PSYCHOPHYSIOLOGY

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Psychophysiological basis of the individualization of schoolchildren training

The modified psychomotor Ilyin's test for the definition of the basic properties of nervous system is suggested. This express-test allows to make the conclusion about the force-weakness, the mobility and inertness of the nervous processes of each student, features of psychomotor working accustom, working capacity, reliability and will of the examinee for a short period of time (Ozerov, V.P., 1999). The researches have allowed revealing three types of the nervous system. Besides, this test allows to judge about the character of working adjustment in the high-speed activity. The suggested variant of the test can be especially useful at vocational guidance and professional selection, especially in high-speed kinds of activities (sports), and it will find broad application in training and consultation for the individual style of activity formation (Ozerov, V.P., 1989). The technique of usage of typological features of schoolchildren and students for increase of the teaching and educational process efficiency of schoolchildren and for perfection of the training and education individualization is also suggested (Ozerov, V.P., 1996, 1999).

Key words: *psychophysiological bases, expresstesting, the basic properties of nervous system, psychomotor abilities, an individualization of training of schoolchildren, a technique of activization of teaching and educational process.*

"The one, who diagnoses correctly,
treats and teaches correctly"
(The Latin proverb)

The definition of the basic properties of nervous system plays an important role in theoretical and applied researches [2, 3, 18, 19, 21]. Many of the laboratory methods of the basic properties diagnostics of nervous system demand special carrying out conditions, equipment and they are quite labor-consuming. The express-techniques, in particular Ilyin's tapping-test, mostly lack these imperfections [5, 6].

The force of nervous system is a parameter of working capacity of nervous cells and nervous system as a whole. Ilyin's technique [6] is based on the dynamics definition of the maximum tempo of hands movement: first right hand, and then left hand. The variants of the maximum tempo dynamics, which are received as a result, can be conditionally divided into five types:

– *convex type:* tempo increases during the first 10–15 seconds of work; during subsequent time it can even decrease below the initial. This type of a curve,

by the author's opinion, is the evidence of the presence of the examinee's strong nervous system;

– *equal type:* the maximum tempo is kept approximately at one level during all operating time, which characterizes nervous system to be of the average force;

– *descending type:* the maximum tempo decreases from the 2-nd 5-second piece and remains at the lowered level during the whole work, which is the evidence of the weak nervous system;

– *intermediate type:* tempo of work decreases after the first 10–15 seconds. This type is regarded as the average-weak type of nervous system;

– *the concave type:* initial decrease of the maximum tempo is replaced then by short-term increase up to the initial level, which characterizes the author as having the average-weak nervous system.

– Despite of many advantages, Ilyin's test [6] has also some imperfections:

descriptive method of the definition of nervous system force by the character of a movement tempo curve;

– absence of quantity indicators of the weakness and force of various examinees;

– the test provides individual, but not group testing.

Therefore we offer the modified psychomotor Ilyin's test, which has a number of positive features [13, 14]. Besides, our variant is the express-test, it allows to reveal during 50 seconds in the whole class of schoolchildren or group of students not only the force-weakness of nervous system, but also to make the conclusion about the mobility and inertness of the nervous processes of each student, features of psychomotor working accustom, working capacity, reliability and will of the examinee [13].

The equipment: each examinee should have a standard piece of paper (203x283 mm), in the upper part of which there should be drawn and numbered 10 squares, five in each row, of the size 20x20 mm, a convenient ball pen or a pencil. The experimenter should have a stop watch or watch with a second hand.

1	2	3	4	5
6	7	8	9	10

Fig. 1. The test report of the examinee

The instruction: by experimenter's signal: "Ready!.. Go!" you should start to put down dots in each square of the row from 1 to 5 and from 6 to 10 by doing vertical movements of a hand with the maximum speed for 5 sec in each square. Transition from one square on another is done by the experimenter's command "Next" according to the number of a square from 1 to 10. Work in the maximum for you tempo all the time. And now take a pencil conveniently with more "dexterous" hand and practice your speed of putting the dots down for 2–3 seconds outside of the experimental squares. Enough. Take 2–3 deep breathes and get ready to the performance of the test in the maximum tempo. The experimenter commands: "Ready!.. Go!" After every 5 seconds of work the experimenter commands "Next", and after 50 seconds – "Stop".

