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(FOUO 2/81)

Psychophysiological Screening of Military Specialists

A Methodological Handbook

Ed. by Zh. I. Rimanova

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PSYCHOPHYSIOLOGICAL SCREENING OF MILITARY SPECIALISTS

A METHODOLOGICAL HANDBOOK

Moscow PSIKHOFIZIOLOGICHESKIY OTBOR VOYENNYKH SPETSIALISTOV: METODICHESKOYE POSOBIYE in Russian 1973 signed to press 18 May 73 pp 1-206

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ANNOTATION

The purpose of this handbook is to provide practical aid to physicians, psychologists and engineering psychologists in developing and implementing measures for psychophysiological screening of various specialists for the USSR Armed Forces. It can also be recommended for all officers concerned with this matter.

The following participated in preparing this handbook: V. A. Bodrov and V. I. Medvedev, doctors of medical sciences; T. T. Dzhamgarov, doctor of psychological sciences; G. M. Zarakovskiy, candidate of medical sciences; and A. A. Genkin, candidate of biological sciences.

INTRODUCTION

The problem of assuring highly efficient performance by military specialists in the system of control of military technology is solved in three ways: adaptation of machines to man, rationalization of teaching and training of specialists and psychophysiological screening of personnel.

Psychophysiological screening is a system of measures directed toward identifying individuals who conform, in their psychophysiological traits and professional abilities, with the requirements of specific specialties, i.e., the best suitable for training and subsequent efficient performance of their work. Such screening not only increases the efficiency of specialists in the system of controlling military equipment, but reduces significantly the time required to instruct and train them, and lowers the drop-out rate among personnel.

Professional ability refers to the structure of rather stable personality traits which, however, change under the influence of a number of biological and social factors, that determine the success of training, advancement of knowledge and skills, and performance of specific work tasks. The aptitudes [abilities] for a given occupation are determined by the requirements that this occupation makes of the personality. Of course, studies of personality traits should be directed toward determination of structural correlation thereof, i.e., the studies must not be reduced to isolated evaluation of some individual trait, but should provide for determination of the state of each trait in close relation to other personality traits.

However, determination of abilities and aptitudes does not yet mean that they will be successfully expressed in the course of training or professional performance.

Several opposite traits (for example, aptitude for calculations and laziness) may be present in a person, and development of the required abilities and aptitudes does not necessarily occur. For this reason, along with the task of detecting abilities, psychophysiological screening also has the purpose of predicting an individual's capacity to develop the demonstrated traits. If this process is overlooked, it could lead to a situation, in a number of cases, where the specialist's abilities do not coincide with the actual effectiveness of his training and subsequent work.

Thus, the problem of screening amounts, in the first place, to determination of the requirements made of an individual by a specific form of work and abilities on which the specialist's successful performance depends, and, in the second place, to determination of test methods that would permit evaluation of these abilities and possibility of further development thereof.

In developing the system of psychophysiological screening, one should, first of all, define the military specialties for which the screening is to be performed. The need for screening arises for the following reasons: the success of specialist training depends largely on professionally significant psychophysiological traits, while inadequate development of these traits in a specific group of trainees is the cause of their poor earning achievement and dismissal from the educational institution; when there is drastic differentiation between good and poor specialists, with regard to effectiveness of their professional performance (for example, number and nature of erroneous actions, speed of performance of work operations, etc.), and this differentiation is based on differences in state, degree of development of specific psychophysiological traits in representatives of these groups.

In those cases when errors in the work of specialists, which are determined by the distinctions of the state of their psychophysiological traits, are insignificant and do not lower appreciably the combat efficiency of the equipment, it is not expedient to conduct the screening. Screening will also be of little help when specialists, whatever their qualifications, make many mistakes or cannot master work with the given combat equipment. In this case, improved efficiency of using combat equipment [technology] may be achieved either by changing the nature and duration of training, or by changing the informational structure of operating [controlling] the equipment.

Development and implementation of screening measures referable to military specialists should take into consideration the principles determining the content and order of implementation of these measures. The first principle we should mention is complexity of professional screening. This means that in professional screening of military specialists there must be provisions for rating the suitability of draftees and graduates according to a set of indicators (physical, psychological, physiological, social and others). In other words, professional screening must be systemic and include comprehensive examination of the personality.

At the present time, screening has been developed and is being used on military personnel according to medical indicators, education, physical conditioning, social and moral-political indicators.

Psychophysiological screening, which is an element of professional screening, differs substantially from the above-listed forms of screening. Its main objective is to detect individuals who conform with the requirements of a specific specialty in their professional abilities and individual psychophysiological traits.

Determination of the criteria of professional fitness [suitability] is one of the difficulties of psychophysiological screening. These criteria cannot be strictly definitive, they should change under the influence of a number of conditions, in particular, the parameters of the control systems and structure of the work process determined by them, conditions of work, time allowed for and distinctions of the teaching and training process, and, finally, socioeconomic limitations of screening. Hence, the need to divide the entire group being screened into three: individuals who are definitely fit, conditionally fit and unfit.

The unconditionally fit include individuals who will succeed in learning a specific specialty with the existing ways and means of instructing and training, and will perform their professional duties efficiently using the available forms of combat equipment.

The conditionally fit must refer to two categories of individuals. One of them consists of those who will cope with their duties, but there could be mistakes in their work due to some changes in present factors. These mistakes will lower the overall efficiency of the functional system only negligibly. The other category refers to individuals who require a longer time and change in mode and structure of instruction and training. Of course, use thereof to perform professional duties will depend on a number of general conditions, for example, correlation between required number of specialists and manpower resources from which the screening is performed.

The unfit group refers to all individuals whose instruction in a specific occupation is minimally productive, while work in the specialty could definitely lower the overall efficiency of the functional system, even if the modes and structure of instruction and training are altered.

The second principle is that of active selection. At the present time, there is a tendency toward narrowing the group of selected individuals by increasing requirements expected of them. This is the easiest route, but it is not the best.

The possibility of expanding the group of screened individuals ensues from the principle of active selection, which makes it necessary to use the results of psychophysiological examination, not only to settle the question of fitness of candidates for a specific activity, but to elicit the required change, adaptation of design of equipment with which man interacts to his psychophysiological abilities, as well as for rational automation of a number of work operations, development of physiologically and psychologically justified systems for teaching specialists and optimization of training modes, introduction of nonspecific agents (pharmacological, physical and others) to enhance the stability of man's psychophysiological functions and maintain them on a certain optimum level.

In other words, one should construct the system of psychophysiological screening as an integral part of other means of improving the efficiency of military specialists.

The third principle is the principle of differentiated forecasting. It must be conceded that, as a rule, development of measures for screening for specific specialties is not entirely purposeful. The number of occupations, for which specialists have to be selected, is large; with each year, more and more new occupations are appearing; within each of them control systems are being constantly refined and, consequently, the nature of the work is changing. At the same time, some occupations have an analogous functional structure of operations, and the performance distinctions that characterize them make identical requirements of the main psychophysiological traits of an individual.

For this reason, development of procedures and criteria of screening for groups of specialists, established on the principle of similarity of the main elements in the structure of work or professionally important personality traits, is the most promising.

This principle does not rule out the possibility and, in a number of cases, necessity of developing measures to screen candidates for specific specialties as well.

The fourth principle is the dynamism of screening. This means that the screening system must consist of a set of successive measures that have the goal of continuous accumulation of information about the state and distinctions of development of professional personality traits. This information is needed to define the forecast of learning achievement and work performance of specialists, on the one hand, and to settle the question of placement of specialists after graduating from the educational institution, desirability of use thereof, assignment to new positions, involvement in servicing new control systems, etc., on the other hand.

This principle must be implemented by means of periodic psychophysiological examination of specialists and gathering information about their personality traits manifested in different personal and occupational situations, at different stages of instruction and work.

At the time of the call up, when determining whether it is expedient to send the draftees to some military educational institution, it is imperative to screen them in order to determine fitness for training in some specific specialty.

Upon graduating from the educational institution, one should screen the graduates to issue recommendations for filling a specific position, referral for work in a specific system of military technology.

The scope and form of psychophysiological screening must change at each stage. At the first stage, examination of questionnaires, references, holding talks and group psychophysiological testing with the use of a limited number of methods requiring the use of forms play the dominant role; at the second stage this applies to individual and group testing with the

use of forms and instrument methods, as well as the method of conversation and observation; at the third stage, this applies to the use of individual methods, including simulating and modeling of the process and conditions of future work, as well as conversation, observation and generalization of the different personality traits of the serviceman.

The scope of the examination depends on the time scheduled for screening and number of people examined, and it is specially set in each individual case.

The fifth principle is the principle of dynamism of criteria. At the present time there is a tendency toward orientation in military personnel screening on parameters that, in the opinion of examiners, must assure excellent performance of functional duties by specialists. However, there is no doubt that it is senseless to demand excellent work and always flawless work performance of everyone. For this reason, it can be assumed that it will be useful, in a number of cases, to conduct screening by the average or even bottom criterion, rather than the top one, i.e., to determine the possible extent of decline of combat efficiency that may occur due to expansion of the circle of enlisted specialists. However, at the present time it is difficult to implement this principle.

CHAPTER 1. PSYCHOPHYSIOLOGICAL REQUIREMENTS FOR MILITARY SPECIALISTS

Main Principles of Psychophysiological Analysis of the Work of Military Specialists

The psychophysiological requirements for military specialists should ensue from the distinctions of their work, those that are common to all and those that are specific and referable to only some groups. The psychophysiological distinctions are demonstrated by means of analysis of work (combat) performance, which is the result and immediate manifestation of a number of mental and physiological processes. For this reason, psychophysiological analysis always implies multidimensional (according to a number of criteria or signs) description of a given activity of the personality.

Use of quantitative evaluations and clearcut determination of the level of analytical examination of a work process constitute an important prerequisite.

On the pragmatic level, there is examination of the work cycle as a whole, for example a flight to intercept a target, a torpedo attack.

The operational level implies separation of the work cycle into separate operations and suboperations. For example, the work of a pilot when flying to intercept a target is made up of four main operations of first order: gaining altitude, accelerating the aircraft, making a turn, aiming and firing a rocket. The last operation contains secondary operations: turning on the gunsight, detecting the target marker, holding the marker in the sighting zone, etc.

There may also be operations of third, fourth or higher orders.

The psychophysiological level reflects the fact that analysis is carried out to the degree of demonstration of mental or physiological processes that are directly involved in performance of work operations.

In this Handbook, we are offering methods for the psychophysiological level of analysis. The main factors that must be borne in mind are as follows:

1. General description of work activities; its purpose, place of the object in the system of control of military equipment, organization of flow of information, principal data pertaining to construction of the object.

2. Hygienic and social aspects of working conditions.

3. Psychophysiological structure of the work process and intensity thereof.

4. Characteristics of work and rest schedule.

In solving problems of psychophysiological elements, the chief element is knowledge of the psychophysiological structure of the work process and its intensity, since expressly this enables us to determine which psychophysiological traits are of the most importance to efficient performance of a specific type of professional work.

Analysis of the work process should result in filling out a chart of the psychophysiological (ergonomic) classification of the specialty (profession), including determination of conformity of the psychophysiological distinctions of the work to personality traits.

Psychophysiological Distinctions of the Work of Military Specialists and Classification Thereof

The elements of work structure that characterize the distinctions of information processing by a person, as well as specific and nonspecific tension, are of the greatest importance to the tasks of psychophysiological screening.

With regard to tension criteria, a distinction is made between the following groups: specialties involving the optimum tension, those with extreme and superextreme tension.

Extreme tension is related to conditions that require mobilization of "buffer" reserves of the body, and superextreme tension is related to conditions that require mobilization of "emergency" reserves (immediate threat to life, responsibility for subordinate group under combat conditions, etc.).

Extreme or superextreme tension is inherent in all military specialties. Accordingly, all military specialists must have a number of positive traits contained in the group of activational personality features. The degree of development of these traits must be taken into consideration when recommending a candidate to a group of specialties with extreme (for example, radar station operators, staff officers, artillerymen) or superextreme (for example, pilots, scouts, submarine commanders, tankmen) tension.

Table 1 lists the classification of specialties according to the criterion of distinctive features of information processing during the work process.

Table 1. Classification of specialties according to criteria of information processing

Type	Subtype	Class	Subclass	Kind	Form	Examples of specialties
1. Physical		1. Manual	1. Simple	--	--	Unskilled construction workers
			2. Complex	--	--	Riggers
		2. Instrumental	1. Simple	--	--	Riflemen
			2. Complex	--	--	Divers, general engineers
2. Informational	1. Administrative	1. Operator	1. Stereotype	1. Discrete-operational	1. Sensorimotor	Console operators, engine mechanics, plotters
					2. Sensorirecoding	Radio operators, hydroacoustic specialists
				2. Analog-operational	--	Radar station operators, plotters
			2. Non-stereotype	1. Discrete-operational	1. Dynamic-motor	Control console operators, electricians
					2. Engram	Scouts, observers
				2. Analog-operational	1. Drivers	Drivers, mechanic-drivers, helmsmen
					2. Pilot	Pilots, parachutists
		2. Operative	1. Technological	1. Operating	--	Power plant operators
				2. Servicing	---	Engineers, equipment technicians
			2. Dispatcher	--	--	Command post officer-operators, navigators
			3. Games	1. Tactical	--	Chiefs of staff, officers in operational sections
				2. Commander	--	Commanders of units [chast'] and subunits [podrazdeleniye]
	2. Heuristic	1. Logical-productive	--	--	--	Officers, generals involved in strategic and scientific research work
		2. Graphic-productive	--	--	--	Musicians

According to this classification, operator specialties are referable to the operator and operative classes, with the exception of subclass 3--games. We list below the differential (having the greatest weight) signs for these groups of specialties, for which this Handbook was prepared.

The physical specialties refer to those that make high demands of the individual's physical condition and certain physiological functions. There are minimal psychophysiological requirements, so that it is not expedient to perform screening.

The informational specialties are characterized by the existence of an intermediate system between a person and the object of work. As compared to heuristic specialties, administrative ones involve relatively few creative thinking operations.

Operator specialties differ from operative ones in that there is a low-ranking intermediate system and greater weight of reproductive, transforming operations. Operative specialties, however, are characterized by productive transforming operations, i.e., such personality traits as logical abstract thinking, ability to generalize and concretize, etc., are important to them.

The further hierarchic description of specialties is based on singling out some common psychophysiological feature of the profession and corresponding personality trait.

The classification shown in Table 1 should be considered tentative, to orient the researcher in selecting methods and permit determination of the principal nature of measures for vocational guidance and screening.

The large number of various specialists needed in the USSR Armed Forces makes it extremely difficult and often even unnecessary to elaborate screening methods for each concrete sort of specialty, since the psychophysiological structure of work is the same in many specialties. For this reason, it is deemed possible to work out methods for the screening for only groups of occupations, so that subsequent differentiation into sorts of specialties is made with the least number of methods and within a very short time. For example, examination of an individual's capacity for rapid change in stereotype reactions, to switch from one form of activity to another, makes it possible to classify the entire screened contingent intended for operator work into two groups already at the stage of primary vocational guidance: one would be recommended for training in the specialties contained in the stereotype subclass and the other, the nonstereotype one. This phase of screening will no longer have to be done at educational centers or schools, so that special attention will be given to demonstration of distinctions of operational [active?] memory and attention, from the features of which one can refer conscripts to specific educational groups.

Personality Structure of Military Specialists. Classification of Elements in Personality Structure

In order to disclose the psychophysiological essence of each element of the work process isolated as a result of analysis of work activity, we must have a clear idea about the structural aggregate of personality traits, content and hierarchic relations thereof.

Proceeding from the thesis of personality structure as an aggregate of socially and biologically determined personality traits, Table 2 shows the classification of elements (properties, processes, forms and types of implementation thereof, function) of personality structure of military specialists. It is expedient to put them into two major categories, in accordance with the concepts adopted in Soviet psychology. The first category, "Operational personality distinctions," refers to traits that implement primarily processes of information processing, i.e., its perception, processing and motor influence on some system (perception, memory, thinking, etc.). The second category, "Activational personality distinctions," refers to traits that cause a certain level of function of the process of information processing by an individual (traits of orientation of personality, attention, etc.).

During screening, it is important to take into consideration as well the state of an integral distinction of personality structure, such as its characterological traits which, like abilities, constitute a certain individual aggregate of special personality traits.

In view of the fact that psychophysiological screening is based on examination of the state of certain personality traits in different individuals, each of these traits must be characterized by certain indicators, which disclose the distinctions of their manifestation when performing specific assignments (methods).

We list below the main rating parameters of elements of personality structure, which make it possible to describe quantitatively and qualitatively the state of the personality traits under study.

1. Sensation. The physiological characteristics of sensation are: threshold, absolute thresholds (top, bottom, range), differential thresholds.

2. Perception. The quantitative characteristics of perception are: speed, accuracy.

3. Memory. The quantitative characteristics of memory are: scope, speed of retention and reproduction, accuracy of reproduction and duration of retention.

4. Thinking. The quantitative characteristics of thinking are: speed and accuracy of thinking processes, novelty of creative activity.

Table 2. Classification of elements in personality structure of military specialist

Hierarchic coordinate-criteria (L)							Elements of personality structure
1	2	3	4	5	6	7	
1							Operational personality features
	1						Psychophysiological traits
		1					Sensation properties
			1				Sensation threshold
				1			Intensity
				2			Frequency
				3			Spatial distance
				4			Duration of stimulation
		2					Perception
			1				Spatial perception
				1			Perception of extended properties of objects
					1		Shape perception
					2		Size perception
					3		Volume perception
				2			Perception of texture of objects
				3			Perception of distance between objects
				4			Perception of distance between objects and observer (depth perception)
				5			Perception of position of objects in space
				6			Perception of spatial position of person ("oneself") in relation to surrounding objects
			2				Time perception
				1			Perception of sequence of phenomena
				2			Perception of duration of phenomena
				3			Perception of rate (speed) of alternation of different processes
				4			Perception of rhythm of complex phenomena or processes
			3				Perception of motion (spatial movements of objects)
				1			Perception of nature of movement (bending, unbending, etc.)
				2			Perception of form of movement (rectilinear, curvilinear)
				3			Amplitude of movement (full, partial)
				4			Direction of movement (to the right, left, etc.)
				5			Duration of movement (brief, long)
				6			Speed of movement (rapid, slow)
				7			Acceleration of movement (uniform, accelerating, etc.)
			4				Perception of simple images
			5				Perception of complex images (integral perception)

Table 2. (continued)

1	2	3	4	5	6	7	Elements of personality structure
		3					Memory
			1				Duration of retention of material
				1			Short-term memory
				2			Long-term memory
			2				Types of memory
				1			Graphic-image memory
				2			Verbal-logical (meaning-related) memory
				3			Emotional memory (memory for feelings)
			3				Modality of memory
				1			Auditory memory
				2			Visual memory
				3			Motor memory
				4			Combined memory
			4				Principal memory processes
				1			Memorizing
				2			Reproduction
					1		Recollection ["vospominaniye"]
					2		Recall ["pripominaniye"]
				3			Recognition
				4			Forgetting
			5				Operational memory
		4					Thinking
			1				Types of thinking
				1			Graphic-effective thinking
				2			Abstract-logical thinking
				3			Imaged thinking
			2				Forms of thinking (nature of transformation of information
				1			Reproductive thinking
					1		Grouping thought processes
					2		Counting thought processes
				2			Productive thinking
					1		Deductions
						1	Conceptions
						2	Judgments
						3	Concepts
						4	Programs
					2		Heuristics
				3			Thinking operations
					1		Comparison
					2		Abstraction
					3		Generalization
					4		Concretization
		5					Psychomotor aspects
			1				Types of actions
				1			Motor type
				2			Verbal type

Table 2. (continued)

1	2	3	4	5	6	7	Elements of personality structure
			2				Complexity of action
				1			Simple static action
				2			Simple dynamic action
				3			Complex coordinated action
2							Activational personality features
	1						Dominance
		1					Personality orientation
			1				Personality needs
				1			Material needs
				2			Spiritual needs
					1		Need to work (military work)
					2		Need for public [social] activity
					3		Need to acquire military knowledge
					4		Need for creativity
					5		Need for socialization
			2				Interests
				1			Individual interests
					1		Material interests
					2		Spiritual interests
				2			Public interests
					1		Material interests
					2		Spiritual interests
			3				World outlook
			4				Motives
				1			Motives of self-protection (preservation)
					1		Personal danger
					2		Alimentary disturbances
					3		Pain, cold, heat
				2			Motives of protection (preservation) of species
					1		Responsibility for others (subordinates, crew members, etc.)
					2		Domestic relations and feelings
				3			Motives attributable to social environment
					1		Responsibility for reaching work (combat) goals
					2		Novelty of impressions
					3		Cognition
					4		Communication
					5		Moral-ethical motives
					6		Achievement of personal goals (promotion, advancement of military qualifications, etc.)
					7		Achievement of public [social] goals
		2					Attention
			1				Types of attention
				1			Voluntary attention
				2			Involuntary attention
	2						Conative [volitional] personality traits

Table 2. (continued)

1	2	3	4	5	6	7	Elements of personality structure
		1					Conscious activity (goal-orientation, initiative, decisiveness, vigor)
		2					Stability (persistence, patience, endurance)
		3					Organization (compliance, discipline, self-control, confidence)
	3						Emotional and sensory personality elements
		1					Feelings
			1				Moral feelings (happiness in work, sense of duty, sense of friendship and camaraderie, conscience, shame, pride)
			2				Intellectual feelings (inquisitiveness, curiosity, amazement, bewilderment, doubt, sense of novelty, fear of novelty)
			3				Esthetic feelings (sense of beauty, ugliness, coarseness, grandeur, inferiority, baseness, tragedy, comical)
		2					Emotions
			1				Main emotional states
				1			Pleasure
				2			Displeasure
				3			Excitement
					1		Mobilizing excitement
					2		Disorganizing excitement
				4			Calming
				5			Tension
				6			Anxious anticipation
				7			Confusion
				8			Fright ["ispug"]
				9			Fear ["strakh"]
				10			Panic
	4						Typologically determined personality aspects
		1					Types of higher nervous activity
			1				Properties of nervous processes
				1			Force of nervous processes in relation to excitation
				2			Force of nervous processes in relation to inhibition
				3			Equilibrium of nervous processes
				4			Lability of nervous processes
		2					Temperament
			1				Choleric temperament
			2				Sanguine temperament
			3				Phlegmatic temperament
			4				Melancholic temperament
	5						Occupation-determined personality aspects
		1					Professional training [preparedness]

Table 2. (continued)

1	2	3	4	5	6	7	Elements of personality structure
			1				Knowledge(in military and applied disciplines)
			2				Aptitude [ability]
			3				Skills (practical-military)
				1			Motor skills
				2			Sensory skills
				3			Thinking skills
		2					Experience in professional work
			1				Psychomotor activity
			2				Intellectual activity
			3				Technical activity
			4				Literary activity
			5				Musical activity
			6				Organizing activity
			7				Athletic activity
			8				Military and applied activity

5. Psychomotor aspect. Biomechanical characteristics of movement: force, endurance (muscular), pace (frequency of repetition of the same movements)--maximum and required; speed, route (trajectory of movement)--form of movement, direction of movement, volume (amplitude) of movement; rhythm, accuracy and stability.

6. Orientation of personality. Degree of orientation: level (deep, superficial); breadth (meaningfulness--broad, narrow); intensity (mild--contemplative, strong--prompting initiative and creative activity); stability, effectiveness.

7. Attention. Properties of attention: scope, distribution, intensity, stability, concentration, flexibility.

8. Will. Properties of will: strength, stability.

9. Feelings. Properties of feelings: stability, effectiveness, strength, breadth.

10. Emotions. Nature of influence of emotions: sthenic, asthenic. Duration of manifestation: stable, unstable.

11. Types of higher nervous activity. State of excitatory and inhibitory processes: force, equilibrium, lability.

12. Temperament. Characteristics for demonstration of temperament: level of activity and efficiency, distinctive features of communicativeness or social contact, flexibility or ease of adjustment to changing conditions, level of emotional tonus and lability.

13. Professional training: Scope, level (depth).

Appropriate methods must be used to obtain objective and full enough information about the different personality traits (or combinations thereof). One can examine various manifestations of a given trait (for example, visual or auditory memory, the process of reproduction or time of retention), as well as different forms of correlation between a given trait and others (for example, memory as related to distinctions of perception, attention, emotional stability), depending on the nature of the task (its content and form of presentation). For this reason, when examining personality traits the investigator must have at his disposal a large and diversified assortment of methodological procedures, from which those required to solve special, concrete problems are chosen.

General Description of Methods for Psychophysiological Analysis of the Work of Military Specialists

The main methods of obtaining information that is required for psychophysiological analysis of the work of military specialists are as follows: extraction of information from records; engineering psychological inspection of equipment; observation of work process and specialist's behavior; conversation with specialist; self-accounting during the work process; questionnaires and expert evaluation; recording and measuring different parameters of the work process; analysis of mistakes in the specialist's work; algorithmic analysis of work; measurement of parameters of environmental factors; experimentation.

Extraction of information from records: From the standpoint of psychophysiological analysis of work, records can be divided into three groups: a) those characterizing the content and organization of work, arrangement of control system, distinctions of the environment; b) records reflecting the results of work; c) records characterizing the personality distinctions of military specialists.

The records referable to the first group (a) include descriptions of technological objects, instructions, manuals on operation and combat use, standards on combat preparations [or training], etc. Examination of these documents helps one learn about the substance of professional work, arrangement of the work place, organization of interaction between specialists and between the specialist and equipment.

At first, one singles out the most important operations (those related to a shortage of time, emergencies, etc.) on different sublevels, and a tentative evaluation is made of the psychophysiological substance of performance thereof by specialists.

In order to obtain information about the modes of specialist work, one must find answers to the following questions:

1. Distribution [schedule] of different forms of work and recreation in the course of the day.

2. Duration of duty (watch) shifts and intervals between them.

3. Characteristics of the mode of performance of the main operations: a) continuous servicing of systems; b) mode of operational readiness; c) mode of continuous monitoring of instruments and system as a whole; d) mode of sporadic operation of system under emergency conditions, operational support, etc.

The standard-setting documents are used for approximate evaluation of the degree of specific tension involved in performing the work (according to required speed of work, accuracy of operations, etc.).

The records referable to the second group (b) include logs of training progress, copies of educational combat problems, records of study progress, etc. This material is one of the sources of data used to analyze errors in the work of specialists (pp 25-27). In addition, it can give information to evaluate personality traits and level of professional proficiency of concrete individuals. From this point of view, it is interesting to analyze the individual records of a number of specialists (flying and diving "books" [logs], etc.), as well as medical records. However, it must be borne in mind that such records may also contain information that is not reliable enough.

The records referable to the third group (c) refer to certification of officers, service, party-political and medical records; submission of name for assignment to a post, etc.

Engineering psychological inspection of equipment: The study of the distinctive features of equipment and arrangement of combat posts and work places of control consoles makes it possible to gain additional information about the distinctive features of performance of individual work operations, complexity thereof, existence of adverse factors that make the performance of these operations more difficult, logical structure of actions by the specialist, etc. The data obtained in the course of the engineering psychological examination also help identify the factor on which the efficiency of specialist work depends: some flaws in the equipment and arrangement of systems or individual distinctions that determine the degree of success of professional performance of specialists. The methods of engineering psychological and physiological-hygienic evaluation of work places and control consoles of specialists referable to the operator category are described in [29].*

Observation of work process and specialist's behavior: One can construct the characteristics of the channels of flow of information and time characteristics of work, evaluate the distinctions of information directed to the specialist, as well as the load on and functional distinctions of different systems of the body on the basis of observation of the work

*Numbers in square brackets refer to bibliography.

process. Observation of the behavior of a specialist, with either high or low qualifications, during the work period permits evaluation of the degree of difficulty and intensity of the work process.

While observing the work process, answers must be obtained to the following questions:

1. Characteristics of channels of information flow:
   1) number of information channels
   2) dynamics of information flow in time (unidirectional, alternating, combined).

2. Time characteristics of work:
   1) continuous (limited time, anticipation mode)
   2) discrete (limited time, anticipation)

3. Characteristics of data (information and orders [commands]) directed to the specialist:
   1) orders:
      a) content of main orders directed to specialist while performing different work operations
      b) route and nature of orders (from whom and how transmitted: direct verbal [oral] order, telephone ["voice pipe"], by translation, light signals)
      c) exemplary [or approximate] classification of information (orders): information upon receipt of which there must be an immediate action; information that must be retained for a specific period of time, then processed; information that has to be passed on
      d) physical force of order (volume at receiving point)
      e) quantitative characteristics of orders over the main stages of the work process (overall quantity and per unit time)
   2) characteristics of audio information:
      a) brief description of information channels (source, whether there are intermediate points)
      b) characteristics of information (physical force, frequency of delivery over given channel, time of individual signals and intervals between them, simultaneous delivery thereof)
      c) characteristics of different channels of audio information (relative load on channels, possibility and frequency of simultaneous delivery of information over two or more channels)
      d) interferences in transmission of information over a given channel (noise--intensity and nature thereof, mistakes in transmission element; discernability--technical and individual--of speech)
   3) characteristics of photic (visual) information:
      a) brief description of information channels
      b) quantitative and qualitative characteristics of information (intensity and color of lights, contrast in relation to background, duration of signals and intervals between them; frequency of delivery of information)

c) characteristics of different channels of delivery of visual information (relative load on channels, possibility and frequency of simultaneous delivery of information over two or more channels)
d) interference in transmission of information over a given channel, possible errors.

4. Data on function of analyzers:
1) which analyzer (analyzers) is the leading one (most loaded or important to implementation of work process)
2) some distinctions of conditions under which analyzers function:
a) characteristics of signals according to force (maximum range, average values of absolute force)
b) characteristics of differential thresholds (minimum difference in intensity of sound or light that must be perceived)
c) noise stability (are there difficulties in perceiving signals or orders against the background of "noise," and of which precisely; at which intensities of useful signal and "noise" they are perceived)
d) characteristics of required mobility (lability) of a given analyzer (number of signals, maximum and minimum, delivered per unit time; simultaneousness of signal delivery)
3) characteristics of dynamics of involvement of different analyzers in work, tension thereof at different times and throughout the work process:
a) time of continuous observation of instruments and perception of signals
b) mode of analyzer function in the case of periodic observation
4) characteristics of interaction between the set of analyzers (frequency of shifting from one analyzer to another; simultaneous, unidirectional and multidirectional analyzer function)

5. Data concerning function of skeletomuscular system:
1) posture during work and active rest
2) nature and frequency of changing position during different manipulations, the most typical position for a specific type of activity
3) nature of work movements of the hands (direction of movement, amplitude, pace, force applied)
4) position of the head, nature of its movement
5) data on speed and degree of muscular fatigue and impairment of coordination
6) energy expended during work (intensity).

6. Data on function of the central nervous system:
1) characteristics of immediate [operational] and long-term memory:
a) number of data (information) that must be retained for short and long periods of time while performing work operations
b) form of retention of information (mentally, making a note, marking an instrument, etc.)
c) nature of material to be retained (digital, graphic, logical-verbal, etc.)

2) characteristics of processes involved in analyzing information and making decisions
   a) procedures and devices used to analyze and synthesize incoming information and to make decisions (tables, diagrams, formulas, calculators, deductive operations, etc.)
   b) characteristics of principal methods of information processing (decision making): automatic reactions of choice, tracking, etc.; thinking operations: logical, arithmetic, creative
3) characteristics of parameters of speed, accuracy and reliability of performance of work operations
   a) predominant type of set in performance (oriented toward speed, accuracy, reliability or different combinations of these parameters)
   b) significance of these parameters to efficient performance by the specialist
   c) permissible quantitative fluctuations of these parameters
   d) characteristics of these parameters during performance of main operations: time between delivery of signal and reaction; time spent on different elements of an operation to prepare for a decision (in the most common and most difficult situations)
   e) characteristics of errors (they are analyzed on pp 25-27).

7. Conative and emotional tension:
   1) will situations arise (and if so how often) that require great will power (working under adverse environmental conditions, in the presence of distractions in the presence of danger, etc.)
   2) causes and degree of emotional tension (situations involving danger, accidents [emergencies], high degree of responsibility, shortage or "surplus" of time or information, increasing flow of information, etc.)

It is desirable to conduct observations of the work process following a graph-chart of the algorithm for performance of the most important operations (pp 27-31).

In order to study the flow of communications, it is convenient to use forms for recording the delivery of reports (Figure 1), which can then be used to prepare charts reflecting the load on channels of verbal communication (Figure 2).

Observation of the behavior of a specialist during work yields information about the specific and nonspecific intensity of work, on the one hand, and level of professional proficiency and personality traits of specific individuals, on the other. It is desirable to supplement observation with instrument methods of evaluating changes in physiological systems and mental status.

The plan of observations ensues from the list of personality trait. The psychologist who is conducting the observation must have experience in perceiving and evaluating signs in an individual that most people do not notice, for example, skin color on the neck, "behavior" of the hands [1, 9, 22].

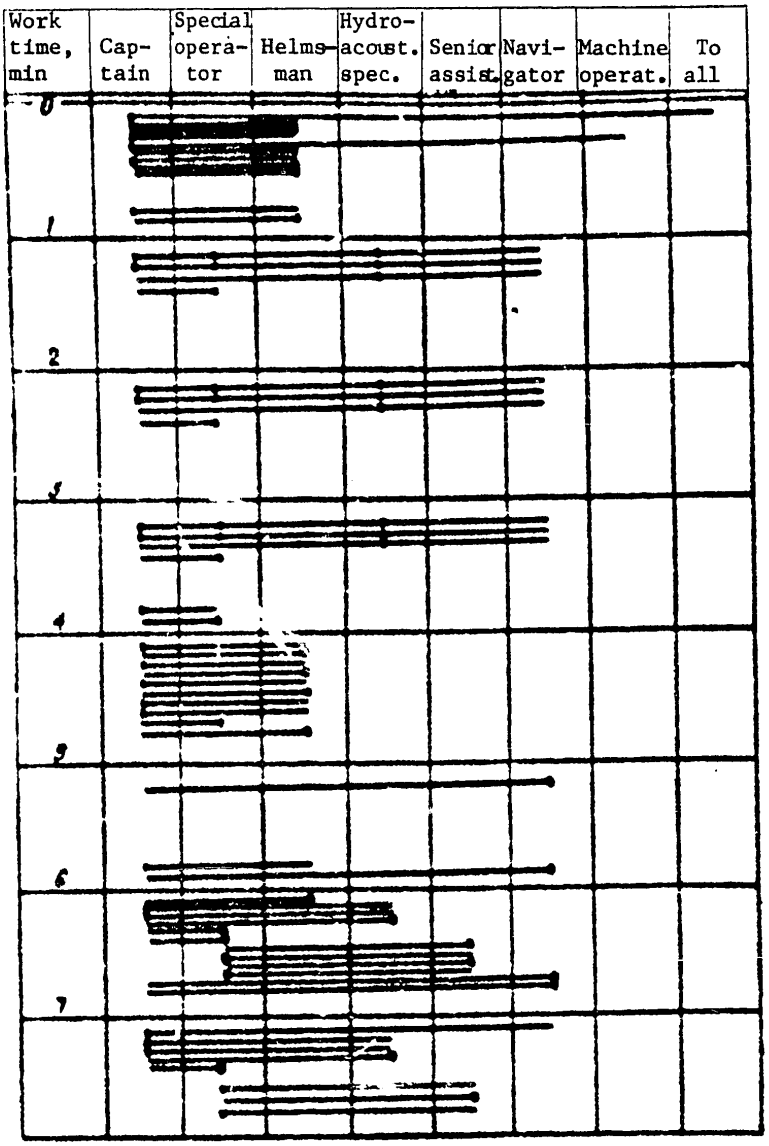


Figure 1. Form for recording route of communications

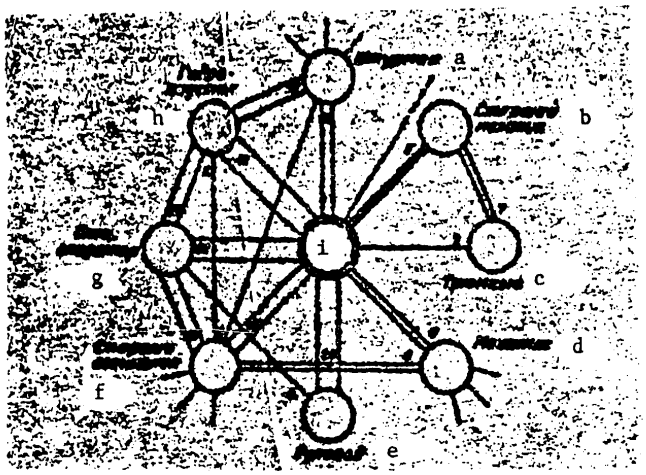


Figure 2. Diagram of load on channels of verbal communication

Key:

a) navigator
b) senior machine operator
c) cargo mate ["tryumnyy"?, damage control man?]
d) mechanic
e) helmsman
f) senior assistant
g) special operator
h) hydroacoustics specialist
i) captain

It is of special importance to demonstrate emotional tension during observation. To evaluate it, we can recommend a set of signs that are listed in the description of methods of conducting talks with specialists and observing them.

