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BIOMEDICAL AND BEHAVIORAL SCIENCES

(FOUO 17/81)

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HUMAN FACTORS

SUBSTANTIATING PROCEDURE FOR INVESTIGATING INDIVIDUAL DECISION MAKING CHARACTERISTICS IN CONFLICT SITUATIONS

Moscow VOPROSY PSIKHOLOGII in Russian No 4, Jul-Aug 81 pp 127-131

/Article by A. N. Kovalev/

/Text/ It is well known that at the present stage of the scientific and technical revolution mankind's power and technical equipment greatly exceeds its capacity for making prompt and substantiated decisions /7/. The use of mathematical methods and modern computer hardware in the problems of man's decision making in various, including conflict, situations is a promising way of eliminating this disproportion. The appearance of the mathematical game theory, which studies formal decision making models under conflict conditions, was a natural stage in the development of investigations in this area.

The limiting possibilities of this theory are clearly outlined /1/. One of its limitations is the fact that, when the real behavior of people carrying out their activity in accordance with the infinite diversity of their needs is modeled within the framework of the game theory, the psychological rules of this activity are either ignored completely, or are taken into account in a generalized manner, on the average, whereas the "application of general psychological rules to life should always be mediated by the knowledge of individual differences" /12/. On the other hand, psychology, which has long included decision making problems in the sphere of its interests, cannot bypass the positive experience accumulated with the formal-logical approach to the investigation of decision making processes in conflict situations, in particular with the use of computers for the solution of various problems pertaining to this area. At the same time, it is appropriate to note that an active involvement of computers in the process of man's decision making, along with expanding his intellectual capabilities, at times leads to certain changes in the "style" of human thinking by including in its structure operations, the possibility for the performance of which is offered to man by computers, because "not the determining tendency, that is, goal (beginning and end), determines the entire course and structure of the process, but the average moment. The properties of the tool are the functional center and they determine the entire course of processes, their change and so forth. The entire specificity of behavior is determined by the average member of the instrumental act" /2/.

On the basis of the expressed view, turning directly to the problem of development of a procedure for an experimental investigation of individual decision making characteristics in conflict situations and, at the same time, taking into account

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the significant potentials of games in the modeling of such situations, as well as the role and possible functions of computers in their resolution, we considered it advisable to include a computer in the experiment, formulating it in the form of a game between man and computer. The introduction of a computer into an experimental situation makes it possible to solve a number of diverse problems, whose concretization depends on the goals and conditions of the experiment. By means of it it is possible to create a "problem environment" imitating conflict conditions. It can act in the role of man's assistant and opponent and makes it possible directly in the course of the experiment to immediately change its conditions depending on the results and to vary the methods of training the tested individual (in "adviser" and "instructor" modes) and the computer's "strength of the game" (in the "opponent" mode) and so forth.

The inclusion of a computer in the experiment also makes it possible to solve the problem of an objective recording of the characteristics of behavior of the tested individuals during the game for the purpose of detecting their individual characteristics in the subsequent analysis. The package of applied computer programs (the Alisa automated logical game system) designed for games between man and computer, which was especially developed at the laboratory for mathematical modeling of mental processes of the Scientific Research Institute of General and Pedagogical Psychology of the USSR Academy of Pedagogical Sciences, includes a dossier system for every tested individual, where objective data on the tested individual, the moves and answers of the tested individual and the computer, the time spent on thinking them out and the elements of the dialog between man and computer are recorded. At present work is done on the further expansion of the capabilities of the Alisa system. Its organization envisages the extraction of information from the computer memory in various combinations and print-out for a subsequent analysis of the data files unified according to the criteria of interest to the experimenter--methods of the game, its time parameters, the type of thinking of tested individuals, their age, sex and education and so forth.

Since a game always represents a conflict of personalities and antagonism between characters, the selection of a computer as man's game partner also has the advantage that it makes it possible to fix at a permanent level the characteristics of one "personality" (computer) for the purpose of creating the same experimental conditions for all tested individuals, at the same time, giving the experimenter wide possibilities of varying these characteristics in accordance with the specific purposes of the experiment.

The selection of a computer as a tool of investigation was only the first step in the development of the procedure of interest to us. The next step consisted in the solution of certain individual problems, that is:

1) selection of specific models of conflict situations (games) most suitable for the investigation and recording of individual decision making characteristics;

2) performance of preliminary experiments for the purpose of determining the possibilities of the procedure for detecting the characteristic features manifested by various tested individuals in the course of the game;

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3) preliminary classification of individual characteristics according to the stages of a conflict activity.

The results of the solution of the indicated problems are briefly presented below.