The processing of the results includes the following procedures:

1. To count up the quantity of dots in each square and write down near its number.
2. To construct the plot of working capacity by postponing ten 5-second time intervals of the test for abscissas axes, and for ordinates axes – quantity of dots in each square (scale of measurements is 1 sm = 5 sec = 5 movements./sec) (see fig. 2).

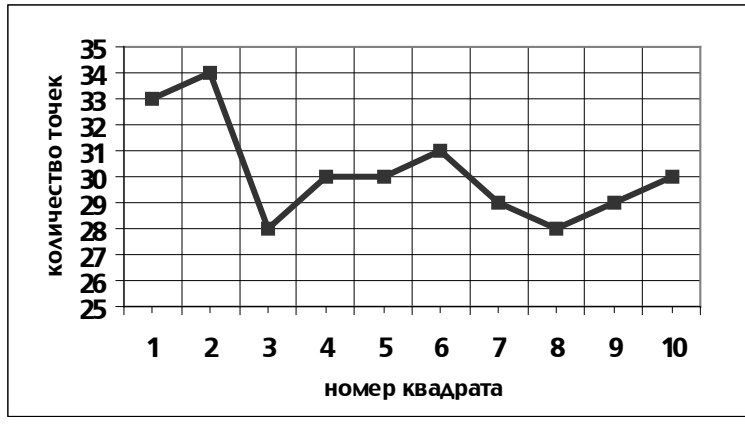

Fig. 2. A curve of working capacity of nervous system

3. To count up the value of the average arithmetic tempo in the first (x1) and in the second part of the experiment (x2), for this purpose it is necessary to sum up the quantity of movements in the first five and last five squares by dividing the received value of the sum by 5 every time.
4. The received results are substituted in the formula [13] of nervous system force (NSF):

$$NSF = x_1 - x_2.$$

The flight researches led on 1000 examinees have allowed revealing three types of the nervous system:

1) if value of formula difference is less than 0, hence, the "strong" nervous system of examinees is observed;
2) the difference of less than two units characterizes "average" by force nervous system;
3) the curve inclination for more than two units means, that the examinee has "weak" nervous system.

The analysis of the results: the force of nervous system is a parameter of working capacity of nervous cells and nervous system as a whole. The strong nervous system maintains greater by value and duration loading, than the weak one [10;16;22]. Our technique is based on the definition of the maximum tempo dynamic of the hand movement in the first and second halves of the experiment. The received results of testing can be conditionally divided into three types by the force and weakness of nervous system depending on the value of a difference of working capacity in the first half (x_1) and in the second half of the experiment (x_2) – see the formula.

Thus, if the result of formula NSF = $x_1 - x_2$ is less than 0 it means the presence of the examinee's strong nervous system, if the difference is less than two, the examinee possesses average by force nervous system, and, at last, if the result is more than two, the examinee possesses weak (less efficient) nervous system.

Except for power characteristics, our updating of the technique enables to analyze quickness characteristics of our examinees and a number of other parameters. If in any of 5-second time intervals the examinee will show more than 35 movements (dots), it is possible to say that he has a mobile nervous system. If the maximum tempo for 5 seconds did not exceeded 25 movements, it testifies that at the examinee has an inert type of nervous system. And, at last, if the tempo of movements is above 25, but below 35, it is possible to characterize nervous system as the nervous system of average mobility.

Our test allows to judge about the character of working adjustment in the high-speed activity. If the examinee shows his highest tempo in the first square, it means high working adjustment and starting mobilization. If the examinee increases his tempo of work at the end of the test (last squares), it means good strong-willed (finishing) effort of the examinee. And, at last, the quantity of dots in all 10 squares means the total psychomotor working capacity, and the minimal difference between the maximal and average tempo of work shows psychomotor working capacity of the examinee [13, 14].

Repeated approbation of the test has shown that our variant of the test can be especially useful at vocational guidance and professional selection, especially in high-speed kinds of activities (sports), and it will find broad application in training and consultation for the individual style of activity formation [13].

The technique of usage of typological features of schoolchildren and students for increase of the teaching and educational process efficiency of schoolchildren and for perfection of the training and education individualization is shown below [13, 14].