Conversation with specialist: This talk can have two goals: in the first place, to obtain information about work in addition to what was learned by studying records and observing the work process; in the second place, to gain information about the subjective reflection in the specialist of some work operation or other (for example, to determine the actual operative units of signal perception).

In order to achieve the first goal, one must distinguish the specialist's biased attitude toward evaluting the work in his specialty or another specialist, about whom he is asked. To reach the second goal, one must bear in mind that many work operations and elements thereof are either not reflected in consciousness, or are reflected in a distorted form.

To reduce the probability of obtaining false information in the course of conversations, one must adhere to certain rules.

The talk can be conducted in the form of free conversation between two interlocutors or as an interrogation, depending on the purpose of the study

and time available to the experimenter. But in both cases, the success of the talk depends largely on the experimenter's tactfulness, his ability to gain the favor of his interlocutor and elicit a natural [easy], frank conversation. There are several procedures that are helpful in rapidly establishing a rather free conversation tone. For example, the experimenter can learn beforehand about the interests and fancies of his future interlocutor through individuals who know him or from his records. And it is expressly with such interests that the conversation should begin.

In the course of the talk, one should try not to write anything down, but to remember what is said. One should adhere to some plan (an example of which as applied to the study of personality traits is given in Chapter 2) in order to remember better and not overlook important questions. The plan for the talk may vary, depending on its specific objective [13, 28].

One must be convinced of the interlocutor's sincerity. One of the procedures for checking the accuracy of information is to repeat the same question, but in a different form and not right away, but after a certain time, which is spent talking about other things.

The objective of the talk is to learn the subjective features of the form of work, rather than the individual's personality.

The experimenter must not indicate precisely what he would like to hear in answer to a question.

Self-accounting of work process: The part of activity that proceeds as a mental process on the basis of active reflection in consciousness is submitted to analysis. It is only in this case that the verbal account about operations performed by the specialist will not disrupt the psychophysiological structure of the activity. For example, efforts to use a report by radio to estimate the time of perception by a pilot of flying instrument readings during a flight turned out to be unpromising. The obtained results were excessively exaggerated in view of the fact that in his real work the pilot reacts automatically on the controls, without translating the instrument readings into a verbal code.

For the time being, the method of ongoing reporting ("thinking aloud") is irreplaceable for analysis of the internal structure of thinking operations. A tape recording is generally used for this purpose. The value of this method and its objectivity (in spite of its subjective form) have been confirmed, in particular, by works dealing with development of heuristic programs for cybernetic devices on the basis of analysis of verbal reports while solving logic problems.

Questionnaires and expert evaluation: The use of questionnaires, i.e., obtaining written answers to questions, involves giving free answers or multiple choice. In the first case, the questions are formulated in such a manner that the subject can write down any answer in any form. In the

second case, each question is followed by a list of possible answers, one of which is to be selected and underlined. The multiple choice type is a variant of alternative questions, i.e., those that are so worded as to require a "yes" or "no" answer.

The advantage of the questionnaire of the free answer type is that it does not restrict the specialist's initiative. Its flaws are that much time is needed to fill it out, mistakes are made that are related to misunderstanding the meaning of a question or forgetting possible answers.

The multiple choice type of questionnaires can be filled out much faster and subsequent statistical processing is easier; however, they preclude answers that are not provided by the experimenter.

In some cases, there are questions of both types in the same questionnaire.

A grade is given in expert evaluation with scaling. This procedure is used extensively in athletics, for example, to grade the performances of figure skaters or gymnasts. Expert evaluations may be used in an analysis of work performance to determine, for example, the degree of specific tension.

Recording and measuring different parameters of the work process: Information about the number of different operations in the work process, their time characteristics and intensity can be obtained in the following ways: a) recording the specialist's eye movements [7, 34]; b) recording the movements of controls [22]; c) recording verbal communications [22, 25]; d) recording the parameters of certain physiological functions [19]; d) time studies.

Analysis of mistakes in the specialist's work: The study of errors and determination of their causes provides rich material for evaluation of specific and nonspecific tension, as well as determination of the most difficult operations. If one knows the psychophysiological essence of mistakes, one can draw a conclusion as to the individual traits of a person that are of greatest importance to a given occupation. Various methodological procedures are used to detect errors: observation of the work process, conversation, questionnaires, participation in meetings of methodological councils, etc. Analysis of demonstrated errors is based on classification thereof, in which the errors are distributed in groups with the use of several criteria.

Classification of errors arising during work

A. External signs of errors:

1. Elimination of elements of work process (operations): efferent operator (elementary operation), afferent operator, delay operator,

logical condition,* complex (segment of algorithm of operation), work process of a broader order (total malfunction).

2. Appearance of additional elements in work cycle: false efferent or afferent operators, false logical conditions. Multiplication** of operators and complex, wrong choice of algorithm.

3. Qualitative mistakes: distortion of signal (wrong identification of all signs or individual ones), impaired order of running terms in algorithm; errors of logic: in action with concepts, judgments, conclusions.

4. Quantitative errors: deviations of parameter from set value in afferent-efferent actions (tracking, setting or determining instrument readings, etc.), arithmetic mistake, excessive (above permissible) increase or decrease in time of performing action.

B. Psychophysiological essence of errors:

1. Motivation: conscious (deliberate), involuntary (as a result of negative attitude toward work performed, with positive motivation).

2. Awareness: awareness or unawareness of mistakes.

3. Information load: as a result of overload (excessive volume or speed of delivery of information) or underload (monotony of work).

4. Informational noises: as a result of noise (interference)--"relevant" or "irrelevant"; in the absence of noise.

5. Functional state of the specialist with normal or altered physical condition (as a result of fatigue, exposure to extreme environmental factors, emotional influences, under the influence of a pathological process).

C. Causes of errors:

1. Flaws in organizing the work: distribution of functions among specialists, setting work standards of efficiency (productivity norms, etc.), in the system of motivation (educational work, incentives, punishments, etc.), in the mode of alternation of work and rest, content (quality) of rest.

2. Flaws in equipment design: lay-out of instrument displays and arrangement thereof; code, volume and mode of signal delivery; arrangement of contorls, design of work place and general arrangement

*See method "Algorithmic Analysis of Work." [starts on the next page]
**Repeated performance of action or groups of actions.

of equipment (interaction between displays and controls, conformity with logic of work operations, etc.).

3. Flaws due to sanitary and hygienic conditions.

4. Individual psychophysiological distinctions of specialists.

5. Deviations in health status of specialists.

6. Improperly formed skills or "poor training" of specialists.

D. Influence of errors on efficiency:

1. No influence on efficiency [effectiveness] of work (ordinarily, such errors are not considered errors, but deviations in activity).

2. They cause moderate disturbances that can be compensated.

3. They cause serious disturbances and create the danger of disruption of performance of combat assignment.

While analyzing errors, there may be various conjectures as to their causes which cannot be determined directly from the available material. In this case, one can use various additional procedures and methods: expert medical evaluation of specialists, experimentation, etc.

Algorithmic analysis of work: The essence of such analysis consists of breaking down the work process into qualitatively different elements, determination of their logical correlation, order of performance and determination of measures that have specific psychophysiological meaning [5].

The separation of the work process must be made down to the operational level. In this case, the elements will be operative units of information (OUI, or logical conditions) and elementary operations (EO, or "operators"). OUI is a signal (image, concept, judgment, etc.) that is distinguishable in the course of a given activity from other signals with regard to one tag [feature, sign]; EO refers to transformation of information and (or) energy (perception, retrieval from memory, mental action, motor reaction, etc.) leading to formation of one OUI.

In order to obtain base material, at first one fills out the table of characteristics of algorithm terms, then an algorithmic description of the work is prepared.

There are three main methods for algorithmic description of work processes.

First method--verbal description, i.e., successive description of all operations performed by specialists and order thereof, depending on conditions. For example, before starting to work the specialist has to

check whether the instrument, with which he has to work, is in order. This is done by means of the following instructions.

1. Check whether instrument is connected to power source. If it is, move on to instruction 3; if not, go to 2.
2. Connect instrument to power source.
3. Depress switch.
4. Check to see if red light goes on. If so, move to 5, if not, move to 6.
5. Commence work.
6. Call mechanic.

Operations 5 and 6 are the final ones and work following the algorithm ends there, depending on whether or not the preceding condition is present.

Second method--preparation of flowcharts [logic diagrams] of algorithm in symbolic form and line printing. To prepare algorithm flowcharts, the work process must be separated into elementary operations (EO), and the logical conditions (OUI) in response to which these acts are performed must be identified. Elementary operations are designated with upper-case Latin letters (A, B, C, ...) and the logical conditions that must be considered with lower-case letters (a, b, c, ...).

The logic diagrams are expressions made up of EO and OUI that follow one another [5].

Such elementary operations as each successive turn of a flywheel (or other similar manipulation), delivery of signal, read-out and analysis of instrument readings that give information about one variable are considered to be individual EO and OUI.

Third method--use of graph-diagrams (functional diagram) that offer a graphic image of all relations and interactions in the algorithm. This form of presentation of algorithms is needed primarily to observe actual work. It is convenient for following the course of the process in each specific instance and to gather data on the frequency of running different variants of the algorithm, time parameters and errors arising in some term of the algorithm.

In the more complicated cases, special forms of recordings and additional symbols are used [5, 12, 35].

Algorithmic description of the work process makes it possible to obtain some psychophysiological parameters that characterize quantitatively the "controlling" work of a specialist. Thus, the number of logical conditions, each of which may or may not be present, is indicative of the number of possible variants of expression of the algorithm. Consequently, the number of logical conditions may be a gage of the uniqueness [nonstandard nature] of the work (see p 30 with regard to the coefficient of uniqueness).

In some sense, the total number of different operators and logical conditions may characterize the degree of diversity in the specialist's work.

One of the objectives of studying work activity is to record it during expression of the algorithm. This permits evaluation of both the mean intensity of the work and dynamics of intensity in the course of the work day. If one knows the number of elementary operations (N_0) and logical conditions (N_l) in the work cycle, the absolute incidence of each elementary operation (q_0) and logical condition (q_l), as well as duration of the work process (T), one can estimate the mean dynamic intensity V of the work process or some segment of the algorithm by means of the following formula:

$$\overline{V} = \frac{N_0 \cdot q_0 + N_l \cdot q_l}{T}$$

Evaluation of degree of "stereotypism" of work and its complexity in relation to the volume of logical operations is very important to the psychophysiological description of work activity.

The description of stereotypism of the work process is based on analysis of the distribution of elementary operations in groups: the more groups in the algorithm that turn on a continuous sequence of operation elements, and the longer these sequences, the more marked the stereotypic component in this form of work.

The coefficient of stereotypism of the work process β is calculated with the following formula:

$$\beta = \overline{S}_{0_l} = \sum_{i=1}^{l} iP_{0_i},$$

where S_{0i} is the mean number of elementary operations in the group (i = 1, 2, 3, ...) and P_{0i} is the incidence of the 1st, 2d, 3d, ..., ith group in the algorithm.

The characteristics of the dynamic element of work (if it is considered as a dynamic stereotype) may be expressed as by the gage of its logical complexity. This gage must reflect the distribution of logical conditions in groups, analogous distribution of elementary operations.

The coefficient of logical complexity of the work process γ is calculated with the following formula:

$$\gamma = \overline{S}_{l_l} = \sum_{i=1}^{l} iP_{l_i},$$

where $\overline{S}_{l_i}$ is the mean number of logical conditions in the group (i = 1, 2, 3, ...) and P_{l_i} is the incidence of the 1st, 2d, 3d, ..., ith group in the algorithm.

Analysis of distribution of logical conditions in groups of complexity enables us to derive the gage characterizing the degree of automatism of the work.

Automatism in the work of a person is not equated with stereotypism. While stereotypism consists of rigid determination (certainty) of reactions, automatism consists of the fact that the appropriate action is performed without active participation of consciousness, depending on the logical condition. Since automatism can be developed only for simple logical conditions, it can be arbitrarily considered that the coefficient of automatism ρ will be expressed as the relationship of probability of groups referable to one logical condition to the probability of all other groups of logical conditions, i.e.,

$$\rho = \frac{P_{l_i}}{1 - P_{l_i}}$$

The total number of different elementary operations and logical conditions in the complete algorithm of work can describe the volume of long-term memory.

In view of the fact that the degree of "standardness"(or nonstandardness) of work is determined by the degree of its logical complexity and stereotypism, the quantitative expression of this gage (coefficient of nonstandardness μ) can be presented in the form of a ratio of the coefficient of logical complexity γ to the coefficient of stereotypism β of this work:

$$\mu = \frac{\gamma}{\beta}$$

Emotional and neuropsychological tension involved in performance of some term of the algorithm is evaluated by the investigator on the basis of his own observations, as well as data obtained from talks with the specialists. It is convenient to use for this purpose a point system for grading the tags: a grade of 2 is given to maximum tension and 5 for minimum tension, and then the parameter of emotional stability ε will acquire the following appearance:

$$\varepsilon = \sum_{r=2} rP_r$$

where r is the number of grades (1, 2, 3, ..., r) that rate the term of the algorithm and P_r is the frequency of such terms.

In essence, algorithmic analysis is a form of formalized professiography, and for this reason it is the focal procedure in psychophysiological analysis

of work activity. This analysis can vary in depth and extent, depending on available possibilities. But it is mandatory to single out at least the main operations in the work process, with very approximate evaluation of the psychophysiological essence of these operations.

Practical analysis of operations contained in work, evaluation of conditions at the work place, detection of errors, etc., are often performed simultaneously. For this reason, it is expedient to use a complex system [scheme] to examine work, in which identification and description of operations (terms of algorithm) are combined with the solution of other problems.

Measurement of parameters of environmental factors: This group of procedures includes the usual methods for measuring physicochemical factors (gas composition and temperature of air, acoustic noises, illumination, etc.).

The study of hygienic environmental factors is needed, both to determine the causes of functional changes in the condition of professionally important psychophysiological traits and to demonstrate the components of the environment that are either the source of interference in the function of these traits or the cause of nonspecific tension during work. The presence of deleterious factors serves as grounds to use methods in the screening process that are directed toward examining the stability of some functions or other.

Measurement of features of the psychological environment occupies a special place. For this purpose, one uses the methods of observation, talks and questionnaires, which have already been described. It is also desirable to use some of the procedures of sociological evaluations [20].

Experimentation: Experimentation can be used in analysis of psychophysiological distinctions of work to solve many problems, which it is difficult to do solely on the basis of studying a naturally proceeding work process. There are two groups of experiments: those based on actual work and on simulated work.

Experiments Based on Actual Work

a) Work method [33]. The psychophysiologist-researcher himself learns the profession and, on the basis of his own sensations, describes it. The use of this method is limited to simple forms of work. However, even in complicated cases, it is sometimes useful for the psychophysiologist to learn at least some of the operations, to "get a feeling" for the work process.

b) Method of additional assignments. The working specialist is asked to perform additional tasks that can be readily graded. Discrete sensorimotor reactions with a short alphabet of signals, arithmetic problems and simple logic problems [4] are used as such assignments. The main prerequisite for a successful experiment is a high degree of motivation in the specialists

with respect to the additional tasks. For this reason, it is desirable to select tasks that are contained in the structure of real work.

c) Situational experiment. In order not to wait for situations that arise very seldom in actual work, they can be created artificially. Of greatest importance are situations that elicit psychological stress reactions. In practice, it is only under such conditions that one can obtain reliable characteristics of emotional and conative [volitional] traits of specialists.

Models of stress situations must comply with three conditions: they must have a definite direction consistent with the objectives of the experiment; they must be subjectively perceived by the subjects as being real, and ethical standards must be met.

The main forms of requirements and examples of situational models are: self-preservation and responsibility for the health of the group--simulation of a fire, nociceptive electrical stimulation; desire to achieve work goals--introduction of very difficult or unsolvable tasks, malfunction of work equipment; self-assertion--creation of conflict situations in relations between specialists.

The design and execution must be known only to a very small number of individuals for the situations to be perceived as real. The secret should also be kept after the experiment. A new form of model must be devised for each experiment.

Experiments Based on Simulated Work

a) Separation of different elements of the work process for comprehensive study. This group includes all of the investigative methods using simulator stands, simulators, trainers, tachistoscope, etc. [21].

b) Examination of specialists by means of analytical psychophysiological methods that are ordinarily used to screen specialists after demonstration of individual traits that are the most important to a given occupation. However, the opposite problem can also be solved with these methods: determination of the psychophysiological essence of the most difficult and important operations. The following principle is involved. The methods whose psychophysiological essence is well-known are used to examine the best and worst groups of specialists. Then determination is made of the correlation between the results of examination and parameters of efficiency of work. Apparently, the methods that will demonstrate a high correlation reflect the psychophysiological essence of the most difficult operations in the form of work under study.

Procedures for Substantiation of Professional Requirements

The study of work activity by means of methodological procedures makes it possible to prepare a description of its psychophysiological, hygienic,

organizational and other distinctive features. On the basis of the obtained data, one can provide a psychophysiological description of an occupation, prepare its psychophysiogram, which serves as base material for determination of personality traits required for the specialist to perform his work tasks, i.e., to compile the professional requirements.

One should use the procedure of quantitative evaluation of degree of importance of psychophysiological traits to the performance of different work operations and the work process as a whole for the purpose of objective definition of professional requirements. In essence, this procedure consists of determining, after preparation of the professiogram, of the personality traits, mainly psychophysiological ones, that provide for the performance of each element (operation) of the work process. Then the psychophysiological functions demonstrated in the course of such analysis are graded on a 5-point scale in accordance with the following characteristics: 1) degree of importance of each function to achievement of the end result of a specific work operation; 2) duration of function in the course of the entire work process; 3) degree of load on function when performing different work operations; 4) degree of complexity [difficulty] of performance of each function.

In order to obtain the first characteristic, one must evaluate the significance of each psychophysiological function to implementation of performance of a specific work operation. For example, the operation of reading an instrument can be implemented by the functions of perception, attention and memory. Depending on the distinctions of the task to be performed, arrangement of the instrument, its location on the console, nature of markings, illumination, etc., the performance of this operation may involve a load chiefly on spatial (or motion) perception or operational (or short-term, long-term) memory, or attention span (or concentration, flexibility). These functions are rated higher than all of the others involved in performing operations.

The second characteristic is determined from the data of time studies of the work, in particular the time required to perform each work operation implemented by a given function. The overall time of a concrete function is expressed as a percentage of total time of the work process, and then it is also graded on a point scale.

The third characteristic (load) is based on the use of the quantitative parameters of load on a function. For example, the load referable to volume of memory is characterized by the number of operative units that are retained and reproduced; abstract-logical thinking is characterized by the number of logical conditions considered for decision making, etc.

Finally, the fourth characteristic is an expression of the complexity of implementation of the psychophysiological function as related to hygienic conditions, functional state of the organism, organization of the work process and the effects of other factors. For example, implementation of the function of perception is more difficult in the presence of noise, signal interference and fatigue.

The mean evaluation of the importance of each function to implementation of different work operations and the work process as a whole is based on data referable to the above characteristics. All of the psychophysiological functions are ranked on the basis of this summary rating according to the degree of their importance to the work under study.

One can define the list of psychophysiological traits (professional requirements) that is to be evaluated during the examination in the screening process on the basis of the criterion of significance of these functions specified by the experimenter (depending on the purpose of the screening, available human resources and required number of specialists, etc.).

CHAPTER 2. PSYCHOPHYSIOLOGICAL EXAMINATION METHODS

General Description of Psychophysiological Examination Methods

Psychophysiological examination includes evaluation of both individual psychophysiological personality traits (operational and activational properties of the individual) and a number of integral features that are required for the performance of some specific professional work.

Methods of subjective and objective evaluation of personality are used as examination procedures. The former are based on obtaining information about the traits of an individual that are manifested in different ordinary or experimental situations, or from the individual himself (by means of self-observation and self-accounting), or else directly by the experimenter (by means of analysis of external manifestation of these traits in the subject or data obtained from him).

Objective evaluation of personality is made on the basis of analysis of the results of performing specific (usually standard) tasks or functional tests aimed at examining the state of various psychophysiological traits of a military specialist.

Table 3 lists the classification of methods for psychophysiological examination of military specialists.

We are submitting a list of methods (Table 4) prepared on the basis of their orientation toward evaluation of different elements of personality (or set of such elements) that play a substantial role in mastering a certain military specialty.

The methodological procedures for evaluating the psychophysiological traits of an individual are not limited to the list given in Table 4. Other methods of studying an individual's personality may also be used in conducting screening of military specialists.

Main Requirements for Psychophysiological Examination Methods

The methods used for psychophysiological professional screening must be reliable, have prognostic or informative value and differentiation.

Table 3. Classification of methods for psychophysiological examination of military specialists

1. Methods for subjective evaluation of personality					
Interview	Conversation				
	Questionnaire				
	Self-observation (self-accounting)				
Observation	External	Indirect			
		Direct	Passive		
			Active	Natural experiment	
				Situational test	
2. Methods for objective evaluation of personality					
Analytical examination procedures	Form methods				Verbal
					Diagrammatic
					Motor
	Instrumentation methods for examination of different psychophysiological functions				
Synthetic examination procedures	Simulators, trainers, modeling devices for examination of a set of psychophysiological functions corresponding to structural elements of work				

Reliability refers to stability of results (parameters) obtained from examination by means of a specific method on the same person. Sufficient reliability is necessary so that the result obtained with this method can be used as a stable element of the overall evaluation.

To assess the reliability of a method one can use the so-called odd-even coefficient of intratest reliability, which is defined as the coefficient of correlation between the sums of results obtained by a given method from examining the same people on odd and even days. Of course, the examination of the same people on odd and even days must be conducted with other conditions being equal (time, place, work and rest schedule, etc.). The minimal permissible value of the coefficient of reliability (odd-even) is considered to be 0.7.

The prognostic or informative value of the method (parameter) refers to a parameter that describes the degree of difference in state of the function (trait, ability, etc.) under study in individuals differing in level of its development and, ultimately, differing in level of achievement in learning or practical work.

Table 4. Exemplary list of methods for studying elements of personality structure

No	Personality structure element	Method	Bibliographic source with description of method
1	Perception of stimulus intensity	1. Absolute threshold of light sensitivity (adaptometry)	8, 11
		2. Threshold of contrast sensitivity	11
		3. Absolute threshold of auditory sensitivity (audiometry)	11, 16
		4. Differential threshold of auditory sensitivity	11, 16
		5. Absolute threshold of vestibular sensitivity	11, 16
		6. Nystagmus test	11
		7. Absolute and differential thresholds of tactile sensibility (Frey's hairs method)	11
		8. Differential threshold of kinesthetic sensibility (mercury dynamometry)	11, 18
2	Perception of stimulus frequency	1. Pigment tables	11
		2. Anomaloscopy	11, 16
		3. Differential auditory threshold for frequency	8, 11, 16
		4. Determination of rhythmic sensitivity of hearing	11
3	Perception of spatial amplitude of stimulus	1. Determination of visual acuity	11, 16
		2. Determination of field of vision	11, 16
		3. Examination of stereoscopic vision	11, 16
		4. Examination of binocular fixation reflexes	11
		5. Examination of accommodat. reflexes (testing near and nearest points of clear vision and range of accommodation)	11, 16, 18
		6. Visual ergography	11
		7. Determination of minimum speed of moving object	11
		8. Determination of sound source	11
		9. Determination of differential thresholds for distance in tactile analyzer	11

Table 4. (continued)

No	Element	Methods	Bibl. source
		10. Reproduction of specified movement	11
		11. Determination of body position in space	11
		12. Instrument dials	11
4	Perception of time parameters of stimulus	1. Critical fusion frequency , visual	11, 18
		2. Stability of clear vision	11, 18
		3. Critical fusion frequency, audit.	11
		4. Time differential of threshold of auditory sensitivity	11
		5. Determination of recognition threshold	11
		6. Determination of sense of time	18
		7. Time reflex	18
5	Short-term memory:		
	a) graphic-image	1. Scope of immediate recall (retention of numbers)	26, 32
		2. Memory for numbers (retention of 12 numbers)	14, 15, 18
		3. Memorizing 10 words (retention of words)	13, 16
		4. Instrument table	14, 15
		5. Remembering geometric figures (visual memory)	26
		6. Remembering pictures with "plot"	26
	b) logical-verbal	7. Reproduction of text (retention of brief text)	13, 16
		8. Memorizing 24 numbers	15
		9. Association words	14
6	Long-term memory	1. Synonym method	26
		2. Reproduction of words starting with specified letter	26
		3. Long-term and operational memory	14
7	Operational memory	1. Reading series of numbers	14
		2. Establishing patterns	14, 15
		3. Operational memory	
		4. Visual memory	
		5. Scales	
		6. Complex testing of tracking and operational memory function using KSF instrument	
		7. Memory for movements	
		8. Retrieving and counting specified signals	

Table 4. (continued)

No	Element	Method	Bibl. source
		9. Long-term and operational memory	
8	Reproductive thinking:		
	a) grouping operations	1. Methods based on comprehension of simple physical laws	
		2. Maze	
		3. Mede test with transmissions	32
		4. Test for combinatory aptitude	
		5. Composition of phrases	
	b) counting operations	6. Elementary arithmetic operations	
		7. Scales	15
		8. Determination of divisibility of numbers	
9	Productive thinking:		
	a) conclusion operations: deductive conclusions (concretization)	1. Syllogisms	15
		2. Criticism in associative thinking	
	inductive conclusions (generalization)	3. Exclusion of concepts	
		4. Logic of thinking	32
		5. Establishment of patterns	
		6. Assembling cube	13, 16
		7. Relating phrases to proverbs	
	b) concepts	8. Superfluous fourth	10, 26, 32
		9. Exclusion of third	
		10. Free classification	
	c) judgments	11. Reconstruction of judgments from specified set of words and determining their intensity	
		12. Filling gaps in judgments	26
	d) heuristic operations	13. Methods for nonstandard thinking	23
	e) spatial imagination (activation of engrams)	14. Mental cutting of figures	2
		15. Compasses	14, 15
		16. Blocks	
10	Psychomotor functions:		
	a) speed and accuracy of simple and complex motor acts	1. Examination of sensorimotor reactions	13, 14, 15, 16, 18, 22, 24

Table 4. (continued)

No	Element	Method	Bibl. source
	b) speed, rhythm and stability of muscular movements	2. Tapping test	18
		3. Hitting wall with ball	
		4. Moving upon command	
	c) accuracy of motor reactions	5. Reaction to moving object (RMO)	18, 22
	d) strength and endurance during static and dynamic exercise	6. Dynamometry	18
	e) coordination of movements	7. DKN-3 method	15
		8. Emocoordinometer	24
		9. Tremometry	
		10. Coordinometer	
11	Attention:		
	a) span	1. Retrieval of numbers	13, 14, 15 16, 30
		2. Arrangement of numbers	14
		3. Tachistoscopy	30
	b) distribution	4. Alphanumerical combination	11, 15
		5. Attentiometry	14, 15, 24
		6. Complicating apparatus	30
	c) stability	7. Twisted lines	8
		8. Cancellation test	13, 14, 15, 16, 18
		9. Continuous counting at specified speed	13, 16
		10. Counting method	30
	d) flexibility [ability to switch attention]	11. Retrieval of numbers with switchovers	13, 14, 16, 30
		12. Alphanumerical combinations	14, 15
		13. Two-scale method	14
		14. Cancellation test	13, 14, 15, 16, 18
		15. Continuous counting at specified speed	14, 16
		16. Attentiometry	14, 15, 24
		17. Adding numbers with switchovers	16
		18. Addition and subtraction with switchovers	
	e) concentration	19. Series of numbers	8, 14
		20. Rybakov method	26
		21. Twisted lines	8

Table 4. (continued)

No	Element	Method	Bibl. source
12	Emotions	1. Observation (distinctions of mimicry, pantomime, tremor, articulation, intonation, pilomotor and behavioral reactions) 2. Evaluation of autonomic, biochemical and hematological reactions	14, 15, 24
13	Type of higher nervous activity	1. Anamnestic method of determining typological distinctions of higher nervous activity 2. Experimental method of determining typological distinctions of higher nervous activity 3. Examination of lability of nervous processes using the "Temp" instrument	6, 27 17, 31
14	Orientation of personality		
15	Characterological personality features		
16	Sensory content of personality	1. Conversation 2. Questionnaires 3. Examination of features 4. Observation	
17	Temperament		
18	Occupation-determined personality aspects		

The value of the methods and tests is usually measured by the coefficient of correlation between the result of an examination using given methods and parameters that are used to evaluate learning or combat achievement. The procedure for determining the prognostic or informative value of methods for professional psychophysiological screening is described in Chapter 4.

Differentiation: The methods and tests must be directed toward evaluating a specific function or group of functions. It is imperative for there to be the lowest correlation between the results of the selected method and results of other methods directed toward evaluation of traits (functions) known to be different. In other words, if x_1, x_2, x_3, ..., x_n are the quantitative values for the parameters by one method and y_1, y_2, y_3,

..., y_n are the values by another method, differentiation is determined by the following:

$$R = \frac{\Sigma (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma (x_i - \bar{x})^2 \cdot \Sigma (y_i - \bar{y})^2}},$$

where $\bar{x}$ and $\bar{y}$ are the arithmetic mean values of the parameters of the methods under study.

The method should be considered differentiating when $R \leq 0.5$.

In order to provide for high enough reliability and prognostic value of methods, one should bear the following in mind in choosing and developing them: justification of methods and tests, i.e., they should evaluate expressly the psychophysiological traits that are professionally important to a given form of work; objectivity, i.e., need for strict consideration of whether standard conditions prevail with regard to the situation and set-up of the experiment, method of examination and instructions, form of recording, analysis and interpretation of results of examination; if there is not sufficient standardization of examination conditions the reliability and, consequently, value of the method diminish; practicality: the methods used for mass-scale psychophysiological screening must be economical, from the standpoint of cost of equipment, performance of tests and processing the results thereof, as well as time scheduled for the examination. They must be simple, suitable for mass scale examinations and involve the fewest possible number of personnel. As a rule, the methods should not require any special preparation of the subjects.

Perception

1. Compasses

This method is directed toward testing the ability to perceive spatial relations.

For this test, one needs special forms (Figure 3), pencils, stopwatch, blackboard or ancillary table (to explain the task), which consists of a sample drawing, with depiction of compasses. On the special form there are sketches of compasses (5 per line on each of 10 lines), and only one side of the world is designated on each, with a needle pointing to some undesignated part of the world. The compasses are positioned in the most varied directions ("north" may be at the top, bottom, side, etc.). The subject must indicate the direction shown by the needle on each compass and write it in abbreviated form under each compass (N, S, E, W, NE, NW, SE, SW).

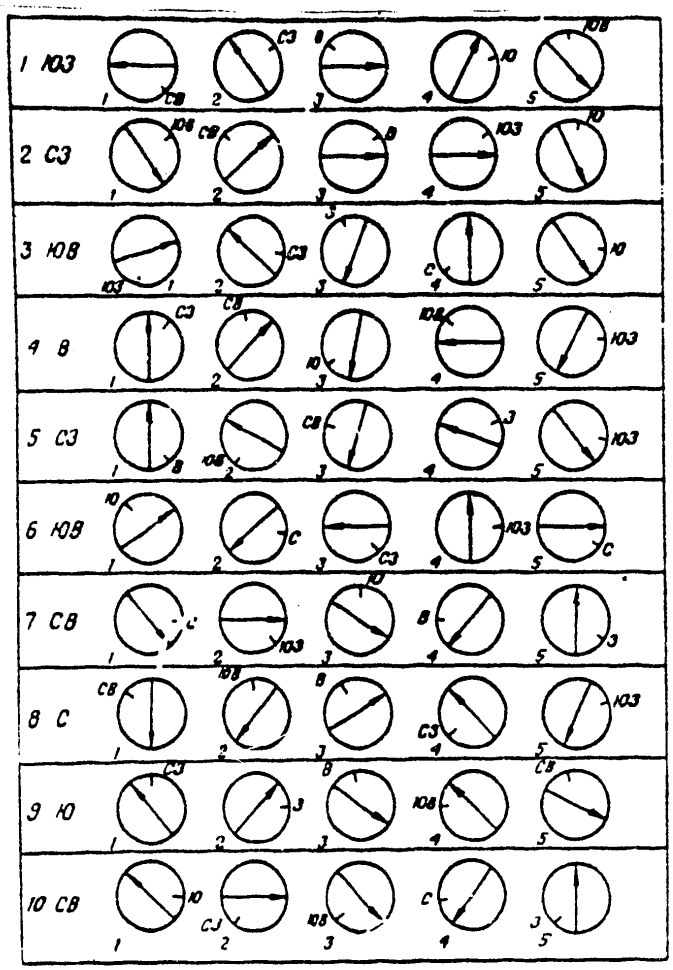


Figure 3. Form for "compass" method

Key:

С) north	Ю) south	В) east
СВ) northeast	ЮВ) southeast	З) west
СЗ) northwest	Ю3) southwest	

This method can be used for group tests. The subjects sign the forms and turn them around. The assistant hangs up the sample drawing [form].

The experimenter gives the following instructions: "You all know the location of countries of the world on a compass or geographic map: north is at the top and south opposite it, at the bottom; east is to the right of north and west to the left; northeast is between north and east,

northwest is between north and west, southeast is between south and east, southwest is between south and west"(pointing to these places on the sample drawing).

"Now, let us imagine that we turned the compass about its axis so that SW is in the place of NE. As you see, the order of the points did not change."

"There are drawings of compasses with needles on your forms"(showing them). "The compasses are not in their proper position in relation to a map, but in the most varied ones, and only one direction is shown on each compass--N, S, E, W, NE, NW, SE, SW. The needle may be pointing to any of eight directions. One can determine which direction by comparing the position of the needle to the direction shown on the compass" (he discusses five compasses on his sample drawing, the first one by himself, and the others with audience participation).

"Your task is to determine where the needle is pointing on each compass, and to write your answer in abbreviated form, under the compass (turning the forms is not allowed). If you complete this task within less than 10 min, raise your hand, and I shall tell you the time that should be written on the form. When I say 'Get ready!' take the forms out of the folders and pencils; when I say 'Start!' begin to work; when I say 'Stop' draw a vertical line and put the forms under the folder. Are there any questions?" (he answers the questions).