1) When selecting games, we tried to reflect the following characteristic features in the model of a conflict situation:

a) its specific duration and the need to establish a sequence of specific operations (perhaps even one-type operations) for its resolution;

b) changeability of the situation in the process of its resolution and the need to take into account the results of previously performed actions;

c) the need for decision making under conditions of uncertainty in combination with the possibility of applying logical actions for reducing it;

d) a sufficient diversity of final situations denoting a victory in this conflict;

e) a sufficient diversity of ways of attaining a victory and their nonequivalence.

f) the possibility of attaining a victory at any stage of the conflict, including the initial stage.

Furthermore, the following condition was made: The game should minimally affect the specific habits or professional experience of the tested individuals.

As a result of an analysis of various games, three out of the set of variants of the logical game "Symbols" representing modifications of the Master-mind game known in our country by the name "Bulls and Cows" were selected as the first model of a conflict situation meeting the enumerated requirements /3/. In general form the "Symbols" game can be described as follows. A set containing n various elements (figures, letters, symbols, concepts and so forth) is announced to both participants in the game ("opponents"). Each participant secretely from the other must make from them an ordered sequence containing m elements (in general there are no constraints on n and m). The task of the participants is to determine the sequence thought of by the opponent in a minimum number of moves. The moves are made in turns. Each move consists of the "trial" of one participant and the "answer" that another participant gives to this "trial." Any ordered sequence of m symbols forming part of the announced set of n elements selected by the participant in the game is a "trial." Two numbers are the "answer." The first (number of "bulls") is equal to the number of elements of the "trial," which in the held place and type coincide with the elements of the sequence thought of and the second (number of "cows") is equal to the number of elements of the "trial" forming part of the sequence thought of, but not coinciding with them in place. The participant who first got the answer--m "bulls," zero "cows"--is considered the winner. The "Symbols" game is finite. However, the number of personal moves (strategies) in it is $C=n^m$, which offers the experimenter wide possibilities of varying the conditions of the game for the purpose of disclosing the characteristics of behavior of the tested individual in the range from the finite to infinite game, which the "Symbols" game seems to man with a growth of m and n.

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In the first two selected variants of the game figures served as elements of the announced set: for the first variant $n_1=5$, for the second variant $n_2=10$ and for both variants $m=5$. A repetition of the same figures in the number thought of was prohibited and the use of zero in a high order was permitted. In such form the selected variants of the "Symbols" game maximally approximated the "Bulls and Cows" game. It can be easily seen that the probability P_1 of accidentally guessing the number thought of during the first move for the first variant is inverse to the number of permutations of 5 elements, that is, $P_1=1/5!=1/120$. For the second variant this probability is inverse to the number of permutations of 10 elements taken 5 at a time, that is, $P_1=1/A^5_{10}=1/30240$. There are rules making it possible to sharply increase (up to a unit) the probability of accidentally guessing the number thought of with the subsequent move. However, as the experiment showed, no tested individual used these rules, even when they were explained to him by the experimenter. The tested individuals tried to reduce the uncertainty of the situation in another way, using various methods, in which logical steps and intuitive guesses were combined.

The inclusion of a computer in the experiment also made it possible to realize a third variant of the "Symbols" game, in which at the beginning of the game the computer does not at all "think of" a specific sequence of symbols, but gives the tested individual, according to a program previously fixed by the experimenter in the form of answers, instructions for specific subsets of the set of answers possible with the given trials of the tested individual. This means that for any sequence of trials of various tested individuals the sequence of answers O_i for each of them will appear the same (for example: $O_1=02$; $O_2=02$; $O_3=02$; $O_4=21$; $O_5=21$; $O_6=50$. Here the first figure of the answer means the number of "bulls" and the second, the number of "cows"), which creates the same initial situation for all the tested individuals and provides especially "pure" experimental conditions for a comparative study of the game strategies used by man. It is appropriate to note that, in practice, the realization of such a game variant without the help of a computer is impossible.

2. A total of 49 tested individuals aged 17 to 53 participated in the preliminary experiments. A total of 145 records characterizing the game process of the tested individuals in six experimental series devoted to various aspects of the investigation were obtained. The detection of the methods and techniques of the game used by the tested individuals was the main problem in the first series (25 experiments with 12 tested individuals), which was preliminary and was conducted without the participation of a computer. The same problem (incidentally) was solved in the remaining five series, but against the background of other goals. Three series were devoted to a clarification of the characteristics of the process of the game in its above-mentioned three variants, one series was a control series (two tested individuals with different types of thinking, five sets with each) and the sixth series was devoted to an attempt to correct in individual tested people the errors characteristic of them and to form in them elements of the theoretical type of thinking. In this section we will dwell only on a brief description of the characteristic methods and techniques of the game used by the tested individuals, which were disclosed in the experiment.