For an effective utilization of specific-typological features of the schoolchildren, revealed in the express-testing, it is necessary to seat class students, according to the author's concept, down to separate rows according to the "force" and "weakness" of nervous system, and inside of the row to place students according to the "mobility" and "inertness" of the nervous processes in conformity with the scheme:

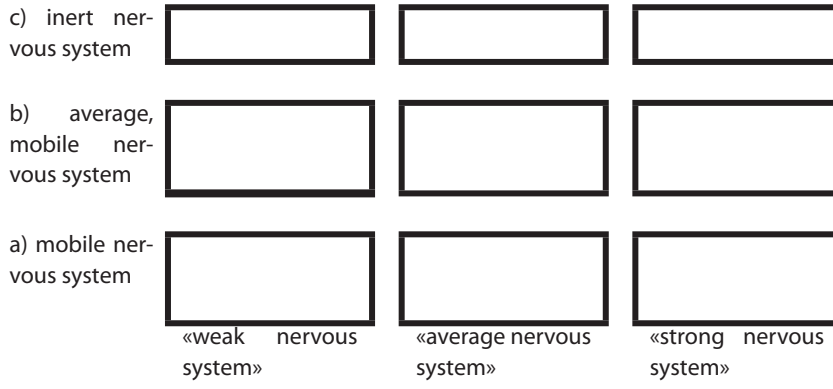

Fig. 3. The scheme of the arrangement of students by the HNA (High Nervous Activity) typology in a class room

Numerous researches among natural specific-typological features of the person's high nervous activity, have shown, that the "force-weakness of CNS" (in other words, a degree of endurance, working capacity of nervous system, its stability to different sorts of hindrances) and "mobility-inertness" of nervous processes is the most important and is frequently applied in practical life [1, 5, 19, 24]. These characteristics leave traces on specificity of school work with students, who are different by their typology [4, 7, 9, 25].

Students with strong nervous system in a situation of difficult lessons (compositions, long school day – 6–7 lessons, examination, test, work in noisy, restless conditions, work in fast rate) can work without a special pressure for a long time either in class, or at home without feeling fatigue even at the end of school day. Students with the "mobile nervous system" differ from the "inert", according to the typology, children by the tempo and dynamic of mental working capacity [4, 7, 11].

The teacher's confidence about the correctness of the weak nervous system diagnosis will become stronger, if the student experiences difficulties in the responsible, emotional-strained situations, which are listed above. The teacher should use neurodynamic features of children during the construction of dynamic models of a lesson, alternation of work and rest of students, an individualization of their training [12, 14, 15].

We shall get acquainted with some of special methods and preventive means, which the teacher can apply for simplification of teaching and educational activity of

the students, proceeding from his individual typological features of the high nervous activity and their psychomotor abilities [13].

In relation to the students with "weak nervous system" the teacher is recommended to observe the following rules:

- not to put them in a situation of an unexpected question, which demands a prompt reply, to give sufficient time for thinking and preparation, the questions should be asked not in oral, but in written form;
- to give time for checking and correction of the written during the answers preparation – whenever it's possible to ask them in the beginning of a lesson and in the beginning of a school day;
- not to demand to answer a new, just learned material, it is better to postpone the interrogation to the next lesson;
- it's in their power to form confidence by the correct tactics of interrogations and encouragements, and not just by the mark, but also by the statements like "good", "excellent", "good fellow" – it is obligatory to encourage them for diligence even if the result is far from the desirable;
- to estimate failures of these students cautiously – in fact, they concern them rather painfully;
- to distract them from work in the minimal degree, to create quiet conditions for them;
- to teach skill how to get over failure. For this purpose it is necessary to explain, that sometimes failures are normal and inevitable; unsuccess is not a cause for despair and contempt to yourself;
- to try to involve the child from early age into the wide circle of hobbies, to let him feel his opportunities, to learn, where, in what kinds of activity they will be shown in the best way;
- for such children wide testing of psychomotor and cognitive abilities is necessary [12, 13, 14].