The order to "get ready" is given, the subjects turn the blanks over and, when the order to "start" is given they begin to work; simultaneously with this order, the experimenter starts a stopwatch. The sample drawing is removed before the test is started. While performing the test, the experimenter and his assistant observe the subjects and, if necessary, help some of them, entering this information in the log. The order to "stop working" is given after 10 min.

The results of this test are processed by means of a form which gives all the correct answers. The following elements are taken into consideration: number of compasses examined and marked (productivity); number of incorrectly marked compasses (number of mistakes); relative frequency of wrong answers (the quotient from dividing the number of mistakes by productivity).

2. Instrument dials

This method is designed to assess the function of visual perception of the features of an informational model of control (panel). The test is conducted with the use of a form (Figure 4), on which there are nine instrument dials executed on the same scale, but differing from one another in shape, scale factor, lettering and reading direction. There is a needle [indicator] on each dial pointing to some whole number. All of the dials must be examined, and the reading of each needle determined.

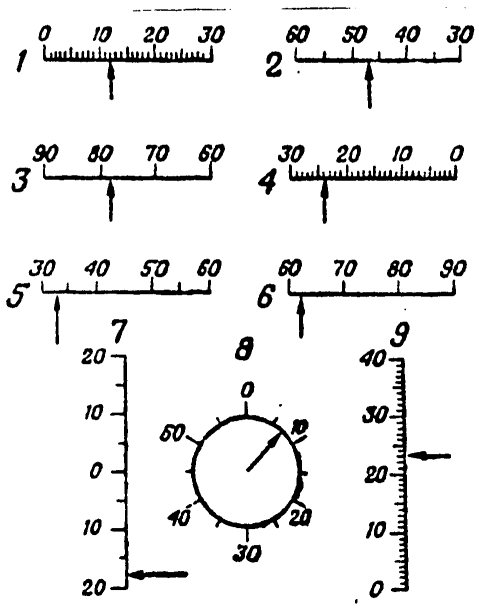


Figure 4. Form used in "instrument dials" method

In addition to the forms, pencils, a stopwatch, blackboard or ancillary table are needed (to explain the task).

This method can be used for group tests. When so instructed by the experimenter, the subjects sign the forms.

Then the following instructions are given: "There are drawings of nine instrument dials on the form, which are executed on the same scale, but differ from one another in shape, scale factor, lettering and direction of readings (these differences should be indicated on the ancillary [visual aid] table, or else the dials should be drawn on the blackboard). "There is a needle for each dial that is pointing to some whole number. In some cases the needle is pointing to a point [line] and the number can be determined by reading the dial points. In other cases, when there is rough calibration of the scale, one must mentally graduate the dial into smaller parts to determine the number. After finding the number, write it down near the needle" (this must be illustrated with examples). After writing down the needle readings on all dials, raise your hand, and I shall tell each of you how long you took to perform the task. Write the time down on the form. Is everything clear?" (he answers any posed questions).

The order to "get ready" is given and the subjects place the forms in front of them, and commence work upon hearing the order to "start" (when the stopwatch is set). After writing down the readings on all dials each subject raises his hand, the experimenter tells him the time without stopping the stopwatch (for example, "forty-seven seconds"), which the subject writes on the form. The experimenter and assistant must see to it that each writes down the time and then puts the form away under the folder.

The results of this test are checked by means of a "key" form, on which the exact answers are given; determination is made of the number of wrong answers. In order to assess the function of visual perception, the time taken to perform the test, number of wrong answers and speed of performing the task (quotient from dividing the number of correct answers by time spent on the test, in seconds) are taken into consideration.

3. Blocks

This method is designed to test spatial perception and imagination.

For this test, one needs a chart with 20 incompleted cube figures, each of which is 15-25 cm in size (Figure 5), the Psychological Examination Chart (see Appendix to this Handbook, section 5), on which the answers are entered, pencils and a stopwatch.

The method can be used for group testing.

In essence, it involves presentation to the subjects of an unfinished geometric figure, a cube, on a chart. They must determine mentally how many blocks are missing to finish the cube.

The subjects are given the following instructions: "Find the place on the psychological examination chart where the results of the 'blocks' test are to be entered."

Before you are some geometric figures made up of blocks. The problem is to determine how many blocks are needed to complete the cube. You must only count the number of missing blocks that would be visible."

"Let us examine, as an example, figure 1. It lacks three blocks for a cube. This means that we shall write down the answer, 3 blocks in figure 1. The figure numbers are given in the upper left corners of the rectangles. You have 4 min for this test. Are there any questions? Get ready! Start."

The order to "stop" is given after 4 min.

The results are graded with a "key" (Table 5), in which the number of missing blocks for each figure is given.

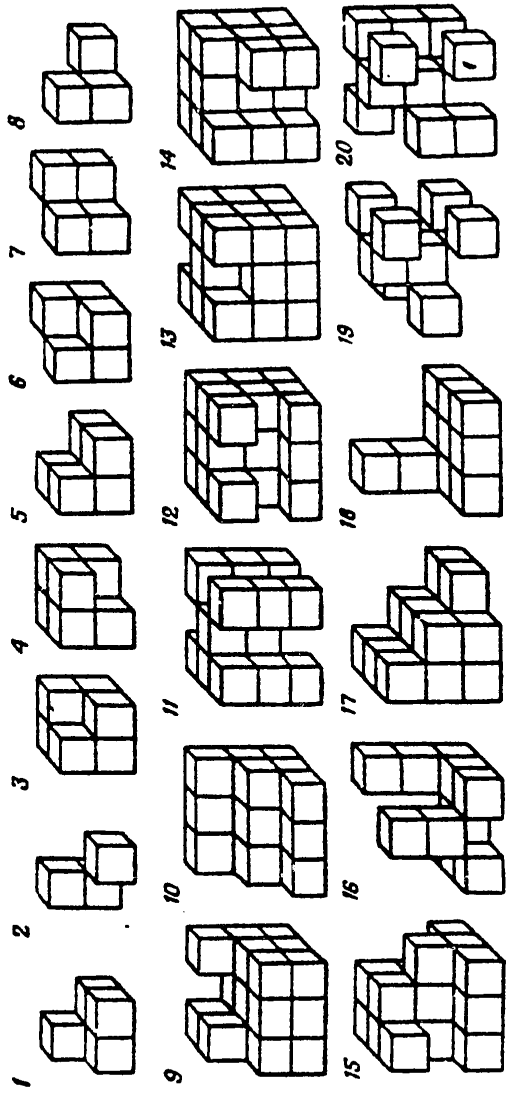


Figure 5. Sample of chart used to conduct the "blocks" test.

Table 5. Key for scoring test results

Cube No	Missing blocks	Cube No	Missing blocks	Cube No	Missing blocks	Cube No	Missing blocks
1	3	6	2	11	7	16	16±1
2	5	7	3	12	4	17	10
3	1	8	4	13	2	18	15
4	1	9	6	14	4	19	18±2
5	2	10	9	15	8	20	14±1

In some of the problems, dissimilar answers are permissible, i.e., the subject may be mistaken by 1-2 blocks in either direction. In the key such instances are shown as: 16±1, 18±2. Then the number of correctly solved problems is counted and a score is derived (Table 6).

Table 6. Evaluation of test results

Number of correct answers	6 or less	7	8	9–10	11–12	13–14	15–16	17	18 or more
Score	1	2	3	4	5	6	7	8	9

4. Reflex to Time

This test is designed to assess the accuracy of perception of duration of processes (sense of time).

There are two tests in this examination: reproduction of time interval of 1 and 15 s.

For this test, a stopwatch, as well as system consisting of an electric stopwatch, power source and telegraph key connected successively (one can use the electric circuit assembled to test reactions to a moving object), are needed.

This method is used for individual testing.

First, the accuracy of reproducing a 1-s interval is evaluated (using the circuit with the electric stopwatch). The subject sits at a table in such a manner as to have the electric stopwatch facing him. He undergoes some training (to develop the "time reflex"): the subject sets the hand of the

electric timer to 0, starts it by depressing a key and, observing the hand, stops it after exactly 1 s (on 0), turning the power off. He practices in this manner 4 more times. The subject must remember the length of the specified interval from the time the electric stopwatch is started and stopped under visual and auditory (from the sound made by the running stopwatch) monitoring.

After this practice, a "test" is conducted, during which the electric stopwatch must be outside the subject's field of vision (the needle is set at 0 and stopwatch is read by the experimenter). To evaluate the test results, determination is made of the arithmetic mean deviation from 0 (in hundredths of a second) for 5 tests.

A spring-loaded timer is used to evaluate the accuracy of reproducing a 15-s interval. When undergoing conditioning for the "reflex to 15 s," the subject starts the timer and, watching the indicator, turns it off after 15 s, trying to retain the interval between starting and stopping the timer. He practices 5 times. During the "test," which consists of five problems, the subject must not look at the dial of the timer; it is read, after the indicator stops, by the experimenter, who must not report the results of each problem to the subject.

The results of the test are scored by determining the mean value of B, the deviation of the indicator from the point where it stopped (15 s) in the 5 tests, expressed as a percentage:

$$B = \frac{M \cdot 100}{15}$$

where M is the arithmetic mean deviation from 15 s.

Memory

5. Visual Memory

This test is designed to examine short-term visual memory for the shape and position of objects in space.

Posters (Figure 6) are needed for such tests, as well as the psychological examination chart (see appendix, paragraph 1), on which the results of the tests are entered, pencils and a stopwatch. The figures to be recalled may also be projected using a type 4LETI epidiascope [slide projector].

The essence of this method consists of displaying to the subjects a diagram containing 7 different geometric figures in a square with 16 boxes, for 30 s. The size of the chart is that of a standard sheet of Whatman paper. They must memorize the spatial arrangement and appearance of the figures then draw them within 45 s in the appropriate empty boxes on the psychological examination chart. In all, four diagrams (A, B, C, D) displayed, with a 1-min interval between each.

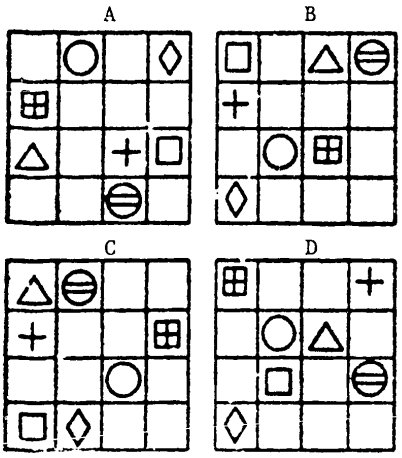


Figure 6.
Samples of charts for "visual memory" test

This method can be used for group testing.

The instructions to subjects are: "I shall now show you diagrams, each for 30 s, on which there are different figures. Try to remember the figures and how they are placed in relation to one another. I shall then instruct you to 'draw' and you will trace in the figures that you were able to remember in the boxes of the Psychological Examination Chart (section 1). A total of 45 s is allowed for each digram. Are there any questions?" (Questions are answered).

"Your attention please--I am showing you diagram A"(it is shown for 30 s).

"Draw!" (45 s are allowed).

"Stop! Put down your pencil, prepare to work with the next diagram" (30-40-s pause).

"You will fill out square B. Find it on the psychological examination chart" (5-s interval).

"Your attention--I now show you diagram B...," etc.

The results are scored by counting all of the drawn figures and mistakes using a "key" (for all 4 diagrams). Table 7 is used to find the score (according to total symbols and mistakes in all four diagrams).

6. Retaining Brief Texts

This test is intended for examining the ability to rapidly memorize and recall meaningful material.

Clean sheets of paper, pencils and a stopwatch are needed for these tests. The tests must be performed in 5 min.

This method consists of presenting to the subjects some short texts containing a specific number of "meaningful units." This method is convenient for subsequent quantitative analysis of the material that has to be memorized and reproduced within a specified time. Each story has eight such units (in the form of brief sentences) and one numerical value.

Table 7. Scoring of test results

Number of symbols drawn	Score with indicated number of mistakes															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
28	9	9	8	7	7	6	6	5	5	4	4	4	3	3	3	3
27	9	9	8	7	6	6	5	5	4	4	4	3	3	3	3	3
26	9	8	7	7	6	6	5	5	4	4	4	3	3	3	2	2
25	9	8	7	6	6	5	5	4	4	4	3	3	3	3	2	2
24	9	8	7	6	6	5	5	4	4	4	3	3	3	2	2	2
23	8	7	7	6	5	5	4	4	4	3	3	3	2	2	2	2
22	8	7	6	6	5	4	4	4	3	3	3	3	2	2	2	2
21	8	7	6	5	5	4	4	4	3	3	3	2	2	2	2	2
20	7	6	6	5	4	4	4	3	3	3	2	2	2	2	2	2
19	7	6	5	5	4	4	4	3	3	3	2	2	2	2	2	1
18	7	6	5	4	4	4	3	3	3	2	2	2	2	2	1	1
17	6	6	5	4	4	3	3	3	2	2	2	2	2	2	1	1
16	6	5	5	4	4	3	3	2	2	2	2	2	2	1	1	1
15	6	5	4	4	3	3	3	2	2	2	2	2	1	1	1	1
14	6	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1
13	5	4	4	3	3	2	2	2	2	2	1	1	1	1	1	1
12	5	4	3	3	3	2	2	2	2	1	1	1	1	1	1	1
11	5	4	3	3	2	2	2	2	1	1	1	1	1	1	1	1
10	4	4	3	3	2	2	2	2	1	1	1	1	1	1	1	1
9	4	3	3	2	2	2	2	1	1	1	1	1	1	1	1	1
8	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	1

Instructions to subjects: "Write down on the sheet of paper the heading 'Retention of brief text,' as well as your name, surname and patronymic. Is it done? Now listen carefully."

"I shall read a brief story to you. You must listen to it, pick up the meaningful associations, retain it and, when instructed to 'write,' rapidly (within 1 min) write down the gist. The sentences can be shortened somewhat if their meaning is not lost."

"For example, there could be such a story: 'The heavy rain was falling in sheets outside. We wondered how we would get home. We decided to call a cab to avoid getting drenched...,' etc."

"You could write: 'It is raining hard. How are we to get home? We called a taxi'."

"If you are able to write down the entire story, so much the better, but remember that only one minute is allowed for writing. Are there any questions?" (questions are answered). "Your attention please--I will read the first story."

"The ship entered the harbor. Bright lights illuminated the pier. The crew got ready to land. The seamen put on fresh uniforms. What were they going to do on shore? Eighteen men were going to the theater, and the others decided to stroll around the city. Soon the tugboat approached."

"Start writing!" (1 min is given to write). "Stop! Put down your pencils" (15-sec pause).

"Your attention, I shall read the second story."

"Many people gathered in the public dining room. There were 26 people standing near the cashier, it became very stuffy and noisy. Then they turned on the fans and stationed a second cashier. The people's mood improved. Soon everyone was taken care of."

"Start writing! Stop! Put down your pencils."

"Your attention. I shall read the third story."

"There was a flow of cars moving along the street. Suddenly, several militiamen [policemen] drove up. The traffic was immediately stopped; a group of bicycle racers was to pass by. Soon the leading racers appeared. Within 4-5 minutes all of the sportsmen had gone beyond the intersection, and the traffic began to move normally, while in the distance there was a band already greeting the winners."

"Start writing! Stop!"

The results are scored according to number of meaningful units that the subjects retained and reproduced in their notes plus the number of correctly reproduced numerical values. Thus, for the three stores, a correct answer may consist of 8 meaningful units × 3 = 24, plus 3 numbers, for a total of 27.

The scoring is made by the number of correct answers in accordance with Table 8.

Table 8. Scoring the test results

Correct answers	10 or less	11—12	13—14	15—16	17—19	20—21	22—23	24—25	26—27 or more
Score	1	2	3	4	5	6	7	8	9

7. Operational memory--I

This method* is designed to examine the stability and productivity of operational memory.

Pencils, a blackboard and stopwatch are needed for the test, as well as the Psychological Examination Chart (see Appendix, 2).

This technique is used for group testing.

It consists of the experimenter calling series of one-digit numbers (on tape or vocally), and the subjects must remember these numbers and perform mentally the most elementary arithmetic operations: add the first number to the second (write down the sum), the second number to the third (write down the sum), the third number to the fourth (write down the sum), etc. The numbers are so selected that the sum thereof does not exceed 9. The difficulty of the task is gradually increased by adding to the series of numbers called (from 3 to 7 numbers, i.e., 2 to 6 sums to be written down). Problems of equal difficulty are presented twice.

Instructions to subjects: "I will now read groups of single-digit numbers. Your task is to remember these numbers in the order I shall read them, then mentally add the first number to the second, the second to the third, the third to the fourth, etc., and write the sums in the blocks on your form under the heading of "Operational Memory--I." I shall indicate the end of a series of numbers by stressing the last number."

"This is how it is done. For example, I call off: 2, 5, 3, 5" (he writes the numbers on the blackboard). I add the first number to the second, and get a 7; I add the second number to the third and get 8; I add the third number to the fourth and get 8. I write down 7, 8, 8" (he writes on the board). Some people make the mistake of adding all of the sums together, you should not do this. Just write down the sum of each preceding and subsequent number, like I showed you on the board. You must retain the series of numbers in your head, without writing it down anywhere. Are there any questions?" (questions are answered).

"Your attention! I shall now read off the numbers. Get ready to work, pay attention. No more questions."

"Listen to the numbers!"

"Your attention: 4, 5, 2" (10-s pause).
"Your attention: 3, 2, 6" (10-s pause).
"Your attention: 5, 2, 6, 3" (15-s pause).
"Your attention: 3, 5, 2, 4" (15-s pause).
"Your attention: 3, 2, 4, 5, 3" (20-s pause).

*Developed by T. T. Dzhamgarov, V. L. Marishchuk and G. N. Khilova.

"Your attention: 4, 3, 6, 2, 5"(20-s pause).
"Your attention: 2, 5, 1, 7, 2, 6" (25-s pause).
"Your attention: 4, 3, 5, 2, 7, 2" (25-s pause).
"Your attention: 5, 2, 4, 3, 6, 2, 4" (30-s pause).
"Your attention: 6, 2, 3, 5, 2, 7, 2" (30-s pause).

"Stop! Put down your pencils."

There is a 1-s interval between delivery of each number.

The test is scored using a "key."

Key for scoring the test results

9, 7
5, 8
7, 8, 9
[illegible] 7, 6
5, 6, 9, 8
7, 9, 8, 7
7, 6, 8, 9, 8
7, 8, 7, 9, 9
7, 6, 7, 9, 8, 6
8, 5, 8, 7, 9, 9

Table 9. Scoring the test results

Number of correct sums + 1	Failed	3	4	5	6	7
Score	1	3	4	5	7	9

Each task is considered performed if there are correct answers to at least one of two presentations. Achievement is scored from the results of the most difficult of the correctly performed tests.

The number of correctly reproduced sums is increased by 1 and translated into a score according to Table 9.

8. Operational memory--II

This method* is designed to examine stability and productivity of operational memory.

Blank sheets of paper, pencils, blackboard and stopwatch are needed for this test.

This method is used for group testing.

Series of one-digit numbers are read off to the subjects. The problem is to retain these numbers and add each successive number with each following one mentally, then write the sums down. Ten series of five one-digit numbers are called off. When time is limited, one can use 5, instead of 10, series of five one-digit numbers.

There is a 15-s interval between calling off the series. The numbers are so chosen that their sum does not exceed 9. The results are written down in a column.

Instructions to the subjects: "I shall read series of five one-digit numbers. Your task is to retain these numbers in the order I will read them, then after hearing each series you must mentally add the first number to the second, the second to the third, the third to the fourth, the fourth to the fifth and write down the four sums you get in a column on the sheet of paper."

"I will put stress on the last number to indicate the end of a series of numbers."

"For example, I will read: 2, 5, 3, 1, 4" (he writes this on blackboard). "I add the first number to the second and get 7, I add the second number to the third and get 8, I add the third number to the fourth and get 4, I add the fourth to the fifith and get 5. I write down: 7, 8, 4, 5. You must perform this addition operations mentally, retaining the original presented numbers."

"Do all of you understand the task? Are there any questions?"

"Now the numbers will be called off for you. Get ready!"

"Attention: 5, 2, 7, 1, 4" (15-s pause).
"Attention: 3, 5, 4, 2, 5" (15-s pause).
"Attention: 7, 1, 4, 3, 2" (15-s pause).
"Attention: 2, 6, 2, 5, 3" (15-s pause).
"Attention: 4, 3, 6, 1, 7" (15-s pause).

*Developed by G. N. Khilova.

"Attention: 3, 1, 5, 2, 6" (15-s pause).
"Attention: 2, 3, 6, 1, 4" (15-s pause).
"Attention: 5, 2, 6, 3, 2" (15-s pause).
"Attention: 3, 1, 5, 2, 7" (15-s pause).

"Stop! Put down your pencils!"

The results of the test are graded according to the number of correct sums on a 9-point scale (Tables 10 and 11).

Table 10. Scoring test results when presenting 10 problems

Correct sums	20 or less	21—23	24—26	27—29	30—32	33—34	35—36	37—38	39—40
Score	1	2	3	4	5	6	7	8	9

Table 11. Scoring test results when presenting 5 problems

Correct sums	9 or less	10	11	12—13	14—15	16—17	18	19	20
Score	1	2	3	4	5	6	7	8	9

9. Operational and Unconscious Visual Memory

This method* is designed to test immediate memory when processing visual information and for evaluation of unconscious [involuntary] visual memory.

Charts, sheets of paper on which the results of the test are written, pencils, blackboard and a stopwatch are needed for this test.

This technique consists of operating with a specific volume of information in the form of one-digit numbers. These numbers, which are presented in

*Developed by G. N. Khilova.

series of two numbers each, must be added and subtracted mentally, retaining the answers (nine in all) which must be written down from memory on the form after the chart is removed.

Samples of charts for "Operational and unconscious visual memory" test

A

2	6	
5	9	
3		3
4	5	
2	1	
7		6
8		7
3		5
1	3	

B

6	3	
2		1
5		8
2	4	
5	8	
2	1	
9		5
7		6
3	9	

The charts are shown twice. Exposure time is 1 min, and reproduction time is 30 s for each.

The second task, which is performed by this method is as follows: after performing the test for operational memory against the background of a goal set, which requires that arithmetic operations be performed and only the results of these operations be retained, as well as after the chart is removed and the answers of the operations are written down, the subjects are asked to write down the first row of numbers shown on the chart.

The subjects are instructed as follows: "You will be shown a chart for 1 minute, which contains 9 rows with 2 numbers in each" (points to sample on blackboard). "In addition, there is a blank box for a third number in each row. You must add the two numbers in each row and remember the difference between your answer and 10 (by how much it is greater or smaller). Retaining in memory each figure, try to find the answers for all nine rows, and when the chart is removed write these answers on your forms in the boxes of each row that were empty on the chart."

"For example, in the first row you see the numbers 5, empty box, 3" (he shows this on the board),"the sum is 2 less than 10. You must remember that this number has to be in the second box of the first row. The second line has the numbers 6, 7 and empty box. This means that on the second line there should be the number 3 in the last box and you must remember this, etc."

"I repeat, you will write down only the answers, i.e., on each line you will write only one number that shows by how much the sum you found is greater or smaller than 10. Are there any questions?" (questions are answered).

"Put down your pencils! Attention, I show you Table A"(1 min allowed to count numbers and retain them). "Write down the results"(30 s allowed for this).

"Stop! Put down your pencils! Get ready to work with the second table" (30-s pause).

"Attention, I show you Table B" (1 min). "Write down the results" (30 s).

"Stop! And now, if any of you has remembered the numbers shown on the poster in the first row write them down on your form, also in the first row. If you have remembered nothing, write nothing down (this is involuntary memory, for I did not ask you to remember this numbers). Whoever has retained several numbers (at least one or two), write them down" (1 min allowed).

In assessing the results of testing visual memory with the use of a "key," the number of entirely correct answers is counted (i.e., answers in which the place for entering the result and answer were given correctly) and the number of partially correct answers, in which the number is written on the proper line but an error was made with regard to its box (written in a different box on the same line). Completely correct answers are graded as 2 points each, and partially correct ones as 1 point. Thus, there can be a maximum of 36 points awarded to the answer. The scoring is done according to Table 12.

Table 12. Scoring the results of visual memory test

Points	6 or less	7—9	10—13	14—17	18—23	24—27	28—30	31—33	34 or more
Score	1	2	3	4	5	6	7	8	9

Table 13. Scoring the results of unconscious memory tests

Correctly written numbers	0	1	2	3	4	5	6	7	8 or more
Score	1	2	3	4	5	6	7	8	9

When grading involuntary memory with a "key," the number of correctly written numbers is counted. Scoring is performed according to Table 13.

10. Memory for Numbers

This test permits evaluation of the span of immediate graphic-image memory and degree of retention of material.

For this test, one needs two versions of tables (400×250 mm in size) with 12 two-digit numbers, blank sheets of paper, pencils and a stopwatch.

Variant of table for "memory for numbers" test

21	43	85	67
38	96	18	21
14	57	71	32

This test consists of showing the subjects a table with numbers for 30 s; they must memorize it and then reproduce it on a form ("Memory-I") within 1 min.

After the subjects sign the "Memory-I" forms, the following instructions are given: "You will be shown a table with numbers" (sample is shown). "Your task is to retain as many numbers as you can in 30 s. After 30 s I will remove the table, and you must write down on the form all the numbers you have retained. Two tables will be shown simultaneously; the subjects assigned even numbers will look at and memorize the numbers on

the table labeled "Even," and those assigned odd numbers will do the same for the table labeled "Odd." Does everyone understand which table they are to work with?"

"The procedure is as follows. When I say 'Attention' all should look at the table, each at his own, and try to retain as many numbers as possible. You may not pick up your pencils at this time. I shall remove the table after 30 seconds and give the order 'Write!' and you must write on your forms the numbers you retained, one number per box. The order in which you write the numbers is unimportant. One minute is allowed to write them down. When ordered to 'Put down your pencils,' you must stop working. Are there any questions?" (questions are answered).

The experimenter shows the tables and at the same time starts the stopwatch. While the tables are in view, the experimenter and assistant watch that no one takes a pencil or writes anything. The tables are removed (or covered) and the order to "Write" is given. It is imperative to see that no one is copying someone else. After 1 min the order is given to "Put down your pencils!" The subjects must stop working and put the forms under the folder.

In order to determine the degree of retention of digital material, the subjects must reproduce the numbers previously displayed after 30 min (without showing the "Memory-II" tables a second time).

The following instructions are given: "Take the "Memory-II" form out of the folder and sign it. Now you must recall the numbers that I showed you on the table before, and write on the form just as you did before. I shall not show you the table again. Are there any questions?" (questions are answered).

"Attention! Start writing!"

After one minute, the order is given to "Put your pencils down! Put the forms under the folder!"

To analyze the results of this test, one has to compare the entries made by the subjects referable to the appropriate ("even" and "odd") tables and determine how many numbers the subject correctly retained and recalled.

11. Dials

This method* permits testing some features of operational memory.

It can be used for group and individual testing.

*Developed by B. L. Pokrovskiy.

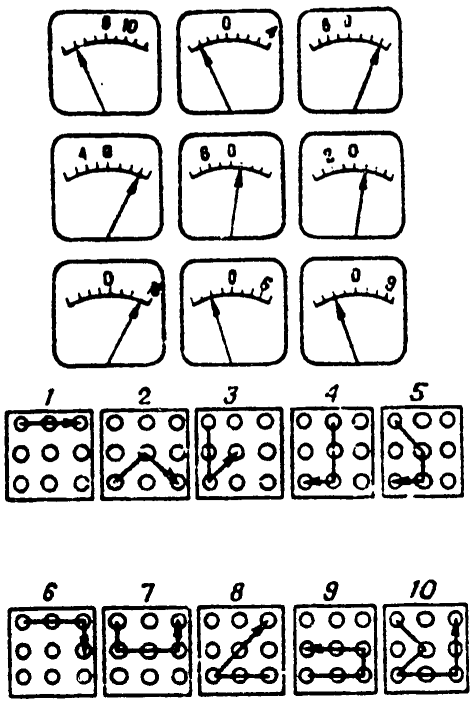


Figure 7. Form for "Dials" test

Forms (Figure 7), pencils, stopwatch and an ancillary table, which is an enlargement of the test form, are required for this test. The test involves mental addition of instrument readings in accordance with specific schemes, calculating simultaneously the scale factor of each dial and position of pointer on the instrument, retaining in memory the preceding sum of readings.

The subjects are asked to sign the forms, and they must close the folders (or else place the forms face down).

Then the following instructions are given: "There are nine instruments with needles on your forms. At the bottom there are 10 assignment squares, with 9 circles and a needle in each square. The circles arbitrarily designate instruments: top row for the top instruments" (he points to them on the enlarged chart),"middle row--middle instruments and bottom row--bottom ones. The arrow shows the order in which the instrument

readings are to be added to solve the problem. For example, in the first square, the arrow is set thus" (points to it on the diagram), "i.e., to solve the first problem you must add the readings of these instruments" (he shows which ones on the chart) "and write the answer, i.e., the sum obtained, below the first box" (showing where). "To solve the second problem you must add the readings of these instruments" (pointing to them) "and write the answer, the sum, under the second square. To solve the 10th problem, where the arrow is shown thusly" (pointing to it), you must add the readings of these instruments"(shows them) " and write the answer, the sum obtained, under the 10th square."

"How do we take an instrument reading?"

"There is a zero in the middle of each dial. There are four graduations to the right and to the left of zero. There is a number near one of the graduations. Fron this number, one must determine the scale factor per graduation then determine what the needle is showing. For example, on the first instrument, the number 10 is at the second graduation from zero" (shows it). "This means that the scale factor per graduation is 5 and the needle is pointing to 15. On the next instrument" (showing it), the number 4 is on the 4th line from zero. This means that the scale factor is 1, and the needle is pointing to 3. If the needle is to the left of zero, it is a minus, negative number. For example, on the first dial" (pointing to it) "the needle is pointing to -15" (the subjects must determine the scale factor themselves and tell what the instrument reading is). The instrument readings must be added algebraically."

"Let us try to solve a problem together. Our first problem is this" (showing arrow in first square). "This means that we must add the readings of these three dials" (pointing to them). "The scale factor is 5 on the first dial, and the needle shows -15. Let us remember this number. On the second dial, the scale factor is 1, and the needle shows -15. By adding these, we get -18. Let us remember this number. On the third dial, the scale factor is 4 and the needle is pointing to +12. We add this" (the subjects should do this themselves and give the numbers). "Consequently, the answer to the first problem is -6. We write this under the first square, right here" (shows it on the chart). "Let us solve the second problem" (the second problem is to be solved together with the subjects). "In the third problem, the readings of these instruments must be added" (do not solve this problem!), etc.

"Let me warn you that you may write nothing down anywhere, with the exception of the final answers; everything must be done mentally. Having determined what the needle shows on an instrument retain this in your memory. After calculating the readings of the other instruments, add them mentally. You may only write down the final answers."

"You will have 6 minutes to work in. You must try to solve as many problems possible, but the main thing is to solve them correctly. Do not count out loud, since this could disturb your neighbors."

"Are there any questions?"

After questions are answered, the order to "Get ready" is given, when the forms are placed in a convenient position. Then the order to "Start" is given and the stopwatch is started. After this, the assistant removes the demonstration chart. The experimenter and assistant walk in the aisles and carefully watch to see that the subjects are solving the problems only mentally.

The results are processed with a "key" form that has all the answers. Processing is very simple and requires little time. The number of correct (Table 14) and wrong answers is counted.

Table 14. Scale for scoring test

Number of correct answers	10	9	8	7	6	5	4	3	2 or less
Score	9	8	7	6	5	4	3	2	1

High scores are indicative of good operational memory and stable attention.

12. Long-term and Operational Memory

This test* makes it possible to examine some functions of memory (speed and stability of retention, distinctions of reproduction at a forced work pace and with more complicated activity). Complicated activity is created by means of having the subjects perform an additional task concurrently with the main one.

A "Memory" instrument, table of signals and keys, log forms, stopwatch and equipment for recording the main physiological reactions (pulse and respiration rate, minute respiratory volume and others) are needed for this test.

The instrument (Figure 8) has two consoles, one for the experimenter and one for the subject. Figure 9 illustrates its schematic [key] diagram.

The subject's console consists of a dull screen, on which two lamps light up simultaneously in different combinations: one at the bottom of the screen (white, green or red) and the second in the top part (green or white). The lights should be turned off by means of specific keys (three buttons on the subject's console), depending on the color combination. In

*Developed by V. M. Mishurin; M. I. Klevtsov, V. S. Fomin and Yu. S. Chugunov participated in designing the instrument.

all, 6 combinations are displayed, 4 positive and 2 inhibitory (Figure 10). The automatic programming device on the console is designed to deliver stimuli to the subject at the rate of 20, 40, 50, 60 or 70 presentations per minute. The subject's console consists of a rate commutator, switch that turns on automatic unit of instrument and type МЭС-54 electric meters ["counters"] to record reaction time when operating the keys, number of correct and incorrect reactions, pulse rate, pulmonary ventilation volume and parameters of electrodermal conduction.

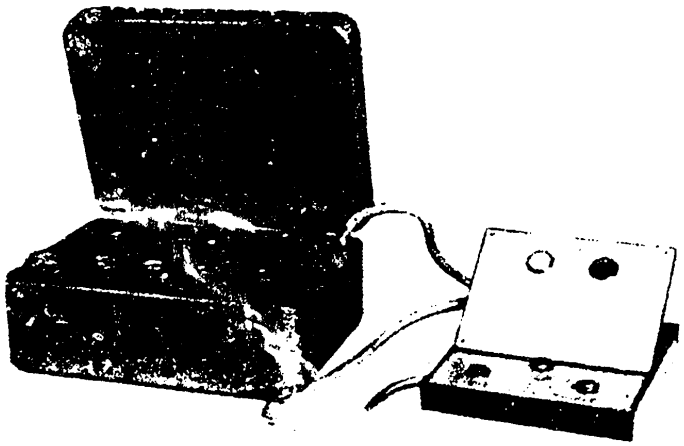


Figure 8. View of "Memory" instrument (experimenter's console on the left and subject's on the right)

After turning the instrument on, the experiment must depress the button of the automatic unit for delivery of stimuli, which turns itself off automatically after 25 presentations (21 positive and 4 inhibitory).

The first test is performed at the rate of 20 presentations per minute. The subject must count simultaneously the number of "green-green" combinations. The second and subsequent tests are conducted at a faster pace: 40, 50 and 60 per minute. The subjects count combinations of two other colors. This procedure permits indirect determination of the subject's capacity to retain elementary information for a brief time in the course of his work.

After giving brief instructions and acquainting the subject with the nature of the task, he is shown a table with a combination of colors and keys that he must remember. A record is made of the time he spends on retaining them. If the subject makes one mistake when checking his retention, he is given additional time, which is added to the first period.

