immaturity of the structures of the left hemisphere in the process of individual development is often considered as the cause of speech impairment (Rosenblum & Dorman, 1978). In favor of this theory, facts are given that among stutterers there are a large number of left-handers and ambidexters (Dmitriev, Zaitseva, Kuzmin, & Morozov, 1988).

With the advent of tomographic research methods in neuroscience, evidence has emerged that the smoothing of lateralization is the cause of various speech disorders (Guibert et al., 2011; Illingworth & Bishop, 2009; Whitehouse & Bishop, 2008) and, moreover, a decrease in the severity of asymmetry is due to the immaturity of brain structures (Luna, Marek, Larsen, Tervo-Clemmens, & Chahal, 2015; Nikolaeva, Brisberg, & Koroleva, 2021; Nikolaeva et al., 1995). Immaturity, in turn, can be explained by a large number of left lateral signs. It has been shown that the more left signs, the slower the brain structures mature (Goldberg, 2001).

To assess the consistency of these representations with the facts in 2018–2019. E. I. Nikolaeva and A. V. Dobrin first assessed lateral indicators and executive functions, which made it possible to determine the maturity of the cognitive functions of participants in different-age groups of family logopsychotherapy, who worked on the basis of the Psychological Institute of the Russian Academy of Education under the guidance of N. L. Karpova, and then the study was repeated after conducting logopsychotherapy directly and remotely six months after the end of the control-supporting stage of the group's work.

The subjects were stuttering boys and girls (mean age 21.1 years). The first study was conducted before the start of the group's work.

To achieve the goal of the study, the following *methods* were chosen. To identify the leading hand, the leading eye, the leading ear and the leading leg, they were carried out using tests (Nikolaeva & Brisberg, 2021).

To determine the location of the center of speech, the technique of verbal-manual interference was used (Yanson & Kenga, 1983). The subject was asked sequentially with each hand for 10 seconds to perform tapping as quickly as possible in the corresponding square of the sheet, divided into six equal squares. After each hand performed the movements three times, everything was repeated, but with a verbal task. The change in the value of tapping was assessed without and with a verbal task for each hand. Declension of nouns was proposed as a verbal task.

Tapping change for each hand was determined by the formula: $(A - B)/3 \cdot 100$, where $A = (N_{pr1} + N_{pr2} + N_{pr3})$, $B = (N_{ver.1} + N_{ver.2} + N_{ver.3})$, where N_{pr} — number of hand movements in 10 s without verbal task, $N_{ver.}$ — with a task.

Next, we evaluated the effectiveness of inhibitory control in the go/go and go/no-go paradigm (Nikolaeva & Gajibabayeva, 2011). The essence of the task consisted in the fact that at first a certain reaction was learned (pressing a computer key when any stimuli appeared), and then it was forbidden to respond to a certain stimulus.

To determine the amount of working memory, a computerized technique by O. M. Razumnikova was used (Razumnikova, & Savinykh, 2016). The technique consists of three series, in each of which 30 items are sequentially presented, from which the subject must choose a new item that he had not previously chosen. If an item is mistakenly selected a second time within the same series, the series ends.

Then the presentation of the same stimuli begins in a different order. If there is an error in the second series, it is interrupted and the third, last series begins with the same

set of stimuli, but presented in a different order. The volume of memorized stimuli in each series is taken into account.

Statistical data analysis was carried out using IBM SPSS Statistics (version 22).

First, data on the lateral preferences of the subjects in the sensory and motor spheres were analyzed. Significant differences were associated with lateral hand preferences. The right dominant hand in this sample was noted in 27.2 % of the subjects, the left — in 18.3 %, mixed values — in 54.5 % of the subjects. Comparing with the results of other studies, one can speak of a decrease in the representation of the dominant hand in relation to population data (Brauer, Anwender, Perani, & Friederici, 2013; Efimova, Simonov, & Budyka, 2012). However, our data do not indicate a decrease in lateralization, but an increase in the number of left and symmetrical signs.

Analysis of the results of the verbal-manual interference test indicates that only 36.3 % of the subjects had one center in the left hemisphere, 45.6 % had two speech centers and 18.1 % had one speech center in the left hemisphere. It should be noted that those subjects who had a typical location of the speech center in the left hemisphere had less pronounced speech changes compared to the general sample.

Our data are consistent with the hypothesis that people with two speech centers are more likely to develop stuttering. It is believed that in this case the second speech center appears during the first year of life as a result of damage to the intrauterine or perinatal speech center in the left hemisphere. In the first year of life, the brain is plastic, and the right hemisphere can compensate for problems that have arisen in the left hemisphere. At the same time, conditions are created for the competition of the two hemispheres during speech utterance, which leads to the emergence of stuttering.

Next, the effectiveness of working memory and inhibitory control was analyzed. We did not find any differences between the subjects in any of these methods. Lateral preferences were not associated with either working memory efficiency or inhibitory control parameters. Our data are consistent with those of authors who did not find cognitive decline in stuttering (Büchel & Sommer, 2004).

Results of a Psychophysiological Examination of Stuttering Children, Adolescents and Adults before and after a Course of Logopsychotherapy

First, the volume of working memory of the subjects was assessed before and after the start of logopsychotherapeutic treatment (*Tab. 5*). Analysis of the results of *Tab. 5* indicates a significant increase in the amount of working memory and, most importantly, the stability of work in the test. If before the start of the work of the logopsychotherapy group by the third series of diagnostics, almost all the subjects were exhausted, tired, then after working in the group they demonstrated stable work in the test.

In stutterers, inhibitory control also improved, although the results are insignificant due to the large scatter of the data. A feature of the research methodology was that it consisted of two identical parts, which was not reported to the subjects. However, some of them guessed it, and then the results in the second part of the methodology improved in

relation to the results in the first part. This is what we note when examining the subjects after participating in the logopsychotherapy group.

Table 5

Comparative analysis of the volume of working memory of stutterers in three series before and after the logopsychotherapy group

Examination in relation to the time of work in the therapeutic group	Presentation procedure		
	1	2	3
Before	12.8 ± 6.3	10.2 ± 5.6	8.9 ± 6.8
After	18.2 ± 6.9*	13.7 ± 6.5	17.8 ± 8.8*

Note. * — the difference between the examination before and after the psychotherapeutic group with a significance level of $p \leq .05$ (Wilcoxon test).

Our data indicate that working memory changes more expressively than other executive functions when a person's behavior begins to change. Inhibitory processes also change, but their change is less pronounced.

At the same time, there were no changes at the level of the autonomic nervous system.

Another examination of the subjects was carried out six months after classes in the logopsychotherapy group. It showed an insignificant deterioration in cognitive performance, which the subjects themselves explained by the lack of time for independent continuation of the classes that they were taught in the process of participating in the logopsychotherapy group.

Conclusions

The presented psychological, psychophysiological and neuropsychological studies of speech and personality changes in stutterers in the process of group and family group logopsychotherapy confirm the determinism of stuttering by many psychological variables, as well as the conclusions of neuropsychologists, psychophysiologicalists and neurophysiologists that it is precisely the disintegration of left-right hemispheric interactions in the implementation of mental activity that can be one of the mechanisms of stuttering.

Neuropsychological diagnostics, carried out under the guidance of J. M. Glzman and with her direct participation, revealed that the most impaired functions in stutterers are such functions as praxis, memory and speech, and it is they that show the most pronounced dynamics after undergoing a course of family group logopsychotherapy.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional and/or National Research Committee and

with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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