Psychohygienic tactics of the teacher in relation to the schoolchildren with "strong nervous system":

- if work is monotonous, equable, deprived emotional shades and opportunities for a discharge, it is very tiresome for students with strong nervous system;
- if the person should perform monotonous work without having a choice, such work causes a fast exhaustion of intellectual forces of "strong" students;
- training of assiduity which, however, should exclude accumulation of an emotional pressure is necessary for them;
- it is necessary to let the students with strong nervous system having short breaks, change of activity kinds (if it is possible, of course);
- in a situation of monotonous activity it is necessary to diversify their activity in a certain degree, for example, during the performance of the same tasks to direct

them to the search of other ways of work, to alternate tasks of different types, etc.;
– they neglect planning and organization of work, frequently acquire school material unsystematically and superficially, "by swoop", without noticing the important details, without getting deeply in the essential of the thing. They are not inclined to recurrence, which allows to lift understanding on the higher level, to establish interrelations in the acquired material;
– the appropriation of school material at a traditional school, apparently, is correlated, in a greater degree, by specific-psychological features of the "weak" and "average" by the HNA typology of students, who often surpass "strong" ones by the depth, systems, correctness of understanding and knowledge application [7, 13, 14, 15, 20].

Psychohygienic methods used by the teacher during work with the "inert" students:
– during work with the "inert" students it is not necessary to demand immediate inclusion in the activity from them, because their activity during the performance of a new kind of task increases gradually;
– to remember, that they cannot actively work with various tasks, and some of them refuse, in general, to perform such tasks;
– not to demand fast change of unsuccessful formulations during oral answers; they need time for thinking, because in answers they often follow standards, home preparations, avoid improvisations;
– not to ask them in the beginning of a lesson, because inert students hardly distract from previous situation (change);
– to avoid situations when it is necessary to receive a prompt reply to an unexpected question; it is necessary to give them time for thinking and preparation;
– not to distract them during the moment of task performance;
– not to demand to answer new, just passed material [7, 9, 13].

Tactics of work with "mobile" students:
– as certain difficulties of "mobile" children in learning are caused by fast fading of activity, loss of interest to the carried out activity;
– they are characterized by frequent derivations from work, they require constant teacher's management and control in a greater degree, than "inert" ones;
– they need help in learning how to adjust the activity in any way, how to organize it properly;
– it is useful to train in special way the students with mobile nervous system in skill how to be constrained, to listen the instruction of the teacher up to the end;
– attentiveness at the lessons is simply impossible to demand, but it is quite possible to develop, bring it up by patient reminding, repeated recurrence of requirements without reproaches and irritation;
– they have high fluctuation of attention and its insufficient stability. Patient development of attention and control of the teacher is necessary for such students [7, 13, 15, 20].

Thus, the consideration of psychophysiological and typological features of schoolchildren is important for achievement of two basic purposes:

1) the increase of learning and education efficiency;
2) the simplification of labor of a teacher and a student.

First, if the teacher knows about specific features of this or that student, he will know, how they influence his studying activity: how he controls his attention; whether he perceives school material quickly; how confident he is; how he overcomes blame and failure. To know these qualities of the student means, to take the first step to the scientific organization of his productive academic work [7, 13].

Secondly, by using these data and carrying out an individual approach in training, the teacher will work more effective and he will be released from additional work with poor ones, from recurrence of not acquired sections of the program, etc. The decrease of his loading, simplification of his work will become the result [7, 8, 14].

The individual approach is one of the main principles of training. It is understood as an orientation to specific-psychological features of students, inclusion in work with them special ways and methods corresponding specific-typological features [7, 9, 13, 20, 21]. The individual approach, which is carried out by means of individualization of the training, is shown in a choice and application of training methods, in a dosage of homeworks, at the definition of variants of independent work and tests (by the degree of their difficulty) and in many other things [7, 9, 13, 14, 15, 20].

It is necessary to develop persistently compensatory methods which let students with weak and inert nervous system cope successfully with educational requirements in the limited frameworks of a lesson, activity [7, 13, 14].

Psychologists have established, that among good teachers there are representatives of different types of nervous activity, if they managed to generate individual plastic style of activity, suitable for work with students of different HNA typology. Diagnostic and forming psychomotor express–techniques, offered by us, make teaching and educational process considerably active due to the scientific organization of educational process, preservation and strengthening of psychological and somatic health of students and teachers in the secondary and higher schools [7, 8, 13, 14, 20].

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