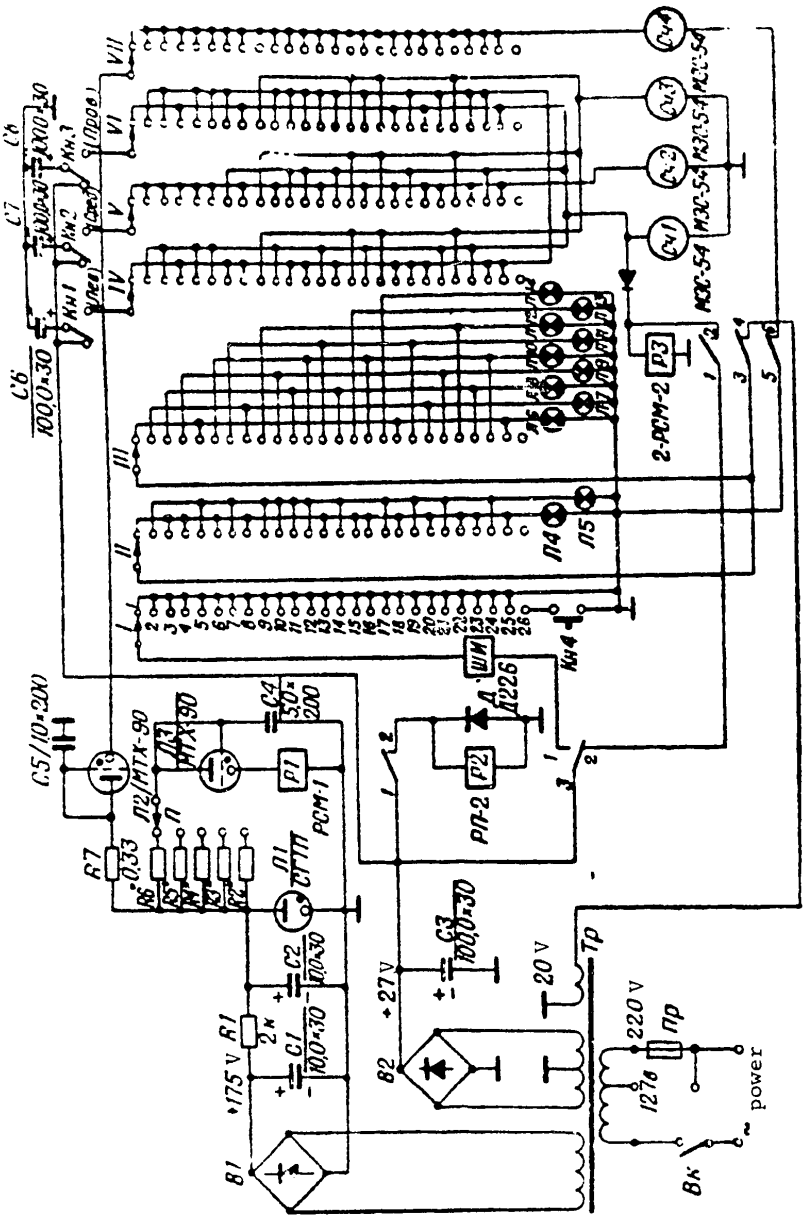


Figure 9. Schematic diagram of "Memory" instrument [best guesses given in key]

Key:
- В) switch or rectifier?
- К) K (kilo)
- С) condenser
- Вк) on switch
- МЭС) electric meter
- СТ) voltage regulator tube
- Пр) fuse
- Тр) transformer
- Л) lamp
- РСМ) Mantissa sum register?
- Р) relay
- лев) left
- сред) middle
- прав) right
- Кн) button switch
- Сч) counter
- Д) diode
- Рг) recorder or relay?
- ШИ) step-by-step switch
- МТХ) thyratron

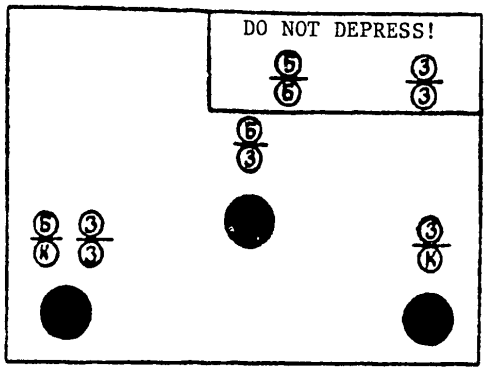


Figure 10. Diagram of "Combination of signals and keys"

Key:

B) white 3) green K) red

The subject's and experimenter's consoles are placed next to one another on the same or different tables, both panels facing the subject. After the order to "Get ready" the order to "Start!" is given, with concurrent depression of the button on the automatic unit of the experimenter's console. Upon completion of a cycle, the experimenter enters in the log the counter readings: mistakes, total reaction time, number of signals counted and parameters of physiological reactions.

To obtain an integral score for the quality of performance, the parameters (number of errors, number of signals counted, mean reaction time) are converted to grades on a 10-point scale, which is established for each group of subjects after statistical processing of data for the entire group. The threshold of the scale is determined in accordance with the requirements made of a given group of specialists. The standard is the result obtained from testing individuals in the same occupation who cope well with their work. When making an expert conclusion, one should take into consideration the degree of nervous and mental tension, which is determined by the subject's autonomic reactions.

Attention

13. Retrieving Numbers

This method is intended to check the distribution of attention.

Two types of form-tables (No 1 and 2), the Psychological Examination Chart (see Appendix, 3 and 4), pencils and a stopwatch are needed.

This method can be used for group testing.

14	5	31	27	37
40	34	23	1	20
19	16	32	13	33
2	6	8	25	9
12	26	36	28	39

Figure 11.
Form No 1: identifying missing numbers in ascending order from 1 to 40

It consists of determining which numbers are missing in the table and striking them out on the Psychological Examination Chart.

First form No 1 (Figure 11) is used for 1.5 min, then form No 2 (Figure 12) for 4 min.

Instructions to subjects: "Take form No 1. Find section 3 of the Psychological Examination Chart, where a series of numbers is given from 1 to 40. The task is to cancel in this series the numbers that are missing on the form. Let us try to start the problem together. We look for the number on the form. We found it. This means that no mark is to be made on the Psychological Examination Chart. We look for the number 2. We found it. We also make no marks. We look for the number 3. It is not on the form. In this case we strike out the 3" (demonstrates on the blackboard) "on the Psychological Examination Chart, etc. Are there any questions?" (questions are answered). "The test lasts one and a half minutes. Get ready! Start!" (concurrently the stopwatch is started).

16	19	42	14	56	27	45
69	26	57	49	68	7	13
31	1	40	21	59	64	70
65	35	45	66	8	34	22
51	6	53	29	17	61	41
46	18	32	12	63	2	50
4	39	23	60	38	55	36

Figure 12. Form No 2: identifying missing numbers in ascending order from 1 to 70.

The order to "Stop working" is given after 1.5 min.

The next task is explained: "Now you will perform exactly the same task but on Form No 2, retrieving numbers from 1 to 70. The missing numbers must be crossed out in section 4 of the Psychological Examination Chart. Are there any questions?" (questions are answered). "The time allowed for this test is 4 minutes. Get ready! Start!"

After 4 min, the order to "Stop working" is given.

The results are checked against a "key." Determination is made of the number of correctly and incorrectly cancelled numbers. Then the number of mistakes is subtracted from the number of correctly cancelled numbers, and the difference is scored using Tables 15 and 16.

Table 15. Scoring for Form No 1

Correctly canceled numbers less mistakes	7	8	9—10	11—12	13—14	15—16	17—18	19	20
Score	1	2	3	4	5	6	7	8	9

Table 16. Scoring for Form No 2

Correctly canceled numbers less mistakes	9	10	11	12	13	14	15	16	Over 16
Score	1	2	3	4	5	6	7	8	9

For example, if the subject correctly found 14 numbers and made 2 mistakes on Form No 1, his score is 14 - 2 = 12, which corresponds to 4 points.

One score for the best parameter is derived from the results of both tests. For example, if the subject received a grade of 4 for Form No 1 and 5 for Form No 2, his score is 5.

14. Retrieving Numbers With Switching of Attention

This method* is intended for testing the ability to distribute and switch attention.

For this test, one needs forms for number retrieval (Figure 13), the Psychological Examination Chart (see Appendix, 6), demonstration chart on which specimens of the number retrieval forms and a sample of writing answers to the test are illustrated, a blackboard, chalk and stopwatch. The task can also be performed with a general chart-form, as well as by writing the answers on blank sheets of paper.

9-т	15-п	9-м	12-м	16-е	3-и	10-в
24-в	23-ф	1-к	19-а	15-л	8-г	17-а
18-т	14-ф	13-ш	6-с	2-л	10-е	25-г
11-к	2-г	24-ч	23-ч	5-ш	12-б	21-н
20-б	17-р	11-р	22-д	19-т	3-с	13-ж
7-х	16-х	6-ж	22-п	14-ц	8-ц	4-з
7-з	1-с	20-н	4-д	5-и	18-о	21-у

Figure 13. Form for "Retrieving numbers with switching of attention" test

This method can be used for group testing.

In essence it involves retrieval of numbers from a table containing 25 red** and 24 black numbers in random order. There is a symbol, some letter, next to each number. The subjects must retrieve in ascending order the red numbers (from 1 to 25) and, alternately, in descending order the black numbers (from 24 to 1), writing the letter symbols of these numbers in the bottom part of the form or on the Psychological Examination Chart.

*As modified by V. L. Marishchuk, I. V. Sysoyev and I. I. Petroshevskiy.
**On the form (Figure 13), the red numbers are in crosshatched boxes.

Instructions to subjects: "You must find on the form red and black numbers alternately: red ones from 1 to 25 in ascending order, black ones from 24 to 1 in descending order. Find the numbers as follows: red 1 and black 24, then red 2 and black 23, red 3 and black 22, etc."

Numbers have to be found, but only the letters next to the numbers must be written down. These letters must be written strictly in order, after finding them in the squares of rectangle A of the Psychological Examination Chart, section 6."

"To make the work easier for you, on each new line of rectangle A (section 6), the first two boxes contain the numbers that should follow in order if you have done everything correctly. If you discover a mistake when you move to a new line, do not pay attention to it, and continue to fill that line, starting with the numbers written at the beginning of the new line."*

"Are there any questions" (questions are answered). "You will have 5 minutes to work in."

"Get ready! Start!" (the stopwatch is started at the same time).

After 5 min the order to "Stop working" is given.

The results are checked against the following key:

КЧ — ГФ — ИД — ЦУ ШН — СА
ЗТ — ЦР — ГЕ — ЕП — РЦ — МШ
ЖБ — ФК — ЛВ — ХМ — АГ — ОХ
ТЖ — БЦ — НЗ — ПС — ЧЛ — ВО — Г

Determination is made of the number of correctly entered letters and mistakes. The performance is scored using Table 17.

15. Retrieving Numbers With Switching of Attention and Simultaneous Delivery of Signals

This method is intended for testing the ability to distribute and switch attention.

Forms (Figure 14), the Psychological Examination Chart (see Appendix, 6), demonstration chart, chalkboard, chalk and stopwatch are needed for the test.

*If the problem is written on a blank sheet of paper, the letters are arranged in a column.

Table 17. Scoring the results of test on "Retrieving numbers with switching of attention and simultaneous delivery of signals"

Numbers scanned	Score (in points) with the following number of mistakes																	
	0	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	22	24
49	9	9	8	8	7	7	7	6	6	6	6	5	5	4	4	3	3	3
48	9	8	8	8	7	7	6	6	6	6	5	5	4	4	4	3	3	3
46	9	8	8	7	7	6	6	6	6	5	5	5	4	4	3	3	3	3
44	8	8	7	7	6	6	6	6	5	5	5	4	4	4	3	3	3	3
42	8	7	7	7	6	6	6	5	5	5	5	4	4	3	3	3	3	2
40	8	7	7	6	6	6	5	5	5	5	4	4	4	3	3	3	2	2
38	7	7	6	6	6	5	5	5	5	4	4	4	3	3	3	2	2	2
36	7	7	6	6	5	5	5	5	4	4	4	3	3	3	3	2	2	2
34	7	6	6	5	5	5	5	4	4	4	4	3	3	3	2	2	2	2
32	6	6	6	5	5	5	4	4	4	4	3	3	3	2	2	2	2	2
30	6	6	5	5	5	4	4	4	3	3	3	3	2	2	2	2	2	2
28	6	5	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	1
26	6	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	1	1
24	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	1	1	1
22	5	4	4	4	3	3	3	3	2	2	2	2	2	2	1	1	1	1
20	4	4	4	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1
18	4	4	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1
16	4	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1
14	4	3	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1
12	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
10	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
8	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
6	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

This test consists of having the subjects find numbers on a table (as in the "Retrieving numbers with switching of attention" test) and simultaneously listen to a series of numbers played on a tape (or read aloud).

The following instructions are given to the subjects: "This task is just the same as the preceding one, only you must do additional work at the same time, you must count the number of zeros in the numbers that will be read to you."

"There is a mandatory stipulation for this task, you must perform it better than the preceding one. You must enlist all your strength and demonstrate that you have high volitional [conative] traits and emotional stability. The number of zeros you will count must be then written down to the right of rectangle B (Appendix, 6) on the Psychological Examination Chart. You will put a circle around this number. Are there any questions? You have

5 minutes for this problem. Get ready! Start!" The stopwatch is started and delivery (reading) of numbers (one every 2 s) begins.

The order to "Stop" is given after 5 min.

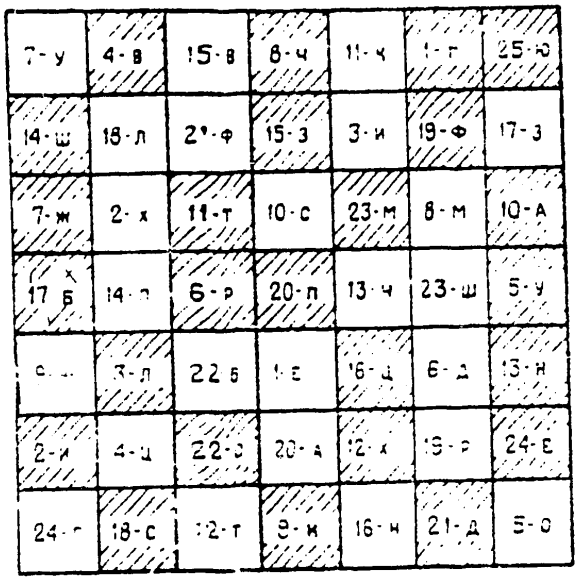


Figure 14. Form for "Retrieving numbers with switching of attention and simultaneous delivery of signals" test

The results are checked against the following key:

ГГ — НЩ — ЛБ — ВФ — УА — РР — ЖЛ — ЧЗ
КН — АВ — ТП — ХЧ — НТ — ШК — ЗС — ПЖ
БМ — СУ — ФД — ПО — ДЦ — ОИ — МХ — ЕЕ — Ю

Determination is made of the number of correctly written letters and mistakes. The scoring is done using Table 17 with the following change: if the error made in counting zeros does not exceed ±2, 1 is added to the number of letters. In the rest of the cases, the results of counting the zeros are not taken into consideration.

16. Cancellation Test With Rings

This method* is used to test attention (intensity, stability), visual perception of space, as well as to determine the speed with which information is transferred in the visual analyzer and the visual-motor system.

For this test, tables (Figure 15), pencils, stopwatch and blackboard or ancillary table to explain the task are needed. The table consists of rings, each of which is broken at one of eight possible points. Guided by a watch dial, the position of the break can be defined as a break at 1, 3, 5, 6, 7, 9, 11 and 12 o'clock. The table consists of 1024 rings (32 rings on each of 32 lines), with 128 rings with each of the break positions.

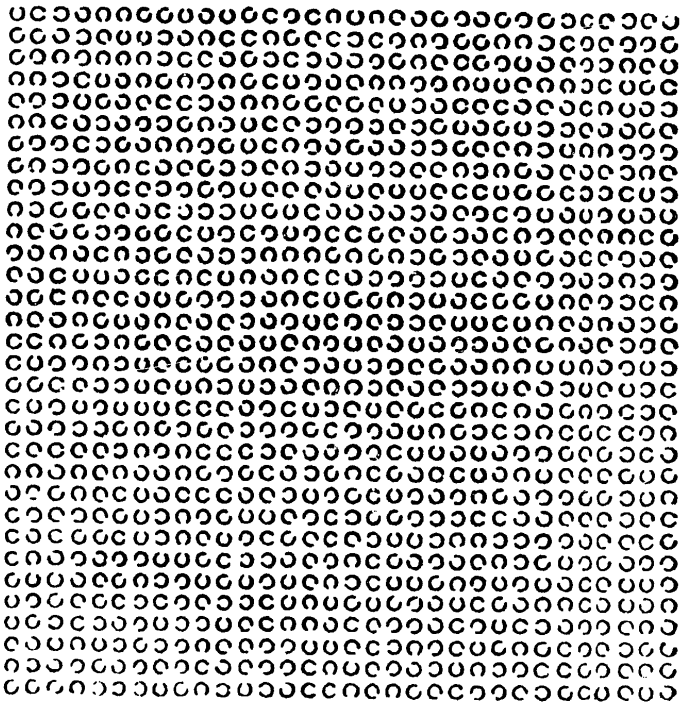


Figure 15. Form for "Cancellation Test With Rings"

The subjects are asked to strike out rings where the break is in a specified position as they examine the table. Each subject is told how long he took to do this task after he has finished.

*Developed by A. A. Genkin, V. I. Medvedev and M. P. Shek; modified by V. A. Bodrov.

Instructions to subjects: "On the tables that you just signed, there is a set of rings with a break in one of eight positions" (the positions of the breaks are explained on the blackboard or ancillary table). "You must examine each line, from left to right as you do when reading, and strike out the rings with a break at '11 o'clock'" (showing how to do this). "When ordered to 'Draw a line' you must make a vertical line at the place you had reached when this order was given" (showing how to do this) "and then continue working without additional orders. As soon as you have looked over the table, raise your hand, and you will be told the time, for example, 8 minutes and 45 seconds, that you should write down on the reverse side of the paper. You must work as fast as possible, but at the same time try not to miss a single ring that should be crossed out. Are there any questions?" (questions are answered). "When ordered to 'Start' turn the table right side up and begin to work."

The experimenter issues the order to "Start!" and starts the stopwatch. The assistant starts his stopwatch at the same time. The order to "Draw a line" is given at the end of every minute. While performing this task, the experimenter and assistant observe the subjects, record the results and inform each one who raises his hand how long he spent on the problem.

The results are checked by means of a stencil made of transparent x-ray film, which has slots over the places of the circles with breaks at "11 o'clock."

The number of rings scanned per minute is determined, and the stencil is used to determine the number of rings that were not crossed out or crossed out in error. A line skipped when scanning the table is graded as one mistake.

The main parameters characterizing the efficiency of performing this test are: performance time, number of mistakes, mean difference in output, rate of information transfer.

The parameter of mean difference in productivity is calculated with the following formula:

$$R = \frac{(P_1-P_2) + (P_2-P_3) + (P-1-P_m)}{m-1}$$

where P is the number of rings scanned per min (P_1 is the 1st min, P_2 is the 2d min, etc.) and m is the value of the last (complete) minute of work.

Calculation of rate of information transfer is made with the following formula:

$$S = \frac{0.5436 \cdot 1024 - 2.807 \cdot n}{T} \text{ bits/s}$$

where n is the number of mistakes (rings skipped or cancelled in error) and T is the time of test performance, s.

17. Cancellation Test With Letters

This method permits testing the stability of attention during prolonged monotonous work, the rate of mental processes, degree of fatigability of attention during work, effects of interference and predominant set on speed or meticulousness of work.

This method is used for group and individual testing.

The proper forms (see portion of "Cancellation table" form [illustrated on the next page]), pencils, tape recorder with tape of audio interference and a stopwatch (in the case of group testing, a blackboard and chalk as well) are needed for this test.

The test consists of having subjects strike out some letters and underline others as specified by the experimenter, altering the mode of work each minute, for a specific period of time and with utmost speed and accuracy.

Before starting the test, three lines of letters are shown on the blackboard, among which there must be several O's and K's separately and next to one another. The subjects sign the forms and put them in the folders.

The following instructions are given: "There are letters in random order on the form. Your task is to scan each line of letters from left to right, as you do in reading, and strike out the letter O, and underline the letter K. If there are two O's or two K's next to one another, each of them must be crossed out or underlined with a separate line. This is the first mode of work."

"In the second mode, everything has to be done in reverse: the O's must be underlined and the K's crossed out."

"You will use both modes, depending on instructions. When given the order to 'Draw line, first mode,' put a vertical line at the spot you were scanning at that moment, and after this line work by the first mode: strike out O's and underline K's. When told to 'Draw line, second mode,' trace a vertical line at your place and work in the second mode after this line: underline O's and strike out K's."

"We shall start working in the first mode" (with the help of the subjects the required letters are crossed out and underlined on the first line and beginning of the second line). Now we are instructed to 'Draw line, second mode!' Draw a vertical line this way" (illustrated on blackboard), "and work in the second mode" (with the help of the subjects the proper letters are crossed out and underlined in the second line and start of the third). "When instructed to 'Draw line, first mode,' you will draw another vertical line and work in the second mode after it" (this is shown on blackboard).

CANCELLATION TABLE

Surname _____

смвыгу тжбшр смы тжбшрсоехвтжбшря цплкдз тжбшря
ашоксмвыгтжбшрсмвыгтжбшрцплдкряхэчфаовггшсмвыж
нанжбшрмжгывтыршбтжбшрцплктжшбшсмвыенажбшпш
нанжбшрмвыгплкдхртхэчфюхэчщтжбшрряенамвыгрябшр
тжбрмвыгоснантжбшрцплкжтжбшхлкпюэздфитжбшсмри
енантжбшрсмвыхэчфцплкджбвшрявгуязркбцсеядлжврыв
хэчфплкдмвгняквнмыаемжняаяыдвбжэмцшкаяугншежмл
ршывждпрмвдрбвкчблынбншнвитмпвдыяауыявянрешежа
яызврвбестелмдбвджчжэспемюнкащарыяыесотогауаведв
ыввыншяберняыгеносотмлбвгншуагзшфлэпжьтщпншднж
дфшздередвшвкбджэтюощнлааяышнрмотмлвдигнлжвден
лэсеблгшеднрнрвчвпмфнгемотаяуаявдбэжпотешаашбвмл
гывжешзяржтвбыяыдпхсцтебнрняжгзшфкшьпжжмпншнр
нуязщлшашычбэнбеммпжхстевигаядвшмжетнкаяуыкмж
жпхмшшютжыняызыфшьбквпмбегрнзвыджбмцотевнгдмп
нвблбэычашашуияузршыкнмжетбопшжостсюмнгаувдмпо
фдргмсншыцшотбеорнрвкмпжосеынрвяшыышзыквблсцоб
жпжтрервадвычбезесоцмпвыгауыызыквлебвныржлбцолг
ынбшышвпжшшкэчлгингреоежвкшзряанеецюквргуекмпш
хпжммпешнрвкмвм.мжптюмтцтомбвгаузгвгнвестмепхы
чкшншфежкжеыгняыадмботопеаяаудыкмпосебгауыябвот
дрргразыяышемосоцмлвнынгыарквчвйосешнйспмшвуыый
яурдгющпбршыбберврырышмтмжврышзфяшлмжевагкел
блэбэбежехвкьраузфшьйщцйюебвнгннужмбернадехотшд
нвлэрлгшыгвявфвбчмжмотевнгауныемтмлврбябзечйщшр
элнбнгаувзгмгевсцтмлнраязфшьйщежнгнуажявшмжынул
чнфндрняыяемышежмсжосоцсюстеыпщтнжнгыямдсмеяуб
рнрыфыкченжетебнунзыявьсщецншырмкежныагрньбмжр
хэчфвфжмвеуняаднвшотебвнгвяубвдецоыжврябдлрыесеэ
ебнлебншнрвямямзмдепевагърмкожмотебвагявчмжгрндр
уягбшаькщйнрнрежохпсэмфвргняуаяунббшршбешнкжлы
мешкпраявдбфбьтэсюсщоцнрнйпяаяуызпшдепжожрвкепб
ежмшвябдбльжкйоюебоернаяаызыфвьешреевжнуаявнуаз
ярдфмшржжшеянъйботеынувяврсжотеынфауаявреждреб
йщжпшгувйгтефньвшксбйотешыаубаыябвдсмбожныауыр
ьдререгнуврмкотжовнгавувъвшотоцсхмрекбвлвлпрадлсы
плегрняуыдбьмкебейшвожншаявзмротобенгауважруизфво
эшкгруоеянзянявьвдосбосйшпжешынуаафоботлтбигншцб
дрязямшгыйжошенуаяуыявфвкмжоюотешыагсоцслнврук

"If the order to 'Draw a line' is given at a moment when you just finished scanning a line, put the vertical line at the end of this line" (this is shown on the blackboard after the second line) "and start working in the specified mode on the next line."

"You should work as rapidly as possible, and your score is based on the number of letters and lines you have scanned. But the main thing is not to make a single mistake, i.e., not to miss a single O or K and to underline or strike them out correctly. When you come to the end of the page, turn the form over and continue working on the other side."

"While you are working, we shall add interference--you will be prompted correctly and incorrectly by a tape recording. Try not to pay attention to it, continue working just as well and follow my orders only."

"When instructed to 'Get ready,' open the folders and take your pencils (pens). When instructed to 'Start,' begin to work. Are there any questions?" (questions are answered).

Then the order to "Get Ready! Start in the first mode" is given and the stopwatch started. At the end of each minute, the order is given to "Draw line, ... mode." The subjects work for 10 min, 5 min in one mode and 5 in another, alternately. For the first 5 min there is no interference. At the end of the 5th min, the order to "Draw line, second mode" is given and the tape is turned on.

Interference is delivered through the tape recorder (and loudspeakers connected to it for uniform volume of sound), and it consists of the following.

During the first minute there is irregular alternation of orders: "Strike out O's, underline K's," "Underline O's, strike out K's."

In the second minute there is alternation of the orders: "Strike out O's, underline O's," "Strike out K's, underline K's."

Third minute, repetition of the following: "First mode, strike out O, underline K," "First mode, underline O, strike out K."

Fourth minute, repetition of the following: "Second mode, strike out O, underline K," "Second mode, underline O, strike out K."

Fifth minute, random alternation of: "First mode, strike out O, underline K," "First mode, underline O, strike out K," etc.

During the time the real orders are given, the interference is removed by turning the "volume" knob. At the end of the 19th min, the order is given to "Draw line, end of work! Place forms in folder."

The tests are checked against a key form, at the end of each line of which the number of O's and K's is indicated, and these letters are lightly shaded. The number of scanned letters (productivity) and mistakes (skips or incorrectly marked letters) is counted over 5 min of work with interference and the total for 10 min. One can form an opinion about the speed of the subject's mental processes from his output; one can determine whether

the set is predominantly oriented toward speed or accuracy from the ratio of output to number of mistakes. A change in quality of work under the influence of interference is indicative of the degree of imperviousness to noise of attention.

Table 18. Guide for scoring test results

Output with consideration of penalty for mistakes	Score
Less than 1000	1
1000—1200	2
1201—1350	3
1351—1500	4
1501—1700	5
1701—1850	6
1851—2000	7
2001—2150	8
More than 2150	9

As a guide for scoring the test results, one can use the scale of scores listed in Table 18, which is based on output, i.e., number of letters scanned in 10 min. One deducts 20 symbols for each mistake (skipped or incorrectly marked letter). If an entire line is skipped, it is not included in total output and, in addition, 60 letters (triple mistake) are subtracted from the result.

When assessing imperviousness to interference of attention, one should proceed from the fact that, when working in the presence of interference, productivity diminishes by an average of 40-50 symbols, while the number of mistakes increases by 1.

The following variants of this test can be used: performance of the same task without interference; working in one mode for 10 min, i.e., striking out 2-3 letters as designated by the experimenter, with minute time marks; striking out 2-3 different letters each minute (when instructed by the experimenter).

The appropriate instructions are given and data processed in accordance with the modification used.

18. Addition With Attention Switching

This method* makes it possible to examine some distinctions of thinking, operational memory and attention.

*Developed by E. Kraepelin and modified by S. Gellershtevn.

It can be used for group and individual testing.

For this test, one needs standard sheets of paper (typewriter paper), pencils and a stopwatch; for group testing, one also needs a blackboard and chalk.

The test consists of having the subjects add one-digit numbers by two alternating methods, changing the method every minute, as rapidly as possible. Before starting, they must be acquainted with the two methods.

The subjects sign the forms, i.e., blank sheets of paper, at the top. They are then instructed as follows: "Your task is to add two one-digit numbers, which you will prepare yourselves in accordance with certain rules. Now I will show you how this is done. Let us take two numbers, for example, 1 and 5. We will write them one under the other, like this: $\frac{1}{5}$" (experimenter writes on the blackboard). "Then we add them mentally. We will write the sum next to the top number" (writes it), "and under it the top number of the preceding pair, like this: $\frac{1}{5}\ \frac{6}{1}$."

"We add the numbers obtained again and write the sum at the top and the top number of the preceding pair at the bottom: $\frac{7}{6}$. The next sum will be a two-digit number--13. In such cases, we write down only numbers up to 9 and discard the digits in the 10's place. We write down the units digit (3) at the top as the first addend and the top addend of the preceding pair, 7, at the bottom" (the demonstration is continued, calling attention to the combination where one of the addends is a zero. It is desirable for the subjects to prompt the experimenter as to what number will be obtained and where they are to be written down).

"You have come to the end of a line. Go to the next one. You may not rewrite the last pair of numbers. On the new line you write at the top the sum (discarding, of course, digits in the 10's place, and at the bottom the preceding top addend" (showing it).

Having gone through several more additions and checking from the answers of the subjects that they have understood the procedure, the experimenter says: "Now try to work on your own, as rapidly and accurately as possible. Write an 8 at the top and 3 at the bottom. Add them like I have shown you." The experimenter then starts the stopwatch and the subjects work for 1 min. In this time, the experimenter and assistant must make sure that all of the subjects are adding correctly. After the order to "Stop working," they must see that everyone stops working immediately and put down the pencils.

After this, the second method of addition must be explained: "What you have just done will be arbitrarily called the first method. I shall now explain the second one. Let us take two numbers, for example, 1 and 5, and the sum will be 6. We will not write it next to the top number, as

by the first method, but next to the bottom one, like this: $\frac{1}{5}\ \frac{}{6}$, and at the top we will right the bottom addend of the preceding pair, like this: $\frac{1}{5}\frac{5}{6}$."

The experiment demonstrates the second method, without hurrying and explaining his actions. He again calls attention to the combination with a zero. Then he says: "Try to work on your own now: work as rapidly and accurately as you can. Write a 4 at the top and 5 at the bottom. Add them by the second method. Start!"

The experimenter allows the subjects 1 minute for this work. He checks to see that everyone is working correctly. Then he says: "What you just did was only for practice.* I shall explain the main task now."

"I will give you two numbers and you will begin by adding them by the first method: write the sum at the top and top addend at the bottom. When instructed to 'Draw line, second method,' you will draw a vertical line and continue the work, using the second method: the sum to be written at the bottom and preceding bottom addend at the top. You may not rewrite the last pair of numbers beyond the line, the addition must be mental, and after the line you must write numbers by the second method. When instructed to 'Draw line, first method,' you will again draw a line and change methods. This will be done several times. I will show you how" (the experimenter demonstrates on the blackboard, again calling attention on how to move from one line to another). "You should work as rapidly as possible, but without making mistakes. If you encounter some difficulty, do not get nervous, but try to find the mistake and continue working. Are there any questions?" (questions are answered).

"Write a 7 at the top and 8 at the bottom and start working by the first method."

The experimenter starts the stopwatch and at the end of the first minute says: "Draw line, second method," at the end of the second minute: "Draw line, first method," etc. It is important not to mix up the instructions. The last order is given at the end of the 10th minute: "Draw line. Enough." During the experiment, the assistant and experimenter observe the subjects and, if necessary, help some of them, recording this in their log. If, as a result of making a mistake, someone writes the following series: $\frac{5\ 0\ 5}{0\ 5\ 0}$ he should be immediately given any two one-digit numbers, one of which is odd.

The following are recommended as necessary pairs of numbers for the main test: 8 and 7, 5 and 9, 2 and 3, 9 and 2, 5 and 3, 5 and 8, 9 and 9, 6 and 9, 9 and 4, which would yield repetition of a series after 60 additions,

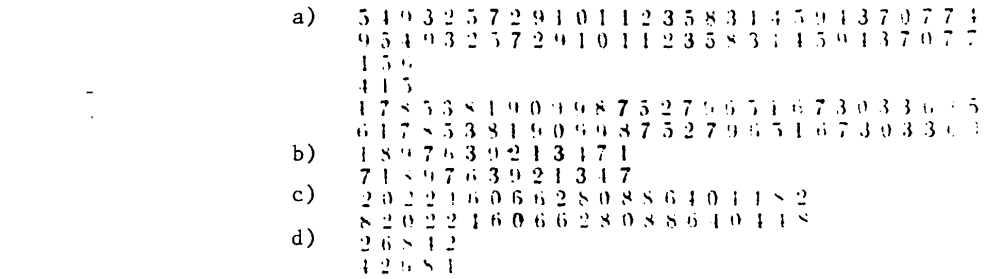
*When doing the practice exercises, the subjects should not know that this was for practice.

if no mistakes are made. However, for easier processing, it is more desirable to give the same numbers.

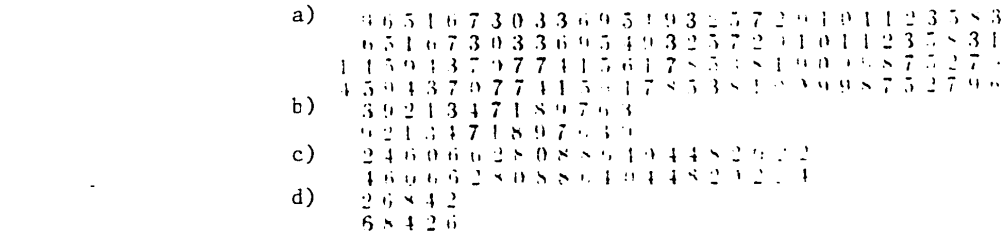
The results are analyzed with the use of a key; in processing the data one takes into consideration the speed and accuracy of work. Determination is made of the number of additions per minute (output) and number of mistakes.

Key for scoring the test results:

First method



Second method



It is more convenient to write down the results on two lines. For example:

1 min	3 min	5 min		7 min	9 min
18	20	23	24	21	22
16	21	23	22	24	21
2 min	4 min	6 min		8 min	10 min

The output is 221 in 10 min.

Mistakes in switching--3.

Mistakes in addition--1.

On the top line one writes the number additions per minute by the first method and on the bottom one, by the second method. The practice results are entered to the left of the vertical line. Separate indication is made of the number of mistakes referable to switching over, addition and total additions in 10 min.

Productivity in excess of 20 additions per min is considered high, 10-20 is considered average, under 19 low, and the latter is indicative of difficulties in performing the work.

When analyzing the mistakes, one must take into consideration their nature. In essence, one encounters two groups of mistakes: so-called switching mistakes, which are related to operational memory, and addition mistakes due to distraction of attention. The first group of mistakes includes the following: independent (without being so instructed) switching to another work method, partial switching when one of the addends is found by one method and the second by the other. The second group of mistakes refers to incorrect addition of numbers and substitution of random numbers in the place of the required ones. There should not usually be more than 2-3 switching mistakes.

A tentative rating scale for the results obtained after processing the findings on a group of young men 18 to 21 years of age, who had graduated from secondary school and were very concerned with obtaining high scores, is listed in Table 19.

Table 19. Tentative rating scale for the "Addition with attention switching" test

Output (additions in 10 minutes)	Score
More than 276	9
251-275	8
226-250	7
201-225	6
176-200	5
151-175	4
126-150	3
101-125	2
Less than 100	1

The score is not altered by 1-2 mistakes referable to switching, 3-5 mistakes lower it by 1 point, more than 5 lower it by 2 points. Two different mistakes in addition are equated with one mistake in switching over. The evenness of work in different methods and comparison to practice results may alter the score by 1 point.

19. Addition and Subtraction With Attention Switching

This test,* which is a modification of the "Addition with attention switching" test using a form, permits evaluation of mental efficiency, stability and flexibility of attention, as well as the distinctions of development and readjustment of mental skills related to computing work.

The method consists of the fact that the subject is asked to add and subtract two adjacent one-digit numbers by two alternating methods.

For this test, forms, pencils, two stopwatches, blackboard or ancillary table are required.

The experimenter asks the subjects to sign the reverse side of the forms, then explains the task for them: "Your task is to add and subtract two adjacent numbers (first and second, second and third, third and fourth, etc.) in two alternating ways. For example" (illustrating on the blackboard), " your table begins with the following series of numbers: 2 5 4 7 3 1, etc."

Using the first method, you must mentally add two adjacent numbers and write the sum above the second number, while the absolute difference between these numbers (without consideration of the sign) under the same number, i.e., 2+5 = 7. The number 7 is written over the 5, and the 2 - 5 = 3 under the 5; 5 + 4 = 9, which we write above the number 4, while 5 - 4 = 1 is written under the 4, etc."

"If a two-digit number is obtained as a result of addition, we write down only the units digit and discard the 10's digit; for example, 4 + 7 = 11, we write down 1; 7 + 3 = 10, we write down 0."**

"We should ultimately obtain the following in our example:"

```
  7 9 1 0 4
2 5 4 7 3 1, etc.
  3 1 3 4 2
```

"I call your attention to the fact that the last number on the first line must be worked with the first number of the second line, the results being written above and under the second number of this pair."

Upon completing the explanation and demonstration of the task using the first method and making sure that the subjects have understood the problem, the experimenter says: "Now try to work independently, as fast and as accurately as you can. Get ready. Start!" (turns on the stopwatch).

They stop working after 1 minute and the experimenter answers questions.

*Developed by V. A. Bodrov and V. V. Kolbanov.

**Translator's note: Source p 102 ends at this point, p 103 is missing, and translation resumes on source p 104 immediately after the **. However, text appears to be cohesive and this is probably a pagination error.

Then the second method is explained: "With the second method, you must also mentally determine the sum and absolute difference between two adjacent numbers, but this time, unlike the first method, the sum must be written at the bottom instead of the top, and the difference between these numbers at the top, instead of the bottom. In other words, the procedure for writing down the results of addition and subtraction must be the opposite of the first method. I shall illustrate this with an example" (demonstrates on the blackboard, again calling attention to the procedure to follow when a two-digit number is obtained and when moving to the next line):

```
  2 4 6 1 2 5
3 5 1 7 6 4 9, etc.
  8 6 8 3 0 3
```

"Now try to do a problem on your own. Start on a new line. Get ready! Start!" (starts stopwatch).

They stop working after 1 minute. The experimenter answers questions, then says: "What you just did was only for practice. Now I shall explain the main task. When I give the order, you will start on the problem on a fresh form by the first method: write the sum at the top and difference at the bottom. When instructed to 'Draw a line, second method,' you will draw a vertical line and continue working using the second method: you will write the sum at the bottom and the difference at the top. When changing to another method, you must take one number before the vertical line and the other after this line, then add and subtract them. When instructed to 'Draw line, first method,' you will again draw a line and change methods. This will be repeated several times. I will show you how to do it" (demonstrates an example on the blackboard, explaining his actions):

```
  1 9 0 9 7       1 4 6 7 3       6 7 1 3 2 6
4 7 2 8 1 6       7 3 9 2 5       1 6 5 8 4 2, etc.
  3 5 6 7 5       3 0 2 1 7       4 5 1 3 4 2

 1st method      2d method       1st method
```

"You should work as rapidly as you can, but mainly without making mistakes. When instructed to 'Draw line, stop working,' draw a line, put your pencils down and turn the forms over. Are there any questions?" (questions are answered). "Get ready. Start working by the first method." The experimenter and assistant set the stopwatches simultaneously with this order.

At the end of the first minute, the assistant says: "Draw line, second method," at the end of the second minute he says "Draw line, first method," etc. At the end of the 10th minute, the order to "Draw line, stop working" is given.

While performing the task, the experimenter and assistant observe the subjects and, if necessary, help some of them, making a record of this in their log. Before starting the test, the examples are erased from the board and the ancillary table is removed.

Output and mean difference in output are evaluated in the same manner as for the preceding test.

A "key" form is used to grade accuracy of the work. It gives the sequence of pairs of numbers that should be obtained when the problems are correctly done by the first and second methods. Determination is made of the number of mistakes in addition, subtraction and switching over, as well as total number of mistakes and relative frequency of incorrect answers (ratio of number of mistakes to output per 10 min of work).

20. Convoluted Lines [Maze]

This method permits testing of concentration and stability of attention. Forms (Figure 16), pencils and a stopwatch are required.

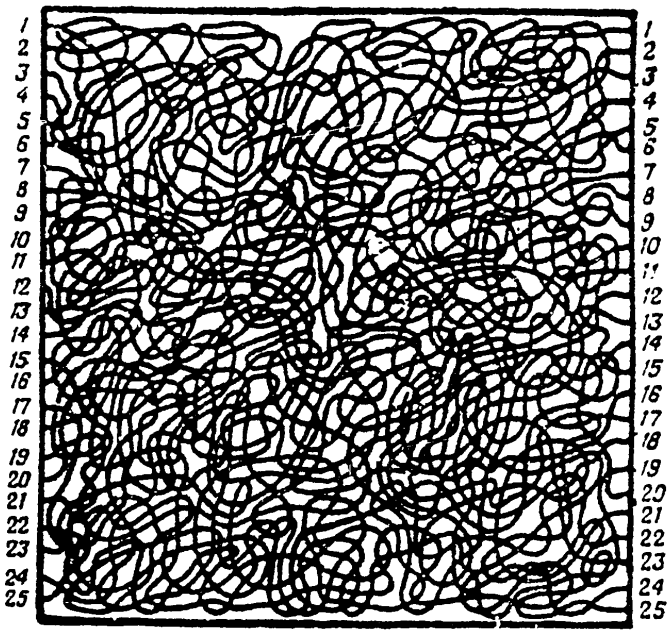


Figure 16. Form for "Convoluted lines" test

There are 25 lines on this form, each of which starts on the left margin and ends on the right. The start and end of each line are assigned a sequential number. The lines intersect one another numerous times.

The test consists of visually tracking the course of each line and determining the number at which it ends.

The subjects sign the forms. Then they are instructed as follows: "There are 25 convoluted lines on the form. You must visually track the course of each line and determine where it ends. There is a number at the beginning and end of each line. The numbers are written in the right and left margins. You will start tracking a line with a number on the left and end with a number on the right. Each line must end at the right margin of the form, it cannot return to the left margin. Each line intersects other lines many times on its path; remember that if two lines meet, they will definitely bisect one another, no matter what the angle of encounter is."

"In case you are unable to determine where a line ends (its end is questionable to you or you tracked it back to the left margin), track it once more and, if you made a mistake again, move on to the next line. The lines should be scanned in numerical order, for the numbers located in the left margin. Write your answer (the number at the place where the line ends, in the right margin of the form) opposite the number in the left margin, where you started scanning. I repeat, you must perform this task only visually, without using your finger or pencil as an aid. Are there any questions?" (questions are answered). "Get ready! Start!" (stopwatch is started).

After 10 min the subjects are instructed to "Stop working!" The experimenter checks that all of the subjects have put their pencils down and turn the forms over.

In processing the results, determination is made of the number of lines scanned and number of mistakes. A key is used to detect incorrect answeres; it shows pairs of numbers corresponding to the beginning and end of each line:

**1—22; 2—1; 3—8; 4—23; 5—6; 6—13; 7—21;
8—14; 9—3; 10—4; 11—11; 12—2; 13—10;
14—15; 15—19; 16—12; 17—16; 18—9; 19—7;
20—25; 21—24; 22—17; 23—20; 24—18; 25—5.**

The following are taken into consideration in analyzing the results of the tests: number of lines scanned in 10 min (output), as well as number

of mistakes and relative incidence of incorrect answers (ratio of second parameter to first).

21. Arranging Numbers

This method is used to test functions of distribution and flexibility of attention. A form (figure 17), pencils, stopwatch and blackboard or ancillary table are required.

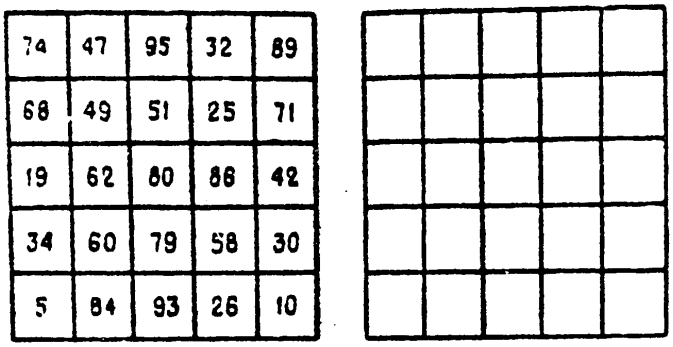


Figure 17. Form for "Arranging numbers" test

In this test, the subjects must arrange in ascending order in the boxes of the right square of the form the numbers written in random order in the 25 boxes of the left square, and they must do this within 2 min.

The subjects sign the form. Then the following instructions are given: "You will perform this task on the form, which has two squares" (shows form). "In the left square, there are one- and two-digit numbers in random order in the 25 boxes. In the right square there are 25 empty boxes. When I instruct you to 'Start working,' you must copy the numbers from the left square to the right one, in strictly ascending order, starting with the lowest. You must fill the right square line by line: first the five boxes (from left to right) on the first line, then the five boxes on the second line, etc. No marks may be made in the left square. If you discover that you skipped some number, do not cross anything out, but write it in the next empty box and put a circle around it. You are allowed 2 minutes for this test. In this time, you must arrange the largest amount of numbers, but without mistakes. Are there any questions?" (questions are answered). "Get ready! Start working!" (simultaneously the stopwatch is set).

The order to "Stop working" is given after 2 min. It is imperative to check that all of the subjects stop working when so ordered and put their pencils down.

The results of the tests are checked against a "key" (Figure 18). The numbers entered in the right square are counted (productivity) and so are mistakes, i.e., skipped numbers (including the mistakes discovered by the subjects and circled by them). Determination is made of the relative incidence of incorrect answers (ratio of mistakes to total written numbers).

Thought

22. Establishing Patterns

This method is intended for examination of some of the distinctive features of the thought process (activity, sharpness [intelligence, quick-wittedness]) and operational memory.

5	10	19	25	26
30	32	34	42	47
49	51	58	60	62
68	71	74	79	80
84	86	89	93	95

Figure 18.
Key for scoring test results

Forms, pencils, stopwatch, blackboard or ancillary table to explain the task are needed.

The form (see sample form on pages 90-91) consists of sets of 5-letter (first 5 lines) and 8-letter (next 20 lines) words, there being 5 words on each line. There is a set of conventional symbols at the beginning of each line.

For the test, the subject must find and underline the words in which the sequence of the letters corresponds to the sequence of the conventional symbols at the beginning of the line. The task has to be performed in 10 min.

When instructed by the experimenter, the subjects sign the forms. Then the following instructions are given: "There are 25 lines on the form, with 5 different words on each line. At the beginning of the line there are conventional symbols, + ? O :, etc. The order of these symbols corresponds to the order of letters in one or several words in the same line. Your task is to find the words on each line where the arrangement of the letters corresponds to the arrangement of the symbols, then underline them. How should this be done?"

"The conventional symbols designate the order of letters in a word. If all the letters in a word are different, then the symbols designating this word must also be all different. If there are repeated letters in a word, then the symbols for these letters must also be repeated. For example, in the word 'KAHAT' [cable, cord], the second and fourth letters are the same, while the first, third and fifth are different. This means that if this word is written in conventional symbols, it should correspond to the

following combination: X O ? O + or + ? O ? ×, etc." (illustrating on the blackboard). "I repeat, the conventional symbols do not correspond to any specific letters, but merely reflect their order in a word. Let us assume that we have the first line of the example form"* (points to it on the blackboard).

"Which words should we underline? On this line, we should underline the word КУЛАК, since in the set of conventional symbols the first and fifth symbols are the same, while the second, third and fourth are different. You should not underline the word РАДАР, because, although the first and fifth letters are the same in this word, the second and fourth are also the same, while the stipulation is that they should be different."

"One should analyze the arrangement of the symbols attentively, since there could be three identical symbols in the problem, or two pairs of the same symbols, etc."

"In such a complicated combination as shown on line 23 of the sample, we underline the word АНТРАЦИТ, since it conforms with the stipulation: the first and fifth letters (A), as well as third and eighth (T) are the same. We do not underline the word АРТЕФАКТ because, although the third and eighth letters (T) are the same, the first and fifth are not" (illustrates on the blackboard).

"In the combination shown on line 25 of the sample, we underline the word ЗАКАЗЧИК, since its first and fifth letters (З), second and fourth (А), third and eighth (К) are the same, while the rest of the letters are different, which corresponds to the arrangement of the conventional symbols: first and fifth (X), second and fourth (O), third and eighth (+), while the rest are different (- and §)."

"Your task is to find and underline on each line the words in which the order of letters is the same as shown by the conventional symbols at the beginning of the same line. There may be one, two, three, four or five such words on a line. You may not write anything on the form, only underline the word-answers. If you happen to underline the wrong word, cross out the line."

"Now we shall practice on the first lines of words consisting of five letters, then you will start the test, you will start with line No 6. You will have 10 minutes to work in. Try to work rapidly, but mainly be accurate. When instructed to 'Stop working,' put a vertical line after the last word you read when this instruction was given. Do not try to get an extra word, you might make a mistake in your haste. Are there any questions?" (questions are answered).

*Translator's note: In this section translations of test words are not furnished, since they are irrelevant to the point made, merely illustrating frequency of letters.

Form for "Establishing patterns" test

1. X : ? + X	КУЛАК	БУБЕН	ТЕАТР	ОРДЕР	РАДАР	
2. + § + O !	ТИТУЛ	ГРУША	БАРАН	ШИШКА	АМБАР	
3. ? X + ? X	ФАЗАН	ТАХТА	АЛМАЗ	РУПОР	КАСКА	
4. O + X — §	ТОПАЗ	МАСКА	ГУДОК	КНЕХТ	КОШКА	
5. § — X § —	КАДКА	БАНАН	АНОНС	КЛЕРК	ДАМБА	
6. X O : § — + O —	ОРНАМЕНТ	ДОМИНИОН	РИФЛЕНИЕ	СТРОЕНИЕ	СМЕКАЛКА	
7. O : + § : ? + :	ЗАКВАСКА	ПИРАМИДА	СМУЩЕНИЕ	ЗАКЛАДКА	ЗНАЧЕНИЕ	
8. X + ! — § : X +	БУМЕРАНГ	ТЕЛЕТАЙП	ДВИЖЕНИЕ	КАРТОШКА	СОЗНАНИЕ	
9. ? — X : X = O X	ОПЕРЕНИЕ	КОМСОМОЛ	ИНДИАНКА	МАРГАРИН	КРОКОДИЛ	
10. § O X § = § + O	ПИСТОЛЕТ	НЕЗНАНИЕ	СНОРОВКА	ТРАВИАТА	ПРЕПАРАТ	
11. ! + § = : X = §	МОНОПЛАН	СКОРПИОН	КВАРТИРА	АРТЕФАКТ	ОКОЛОТОК	
12. ? — X = ! = § O	ОПЕРЕТТА	ЛАБИРИНТ	КАНОНАДА	АЭРОДРОМ	СОЗНАНИЕ	
13. X + ? = § X + O	ИЗВОЗЧИК	ТЕЛЕГРАФ	КОЛЕНКОР	ПРОСПЕКТ	ТАРАНТАС	
14. ! + O — ! + X —	ПЕРЕДАЧА	АНТРАЦИТ	ТОЧНОСТЬ	ИНСТИНКТ	ФЛИФЛРОН	
15. ? X — + § + X §	ДОМИНИОН	АКАДЕМИЯ	ВЕРТОЛЕТ	ФОТОГРАФ	КАРТОШКА	

Form for "Establishing patterns" test (continued)

16. О — + ? + $! Х	СЕКРЕТЕР	ОРИГИНАЛ	КАСТРЮЛЯ	СНОРОВКА	КАРАНДАШ
17. Х — ! $ + $ О ?	МЕРИДИАН	ТАРАНТАС	МАТЕРИАЛ	РАДИАТОР	ИНТЕРЕСЫ
18. О $ + $ + ? $ +	КАРТОЧКА	АРХЕОЛОГ	ЛАСТОЧКА	СКАКАЛКА	КАНОНАДА
19. О Х : $ — ? + !	ЭТАЖЕРКА	ЛЕСТНИЦА	ОРИГИНАЛ	КАСТРЮЛЯ	КЛУБНИКА
20. $: Х + ? — $ +	КВАРТИРА	СНОРОВКА	КОНТРАКТ	ПРЕПАРАТ	ИЗВЕСТИЕ
21. О + ? Х — $: Х	ПИСТОЛЕТ	ОКОЛОТОК	ОПЕРЕТТА	ИНСТИНКТ	СТРОЕНИЕ
22. $ — + ? : — + О	ИНСТИТУТ	ВНИМАНИЕ	СМУЩЕНИЕ	СКОРПИОН	КОМСОМОЛ
23. ! + $? ! Х О $	ОПЕРЕНИЕ	СТРИХНИН	ТРАВИАТА	АНТРАЦИТ	АРТЕФАКТ
24. + $ — ? Х ! — О	ОРНАМЕНТ	СЖИГАНИЕ	ЛАСТОЧКА	СКОРПИОН	ОКОЛОТОК
25. Х О + О Х — $ +	ИНСТИТУТ	МОНОПЛАН	ЗАКАЗЧИК	СНОРОВКА	БУМЕРАНГ

After these instructions, the subjects practice (on the first five lines of the form). The experimenter answers any questions that come up during the practice. The samples are erased from the blackboard, and the ancillary table is removed. Then the appropriate instructions are given and the stopwatch is started. While they are working, the experimenter and assistant observe the subjects and, if necessary, help some of them, recording this in their log. The order to "Stop! Draw a vertical line after the last word you looked at, put down your pencils and turn the forms over" is given after 10 min.

The results of this test are scored using a "key" form, on which all of the correct answers are given. When processing the results, determination is made of the number of incorrect answers (words that were not underlined or underlined in error), number of words analyzed in 10 min (output) and relative magnitude of incorrect answers (ratio of mistakes to output).

23. Combinatory Ability

This method* permits testing of operational thinking, speed of operating with symbolic information and determination of associations by checking different combinations.

*Modified and tested by T. T. Dzhamgarov, V. L. Marishchuk and Yu. K. Dem'yanenko.

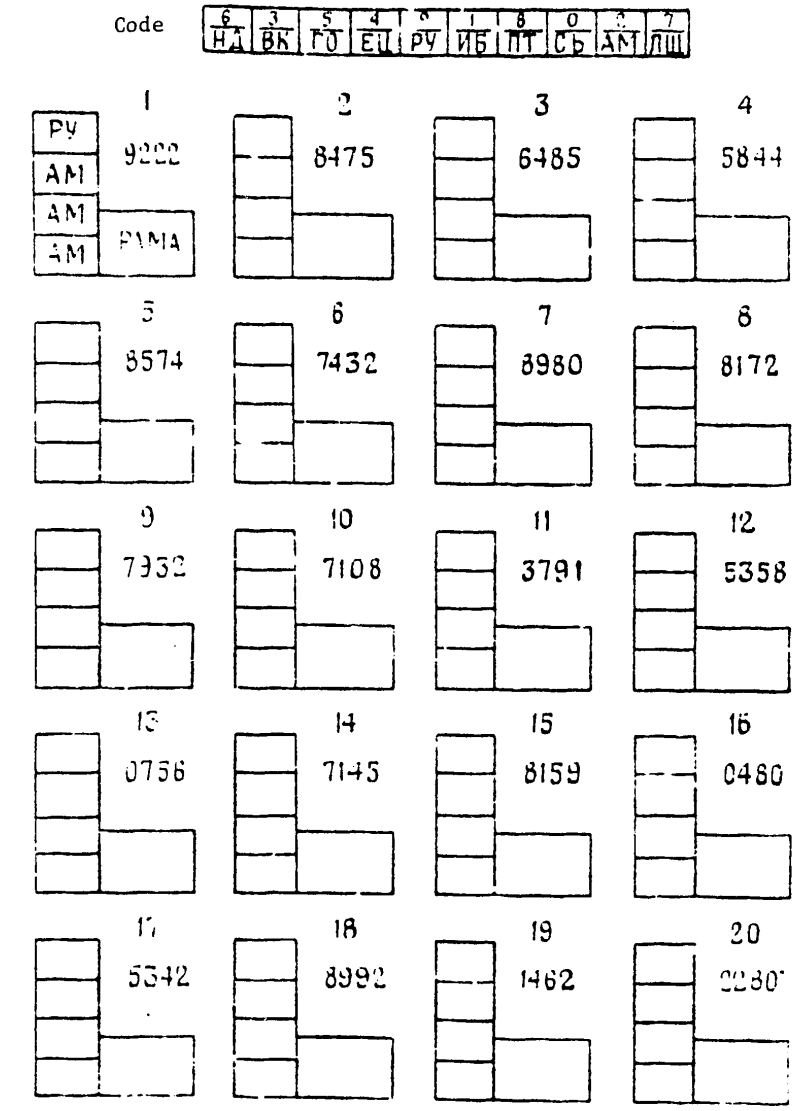


Figure 19. Form for "Combinatory ability" test

Forms (Figure 19), a blackboard and stopwatch are needed for this test.

The essence of this test is that the subjects are asked to find syllables on the forms and write them in accordance with specified number symbols, and then, using the found syllables, assemble words in a specified order under conditions of a time limit.

Instructions to the subjects: "Take the forms. This problem is performed in two stages. First the necessary syllables are found and written down, then words are constructed from these syllables."

"Find the figure under No 1 on the forms. In the middle of the diagram, outside the boxes, there are four digits, 9222. In the code, which is given at the top of the form, each digit (number in the numerator) corresponds to a syllable (syllables in denominator). These two letters are written successively in the vertically arranged boxes. In this case, we write the letters PY in the top box, since they correspond to the digit 9 of the code, and in the other boxes write AM, which correspond to the code number 2."

"When all the letters are written in the appropriate boxes, move on to the second stage of the problem, which consists of the following. Selecting one letter from each syllable, starting at the top, you must form a word that has meaning from four letters. You may not change the order of the pairs. You write the word you found in the empty box that is to the right of the written syllables. In the example discussed, this word is PAMA" [frame in Russian].

"You proceed in the same manner with all of the subsequent problems. Are there any questions? You will have 7 minutes to work in. Get ready! Start!"

The order to "Stop working" is given after 7 min.

In processing the results, a previously prepared "key" form is used to determine the number of correctly written words and mistakes. Scoring in points is performed using Table 20.

24. Criticism in Associative Thinking

This test is used to examine associative thinking and criticism in thinking while operating with rather complex verbal material, and it is designed for individuals with secondary education.

Forms, pencils, demonstration chart, blackboard, chalk and a stopwatch are required for this test.

The test can be used for examining groups of subjects.

Table 20. Scoring test results with "Combinatory ability" method

Number of correctly written words	Score with indicated number of mistakes															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
28	9	9	8	7	7	6	6	5	5	4	4	4	3	3		
27	9	9	8	7	6	6	5	5	4	4	4	3	3	3	3	
26	9	8	7	7	6	5	5	5	4	4	4	3	3	3		
25	9	8	7	6	6	5	5	4	4	4	3	3	3			
24	9	8	7	6	6	5	5	4	4	4	3	3	3			
23	8	7	7	6	5	5	4	4	4	3	3	3				
22	8	7	6	6	5	4	4	4	3	3	3	3				
21	8	7	6	5	5	4	4	4	3	3	3					
20	7	6	6	5	4	4	4	3	3	3						
19	7	6	5	5	4	4	4	3	3	3						
18	7	6	5	4	4	4	3	3	3							
17	6	6	5	4	4	3	3	3								
16	6	5	5	4	4	3	3									
15	6	5	4	4	3	3	3									
14	6	5	4	3	3	3										
13	5	4	4	3	3											
12	5	4	3	3	3											
11	5	4	3	3												
10	4	4	3	3												
9	4	3	3													
8	4	3	3													

The essence of this test consists of performing deduction operations on the basis of associative thinking, with elements of critical analysis (in the presence of debatable associations).

Instructions to subjects: "Take the forms. You see 6 pairs of words in the box at the top, this is the code. Each pair of words in the code is some logical association and is numbered. At the bottom are 20 pairs of words, and next to each pair there are 6 numbers. These pairs of words are also logically related. For each pair of words in this group of 20, you must choose the pair of words from the code that is closest in association. In order to determine which pair of words from the code you selected, circle the number corresponding to the number of that pair."

"For example, let us consider the first pair of words" (showing them on chart): "fright--flight. How can this pair be analyzed? Fright is the cause and flight is the effect. Let us see what this corresponds to in the code. Apparently, poisoning--death (poisoning is the cause of death and death is the effect of poisoning). This means that we shall circle the number 5 next to the first pair of words, i.e., the number of the pair of words we selected from the code. Then, let us look at the

next pair of words: physics--science, etc. Are there any questions?" (questions are answered). "Time allowed for this test is 7 minutes. Get ready! Start!"

Form for "Criticism of associative thinking" test

Code
1. Sheep--herd
2. Raspberry--berry
3. Sea--ocean
4. Light--darkness
5. Poisoning--death
6. Foe--enemy

Fright--flight	1 2 3 4 5 6	Revenge--arson	1 2 3 4 5 6
Physics--science	1 2 3 4 5 6	Ten--number	1 2 3 4 5 6
Correct--true	1 2 3 4 5 6	Cry--howl	1 2 3 4 5 6
Row--garden	1 2 3 4 5 6	Chapter--novel	1 2 3 4 5 6
Pair--two	1 2 3 4 5 6	Calm--movement	1 2 3 4 5 6
Alert--listless	1 2 3 4 5 6	Courage--heroism	1 2 3 4 5 6
Country--city	1 2 3 4 5 6	Coolness--frost	1 2 3 4 5 6
Praise--abuse	1 2 3 4 5 6	Betrayal--distrust	1 2 3 4 5 6
		Night stand--dresser	1 2 3 4 5 6

Table 21. Scoring test results

Correct answers	6 or less	7	8-9	10-11	12-14	15-16	17	18	19 or more
Score	1	2	3	4	5	6	7	8	9

The test results are processed using a "key," and the score is derived from Table 21.

25. Logic of Thinking

This test is designed to examine distinctions of thinking, and in particular to detect mistakes in logical thinking.

Forms and pencils are required for the tests. It can be used for group testing.

It consists of performing simple deductive operations to determine the most logical association between several concepts.

Table 22. Scoring test results

Correct answers	11	12	13	14	15-16	17	18	19	20
Score	1	2	3	4	5	6	7	8	9

Form for "Logic of Thinking" test

1. Garden (plants, gardener, dog, fence, soil).
2. River (bank, fish, fisherman, slime, water).
3. City (car, building, crowd, street, bicyclist).
4. Barn (haystack, horse, roof, cattle, walls).
5. Cube (angles, drawing, side, stone, wood).
6. Division (class, dividend, pencil, divisor, paper).
7. Ring (diameter, diamond, weight, shape [roundness], stamp).
8. Reading (eyes, book, picture, type [printing], word).
9. Newspaper (truth, supplement, telegram, paper, editor).
10. Game (cards, players, fines, punishments, rules).
11. War (airplane, cannon, battle, guns, soldiers).
12. Book (illustrations, war, paper, love, text).
13. Singing (ringing, art, voice, applause, melody).
14. Earthquake (fire, death, earth tremors, noise, flood).
15. Library (city, books, lecture, music, readers).
16. Forest (leaf, apple tree, hunter, tree, wolf).
17. Sport (medal, orchestra, contest, victory, stadium).
18. Hospital (building, garden, physician, radio, patients).
19. Love (roses, feeling, person, city, nature).
20. Patriotism (city, friends, homeland, family, person).

Instructions to subjects: "Take the forms. On each line there is one word (before the parentheses) typed in boldface and five words in parentheses. Your task is to underline only two of the five words given in parentheses, which are the most related to the first word outside the parentheses. Choose two words that designate objects, without which the concept designated by the first word could not exist. For example, look at the first line on your form. The word before the parentheses is 'Garden.' There can be a garden without a gardener or dog, or fence, but it cannot be without soil and plants. Therefore, on the first line the words 'plants' and 'soil' are underlined."

"Are there any questions?" (questions are answered). "You will have 3 minutes to work in. Get ready! Start!"

The order to "Stop working" is given after 3 min.

The test results are processed using a "key," with which the number of correct answeres is determined, and the score is derived from Table 22.

26. Composing Phrases

This method* is used to examine the distinctions of thinking (functions of analysis, distraction and synthesis).

*Proposed by A. N. Rybakov and P. A. Rudik.

It can be used for either individual or group testing.

Forms, pencils and a stopwatch are required for this test.

The subjects are asked to compose and write down, within 5 min, logically and grammatically correct phrases from the set of words listed, without altering the case or verb endings of these words.

Form for "Composing phrases" test

No_____ Class, department_____
Surname, name, patronymic _____ Date _____

Example: Three all have sides triangles. Answer: All triangles have three sides

1. Per the clock minute day one loses_____
2. Diminishes joy and friendship sorrow enhances_____
_____
3. By the war people the economy devasted Soviet national restored the ___
_____
4. A rose a nightingale it is near the crow when often thinks_____
_____
5. Very meaning customs often deep beautiful are old and have_____
_____
6. Several the temperature is than ambient plants higher some degrees level of the_____
7. Important exceptionally agriculture is use of to electricity_____
_____
8. First volcanic number in and Japan earthquakes is place eruptions in of_____

Instructions to the subjects: "Several phrases, the words of which are scrambled, are given to you in the form. You must rearrange the words so as to obtain a grammatically correct phrase, which you will write on the same form. You may not change word endings. You need only to change the places of the words. You are allowed 5 minutes for the entire test. Start only when so instructed by me."

"Let us discuss an example. The following set of words is given: 'Three all have sides triangles.' The answer is: 'All triangles have three sides.' Are there any questions? Get ready! Start!"

The order to "Stop working" is given after 5 min.

The answers are checked against a "key" form with correctly composed phrases.

The number of correct phrases composed within the allowed time is an indicator of comprehension. In evaluating the results, one must take into consideration the subjects' nationality and their proficiency in Russian.

Key-form for "Composing phrases" test

1. Per the clock minute day one loses.
   The clock loses one minute per day.
2. Diminishes joy and friendship sorrow enhances.
   Friendship diminishes sorrow and enhances joy.
3. By the war people the economy devasted Soviet national restored the.
   The Soviet people restored the national economy devasted by the war.
4. A rose a nightingale it is near the crow when often thinks.
   The crow often thinks it is a nightingale when near a rose.
5. Very meaning customs often deep beautiful are old and have.
   Old customs are very beautiful and often have deep meaning.
6. Several the temperature is than ambient plants higher some degrees level of the.
   The temperature of some plants is several degrees higher than the ambient level.
7. Important exceptionally agriculture is use of to electricity.
   Use of electricity is exceptionally important to agriculture.
8. First volcanic number in and Japan earthquakes is place eruptions in of.
   Japan is in first place in number of volcanic eruptions and earthquakes.

27. Exclusion of Concepts

This method* is used to test thinking (abstraction and generalization functions).

It can be used for either individual or group testing.

Forms with a series of conceptions, prepared in advance, pencils and a stopwatch are required.

The essence of this test consists of having the subject analyze 8 lines of words within 3 min to pick up the general, generic concept that is in common to all the words on that line, as well as to exclude a superfluous concept that is not suitable in meaning. For example, for the

*Proposed by B. V. Zeygarnik.

words "paper, ruler, pencil, glass, ink," the generic concept will be "writing equipment." The word "glass" is superfluous in this series. It should be underlined.

After the subjects have signed the forms, they are instructed as follows: "On the forms that you just signed there are seven lines of words. You must find a more general, generic concept for each line of words, that would unite in meaning the rest of the words on that line. If there is an irrelevant word on that line, which cannot be included with the others with regard to generic concept, that word should be underlined. For example, the following words are given" (he discusses the example we discussed above). "Is that clear? You are allowed 3 minutes to do this test. Attention, start!"

A "key" is used to score the test results.

Incorrectly underlined words or "irrelevant" concepts that are not underlined are indicators of inadequate development of abstraction and generalization. The number of such mistakes characterizes the degree of underdevelopment of abstraction and generalization.

Sample of form for "Exclusion of concepts" test

Paper, ruler, pencil, glass, ink.
Bitter, hot, sour, sweet, salt.
Shovel, log, ax, saw, file.
Mother, son, girl, uncle, father.
Clock, barometer, stopwatch, thermometer, airplane.
Fair, honest, kind, brave, untruthful, noble.
Elm, pine, oak, maple, birch [trees].

Key for scoring the test results

Paper, ruler, pencil, glass, ink (writing equipment).
Bitter, hot, sour, sweet, salt (gustatory sensations).
Shovel, log, ax, saw, file (work tools).
Mother, son, girl, uncle, father (relatives).
Clock barometer, stopwatch, thermometer, airplane (measuring instruments)
Fair, honest, kind, brave, untruthful, noble (positive moral traits)
Elm, pine, oak, maple birch (foliate trees).

28. Relating Phrases to Proverbs

This test is used to examine thinking (abstraction and generalization). It is used for individual and group testing.

Forms, pencils and a stopwatch are need for this test.

The test consists of the following. Five proverbs and 10 phrases are written on the forms. Five of these phrases convey the meaning of the proverbs, while the five others have an entirely different meaning that has no bearing on the content of the proverbs. The phrases that convey the meaning of the proverbs are composed of words that are not encountered in the proverbs. The "irrelevant" phrases, however, do contain words that are found in the proverbs. The task is to find and underline those of the 10 phrases that convey the point of the proverbs. This test is to be performed in 2 min.

Instructions to subjects: "There are 5 proverbs and 10 phrases on your form. Underline the phrases that convey the point of the proverbs. You must work as follows: read the first proverb, then find and underline the phrase that conveys its meaning. Then analyze the other proverbs in turn. You are given 2 minutes for this test. Do you understand? Start!"

Sample of form for "Relating phrases to proverbs" test

Proverbs:

1. Strike while the iron is hot.
2. Don't bite off more than you can chew.
3. Where there's smoke there's fire.
4. All that glitters is not gold.
5. An awl cannot be hidden in a paper bag [Murder will out].

Phrases:

1. Hot iron is easier to work on than cold iron.
2. Do not put off a job.
3. Do not tackle a job you cannot do.
4. You cannot chew if you bite off a big piece of food.
5. There is a cause for everything.
6. Burning is associated with smoke.
7. Copper things may also glitter.
8. One should not judge a person solely by his appearance.
9. It is impossible to conceal the truth.
10. An awl is a sharp object.

The presence of underlined phrases containing the words that are in the proverbs but with an entirely different meaning are an indication of inadequate development of abstraction and generalization functions. For example, relating the phrase "Do not put off a job" to the proverb "Strike while the iron is hot" is the correct answer, while the phrase "Hot iron is easier to work on than cold iron" is incorrect.

Key for scoring test results

Proverbs	Phrases
1. Strike while the iron is hot.	2. Do not put off a job.
2. Don't bite off more than you can chew.	3. Do not tackle a job you cannot do.
3. Where there's smoke there's fire.	5. There is a cause for everything.
4. All that glitters is not gold.	8. One should not judge a man solely by his appearance.
5. An awl cannot be hidden in a paper bag.	9. It is impossible to conceal the truth.

29. Syllogisms

Logical deduction, i.e., new judgments about objects, phenomena or processes on the basis of certain judgments, is one of the principal forms of mental activity.

A test involving the use of a form that consists of a set of similar logic problems in the form of syllogisms is used as the method to assess deductive ability. In these problems, the initial judgments are well-known (by virtually everyone) relations of objects and phenomena with regard to size, brightness and possibility (of some event or phenomenon).

The essence of the method can be readily understood if one considers the following example: The subject is given, for example, the following problem:

A is much larger than B
B is somewhat smaller than C
A C

One of the following answers must be given: "A is larger than C" or "A is smaller than C).

In this case, through simple reasoning (deduction) it is easy to conclude that "A is larger than C."

The work form consists of a set of 18 logic problems.

The test is conducted by the rules of group experimentation.

The subjects sign the forms and close their folders, after which they are given the following instructions: "You will have to solve 18 logic problems. On the forms that you just saw each problem is written in this form" (he writes the example on the blackboard without the answer).

"Through reasoning, you should determine whether one parameter (A and C) is larger or smaller than another (C or A), and write the answer under

the line. The words used in the answer are 'larger' or 'smaller.' Other types of problems are solved similarly. For them, the answer will be 'lighter' or 'darker,' 'more likely than' or 'less likely than'" (illustrated on the blackboard). "You must solve the problem in your mind only, without making any pencil marks. You should move from problem to problem in order of their numbers, i.e., from left to right and from top to bottom. You must work rapidly, but the main think is not to make any mistakes. Are there any questions?" (questions are answered trying not to indicate the specific routes of reasoning).

Then the subjects are instructed to "Take your pencils, attention, start!"

The time allowed for this test is 5 min. Primary processing of the results consists of counting the total number of correct answers.

30. Tests Involving the Use of the Matrix Principle

Matrix Instrument

The matrix instrument for psychological tests* is designed in the form of a set of plates contained in a flat box.

The top, removable plate *1* (figure 20) serves as the matrix field, over which 324 (18×18) identical slots are placed uniformly.

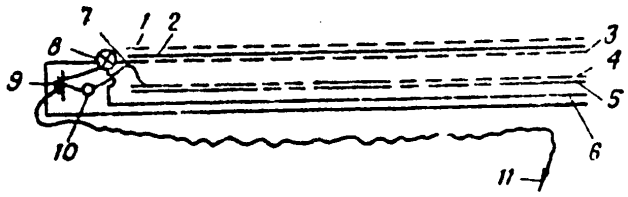


Figure 20. Diagram of matrix device (side view)

1) plate
2) sheet of paper
3) top wall of instrument housing
4) foil
5) programming plate
6) bottom wall of housing
7) electric contact with foil
8) signal light
9) small battery
10) buzzer
11) electric stylus [probe]

The vertical rows of slots are designated on the panel by letters and the horizontal ones by numbers. There are alternating white and red strips next to the rows. Under the template field is top *3* of the instrument, which has exactly the same slots as plate *1* and serves as a support. The bottom *6* of the housing has a metal lining on the inside.

*Designed by G. M. Zarakovskiy, M. I. Klevtsov, N. M. Mikhaylin and K. A. Chernov.

Sample of form for "Syllogisms" test

1. A much smaller than
   B somewhat larger than
   C

   B
   C
   A

2. A much more likely than
   B less likely than
   C

   B
   C
   A

3. A somewhat larger than
   B much smaller than
   C

   B
   C
   A

4. A somewhat darker than
   B much lighter than
   C

   B
   C
   A

5. A somewhat smaller than
   B much larger than
   C

   B
   C
   A

6. A much smaller than
   B somewhat larger than
   C

   B
   C
   A

7. A much more likely than
   B less likely than
   C

   B
   C
   A

8. A somewhat larger than
   B much smaller than
   C

   B
   C
   A

9. A much lighter than
   B somewhat darker than
   C

   B
   C
   A

10. A somewhat larger than
    B much smaller than
    C

    B
    A
    C

11. A much darker than
    B somewhat lighter than
    C

    B
    A
    C

12. A much less likely than
    B somewhat less likely than
    C

    B
    C
    A

13. A somewhat lighter than
    B much darker than
    C

    B
    C
    A

14. A less likely than
    B much more likely than
    C

    B
    A
    C

15. A somewhat more likely than
    B much more likely than
    C

    B
    C
    A

16. A somewhat more likely than
    B much less likely than
    C

    B
    A
    C

17. A somewhat darker than
    B much lighter than
    C

    B
    A
    C

18. A much darker than
    B somewhat lighter than
    C

    B
    C
    A

A programming plate *5*, made of insulating material and covered on the top with foil *4*, is inserted between the top and bottom walls. There are slots in specific places on the plate, as well as areas that are not covered with foil that coincide with specific recesses on the matrix field.

A sheet of paper *2*, which serves to conceal the program, reflect the symbols displayed to the subject and record the subject's actions by perforations with electric stylus *11*, is placed between plate *1* and the top wall *3* of the housing. The electric system of this instrument has two circuits: 1) small battery (3.5 V) *9*--electric stylus *11*--metal cover *6* of bottom wall--signal light *8*; 2) battery--electric stylus--foil of the program plate--buzzer *10*.

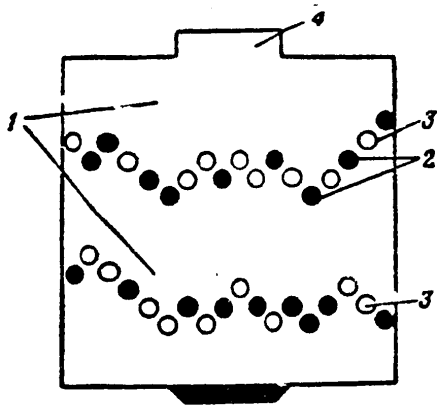


Figure 21.
Drawing of program plate
1) plate surface covered with foil
2) plate sections not covered with foil
3) slots in plate
4) catch pressed down by wire contact

The information presented to the subject can be coded as follows: 1) by symbols on a form; b) color and numbers on matrix field; c) c) lights; d) buzzer.

The time taken to perform the task is recorded with a spring-loaded stopwatch.

The tests that make use of the matrix instrument include the following: "Maze," "Determination of divisibility of numbers" and "Detecting and counting specified signals."

Maze

This test is intended for evaluation of some individual distinctions of reproductive thinking.

It consists of testing the speed and accuracy of transforming the problem conditions in accordance with previously known logical associations between them.

The test is given in the form of a task of going through a dichotomous maze, at each step of which one of eight possible combinations of three binary symbols is presented.

Before the test, a program plate, as well as form with the symbols "1" and "0" on it in checkerboard pattern and random order, which are visible in the cells of the matrix field, are placed into the instrument. Figure 21 illustrates a sample program and Figure 22 a sample form.

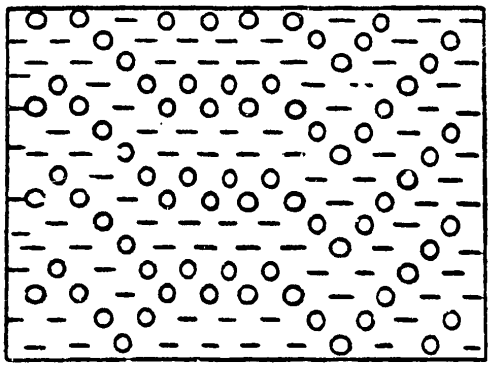


Figure 22.
Sample of form for "Maze" test

The following instructions are given to the subject: "A cell [recess] in the extreme left column will be pointed out to you. It is the start of a convoluted path, a maze, that must end in one of the cells in the last column. The first step from the first cell of the maze must be made by moving diagonally into one of two adjacent cells on the right, designating the selected cell by perforating its place on the form with the electric stylus. If you have made the correct choice, there will be no audio signal at the moment you are making the perforation. But if you hear a buzzer, it means you have made a mistake that must be corrected by changing your choice of cell. You take the next step from the properly chosen second cell of the maze in the very same manner, diagonally to the right, up or down, and so on until you reach the last column."

"In order to make the correct choice of direction for the next step, you must check the conditions stipulated in each starting cell: color of vertical band in which the cell is located; symbol on the form; presence of light signal when perforating the cell with the electric stylus."

The checking should be done as follows: 1) check the symbol and make a preliminary decision (D_1): 1 meaning up and 0 meaning down; 2) check the color of the band and make an intermediate decision (D_2): if the color is white it conforms with the initial decision ($D_2 = D_1$), and if red it is the opposite ($D_2 \neq D_1$); 3) check color of light and make the final decision (D_3): if the signal is present it is the same as the intermediate decision ($D_3 = D_2$) and if there is none, it is the opposite ($D_3 \neq D_2$)."

"You must learn the order and nature of the transformations [conversions], then go through the maze rapidly and without making any mistakes."

Before the actual test, the subject goes through the maze using Table 23 to learn the logical associations between symbols and practice working with the instrument. During and after this practice, the subject's questions are answered and his assimilation of the instructions is checked (indication of the meanings of symbols without making mistakes).

For the actual test, a program with a different maze is put in the instrument. The subject starts at a specified cell when so instructed by the experimenter, with concurrent setting of the stopwatch, which is stopped when the last cell of the maze is reached.

Table 23. Logical order of actions when practicing for "Maze" test

Nature and symbols of decisions made	Features checked and content of decision	Implementation of decision
Preliminary decision (D_1)	Symbols: 1 (D_1)--up 0 (D_1)--down	Remember D_1
Intermediate decision (D_2)	Band color: white $D_2 = D_1$ red $D_2 \neq D_1$	Remember D_2
Final decision (D_3)	Light signal: on, $D_3 = D_2$ off $D_3 \neq D_2$	Perforate selected cell

The following are taken into consideration with regard to performance: time taken to go through maze consisting of 17 steps and number of correctly and incorrectly solved problems at each step by comparing the location of the perforations on the form to a special sample.

Parameter A of quality of performance is calculated to the first decimal point using the formula:

$$A = \frac{D_c - D_i}{T}$$

where D_c is the number of correctly solved problems, D_i is the number of incorrectly solved problems and T is time taken to go through maze, in seconds.

When $D_c - D_i \leq 0$, A is considered to equal 0.

Parameter A indicates the subject's ability to efficiently translate information contained in the delivered signals, in accordance with certain rules.

To simplify the test, it involves only one initial premise and two checking premises of the confirm or deny type. In most cases, such relatively simple problems are performed on the order of logical transformations only for the first three maze problems. Then the subject can remember three-term combinations and corresponding solutions, and the problem will be solved on the order of direct connection of associative links. For this reason, when it is necessary to retest the same subject one should alter the signal meaning of tags, using appropriately altered programs.

Determining Divisibility of Numbers

This test* permits examination of speed and accuracy of actualization of information stored in long-term memory.

*Proposed by V. A. Bodrov, A. A. Genkin and G. M. Zarakovskiy; modified by K. A. Chernov.

The multiplication table, being generally known and well-learned material, is used as information to be actualized.

A program plate similar to the one illustrated in Figure 21 and form, on which there are fractions arranged in checkerboard order, are inserted in the matrix instrument.

The subject is given instructions, accompanied by demonstration with an example: "A cell in the first column will be pointed to you. There is a fraction visible in this cell. You must determine whether the numerator can be divided by the denominator without a remainder. If so, you will make a perforation with the electric stylus in the cell that is next to the first one, diagonally on the right and up, if not, you will do so in the adjacent cell diagonally on the right and down. If you have chosen the correct cell, there will be no audio signal, if incorrect a buzzer will go on. You must correct your mistake by perforating the form in another diagonally situated cell. You will again determine whether the numerator is divisible by the denominator in the correctly chosen cell, moving to the right diagonally up or down, and so on to the last column."

The subject does one practice problem, then the test one with the aim of working correctly and accurately.

The following elements of performance are taken into consideration: time taken to solve 17 maze problems and number of correct and incorrect solutions (according to location of perforations on the form).

Parameter B of "memory readiness" is calculated to the first decimal point :

$$B = \frac{Pc = Pi}{T}$$

where Pc is the number of correctly solved problems, Pi is the number of incorrectly solved problems and T is the time used to go through the maze, in seconds.

Detecting and Counting Specified Signals

This method permits testing of individual distinctions of operational memory.

It involves retention of standard [reference] signals, searching for and counting identical signals in a series containing signals that are both identical with and different from the standard ones.

A blank form and program plate are inserted in the matrix instrument (Figure 23).

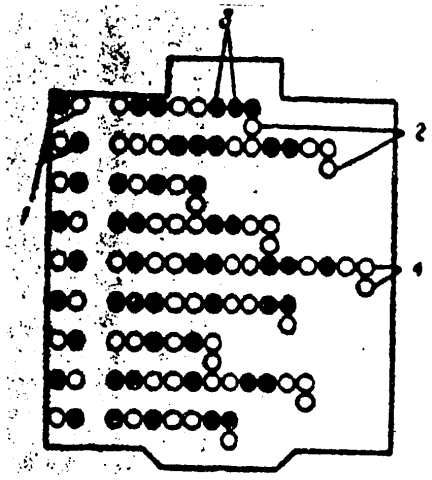


Figure 23.
Sample of program plate
1) standard signals
2) slots underneath standard signals repeated 3 times
3) areas not covered with foil
4) complete perforations

Instructions to subject: "There are two standard signals in the first and second cells of each odd row. The signals have two tags: 1) color (white or red) of vertical band in which the cell is situated, and 2) lights (on or off) when form is perforated in the cell with the electric stylus. The standard signals must be retained then, by checking the signals in the cells of the appropriate row, you should mentally count the number of each of the standard signals. A check perforation must be made in the underlying cell when some standard signal has been repeated three times, and this ends your task. You must not count the sample signals in the first two cells. If you have performed the assignment correctly, the check perforation will cause a signal light to go on. If the check perforation is made prematurely or a three-fold repetition is not detected, the buzzer will go on. You must work rapidly and accurately. You may not check the signals a second time."

In order to acquaint the subject with the nature of the problem and learn the instructions, a demonstration is provided of going through one row, with explanation of the rules for work. Then the subject works on 2-3 problems for practice, until he assimilates the instructions properly.

The test consists of 9 problems varying in difficulty, which is determined by the length of the rows containing 5 to 14 signals. The problems are given in random order of difficulty. The time spent on each problem and length of rows of correctly solved problems are taken into consideration.

Accuracy of performance is determined by counting the perforations in each row of the form and comparing it to a "key" table.

Parameter C of efficiency is the ratio of the sum of signals in correctly solved problems (Pc) to time taken to solve all problems (T) in seconds:

$$C = \frac{Pc}{T}$$

Psychomotor Functions

31. Coordinometer

This method* permits examination of the quality of interaction between the right and left hands, upon which depends the accuracy of resultant movement of the object of control.

The test is conducted on a small stand, which is a 30x40 cm rectangle, on which the subject moves the controlled object, in the form of a miniature car, over a specified route 80 cm in length. The course described by the car (in relation to the specified one) is recorded directly by a special sliding automatic recorder [pen] on a sheet of paper placed at the bottom of the stand. After the test, a template with the specified course is put over the paper with the tracing of the resultant course obtained from the subject's controlling movements, and accuracy of his work is checked.

There are two handles *1* and *2* (Figure 24) to control the object, one of which (*2*) moves in a longitudinal *4* direction and the other (*1*) in a transverse *3* direction. The handles are connected through a leverage system to a specially installed magnet that is adherent to the bottom surface of the rectangle. A second magnet is installed in the plastic car and adherent to the top surface of the rectangle. As the bottom magnet moves, magnetism pulls the car with it and, since there is a pencil firmly attached to the bottom magnet, it traces the car's route on the sheet of paper, which is the vector sum of movement of handles *1* and *2*.

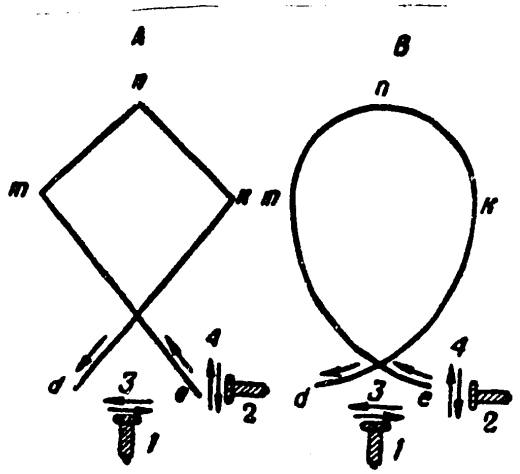


Figure 24. Schematic diagram of routes

*Developed by V. I. Babiyak.

Figure 24 illustrates two route variants: A consists of segments of a straight line and B of segments of circles.

For this test, clean sheets of paper, 30×40 cm in size, are needed for the subject to trace the route while controlling the object, as well as a stopwatch. The equipment of the stand consists of the following: set of routes traced on heavy-weight Whatman paper, stencils of clear film, on which the routes are copied, assortment of pencils of different colors corresponding in diameter to the recorder holder.

Before the test, the operation of the instrument and problem are explained; the problem consists of having the subject guide the object over the specified route, with maximum coordination of movements of the right and left hand, without deviating to the sides, in the shortest period of time.

The instrument is put on a table, and the subject sits before it, on a chair. He tests the instrument and familiarizes himself with its operation for 1 min before the test. The researcher starts the stopwatch when the subject begins the test and stops it when the subject has guided the object over the entire route.

This test can be used in two variants: screening for "primary" giftedness and screening for training aptitude.

In the first case, the subject is asked to guide the object over the specified route immediately after becoming acquainted with the operation of the instrument, after which an evaluation is made of his "primary" ability to control the object by means of combined interaction of the hands.

In the second case, the accuracy of the recorded visual and motor reaction is evaluated successively after practicing on a given route for 1, 2 and 3 minutes. In evaluating training aptitude, consideration is given to an increase in accuracy of controlling the object and reduction of time taken to travel over the specified route.

The following are recorded as parameters of the complex sensorimotor coordination under study: time taken to travel over the entire route; mean amplitude of deviations from the specified route (calculated by averaging the different amplitudes measured over the route with discreteness of up to 1-2 cm, depending on the specified accuracy of measurement); number of erroneous trial movements at switching points and their mean deviation from the points.

The results are evaluated in accordance with the data listed in Table 24.

Table 24. Evaluation of test results

Evaluation	Time, seconds	Deviation of mean amplitude σ* in excess of	Number of deviations at switching point
Excellent	Up to 10	±6	0-2
Good	10-20	±26	2-4
Satisfactory	20-30	±36	4-6
Unsatisfactory	Over 30	Over ±36	Over 6

*σ is the standard deviation calculated for individuals with excellent quality of tested sensorimotor reaction, not exceeding ±10 mm.

32. Reaction to Moving Object

A man's reaction to an object moving at uniform speed in the field of vision and stopping at a certain point on the way is called the reaction to a moving object (RMO). This is a complex conditioned time and space reflex, which is formed on the basis of evaluating the speed of movement and determining the magnitude of the corresponding exercise.

RMO tests permit evaluation of such a feature of a complex sensorimotor reaction as accuracy of reaction, and they also permit evaluation of the correlation (equilibrium, balance) of the main nervous processes.

Having the subject stop the rapidly moving hand of an electric stopwatch at a specific line on the dial is the most convenient procedure for testing the RMO. For this, one needs two telegraph keys (circuit-closing one for experimenter and circuit-opening for the subject) connected in series in a circuit with the electric stopwatch (with a hand that moves at the rate of one revolution per second, type PB-53) and power source. The electric circuit of the device is illustrated in Figure 25.

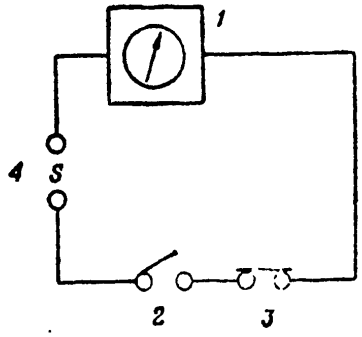


Figure 25.
Electric circuit of device for testing reaction to moving object

1) electric stopwatch
2) experimenter's key
3) subject's key
4) power source

Before the test, the experimenter gives the subject the following instructions: "I shall start the electric stopwatch, whose hand moves at the rate of one revolution per second. You must stop the hand at exactly 0 by depressing your key."

In each test, the first three reactions are for practice, and they are not taken into consideration. The actual reaction test is repeated 25 times. In order to prevent development of reflexes to time, prior to each successive reaction the stopwatch hand is not set at the zero position, but started at the line where it was stopped in the preceding reaction. The hand is set at 0 only if the magnitude of error of the preceding reaction exceeds ±250 ms.

The subject may react prematurely, i.e., the hand does not reach the 0 mark, or belatedly, i.e., the hand "jumped" beyond the 0, or accurate, when the hand stops at 0. Each premature or delayed reaction is given a quantitative score in absolute units of deviation from 0, in milliseconds, and for premature reactions this parameter is designated with a minus sign (-), for delayed reactions a plus sign (+) and for accurate reactions a zero (0).

The instructions set the subject exclusively toward accuracy of reactions. With such instructions, premature or delayed reactions will be involuntary.

To evaluate the results of the test and, in particular, to determine the accuracy of reactions, one must calculate the relative frequency of accurate precise responses (percentage of total number of reactions) and the arithmetic sum of deviations of the hand from 0 in all 25 reactions.

Example: The RMO test yielded the following results:
+4, -6, -1, 0, -3, +3, -4, -2, +4, 0, -3, -2, +2,
-5, -2, +3, -2, +2, -5, -2, +5, -7, -6, 0, +2.

1. Number of premature reactions (-)--14;
number of delayed reactions (+)--8;
number of precise reactions (0)--3.

2. Relative frequency of precise reactions (K):

$$K = \frac{3 \times 100}{25} = 12\%.$$

3. The overall deviation of the hand from 0 equals 75.

33. Tapping Test

This method permits testing of the motor system, in particular, the pace, rhythm and stability of motor actions.

For this test, an electromagnetic pulse counter, telegraph key, power source, connected in the circuit in series, and a stopwatch.

The method of this test consists of having the subject depress and release the key at maximum speed for 2 min when the experimenter says "Zero" (stopwatch is started). The experimenter records the number of reactions per 30-s periods. He must see to it that the subject depresses and releases the key as a result of voluntary reactions, rather than the result of digital tremor (the key handle is held with the thumb, index and middle fingers, with the forearm resting on the table).

The number of reactions per 30-s segments of time is recorded in the test log. Determination is made of the total number of reactions and mean difference in pace within individual 30-s segments (arithmetic sum of differences between number of movements in the first and second, second and third, third and fourth 30-s intervals, divided by 3).

34. Tremometry

This method permits evaluation of the capacity for fine sensorimotor coordination of movements by recording hand tremor.

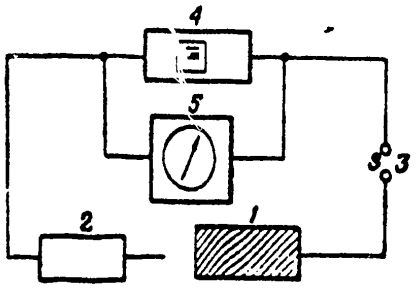


Figure 26.
Electric circuit of tremometer
1) plate
2) contact rod
3) power source
4) pulse counter
5) electric stopwatch

The following items are needed for this test: tremometer, which consists of a metal (aluminum or brass) plate *1* (Figure 26), contact rod *2*, power source *3* and pulse counter *4* connected in series in the circuit; electric stopwatch *5* is connected parallel with the counter. There are slots in the plate (Figure 27) in the form of zigzag and curved lines 600 mm long and 5 mm wide, as well as three holes 5, 7 and 10 mm in diameter. The contact rod, which has a rubber or wood handle, is 3 mm thick.

The test consists of having the subject guide the rod in the plate slots or hold it in a hole without touching the sides of the slots or holes. Every time the rod touches the plate, the electric circuit is closed, and the number of times this happens is recorded by the pulse counter, while the duration of each contact is recorded by the electric stopwatch.

The subject must perform one dynamic test--guide the rod through the curved line slot ("Tremometry-I")--and one static test--hold the rod in the hole that is 5 mm in diameter ("Tremometry-II"). For the first test, 15±2 s is allowed and for the second, 10 s. The subject should be in a comfortable position, the hand holding the rod must not rest on any part of the body or table.

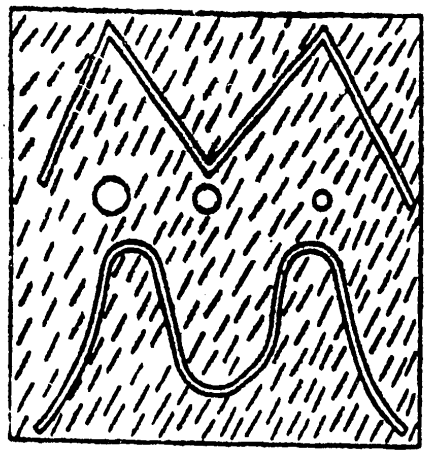


Figure 27
Tremometer plate (panel)

Before the test, there is a practice session, during which the subject must develop the recommended speed for performance of the dynamic test. Subsequently, during the actual test, the experimenter corrects the speed by giving the relevant instructions to the subect ("faster" or "slower").

The instructions given by the experimenter indicate that, when the command "Zero" is given for the dynamic test (when the stopwatch is started), the subject must insert the rod in the left end of the slot and guide it through the entire slot at the specified speed, without touching the edges, and remove the rod at the end of the slot (at which time the stopwatch is stopped). The test is repeated 3 times.

For the static test, when the command "Zero" is given (when the stopwatch is also started), the subject must insert the rod in a hole and hold it there, trying not to touch the edges. When ordered to "Stop" (stopwatch stopped), he must remove the rod from the hold. This test is repeated 3 times.

To analyze the results, one must count the number of times the rod touched the edges per second in each test and the mean duration of one contact (determined as the quotient from dividing the total time of contact in seconds by the number of contacts). The mean value of these two parameters in three performances of each test is recorded.

35. Movement by Command

This method* is intended for testing speed of action.

A tape recorder and two experimenters for every 6-8 subjects are required for this test.

In essence, this test consists of delivering a series of rapid commands to perform elementary hand movements within a limited period of time. The speed of issuing the commands increases in each successive series. Evaluation is made of the ability to perform the task at the specified speed, which corresponds to a certain score in points. The subjects who have not been able to cope with any series of commands are eliminated from the subsequent tests. Each experimenter observes 3-4 subjects.

*Developed by V. L. Marishchuk.

Instructions given to subjects: "Attention! You will be given commands to perform simple hand movements, for example 'left hand up, right to the waist, left to the side, etc.' Upon hearing the command, perform it immediately, leaving the hands in the position they assumed by command, and change positions upon hearing the next command. If you do not have time to make some movement, do not stop the test and make the next movements."

Variants of commands

First series

1.	Right up	11.	Left up
2.	Left forward	12.	Right forward
3.	Left to the waist	13.	Left to the waist
4.	Right to the side	14.	Right to the side
5.	Left forward	15.	Left to the side
6.	Right to the waist	16.	Left to the waist
7.	Right forward	17.	Right forward
8.	Left up	18.	Left to the waist
9.	Left forward	19.	Right to the side
10.	Right to the waist	20.	Right to the waist

Second series

1.	Right to the side	11.	Left to the side
2.	Right to the waist	12.	Right to the side
3.	Left up	13.	Right to the waist
4.	Right forward	14.	Left up
5.	Left forward	15.	Right forward
6.	Left to the side	16.	Left to the waist
7.	Right to the waist	17.	Right to the side
8.	Left up	18.	Left up
9.	Right forward	19.	Left to the waist
10.	Left forward	20.	Right to the waist

"Let us practice: Left forward" (3-s pause), "right up" (3-s pause), "right to the waist, etc." (mistakes should be corrected, procedure to be clarified).

"Now let us do the test. All who are able to perform all of the commanded movements will have the right to perform the next series of movements, in which the commands will be given faster."

The task is considered performed if the subjects are able to make the movements at the set pace making no more than 2-3 mistakes per task.

In all, 20 commands are given within 30 s.

Subjects who did not cope with the "20 commands in 30 s" test are given a grade of 1, and they are eliminated from subsequent tests.

The remaining subjects are given the test involving 20 commands within 20 s. Those who could not do this test, but did perform the preceding one, are given a grade of 3, and they are eliminated from subsequent testing.

The remaining ones perform the test at the rate of 20 commands in 18 s. Those who could not do this, but did perform the preceding test, are given a grade of 5 and eliminated from subsequent testing.

The remaining subjects perform the test at the rate of 20 commands in 16 s. Those who could not perform this test, but did perform the preceding one are given the grade of 7.

The last test is performed at the rate of 20 commands in 14 s, and it is scored at 9.

In the tests involving 20 commands in 16 s or less, each movement is not evaluated individually; rather, attention is given to overall ability to function at the set pace, even though some mistakes are made.

Preliminary training of experimenters is required to conduct the "Movement by command" test.

36. Ball-Throwing Test

This test* is intended for examination of speed of action and dexterity.

A basket ball and stopwatch are needed for these tests.

The test consists of having the subject rapidly throw the basket ball to hit a circle, 50 cm in diameter, that is drawn on a plate (on the wall), from a distance of 2.5 m for 30 s. Throws outside the circle do not count. If the subject drops the ball, he has the right to pick it up and continue the test. He can throw the ball in any fashion. He is given two tries, and the best result is recorded.

Instructions to subjects: "When ordered to 'Start' try to hit the circle on the plate as rapidly as possible (by any means), trying to hit the circle and catch the ball as it bounces back, but you may not step beyond the check line that is 2.5 m from the plate. If you drop the ball, you may pick it up and continue with your assignment. If the ball hits outside the circle, the throw does not count. You will be given two tries. The best of the two is recorded."

The results are scored in accordance with Table 25.

*Developed by V. L. Marishchuk

Table 25. Scoring test results

Throws into circle per 30 s	22 or less	23	24	25-26	27-29	30-31	32-33	34-35	36 or more
Score	1	2	3	4	5	6	7	8	9

Physiological Distinctions of Higher Nervous Activity in Man

37. Use of "Temp" Instrument to Test Lability of Nervous Processes

This method* permits examination of lability of nervous processes. It is best suitable for testing analytical and synthetic activity that is inherent in man.

For the tests, one needs a Temp instrument (Figure 28), stopwatch, log forms, equipment to record the main physiological functions characterizing the autonomic component of reactions. The instrument consists of two consoles, one for the experimenter and one for the subject. The subject's console has a unit for delivery of stimuli, platform with buttons for the subject's reactions and siren [horn]. The instrument is powered by alternating current through a special power unit that lowers voltage to 24 V. The key diagram [circuit] is illustrated in Figure 29.

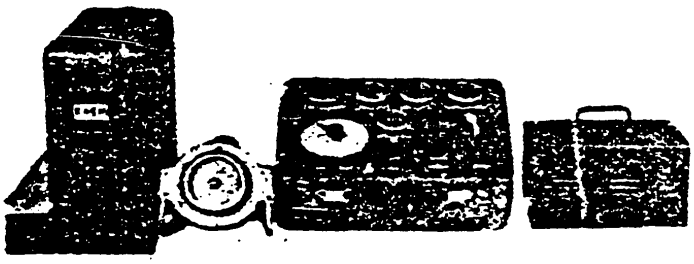


Figure 28. View of Temp instrument

There are five counters (Сч 1 --Сч 5) on the front panel of the experimenter's console, that record the number of stimuli delivered, erroneous reactions and skips, three switches [tumblers] to turn on the power to the instrument, to turn on 24 V power to the film-projector motor and to turn on the entire system of the instrument; program changer, regulator of frequency of stimulus delivery and light that checks synchronization.

*Developed by A. Ye. Khil'chenko [31], modified by V. A. Sergeyev and Yu. S. Chugunov.

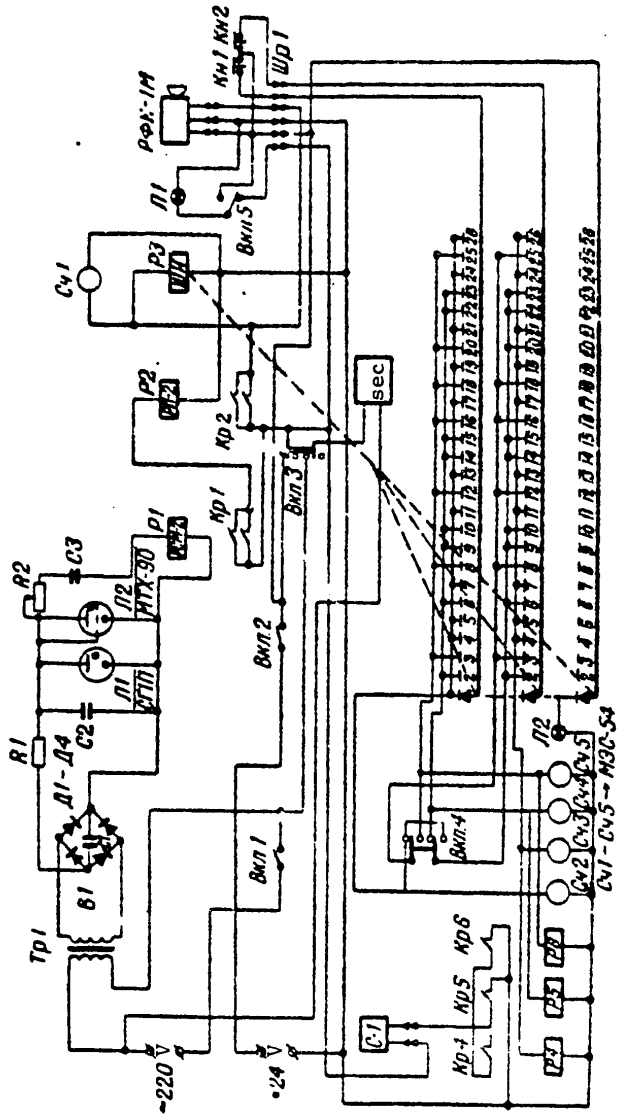


Figure 29. Key diagram of electric circuitry of Temp instrument
[Refer to Figure 9, p 54, for key to Russian letters not given here]

Key:
Вкл) on switch
Кр) relay
РФК) speaker-output
Шр) plug connection

On the subject's console, there is a semitransparent screen, on which stimuli on film are projected by means of a pulsed slide projector, in the form of short words designating the names of animals, plants or inanimate objects. The first two groups of words are positive stimuli and the third are inhibitory. The order of presentation of the words is determined by their arrangement on the film in random order. Time of exposure of the frames can be changed as the experimenter wishes, from 15 to 190 per min. As the subject reacts to words designating animals, he depresses the left button with his left hand; to words designating plants he depresses the right button with the right hand; he does not react to words designating inanimate objects. If the reactions are wrong (incorrect or delayed) the siren goes on, which reports to the subject that his answer was wrong.

The design of the instrument makes it possible to use various methodological procedures, depending on the purpose and goal of the experiment. In particular, one can alter the meaning of delivered stimuli: deliver digits, various geometric figures, as well as drawings or other symbols to be differentiated according to significance or magnitude, instead of words. This is done by replacing the film in the unit for delivery of stimuli. The program for the answers can also be changed by altering the signal meaning of the subject's response buttons, for which purpose there is a special switch on the experimenter's console.

Both instrument consoles are put on the same table, or on different tables. The test can be conducted under ordinary lighting conditions, without darkening the room, provided that the screen of the stimulus delivering unit is not exposed directly to the sun rays. The subjects work in seated position. The experimenter takes a position that will be convenient for controlling the console and observing the subjects. Considerable nervous and emotional tension is created in the subjects, because of the limited time limit caused by the forced rate of performance. The audio signals when mistakes are made increase tension even more.

The following procedures are recommended for purposes of professional screening:

examination of individual neurodynamic distinctions at the early stage of developing skill in working with the instrument at the rate of 60 reactions per min; a total of 500 stimuli are delivered; the mistakes and skips after delivery of every 100 stimuli is recorded, which permits observation of the dynamics of development of the skill; the total mistakes and skips over the entire examination serves as the criterion for evaluating individual neurodynamic distinctions;

determination of individual distinctions of nervous process lability by testing whether the subjects can react to stimuli delivered at increasing speed. The rate of delivery of stimuli is increased in steps, by 10 per min. The criterion of successful performance could be the total errors and skips not exceeding 30% of the number of delivered stimuli.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300080017-2

Instructions to the subject: "On the screen you will be shown the alphabetic designations for words referring to the names of animals, plants and inanimate objects. When words appear on the screen that designate animals you must depress the left button with your left index finger; when you see words referring to plants, depress the right button with the right hand; you do not react to words designating inanimate objects. You must depress the buttons as rapidly as possible and release them immediately. In the case of incorrect reactions or holding the button down until the next frame appears, there will be a loud signal to indicate an inadequate reaction. There will be many incorrect reactions at the start of the test, but with practice there will be fewer. In spite of the many mistakes at the start of the test, it is categorically forbidden to stop the test. Nor is it allowed to ask questions in the course of the test. It should be borne in mind that the instrument records not only mistakes, but skips, which also lowers the test score."

After these instructions, the instrument is demonstrated to the subject and he is given an opportunity to become acquainted with its operation. However, no more than 10-15 stimuli are delivered at this time.

Before starting the test, the orders to "Get ready!" and then "Start" are given. Before testing lability of nervous processes, the subject must be warned that the work pace (delivery of stimuli) will accelerate, and he must apply a maximum effort to perform his task.

The test lasts 8-15 min, depending on the individual distinctions of the subject. The results are recorded on a log form. The results are rated on a 9-point scale, which is prepared for each group of subjects. The scale threshold is determined in accordance with the requirements made of lability of nervous processes in operators referable to a given occupation. The results of testing individuals in the same specialty who coped well with their work serve as the standard for evaluation. The intensity of the autonomic component of the reaction must be taken into consideration in evaluating the test results.

38. Use of KSF Instrument for Complex Testing of Tracking and Operational Memory

This method* is intended for complex evaluation of psychophysiological qualities that are need for the development of skills related to tracking and operational memory.

The KSF instrument (which compensates tracking with forcing) consists of two consoles, one for the experimenter and one for the subject (Figure 30). The key diagram of its electric circuitry is illustrated in Figure 31. A measuring device (milliammeter), the pointer of which the subject must hold in a specific position, is connected to the diagonals of the direct

*Developed by V. S. Fomin.

current bridge. The method for testing operational memory is based on the principle of equally probable presentation of one of three colors, red, white or green (the circuit is assembled on the basis of the ШИ-17 [ShI-17] step-by-step selector [switch]), and the subject has to extinguish them in accordance with a specific condition.

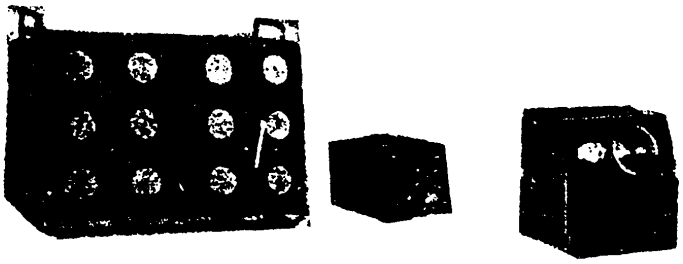


Figure 30. KSF instrument (experimenter's console on the left, subject's console on the right)

The programmed test provides for two modes of delivering stimuli: mode of "complex" tracking, when the subject must continuously track the pointer in order to hold it in a specific position, combined with concurrent differentiation of color-coded stimuli, based on operational retention of their signal meaning; mode of "forced" tracking, which is characterized by increasing difficulty of tracking the instrument pointer with the former mode of differentiation of color stimuli.

After giving the subject written instructions and he has assimilated them, the first 2-min cycle of work in the mode of "complex" tracking is done. The results of this cycle provide an idea about the ability to form a skill. The second cycle (repeating the mode of "complex" tracking) is intended to detect "operator" qualities with a developed skill, i.e., while performing a "routine" task. The third 2-min cycle ("forced" tracking) is directed toward detection of the subject's reserve capabilities for work under more complicated conditions.

In order to intensify emotional tension, the subjects' incorrect reactions are accompanied by an audio signal in all of the work cycles.

Some physiological functions--heart rate, minute volume of respiration, electrodermal conduction, etc.--must be recorded to assess the intensity of the autonomic component of the subjects' reactions.

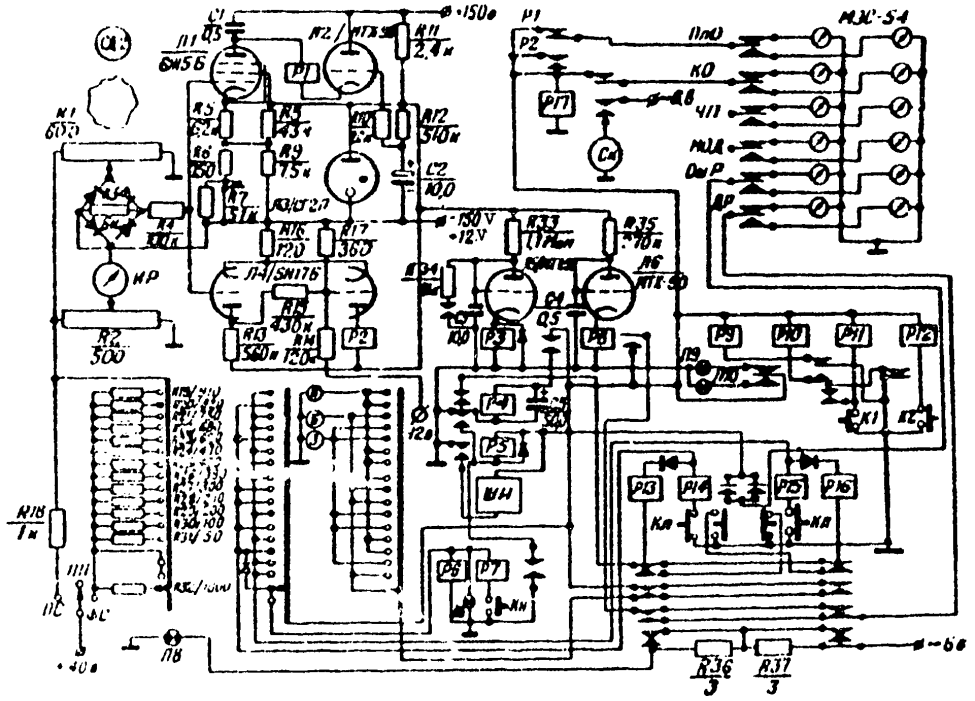


Figure 31. Key diagram of electric circuitry of the KSF instrument [Refer to Figure 9, p 65, for key to Russian letters not given here]

Key:

кл) key
ПлО) relay
кО) relay
чп) pulse rate
МОД) minute volume
ОиР) relay
ДР) relay

Instructions to subjects: "Your task is to work with both the right and left hands together. With the right hand, you will try to hold the hand of the instrument (milliammeter) in the specified sector by means of a handle. If the pointer goes beyond the boundary of the sector there will be an audio signal indicating that you did not adequately prevent the unbalance of the instrument needle. Near the needle indicator, you see a round screen, which will periodically light up in one of three colors, red, green or white. Your task is to extinguish this screen correctly and as rapidly as possible. For this, you must remember the following rule: you extinguish the screen the first time it lights up (regardless of color) only with the left key. Thereafter, you must remember the color that you turned off. When the screen lights up with

the same color as before another time, you turn it off with the right key, but if a new color appears on the screen you depress the left key. In other words, when the color of the screen is the same as the preceding one you extinguish it with the right key, and when it is different you use the left key. Thus, you remember the last color on the screen in order to correctly react to the next one (same or different). The test is done in the form of three repetitions of 2-minute cycles. The procedure will be announced."

The test conditions do not permit preliminary practice.

The display counting device evaluates the following parameters in each of the three cycles of the test: magnitude of mistakes in holding pointer in specified position and number of mistakes over the entire work cycle, for tracking function; overall reaction time and number of incorrect reactions, for operational memory; pulse rate, minute volume and electrodermal conduction, for evaluation of physiological reactions.

It must be stressed that specific and complex test methods must be used for professional psychophysiological screening of some small groups of service-personnel for the most responsible specialties. They include simulators, trainers and other equipment that simulate the most responsible phases or work as a whole of specific specialists. A description of these methods can be found in the relevant instructions and methodological descriptions.

39. Conversations

Conversations are held after a group psychophysiological examination, and they pursue the following objectives: to supplement or define the results of the subjects' psychophysiological tests; to gain information as to the possibility of compensation of some traits contained in the structure, aptitude for learning at the expense of other traits, properties, abilities, etc. (for example, skills in handling and inclinations for working with equipment may compensate for inadequate comprehension and quick-wittedness in learning simple technical specialties); to gain information that would permit prediction of combat performance under extreme conditions: emotional and volitional personality traits, endurance of high and low temperatures, endurance of solitude, etc.; to gain data characterizing the main properties of nervous activity and some characterological traits.

In order to avoid receiving answers known to be false, one must limit the number of questions aimed directly at evaluating the degree of development of some trait and give preference to obtaining indirect information. In other words, the questions should be directed toward eliciting behavioral distinctions under various vital circumstances, while the evaluation of degree and distinctions of manifestation of some traits or other in such behavior should be made by the psychophysiologist himself [physician]. It is also necessary to take into consideration the environment, in which the subject grew up and the forms of activity that he engaged in (studies, work, sports, etc.).

The physician must not suggest answers to the subject. The success of questioning him depends largely on how contact is established between the physician and subject, which will determine not only the seriousness but extremely necessary frankness of the subject's answers. Much depends on tactfulness of the interlocutors, their ability to establish mutual trust.

It is best to question the subject according to a plan, but it should not be interpreted as a questionnaire, to each question of which it is mandatory to obtain an answer; the items on the plan merely indicate the direction of the talk. The conversation should be directed in a free form, even though the psychophysiologist must adhere to a certain plan.

The thoroughness and duration of the talk are determined by the objectives of the examination (occupational screening or vocational guidance), nature of requirements due to the specifics of future work made of the candidate, as well as the time that the psychophysiologist-physician can spend on it.

We submit below a list of questions, to which answers must be obtained in the course of a conversation:

1. Surname, name, patronymic, year of birth, nationality, permanent and most recent place of residence.

2. Occupation of parents, composition of family, financial status and cultural level of the family.

3. Education--where and how he studied; favorite subjects, participation in circles; were there instances of significant infractions of discipline, conflicts with teachers and comrades; when there was best manifestation of his knowledge: at tests or in the course of current quizzes in class.

4. Work--specialty, qualifications, where he worked and in what capacity, work achievements; work schedule and applicability thereof; were there instances of infraction of work discipline, conflicts with management or fellow workers, the nature of these conflicts; how does the subject usually work, rapidly or slowly, does he always work at an even pace; can he easily switch from one type of work (studies) to another, or is such a switchover made with difficulty; does he manifest initiative, creativity in his work, or does he prefer to work following the established example.

5. Involvement in sports--type of sport, qualifications, how he strived for optimum results; when did he demonstrate the best results--at training sessions, simulated [pretend] contests or important competitions; what was his usual condition before starting such activities: combat readiness, "start fever," start apathy; how he reacts to defeat.

6. Involvement in public work--degree of willingness, nature of public services performed and how he coped with them.

7. Hobbies, interests, inclinations (other than sports), what they are, how strong they are and what results are achieved.

8. How he spends his free time and vacations.

9. Level of general development and education--familiary with literary works, is he well-informed on technical matters, events in sociopolitical life, etc.

10. Everday behavioral distinctions--does he have many friends, what does he have in common with them; what is his prevailing mood (high, calm or low, even or are there frequent changes of mood); how does he behave in an anticipation situation (is he calm, does he display impatience, does he become very irritable), or when there are many people around; has he had to overcome obstacles to reach a set goal, did he cope with them, how he behaved in dangerous and difficult situations.

11. How does he tolerate heat, cold, intensive muscular and mental loads, noise, solitude, etc.

12. Attitude toward being in the service in general and in this type of corps in particular; is he interested in any specific military specialty, what motivates it.

13. Evaluation by the subject of his achievements in group experiments (which were the most difficult tasks and why).

Interpretation and systematization of the answers implies that the experimenter has adequate psychophysiological qualifications, he has good knowledge of behavioral traits that express different aspects and personality traits, and he is familiar with the main systems of questionnaires.

In the course of the talk while observing the subject, the experimenter gains additional information characterizing the level of contact, sociability, sincerity, emotional lability, comprehension and other traits. The main sources of such information are the facial [mimic], pantomimic and particularly verbal reactions (speed and intensity, pace, rhythm, cohesion and detail of information, intonation, vocabulary, etc.).

The data obtained from this questioning are important elements in the examination of subjects, and they could be a valuable aid in determining the individual neuropsychological distinctions. In arriving at conclusions, the examiner must carefully take into consideration the aggregate of all data, compare the results of the questioning to psychophysiological tests.

The findings of the conversation should be entered in a special log (talk log), where a general conclusion must be made as to the degree of conformity of the data obtained from the talk with the requirements made of the candidate with respect to specifics of training and work in operator specialties.

Special questionnaires and interrogation forms [6, 17] may be used to evaluate the properties of the nervous system. We submit below one of the variants of a questionnaire to assess the properties of the nervous system and some character traits.

Questionnaire for Evaluation of Nervous System Properties and Some Characterological Traits of Man

List of questions to assess strength of nervous system with reference to excitation

(When scoring the degree of manifestation of this trait, one proceeds from the fact that 7-10 points refer to a high degree, 4-6 average and 0-3 low).

1. Could you say that you are a self-confident person? (1 point for a "yes" answer).

2. Could one say that you are not afraid to criticize publicly comrades and management? (2 for a "yes" answer).

3. Do you like to take chances? (for example, when playing chess, cards, in sports? (1 for a "yes" answer).

4. Do you usually try to be among the first to give answers in class? ("1 for a "yes" answer).

5. Are you hindered in everyday life and sports by the fear of failure, fear of making a mistake, doing something wrong? (1 for a "no" answer).

6. Is it true that you usually perform better on tests than in the course of your studies (or vice versa)? (1 for a "no" answer).

7. Is it true that you usually perform better at sports competitions than at training sessions? (1 for a "yes" answer).

8. Is it true that you can continue to work well in the presence of noise or, in general, when there is some disturbance? (1 for a "yes" answer).

List of questions to assess strength of the nervous system with reference to inhibition

(In scoring the degree of manifestation of this trait, one proceeds from the fact that a score of 7-10 refers to a high degree, 4-6 average and 0-3 low).

1. Is it true that you like to act deliberately, giving thorough thought to all circumstances? (1 for a "yes" answer).

2. Do you sleep deeply, do you often sleep without having any dreams? (1 for a "yes" answer).

3. Do you usually wait for something for a rather long time without any particular tension (for example, when standing in line)? (2 for a "yes" answer).

4. Do you usually show no particular irritation when you spend a long time untangling a ball of yarn, removing a snarl in a fishing line, untying a tight and complicated knot, etc.? (2 for a "yes" answer).

5. Is it true that you become irritable when you are tired or hungry? (1 for a "no" answer).

6. Is it true that you become very irritated if there are unforeseen obstacles to your intentions? (1 for a "no" answer).

7. Can one say that you are cautious in your expressions (you do not say anything superfluous)? (1 for a "yes" answer).

8. Is it true that you do not like people that are always in a hurry? (1 for a "yes" answer).

List of questions to assess lability of nervous processes

(In scoring the degree of manifestation of this trait, one proceeds from the fact that 7-10 points refer to high lability, 4-6 average and 0-3 low).

1. Would you call yourself resourceful? (1 for a "yes" answer).

2. Do you like activities that require speed of actions, frequent switching from one activity to another? (1 for a "yes" answer).

3. Can you start working rapidly after a break? (1 for a "yes" answer).

4. Do you have many friends, do you quickly get along with new people? (1 for a "yes" answer).

5. Is it true that if you are awakened in the middle of the night it is hard for you to fall asleep again? (1 for a "no" answer).

6. Does it often happen that you are very eager to finish something you have started, in spite of the fact that there is no longer a need for it? (1 for a "no" answer).

7. Is it true that many find your speech rapid or facial expressions animated? (1 for a "yes" answer).

8. Do you adjust to a new situation or start a new job rapidly? (1 for a "yes" answer).

9. Do you like to rearrange your furniture, the situation in your apartment or at work? (1 for a "yes" answer).

10. Is it true that you are very displeased when your rest time or usual pace of activity are disrupted? (1 for a "no" answer).

List of questions for demonstration of equilibrium of emotional reactions (emotional lability)

(In scoring this trait, one proceeds from the following: 6-8 points characterizes high emotional lability, 3-5 average and 0-2 low).

1. Do you often have ups and downs in your mood? (2 for a "yes" answer).

2. Does it often happen that, at the time of a sharp argument or test the pitch of your voice changes visible and high or low tones, which are usually not inherent in your speech, appear? (1 for a "yes" answer).

3. Does it often happen that when you are excited or angry you start to shiver and your speech is not coherent, or you turn pale, or blush markedly? (2 for a "yes" answer).

4. Is it true that it is easy to make you lose your temper? (2 for a "yes" answer).

5. Does it happen that minor, trivial unpleasantness throws you for a loop, hinders your work, but after a certain time, when you calm down, you are yourself surprised at the way you reacted to a triviality? (1 for a "yes" answer).

List of questions characterizing presence of heightened nervousness and psychopathic character traits

(In scoring these traits, one proceeds from the following: 11-21 points characterize extreme psychopathy and nervousness, 8-10 high, 5-7 average and 1-4 low).

1. Is it true that someone is unfair to you in particular too often? (2 for a "yes" answer).

2. Do you start to get nervous and angry when you notice that someone is watching you? (1 for a "yes" answer).

3. Do you have personal enemies? (1 for a "yes" answer).

4. Is it true that you are hard to please? (1 for a "yes" answer)

5. Does it often happen that people around you irritate you and you want to be alone? (1 for a "yes" answer).

6. Do you often feel apathy, indifference to your surroundings and, in general, tired of life? (4 for a "yes" answer).

7. Do you feel that you are a special, strange and misunderstood person? (3 for a "yes" answer).

8. Do you gain the impression that attention is being paid to you more often than to others? (2 for a "yes" answer).

9. Do you get the impression that you are being persecuted, that others want to exasperate you? (4 for a "yes" answer).

10. Do you often have headaches, feel dizzy or experience intestinal disorders because of your emotions? (3 for a "yes" answer).

40. Observation During Psychophysiological Examination

One can gain additional information characterizing the intellect, attentiveness, honesty, discipline, emotional lability, efficiency and a number of other traits by observing the behavior of subjects while they are performing psychophysiological tests.

The practice of psychophysiological examination of large groups has shown that individuals who stand out in a crowd, because they are superior or (what happens more often) inferior, are usually in the field of vision of the observer (experimenter). Since the most obvious [or simplest] objective of the screening is to sift out subjects known to be unsuitable because of their traits, the observer's attention is directed primarily toward detecting such subjects.

I. Elements of subject behavior characterizing inadequate comprehension, quick-wittedness and operational memory

After the instructions are read and explained:

1. The questions are irrelevant, sometimes simply absurd, it is requested that the instructions be repeated again.

2. Amazed expression of the face, shrugging shoulders, expression of confusion.

3. Asking neighbor for explanation, as well as repetition of instructions.

4. Writing down the instructions while the experimenter is giving them.

After the signal to start working is given, one observes a delay in starting, examination of how neighbor is working, prematurely stopping (refusing) work.

II. Elements of behavior characterizing inadequate flexibility of attention

1. Delayed reaction to organizational instructions of experimenter.

2. After being ordered to "Stop" and given instructions to get ready for the next test, subjects continue to work on the preceding one.

III. Signs of unconscientiousness, lack of discipline and negative attitude toward examination

1. Provocative questions, retorts aimed at discrediting the psychophysiological examination.

2. Disregarding experimenter's appeals to come to order and be quiet.

3. Noisy behavior, conversations, elements of clowning.

4. Copying a neighbor's work.

These signs must be recorded as often as they are observed. This makes it possible to subsequently gain an idea about the extent to which the subject has traits, with which the experimenter is concerned, along with a general impression about the subject. The observation findings should be entered in a special log for the group psychophysiological examination, with indication of the [code] numbers of the traits that characterize behavioral distinctions and number of comments made for each category (for example, III_{4-2} means that the subject copied from his neighbor twice while performing the test). The log should also contain the names of individuals who displayed a high degree of comprehension, brightness, discipline and other traits valuable to work in the course of the experimental tests.

Emotional lability and excitability can be evaluated by the external manifestations of emotions, which are convenient to score by the following system.*

*Developed by V. L. Marishchuk.

Evaluation of emotional lability and excitability

Facial expressions	Points
Is calm, no noticeable changes in expression	1 point
Slightly excited, negligible changes of expression (slight movements of the lips, cheeks)	2
Very excited, jaw muscles tightened (lumps in cheeks) or mouth open very wide, unwarranted head movements, twitching of the cheeks, eyelids, biting lips, frequent blinking, etc.	3
Tremor	
No tremor	1
Slight periodic tremor of the hands and feet	2
Severe tremor	3
Constraint	
Calm, gentle, coordinated precise movements	1
Some constraint of movement	2
Severely constrained, abrupt movements, not coordinated, subject sits in obviously uncomfortable position	3
Changes in vascular tonus	
Slight flushing of integument of the face and neck	1
Noticeable flushing	2
Pallor or severe flushing	3
Perspiration	
None or slight	1
Noticeable	2
Profuse	3

The results of observation of manifestations of emotional lability are also entered in the log of the group psychophysiological examination. A conclusion is derived from the findings, and it is entered on the individual Psychophysiological Examination Chart, and taken into consideration along with the findings of the psychophysiological examination and results of conversation in determining the degree of fitness of a candidate for training in operator specialties.

CHAPTER 3. CRITERIA FOR EVALUATING EFFECTIVENESS OF TRAINING AND PROFESSIONAL PERFORMANCE OF SPECIALISTS

In order to determine the prognostic value of tests (their parameters), it is imperative to compare the results of experimental psychophysiological examination of specialists differing in level of practical training or professional qualifications.

The evaluation of level of training or qualification must be based on consideration of objective criteria for assessing the professional effectiveness of specialists.

The general requirements for criteria to evaluate professional effectiveness can be reduced to the following basic tenets or principles.

1. ADEQUACY of criteria, from the standpoint of the purposes of screening and distinctions of professional work. The parameters of professional effectiveness must characterize the work for which one proposes to screen specialists. This may refer to education, i.e., acquisition of some specialty, and then the criterion of learning achievement should reflect the effectiveness of acquiring and retaining knowledge, abilities and skills, speed of learning, etc. It may refer to practical work, in which case one should use the parameters of productivity, accuracy and reliability of performance of work operations in a real work situation.

To determine the prognostic value of different tests, one can also use criteria that characterize the effectiveness of performance of specific work operations, which depend on the state of specific psychophysiological traits in the specialist. For example, to determine the prognostic value of tests of psychomotor function, the criteria of professional effectiveness may be the speed and accuracy of inputting various data into control instruments; one can use the parameters of effectiveness of performing work operations under extreme, accident and other similar conditions as criteria for evaluating emotional stability.

2. OBJECTIVITY of criteria, i.e., predominant use of quantitative parameters of professional effectiveness. The following specific parameters are recommended as objective criteria:

a) statistical data concerning the relative number of instances of removal (firing) from professional work at different stages of training, refinement and performance of work functions; here one could single out in particular those removed for the following reasons: obvious professional unfitness due to lack of required abilities; illness or functional disturbances related to the specific difficulties of a given job (occupational deleterious factors); individual's inadequate attitude toward the occupation he is learning, etc.; in most cases one can combine data referable to different causes for dismissal;

b) parameters characterizing speed and quality of mastering the key elements (stages) of professional training; they may include test or practice [check] professional training exercises, specially developed complex exercises, data on time spent or number of trials necessary to perform the standard assignment, etc.

c) parameters of reliability and stability of performance of professional work under normal and extreme conditions, for example, number of mistakes in work operations; number, frequency and nature of preconditions for emergency situations, etc.

The advantage of objective criteria does not rule out the possibility and, in a number of cases, desirability of subjective evaluations of training and administrative personnel as a general or special criterion.

3. COMPLEXITY of criteria, i.e., the need to use several rating parameters of professional effectiveness, followed by singling out the main criterion or use of a general evaluation.

When gathering evaluation data obtained in the course of current checks, tests and examinations, the experimenter should limit himself to merely recording them. In a number of cases, the current ratings [ongoing, day-to-day ratings] play the role of a "stimulating" factor, i.e., they could be slightly exaggerated or underestimated, as compared to the actual level of knowledge and skill. The nature of the ratings is also determined by the subjective criteria used by the instructor and pedagogic staff, and for this reason it may differ appreciably. Consequently, the experimenter should determine, by conversing with instructors and teachers, the degree of conformity of their ratings with the actual level of professional education of the trainees.

It is also imperative to be rather cautious in the approach to consideration of test ratings, since it is known that they do not always permit full determination of degree of professional training achievement. As a rule, it is not recommended to use these ratings as the only indicators of effectiveness of training. They can only be used when one is sure that all of the examiners have used the same criteria to evaluate the learning achievement of specialists (for which purpose one must give special instructions to examiners in advance).

It is also recommended to use the method of interrogation of instructors and teachers, and to have them fill out special questionnaires in order to evaluate specialist achievement in training. The advantage of this method is that it is possible to obtain quantitative indicators of learning achievement of specialists in different disciplines and the degree of development and state of a number of psychophysiological, characterological and other features, which are the foundation for effective training in a specialty.

We submit below a sample of one of these questionnaires [evaluation records]

Qualification characteristics of professional training of student

1. Surname, name, patronymic
2. Military specialty
3. Year and month of being called up, enrolling in school
4. Year and month of completion of school, educational institution
5. Education prior to military service (indicate whether day or night school was attended)
6. Activity prior to military service (student, worked--and in what special field)
7. Place of birth
8. Place where attended school
9. Rank upon graduating from educational institution, school

It is recommended that all questions and comments be read attentively before filling out the following evaluation record.

Questions	Evaluation
1. Technical knowledge Knowledge of location and functional meaning of displays, control and monitoring instruments, manipulators on control console Knowledge of block diagrams, skeleton diagrams, functional diagrams, key diagrams (must be underlined) of control instruments Knowledge required to determine the nature and causes of possible malfunctions in different units of instruments Knowledge of procedures to eliminate possible malfunctions in instrument units	
2. Knowledge of procedures for practical tasks Knowledge of procedures (scope and order) for performing different work operations (preparing instruments for operation, determination of some indicators to solve problems, etc.) Knowledge of procedures to service instruments when performing typical (most common) practical tasks	

Sample questionnaire (continued)

Questions	Evaluation
3. General rating of theoretical training in the main special disciplines (Evaluation is made on the basis of day-to-day marks, performance of standard assignments, tests, etc.)	
4. Level of theoretical training in special disciplines (mathematics, physics, etc.) acquired in school (determination is made of the extent to which achievement in these disciplines in school assures good assimilation of theoretical knowledge in the specialty)	
5. Skills in working with equipment Ability to perform different operations of work (preparing instruments for operation, turning instruments on, determining some elements of target movement, holding moving object on specified course, etc.) Ability to perform the entire set of operations to solve typical practical problems Ability to independently solve and perform practical problems (not according to standard, previously practiced variants)	
6. General evaluation of performance of practical tasks on simulators	
7. Degree of imperviousness to noise during work--ability to perform practical tasks with the required degree of accuracy and speed in the presence of interference (distracting noise, light signals, commands, etc.)	
8. General evaluation of speed of thinking operations (analysis of data and making decisions when performing practical tasks)	
9. General evaluation of speed of motor operations (speed of data input into instruments, switching tumblers, turning knobs [or wheels], depressing buttons in response to an external signal, etc.)	
10. General evaluation of accuracy, error-free performance of different work operations in solving practical problems [or performing practical tasks]	
11. Degree of emotional instability manifested with occurrence of various difficulties in performing practical tasks (confusion, lack of confidence in behavior and actions; muscular tension, constraint; increased perspiration, flushing or pallor of integument)	

Sample questionnaire (continued)

Questions	Evaluation
12. Interest in work in special field, desire to successfully perform his service obligations, desire to advance special skills	
13. Evaluation of some characterological traits Initiative Performance [execution] Persistence Decisiveness Power of observation Discipline Self-control	
14. General evaluation of assimilation of syllabus for theoretical and practical training in specialty (derived on the basis of analysis of general data on speed of learning the syllabus [program] of special training, presence or absence of any difficulties)	
15. Additional characteristics [references]	

Comments:

1. The references must be written by the immediate superiors, or commanders of the serviceman (instructors on the shift, instructors in professional education, etc.) and teachers. In order to define the essence of psychological terms encountered in the references, it is recommended that one refer to the unit (chast') physicians.

2. The professional qualities of the serviceman should be graded on a 5-point scale with the use of the entire range of scores (from 1 to 5):
   - 5--excellent knowledge fully meeting the requirements; practical skills developed outstandingly, performed without mistakes, rapidly, without infractions, etc.
   - 4--good knowledge, no significant gaps in education, skills are well-developed, performance rather rapid, without substantial mistakes or infractions, etc.
   - 3--satisfactory knowledge, some gaps in knowledge about arrangement and operation of the main instruments, procedures for performing practical tasks; skills are satisfactorily developed, main work operations are not performed with sufficient precision, speed, lack of errors, etc.

2--poor knowledge, scope obviously inadequate for performance of the main work operations; poorly developed practical skills; substantial mistakes are made in work operations, slow performance of work actions, etc.

1--knowledge (skills) very poor, lack of knowledge of main information related to arrangement and operation of instruments, performance of main work operations; main work skills are very poorly developed, do not permit performance of work operations due to large number of mistakes and obvious slowness of reactions, etc.

3. The evaluations in the above record are made only for the professional traits that the serviceman displayed adequately during the training period and which are reflected in the special training program.

4. In addition to the elements listed in the above evaluation record, it may include additional parameters reflecting the degree of professional training; these parameters must also be scored on a 5-point system.

_____ Signature_____
(date) (military rank, surname, name patronymic)

We can recommend work tests, i.e., standardized tasks that are elements or sets (units) of elements of actual work operations, as one of the procedures for evaluating some features of practical training level.

The work tests are one of the variants of check (standard) tasks that permit evaluation of the trainee's skill in performing different work operations. The results of the work test, along with other data (evaluations, references, etc.) can be used to determine the general level of professional training. In those cases where the work test is a task, the performance of which puts a load on some psycophysiological function (or group of functions), one can divide the subjects into numbered groups on the basis of its performance, for subsequent determination of the informativeness of specific methods aimed at testing the same function.

The work tests yield comparable results of effectiveness of trainee performance of similar practical tasks, the nature of which is determined by the distinctions of the work process. For this reason, special work tests should be developed for each military profession.

There is a number of work tests that could serve multiple purposes, for example, the "Determination of time and accuracy of reading instruments" test. These tests involve having the subject read the experimental

values of instrument readings with utmost speed and accuracy, and to report them.

As an example, we describe the method developed for one of the navigational installations used on ships. Variants of readings for different instruments are prepared in advance (Table 26).

Table 26. Variants of navigational instrument readings

Variant No	Ship's course I	Speed I	Distance I [or range]	Bearing I	Distance II	Bearing II	Ship's course II	Speed II	Distance III	Bearing III
1	15,0	7,1	135,0	220,5	103,0	297,5	209,0	44,1	134,0	117,0
2	199,5	24,0	66,4	76,5	140,5	80,5	50,0	25,0	58,1	352,5
3	100,0	14,9	52,1	122,0	48,4	130,0	64,0	7,6	74,2	148,5
4	223,0	4,5	102,5	192,5	16,6	256,5	118,0	18,1	27,1	54,0
5	118,5	21,8	55,3	153,0	104,5	81,0	353,0	39,0	95,0	189,0

Before this, determination is also made of accuracy of taking readings; it must conform with the accuracy recommended in establishing the data.

When so ordered by the experimenter, who starts a stopwatch at the same time, the subject turns to face the instrument panel and starts reporting all of the readings shown (for example, "bearing one--one hundred seventy-three," etc.). The experimenter records these reports and then compares them to the data in a check (standard) table. The total time taken to read all displays and relative frequency of mistakes are entered in the log.

CHAPTER 4. MATHEMATICS INVOLVED IN DETERMINING PROFESSIONAL FITNESS

Determination of Informativeness of Testing Methods

The informativeness [prognostic value] of a method is usually determined by means of the coefficient of correlation between the findings with this method and quantitative parameters of efficiency of the work that is to be evaluated [predicted] (learning achievement, work, etc.). However, in a number of cases the correlation approach to determining the informativeness of a method is not very effective, and sometimes simply inconvenient.

In the first place, while quantitative parameters of a method are well-differentiated, another category to be correlated, which characterizes performance, is usually determined by rather rough and undifferentiated evaluations (scores). Statistical studies have shown that, in such cases, estimation of the coefficient of correlation is not very reliable.

In the second place, in cases where there are no strict enough objective criteria of efficiency of performance, the grades themselves are rather subjective characteristics, and for this reason contribute additional unreliability to determination of the coefficient of correlation.

Greater objectivity is obtained when two classes (or groups) are formed from the existing group of specialists, one consisting of those known to be good and the other, to be unquestionably poor operators. Such classes may be few in number (at this stage, one should not in general consider those who are average in training achievement and work performance). Hereafter, we shall refer to the former class with the letter A and the latter, with a B.

Specialists of both classes are tested by means of the method that is being checked. The results constitute two variational series, one of which describes class A and the other, class B. The informativeness of the method is determined by the difference between these series. If they turn out to be statistically indistinguishable, the method being tested generally contains little information to differentiate between the fit and unfit [suitable and unsuitable] , i.e., its informativeness is low. The greater the difference, the higher the informativeness of a method.

One can use different methods to compare the variational series [or set of variables]. In this case, criterion χ^2 is used.

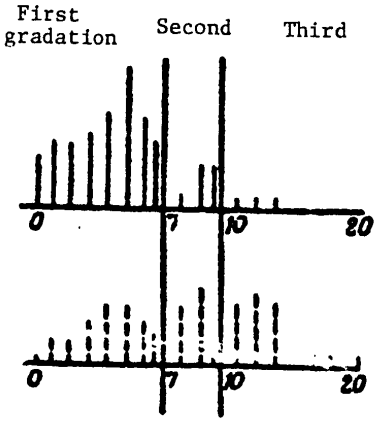


Figure 32.
Histogram of classes A and B

Histograms are plotted from the data obtained for each class (A and B) (Figure 32). The main difficulty here lies in dividing the range of changes into segments (gradations) to plot each column on the histogram. If there are many subjects in the classes, the entire range is divided into equal segments (9-10); if there are few (less than 100), the segments are so chosen as to have maximum differences between classes with respect to frequency of the tag (height of column). One should avoid, as much as possible, extremely sharp differences between probability rations of adjacent limits. For example, if this ratio is 2.450 for one gradation and 0.024 for the next one, it is better to single out a gradation where this ratio is close to 1:1.

There should be at least 5-7 cases referable to both classes for each gradation. It is also desirable for there to be at least one case for any gradation. If there are still many cases of one class in some gradation and zero in another, it would be desirable to replace the 0 with a 1. For example, in the "Ring" test for the class of torpedo electricians, when breaking down the range of values for a tag (time) into gradations, the following frequencies were obtained:

A	6	17	1
B	0	14	5

This distribution was corrected in the following manner:

A	6	17	1
B	1	14	5

When determining gradations with a small number of cases, two types of differences are usually encountered. The first, which is the most common, is a difference in average trends, when two distributions of the same height are shifted in relation to one another. In this case, one can limit oneself to distinction of at least two gradations, in one of which

there will be prevalence of cases referable to class A and in the other, of those referable to class B. True, here too it is useful to single out a third range (intermediate), even though it is limited, where representatives of classes A and B will be encountered with equal frequency.

The second difference is the difference in form of distribution. In this case it is mandatory to single out the average range. Not infrequently, particularly when testing sensorimotor reactions of the same class of individuals, two types of reactions are observed: rise in value of the psychophysiological parameter under study for some of them and drop for others.

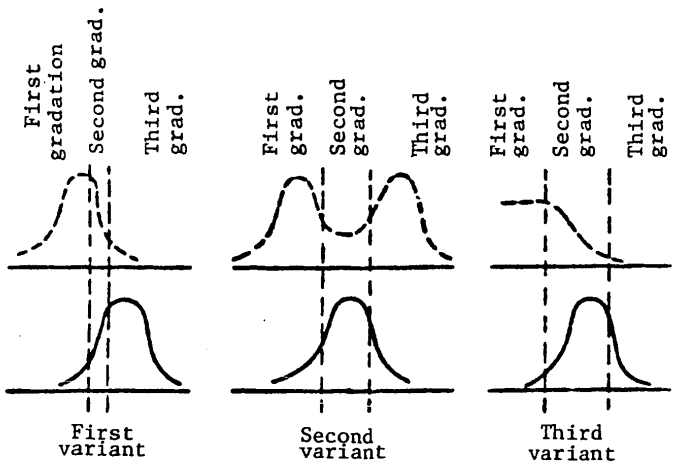


Figure 33. Variants of combinations of distributions

The distribution of this value will have two peaks, most of the cases collecting along the margins of the distribution.

If, for example, in a second distribution (the other class of subjects), most cases are in the middle, the average [middle] gradation will show prevalence of cases referable to one class and the extreme ones, prevalence of the other.

Some of the possible variants of combinations of distributions are illustrated in Figure 33. The choice of number of ranges was made in accordance with the above-mentioned recommendations.

Figure 32 shows two specific distributions. They are the distribution of number of mistakes in the "Compasses" test for classes A and B, respectively.

The subsequent procedure for calculating informativeness will be illustrated with the example of these histograms.

Table 27 lists gradations for the parameter of number of mistakes in the "Compasses" test and corresponding frequencies for each gradation in classes A and B.

Table 27. Distribution of number of mistakes in performing "Compasses" test

Classes		Gradations			Total people in class
		I	II	III	
A	Range of errors	0—7	8—10	>10	57
	Number of people (frequency)	46	7	4	
B	Range of errors	0—7	8—10	>10	46
	Number of people (frequency)	21	9	16	

The formula for calculating χ^2 has the following appearance:

$$\chi^2 = N_A N_B = \left[\sum_{i=1}^{S} \frac{1}{A_i^l + B_i^l}\left(\frac{A_i^l}{N_A^l} - \frac{B_i^l}{N_B^l}\right)^2\right],$$

where N_A, N_B — total number of people in classes A and B;
A_i^l, B_i^l — total number of people in ith gradation;
S — number of gradations

For the distributions shown in Table 27, these parameters will acquire the following values:

$$N_A=57; \quad A_I^I=46; \quad B_I^I=21;$$
$$N_B=46; \quad A_{II}^I=7; \quad B_{II}^I=9;$$
$$S=3; \quad A_{III}^I=4; \quad B_{III}^I=16.$$

Consequently:

$$\chi^2=57\cdot 46\left[\frac{1}{46+21}\left(\frac{46}{57}-\frac{21}{46}\right)^2+\frac{1}{7+9}\left(\frac{7}{57}-\frac{9}{46}\right)^2+\right.$$
$$\left.+\frac{1}{4+16}\left(\frac{4}{57}-\frac{16}{46}\right)^2\right]=13{,}10.$$

The level of relevance of differences for a given parameter is determined on the Tables of Mathematical Statistics.* If the number of gradations is the same with different methods, χ^2 enables us to put them in order of informativeness; if, however, it is different (for at least some tags), χ^2, which is no longer such a good gage, will depend appreciably on f = S-1 (f is the number of degrees of freedom). To overcome this difficulty, we add parameter P--probability that the distributions are different. When calculating probabilities, consideration is given to number of degrees of freedom f, and for this reason one can compare with the use of P the informativeness of different methods.

Probability P is determined from the tables of distribution of χ^2.

Probability P of differences in distribution of a tag for groups being differentiated still does not offer a gage of informativeness, since it depends on the number of cases. If the number of individuals whose data are used to plot the histograms of tags is about the same for all parameters, one can use the above gage of informativeness. If, however, there is a marked difference in number of cases for different parameters, evaluation of informativeness using probability P could lead to erroneous conclusions. In this case, it is recommended that the following variable be used to evaluate informativeness:

$$C=\frac{\chi^2}{N(S-1)}$$

in which the influence of both number of cases N and number of gradations S is ruled out.

However, even a very substantial difference on histograms is a mandatory, but insufficient condition of informativeness of a method. The method will be informative if it is stable and consistent [steady].

*A. V. Bol'shov and N. V. Smirnov, "Tables of Mathematical Statistics," 1966.

Evaluation of consistency of a method requires isolation of a relatively small group of individuals familiar with the principles of the method and running a series of repeated measurements [ratings] on this group. The degree of consistency is determined by the mean coefficient of correlation $\overline{\rho}$. If 5 ratings are made (the repeated ratings can be limited to this number), 10 different coefficients of correlation ρ_1, ρ_2, ..., ρ_{10} between the series of cases will be obtained on different days:

$$\overline{\rho} = \frac{\rho_1+\rho_2+\ldots+\rho_{10}}{10}$$

If $\overline{\rho}<0.7$, the method should be considered unreliable.

Setting Up Evaluation Tables

The data obtained by methods, which were shown to be prognostically informative and independent (see Chapter 2), serve as the basis for setting up evaluation ["diagnostic"] tables.*

For each tag j one calculates diagnostic coefficients (π) using the following formula:

$$\pi_i^j = \lg \frac{A_i^j N_B^j}{N_A^j B_i^j},$$

where A_i^j & B_i^j — are frequencies of appearance of tag j in the ith gradation for classes A and B, respectively

N_A^j & N_B^j — are the numbers of subjects in classes A and B, in whom the tag was measured.

For histograms characterizing the distribution of number of mistakes in the "Compasses" test (see Table 27), the successive stages for calculating the diagnostic coefficients are listed in Table 28.

The construction of such diagnostic coefficients for all informative and independent tests constitutes the diagnostic table, which makes it possible to make a decision as to the fitness of a specific subject for a given job on the basis of the set of psychophysiological traits.

*The modified mathematical method of A. Val'd [3] is the basis for tabulating and using the diagnostic tables.

Table 28. Stages of calculation of diagnostic coefficients

Gradation	Probability for class A	Probability for class B	Probability ratio	Diagnostic coefficients
0—7	$\frac{46}{57} = 0,810$	$\frac{21}{46} = 0,46$	$\frac{0,810}{0,46} = 1,76$	$\lg 1,76 = 0,25$
8—10	$\frac{7}{57} = 0,120$	$\frac{9}{46} = 0,20$	$\frac{0,120}{0,20} = 0,60$	$\lg 0,60 = 1,80 = 0,20$
>10	$\frac{4}{57} = 0,070$	$\frac{16}{46} = 0,35$	$\frac{0,070}{0,35} = 0,20$	$\lg 0,20 = 1,30 = 0,70$

Use of Evaluation Tables (Classification and Projecting Stage)

Use of the "diagnostic" tables is preceded by selection of thresholds, on which depends the probability of erroneously classifying a subject in class A or B.

Two mistakes could be made in classifying: 1) a subject from class A could be put in class B in error, and 2) a subject from class B could be erroneously placed in class A. The first type of classification error is designated by an α and the second, by a β.

The probabilities of errors α and β are determined prior to undertaking classification. In selecting these probabilities, the importance of either classification error must be taken into consideration, as well as the actual situation that arises while performing a given task.

The choice of thresholds is determined by probabilities of classification errors α and β. The threshold as a function of probability is determined using the following formula:

$$\text{Threshold A} = \log \frac{1-\beta}{\alpha}$$

If this threshold is exceeded, it is decided that the subject belongs to class A and, analogously:

$$\text{Threshold B} = \log \frac{\beta}{1-\alpha}$$

When selecting probabilities of α and β (and, consequently, the thresholds), one must take into consideration several practical circumstances.

If the screening is conducted of a small group of individuals and there is a wide choice available to the examiners, the probabilities of errors should be selected at low levels, for example, 0.01 or even 0.001. But when the screening is conducted for referral to training detachments (which was the express purpose of developing the evaluation tables), there is usually not much competition, and therefore the probabilities of errors should not be too low, for example, 0.05 or even 0.1.

When selecting thresholds, one should also take into consideration the importance of the mistakes made. There may be situations in determining professional fitness when it is a more serious mistake to accept a poor specialist than reject a good candidate. This can be taken into consideration by selecting $\alpha > \beta$.

To simplify calculations of thresholds, Table 29 lists the values thereof as a function of magnitude of permissible errors. The values of threshold A are entered in the top right corners and those of threshold B in the bottom left ones.

After selecting the permissible probabilities of classification errors α and β, and having determined from the table the corresponding thresholds, the value of each tag is measured.

Then the diagnostic coefficients corresponding to each of the tag values obtained as a result of the examination are added, until the threshold is reached. If the threshold is reached and too high, with a plus sign, the procedure is stopped and the decision is made that the given subject is referable to class A (fit for a given profession). If a threshold is found with a minus sign, it is decided that the subject belongs in class B. If neither threshold is reached after using all of the available tags, the decision is made that the available information is not sufficient to settle any questions with the specified level of reliability. For some problems, it is desirable to determine 2-3 top thresholds. This makes it possible to single out of a large number of subjects several groups that differ in degree of professional fitness.

Example of working with the table: One needs to determine the degree of fitness of a candidate for training in the specialty of communications system operator.

The diagnostic coefficient must be determined on the basis of preliminary experimental studies for each of the methods used, and all of the values of these coefficients must be tabulated. Thus, to screen communications system operators, one uses a set of 7 methods (9 informative and independent parameters). For each of them a set of diagnostic coefficients is found. Thus, for the cancellation test with rings, if the speed of transfer [carry-over] of information exceeds 1.24 bits per second, the diagnostic coefficient is +0.174; if the carry-over speed is in the range of 1.24 to 1.02 bits per second, the diagnostic coefficient is +0.323, etc.

Table 29. Values for thresholds A and B with different probabilities of classification errors (α and β)

Probability of classification errors β	Probability of classification errors α											
	0.3		0.2		0.1		0.05		0.01	
0.3	−0.37	0.37	−0.50	0.43	−0.80	0.48	−1.16	0.50	−1.80	0.52
0.2	−0.43	0.54	−0.60	0.50	−0.91	0.65	−1.21	0.68	−1.90	0.69
0.1	0.48	0.84	−0.66	0.90	0.95	0.95	−1.25	0.98	−1.96	0.99
0.05	0.50	1.15	−0.68	1.20	−0.98	1.26	−1.28	1.28	−1.98	1.30
0.01	0.52	1.84	−0.70	1.90	−0.99	1.95	−1.30	1.98	−1.99	1.99

Table 30. Values of diagnostic coefficients

Test	Parameter	Parameter gradations and classification coeffic.			
Cancellation test with rings	Rate of information transfer	>1,24*	1,24—1,02	1,01—0,84	<0,84
		+0,174	+0,323	+0,074	—0,357
Addition with switchovers	Output	>150	150—120	119—70	<70
		+0,331	+0,197	—0,031	—0,488
Convoluted lines [maze]	Relative incidence of errors	<0,10	0,10—0,21	0,22—0,51	>0,51
		+0,178	+0,046	—0,252	—0,420
Memory	Number of correctly recalled numbers	>8	8—6	5—4	<4
		+0,468	+0,297	0,142	—0,376
Establishing patterns	Number of errors	<6	6—10	11—15	>15
		+0,431	+0,099	—0,121	—0,386
Quantitative relations	Time spent on test	<230	230—349	350—489	490—570 >570
		+0,279	+0,121	+0,006	—0,113 —0,420
		<225	225—300	>300	
Retrieving numbers with switching of attention	Time spent on test	+0,208	+0,103	—0,425	
		<2	2—6	>6	
Same	Number of errors	+0,212	—0,133	—0,258	
		>0,218	0,218—0,110	<0,140	
"	Time spent on test	+0,316	—0,066	—0,361	

*Parameter gradations given in numerator and diagnostic coefficients in denominator.

The values of diagnostic coefficients for the entire set of methods are listed in Table 30.

Let us assume that candidate K. had the results listed in Table 31, column 3. We find the corresponding diagnostic coefficients for each parameter in Table 30. Their values for our example are listed in column 4 of Table 31.

Table 31. Results of psychophysiological examination of candidate K.

Test	Parameter	Parameter absolute value	Diagnost. coefficient
1	2	3	4
Cancellation test with rings	Rate of information transfer	1.17	+0.323
Addition with switch.	Output	137	+0.197
Convoluted lines [maze]	Relative incidence of errors	0.37	-0.252
Memory	Correctly recalled numbers	8	+0.297
Establishing patterns	Number of errors	14	-0.121
Quantitative relations	Time spent on test	210	+0.279
Retrieving numbers with attention switching	Time spent on test	211	+0.268
Same	Number of errors	1	[illegible]..242
"	Time spent on test	0.237	+0.316
Total....			+1.549

The algebraic sum of diagnostic coefficients is +1.549. By comparing this to the threshold of classification determined from Table 29, which constitutes +1.28 with error probability of 0.05, it can be concluded that this subject is fit for training ("favorable prognosis").

CHAPTER 5. ORGANIZATION OF PSYCHOPHYSIOLOGICAL EXAMINATION

Individuals deemed fit, with regard to physical condition, for training or work in a specific specialty should be submitted to psychophysiological examination for purposes of professional screening.

This examination must be made by specialist-psychologists or engineering psychologists who are well acquainted with requirements that a given specialty imposes on psychophysiological, emotional-volitional and other human traits, and who have the skills required to conduct experimental psychophysiological tests.

The psychophysiological examination can be conducted in group or individual form. In the group experiment, use is made primarily of tests requiring forms, as well as film tests, questionnaires. The individual examination is conducted with the use of instrument and form tests.

The effectiveness of screening depends largely on creating optimum conditions for the test, clearcut definition of the experimenters' duties and other organizational measures.

Preparatory Measures for Examination

Room equipment: Both individual and group examinations should be conducted in a specially equipped room. Preparations consist chiefly of meeting two main conditions: creating optimum hygienic conditions in the rooms and maintaining the desired set in the subjects.

The room, in which experiments are performed, must be rather spacious, with optimum temperature (18-22°C) and humidity. One must be particularly concerned with providing proper light, when conducting form tests and working with colored objects. Excessive or insufficient light leads to eye fatigue and worsens the test results. Illumination of the order of 150-200 lux at the work places is optimum, and it permits discrimination of elements 0.1-0.3 mm in size, with 0.2-0.5 contrast, without strain.

The walls should all be of the same color, preferably warm and light.

Lighting plays a special role in conducting tachistoscopic tests, i.e., when working with an instrument that permits precise graduation of time of delivery of a visual signal to the subject. One must see that the brightness of the pre-exposure field is the same as that of the exposure field, so that elements of dark or light adaptation would not be superimposed on the test results. In addition, there must be a certain contrast and sharpness of outline of exposed objects. Optimum contrast sensitivity is present with brightness of the order of 80 nit.

It is necessary to rule out the possibility of penetration of sudden noises into the room. There must be no objects, instruments or audio signaling devices in the room whose operation could distract the subject's attention. The subject's work place must be comfortable. The subjects should be so seated as not to bother one another when performing tests.

It is imperative to take into consideration a number of requirements referable to the decor of the room to maintain the subject's positive set toward the psychophysiological experiment. There should be tables [desks] of the classroom type in the room, and the items required for the test should be placed on them in advance (forms, instruments, etc.). The desks should be so arranged that the experimenter could approach a subject during the test or observe his behavior from his work place. It is not desirable to have equipment in the room that has no direct bearing on the test, for it could distract the subjects' attention.

Formation of the proper attitude for the experiment: The subjects' attitude toward the experiment, the level of their activity while performing the tests may have a great influence, not only on the course of the test itself, but on its results.

During professional screening, it is the experimenter's task to form a positive attitude in the subjects toward the experiment, i.e., the desire to perform their task with optimum results, in the best way. This desire must be expressed in the form of active and relatively even level of tension throughout the test, and this level of activity should be the same in all subjects participating in the experiment, to the extent this is possible.

There are various procedures for forming and sustaining a positive attitude toward the examination and necessary level of activity. One of the most reliable procedures is the use of natural positive motivation, since a vital goal dictates the need for a positive attitude toward the examination. This involves explanation to the subjects of the significance of test results to settling the question of enrolling them in an educational establishment, assigning them to future positions, etc.

One can obtain a positive attitude toward the experiment in most subjects if the meaning and significance of the tests are explained to them in advance, of course in understandable and convincing form.

Competitive motivation, i.e., the subject's desire to perform the test faster and better than others, is quite important also. However, one should make use of this form of motivation with great caution, and only in very specific situations (for example, when testing emotional excitability of subjects).

The subject's attitude toward the experiment depends largely on the behavior and other personality traits of the experimenter. His confident behavior, even and kind attitude toward the subjects, ability to create a serious and businesslike experimental environment and to react optimally to changes therein--all this aids in creating and sustaining the subjects' positive attitude toward the experiment.

Conducting a Psychophysiological Examination

Creating the appropriate standard background: The concept of standard background refers to standard nature of the surroundings, instructions, type of experiment and interference.

Standard experimental surroundings: This refers chiefly to the external conditions. As a rule, one cannot conduct a psychophysiological examination for screening purposes under the strict conditions of a laboratory, where it is not always possible to maintain the proper lighting and audio background conditions.

Experience has shown that some factors (the room itself, color of walls, uniform extraneous background) have a relatively minor influence on the end results of an experiment, if they do not change from test to test.

The following requirements are absolutely mandatory:

1. There should be no unauthorized [irrelevant] individuals in the room, particularly those who could influence the behavior and set of the subject because of their position. Conversations and unnecessary movement about the room should be forbidden, particularly going in and out of the room.

2. There must be no objects, instruments or audio signaling devices in the room whose operation could distract the subject. If this is not feasible due to existing conditions, one should allow some time for adjustment, habituation of the subjects before the test, during which it should be mentioned that there are some instruments in the room that have no bearing on the test and to which no attention should be paid.

3. There must not be penetration of unexpected, shifting noises that could distract the subjects. In this respect, a steady audio background is less dangerous.

4. Illumination must be stable. Special attention should be given to the location of lamps that should not project a direct beam of light into the subject's eyes or cause appearance of light spots on the equipment.

Standard instructions are a mandatory prerequisite for the test. Negligible changes therein (change in order of phrases or sentence construction) affect the level of subjects' reactions. In this regard, there may be three forms of instructions: direct verbal communication, tape recording and printed forms.

In the direct form of instructions, the experimenter must memorize the instructions exactly, or read them from a printed text. The instructions should be constructed in the form of a report, free of formality, and they must include a detailed plan of action for the subject. In some cases, it is expedient to combine instructions with demonstration of diagrams and examples of performance of actions stipulated in the instructions. In some cases, certain explanatory diagrams are left out during the entire test. For example, in one variant of the "Compasses" test, a diagram illustrating the relationship between compass points is left exposed to the subjects during the test.

The advantage of a tape recording of instructions is that it is strictly standard; however, the lack of direct contact between the experimenter and subject lowers its value.

Printed instructions are used when the test conditions require exclusion of difference in operational memory span of the subjects or when the order and conditions of work are very hard to remember.

Standard format of experiment: The main requirement is to adhere to stability of all physical parameters of the signals that the subject has to work with: size, color, type style, etc., duration of signals, their frequency and amplitude characteristics. This is achieved by the use of standard forms in tests requiring use thereof, standard instruments in instrumentation tests and tape recordings for verbal and audio testing methods.

The intervals between associated stimuli must also be standard, for example, when delivering a pair of audio signals. The intervals between single stimuli should be different (if anticipation time is not the special objective of the study) to rule out formation of a reflex to time.

Standard interference: Many psychophysiological tests are conducted not only to determine the quantitative characteristics of the tested trait or function, but to determine their dynamic range, stability, etc. The use of diverse types of interference is one of the most common procedures. Interference is also used to examine some particular function when there is a great surplus of reactions. For example, in testing speech for intelligibility when a surplus thereof hinders evaluation of a given factor, the use of noise could lower the superfluousness.

Relevant (adequate and inadequate) and irrelevant (adequate and inadequate) interferences are used, depending on the objectives and goals of the test.

Relevant interference is referable, with respect to its physical parameters, to the same class of stimuli as the useful signal used in the test. Thus, any sonic signal is a relevant interference when using audio tests. But if the physical parameters of interference differ from those of the useful signal, such interference is irrelevant.

Adequate interference is interference whose structure coincides with the useful signal. The structure of inadequate interference differs from the structure of the signal.

There are some specific types of interference that are singled out of this classification, since they are special procedures directed at the study of specific traits. We refer to interference used in examining some illusions, interference in the form of performance of some extraneous activity during a test.

When organizing a test, one should define exactly the form of interference, its quantitative characteristics and objectives of using it, since the time and quantitative characteristics of interference must be strictly stable; it is expedient to use some programming device, which automatically starts the interference. In the simplest case, this could be a tape recorder with recorded program, connected through the appropriate relay circuits to the interference generator.

Distinctions of individual testing: All of the preparations for the test must be completed before the subject arrives. One should check whether standard conditions prevail as required for a given series of tests (proper supplies at the work place, absence of extraneous objects, chair position, etc.). The subject should be seated in such a manner as not to see the manipulations performed by the experimenter, and he should be given some time to get used to the situation. Then one holds a brief conversation with him and gives him the instructions. The patient's behavior is observed throughout the test. All of the data are entered in a log. It is also necessary to keep a log when the experimental results are recorded automatically (oscillography or tape recording, electro-mechanical recording, etc.).

In the course of the test, the experimenter makes comments to the subject, if necessary, expresses approval and calls attention to the required test elements.

After the test, one should immediately ask the subject to give a verbal report on how he performed his task, why he acted in a certain way, his opinions, comments and suggestions. All this information is logged and taken into consideration when analyzing the test results.

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Distinctions of group testing: A group test must be particularly well-organized so that there would be no interference related to interaction of individuals in the group. As an example, we shall describe in detail the procedure for a group experiment in the course of screening of candidates for flying school.

The size of the group is 15-20 people, and group testing is performed in the morning. A spacious, soundproof room should be provided for it, with adequate and uniform illumination. There should be no more than two people seated at one desk, and opposite each one a sequential number is attached, so that behavioral distinctions and performance by the subjects can be recorded without asking for names. Before the test, folders with forms must be prepared, instrument operation checked, etc.

After the subjects take their places, the experimenter briefs them on the purpose and procedure of the test. He then gives some general preliminary instructions: "We shall now test your attention, memory, comprehension, ability to work at a fast pace without paying attention to interference and a number of other traits. This examination will enable us to determine the extent to which your personal qualities are suitable for the occupation of .... What is needed to correctly perform all of the tests and receive a good score?"

"First and foremost, you must be very attentive when the task is being described. Every item, every work of the explanation is important. If you are inattentive and miss something, you will not be able to perform everything that is required correctly and rapidly."

"The second factor is to comply with all commands. If you take your pencil, open the folder, start working before being so instructed, or if you continue to work after being instructed to 'Stop,' this will be considered as a flaw in your attention and composure, and it will lower your overall score."

"The third factor is not to turn to your comrades for help. You will not be able to copy anything anyway, since the numbers, words, etc., will be different on your form, or else the speed of working will be such that it will be impossible to copy someone else. And if you do look at a comrade's form, you will lose time yourself and bother him. If there is anything you do not understand, ask me while I am explaining the test. If a question arises while you are working, raise your hand and I or my assistant will come to you right away, we will help you and explain. If your pencil breaks, take the spare one and continue to work in silence. You may not say anything out loud while performing the test."

"Now the folders will be passed out. I repeat, do not open them until so instructed."

A 10-15-min break should be provided every 50-60 min, during which the room is aired.

As each test is started, the experimenter says: "Open your folders and take out the first (second, third, ...) form" (he shows which one). "Write down (do not start until so instructed) your surname, name and patronymic on the line where it is written 'Surname, name, patronymic.' Write down today's date " (reminding them what day it is) "in the right top corner, and the number assigned to your work place in the left top corner. Put down your group number above your surname. Did you understand? Start writing!"

After the subjects have signed the forms, they are asked to turn them face down and close the folders. Then instructions about the test are given, as well as necessary explanations. Questions are solicited. After the experimenter answers the questions, the following instructions must be given: "When ordered to 'Get ready' turn the forms over and take your pencils in your hand. When ordered to 'start' begin to work. When ordered to 'Stop' immediately stop working, turn the forms over and put your pencils down. If someone finishes the test earlier, he should also turn the form over, put his pencil down and sit calmly, in silence."

The experimenter gives the appropriate orders, while the assistant starts the stopwatch. During the test, the behavior (general reaction) of the subjects is observed. Comments are entered in the log concerning individuals who present any marked distinctions (inability to concentrate on the test, manifestation of severe excitement, work is being done very efficiently, calmly, etc.).

Responsibilities of Individuals Conducting Psychophysiological Examinations

In addition to psychophysiologists or engineering psychologists, one can call upon physicians, laboratory technicians and instructors to help the experimenter in group testing, primary processing of examination data and to conduct tests (chiefly individual ones) involving the use of certain methods. In order to participate in the examination, the ancillary personnel must also undergo the appropriate special training.

The size of the group of experimenters is determined on the basis of the objective of the screening, number of tests used, time and other factors.

It is recommended that group testing of groups of 20-25 people be conducted by a psychophysiologist-physician (psychologist) and 2 assistants. The number of experimenters (and assistants) for individual examinations is determined mainly by the number of testing methods used.

The experimenter's duties consist of instructing the subjects, observing them while performing tests, logging the results and giving the necessary orders. For an individual examination, one of the experimenters must have a talk with the subject. The experimenter's responsibilities also

include general supervision of examination data processing (and, if necessary, participation in processing), analysis of examination results and forming conclusions.

The assistants must participate in preparing work places and the room, in which the examination is conducted, in particular, they must prepare the equipment needed for the tests, arrange the tables, air the room, put out the test folders with forms and numbers on the tables, prepare the blackboard, etc. During the examination, the assistants time the tests, prepare the blackboard and ancillary tables that explain the successive tests, they keep order in the room and operate the necessary equipment (tape recorder, slide projector, etc.). Their duties include direct participation in processing examination results, filling out the individual psychophysiological examination charts and rosters of people who have submitted to the examination.

CHAPTER 6. FORMATION OF CONCLUSION

Analysis of the results of the psychophysiological examination and formation of a conclusion as to the fitness of a candidate for training in a given specialty or performance of operator functions in the course of his work constitute one of the most important and difficult stages of this work, which requires much experience, qualifications and attention.

Determination of the professional suitability of a candidate and formation of a conclusion are performed by an experimenter-psychophysiologist (or special commission) on the basis of an integral evaluation of the results of the psychophysiological examination, with the use of the experimentally developed differential diagnostic tables, results of conversations and observation.

Depending on the nature of the external criteria serving as the basis of the developed system of psychophysiological screening, as a result of the examination one predicts either the degree of success (effectiveness) of training a given candidate in a specific specialty, or the quality of his performance of work tasks in a real work situation. In a number of cases, when the appropriate methodological procedures are available and the chosen external criteria are universal to some extent, the adopted screening system can assure rather reliable prediction of both effectiveness of training and work performance.

The quantitative expression of integral parameters of the psychophysiological examination, which characterizes different degrees of professional fitness, as well as the number of gradations of fitness (or unfitness), are determined in accordance with the objectives of the screening, number of people being screened and the needs for certain types of specialists.

In screening practice, the forecasting problem is usually reduced to finding individuals suitable for training or working in a given specialty (positive forecast ["prognosis"]) and those unsuitable for this purpose (negative prognosis). However, there may also be a third group of people whom it is impossible to put in either category due to the specific development of their psychophysiological traits, or flaw or inadequacy of methodological procedures to make a positive or negative prognosis.

Thus, the following conclusions may be derived on the basis of the results of a psychophysiological examination: 1) fitness for training or work in a specific operator specialty; 2) unfitness for training or work in this specialty; and 3) prognosis indeterminate. The individuals with a positive prognosis are recommended for enrollment in an educational institution or assignment to work in a specific specialty, and those with a negative prognosis are not recommended.

With regard to individuals with an indeterminate prognosis, the following decision is made: 1) they can undergo an additional psychophysiological examination to obtain a definite prognosis; 2) they can be accepted for training if they meet enrollment requirements according to other criteria (general education, physical condition, etc.) and if there is a need to fill the quota of an educational establishment in a given specialty; 3) they may not be accepted in the educational establishment if there are unsatisfactory indicators referable to other criteria, or if the educational establishment has a full complement of individuals with a positive prognosis.

As we have indicated previously, the number of gradations of fitness may vary, depending on a number of factors. Each gradation is limited to a specific range of integral evaluation. For example, when screening for flying school, the candidates are distributed in four, rather than three groups, depending on the results of the psychophysiological examination, with the following scores (on a 9-point scale):

1) the candidate is classified in group I with a score of 6 or higher, and "is to be given maximum preference for enrollment in the shool"
2) with a score of 4.1-5.9--group II, "recommended for enrollment at the shcool"
3) with a score of 3.1-4--group III, "may be accepted in the school only if he has high marks in competition tests"
4) with a score of 3 or less--group IV, "not recommended for enrollment in the school."

When screening candidates for training in operator specialties in teaching detachments of the submarine corps, the conclusion derived from the results of psychophysiological examination is submitted in the following form:

Group I (diagnostic coefficient +1.279)--"fit for training in operator specialties (senory or sensorimotor specialties, torpedo electrician, hydroacoustics engineer, and others)"; favorable prognosis according to psychophysiological scores.

Group II (diagnostic coefficient of +0.954 to +1.278)--"conditionally fit for training in operator specialties"; conditionally favorable prognosis.

Group III (diagnostic coefficient +0.953 to -1.278)--indeterminate prognosis.

Group IV (diagnostic coefficient -1.279)--"unfit for training in operator specialties"; unfavorable prognosis according to psychophysiological findings.

When settling the question of disposition of graduates from an educational establishment or assignment to specific posts (to work in a specific control system), the results of the psychophysiological examination are also written up in the form of conclusion as to degree of fitness. The form of the conclusion may be analogous to those indicated above. Of course, the criteria (integral evaluations) for determining the degree of fitness, as well as the number of gradations of fitness (number of fitness-unfitness groups) may vary in each specific case, i.e., for specific conditions and specialties.

The results of the psychophysiological examination are written up in the form of two documents: the individual psychophysiological examination chart and roster of individuals examined, with a conclusion as to group fitness group.

The results of the different psychophysiological tests (absolute findings), scores for each test, integral evaluation, conclusions based on the results of conversation, conclusions based on results of observation, conclusion as to the candidate's fitness group, comment (reason for conclusion when fitness group is changed, comments about different psychophysiological traits, about the need to evaluate them additionally, training [practice], etc.) are entered on the individual psychophysiological examination chart.

The roster of examined candidates indicates the fitness group. This roster is signed by the psychophysiologist-experimenter, and it is submitted to the admissions commission of the educational establishment or to the commission for disposition of specialists.

* * *

The data we have submitted in this Handbook reflect the current views of researchers on development of a system of psychophysiological screening of military specialists as a set of measures having the goal to ultimately define the methodological procedures and criteria for evaluating physiological and psychological functions that are of professional importance to specific types of work [activity]. The logical structure of these measures makes it necessary to solve the following problems:

1. Determination of the desirability of developing screening systems for specific specialties or groups of specialties.

2. Clearcut definition of the objectives of specific psychophysiological screening: forecasting fitness for training, practical work under actual conditions, work under extreme conditions, etc.

3. Physiological, hygienic and psychophysiological examination of the distinctions of work and analysis of the work process in order to define the professional requirements of candidates who are to be trained in a concrete specialty.

4. Selection and development of methodological procedures to evaluate professionally important personality traits (depending on the objectives of screening, stage thereof and nature of work).

5. Experimental study of the prognostic value (informativeness), reliability and differentiation of the methodological procedures used in the psychophysiological examination; development of criteria to evaluate the professional effectiveness of specialists.

6. Development of criteria to evaluate the personality traits that are professionally important.

7. Experimental verification of the developed criteria for predicting professional fitness of specialists.

8. Determination of the organizational and methodological format of psychophysiological screening of military specialists.

These problems can be resolved in practice on the basis of the methodological procedures described in this Handbook.

The choice of a specific set of methods for developing the system of psychophysiological screening must be made in accordance with the distinctions of training and work of specific military specialists. However, this does not preclude the use (and in some cases such use is mandatory) of additional methodological procedures for this purpose, which are not described in this Handbook, which have been developed as a result of research in the area of psychophysiological (psychological) screening of military specialists.

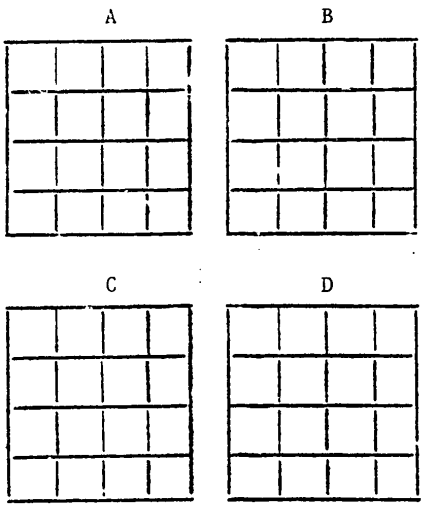
APPENDIX

Psychophysiological Examination Chart No _____

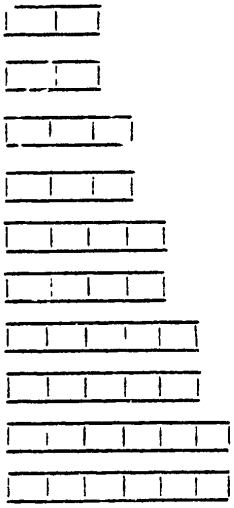
Surname, name, patronymic _____ Subunit (podrazdeleniye)_____

_____ Date _____

1. Visual memory



2. Operational memory



3. Retrieving numbers (test No 1, form No 1). Cross out missing numbers.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	
28	29	30	31	32	33	34	35	36	37	38	39	40	

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4. Retrieving numbers (test No 2, form No 2). Cross out missing numbers.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26		
27	28	29	30	31	32	33	34	35	36	37	38		
39	40	41	42	43	44	45	46	47	48	49	50		
51	52	53	54	55	56	57	58	59	60	61	62		
63	64	65	66	67	68	69	70						

5. Blocks. Write down in the appropriate boxes how many blocks are missing to make up a complete cube (count only the blocks that you see).

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

6. Retrieving numbers with switching of attention. Write down in the boxes the letters corresponding to the sought digits

	A								
1	24								
6	19								
11	14								
16	9								
21	4								

B

1	24								
6	19								
11	14								
16	9								
21	4								

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