The number of moves in a set in all the series ranged from 2 to 25. Such a diversity of the "length" of a set was clearly dependent on the methods and techniques of the game used by the tested individuals. The replacement of one

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element (figure) in the next trials of the tested individual was the simplest. This is a reliable method of detecting the unknown set X (number thought of), but, using it, the tested individual arrives at a solution comparatively slowly. The method of replacing several figures in the next trials is "quicker." However, here the tested individual runs the risk of encountering a multialternative hypothesis, but the selection of one alternative without a sufficient basis often leads to a prolongation of the game. The tested individuals using this method can be divided into two groups depending on the time spent on considering a move. An inversion of the figures left in a trial accompanying the replacement is a variant of this technique. The method of constructing the unknown number on the basis of an analysis of as complete a set of hypotheses as possible is considerably different from these techniques of substitution of elements (replacement of figures). Furthermore, a single tested individual, who had extensive experience in the game and was familiar with the machine algorithm of conducting it, demonstrated a method totally uncharacteristic of man and more suitable for realization on a computer, completing the game in 1 hour and 25 minutes with only six moves, making only 38 support records and effectively reducing the sorting of the remaining 30,202 numbers orally on the basis of simple logical considerations.

A stable use of any one method mostly leads to a prolongation of the game, as their alternation leads to its shortening. The use by the tested individuals of some very simple rules of the game also contributes to this. However, not all the tested individuals "discover" them for themselves and, having discovered them, do not always use them.

In fact, the determination of characteristic methods and techniques and the detection of typical errors of the tested individuals represent the preliminary stage in the analysis. The analysis proper begins with the advancement and check of hypotheses on the causes of the observed phenomena, that is, change in methods, appearance of logical errors, domination in the tested individuals of certain characteristics in the process of the game and so forth. Here it is possible to make an attempt to reconstruct the course of reasoning of the tested individual. However, owing to the ambiguity of the causes of a certain action, the results of such attempts are also distinguished by an ambiguity. Hence the need to analyze the experimental material at least at two qualitative levels. The described level of analysis, giving the investigator only the initial material for a classification of the characteristic features manifested by the tested individuals in the course of the game, at the same time, suffers from a lack of principles for its substantiation and explanation.

3. The next, qualitatively new level of analysis is connected with the superposition of distinctive psychological coordinates on a sufficiently variegated picture of the methods and techniques of the game and their combinations and alternation in time. In order to do this, we will first examine some approaches to the solution of the problem forming the basis for the "Symbols" game as illustrated by its modification "Bulls and Cows" with m=5 and n=10, which, basically, was used in our experiment. Any sequence of 5 nonrecurrent figures in accordance with the conditions of the game are in a certain relationship with each of the 30,240 numbers, which can be thought of in its examined variant (we will designate this initial set by the symbol M_0). For example, the sequence 01234 with the number 43,210 is in the relation one "bull," four "cows" (conventionally 14), in the relation 00 with

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the number 56,789 and in the relation 50 with itself. These relations can be considered models of all the possible relations existing between other real objects. Then the finding of the unknown number in this game, in fact, represents the singling out, from the set of objects similar to it, of a certain object, which, as it is investigated, is revealed in ever newer, previously unknown relations. The system of these relations represents an important criterion of the unknown object. To reveal this system till the end means to determine this object. In fact, if the answer $O_1=b_1k_1$ (we will designate this relation with the symbol A_1) is received to the first trial of the tested individual $\Pi_1=a_1b_1c_1d_1e_1$, this will mean that the unknown number enters a certain subset $M_1 \subset M_0$, each element of which is in the relation A_1 with the trial Π_1. Similarly, if $O_2=b_2k_2$ (second relation A_2) is the answer to the second trial $\Pi_2=a_2b_2c_2d_2e_2$, this will mean that the unknown number enters the subset $M_2 \subset M_0$, each element of which is in the relation A_2 with the trial Π_2 and so forth. From this it is possible to determine the optimum way of finding the system of relations $A_1, A_2, \ldots, A_k$ representing the significance test of the unknown number. Having received the answer O_1 to the trial Π_1, it is necessary to determine the subset M_1, after which the trial Π_2 should be selected not arbitrarily, but only from the elements of the subset M_1. Having received the answer O_2, it is necessary to determine the corresponding subset $M_2 \subset M_1$ and the trial Π_3 should be selected only from its elements and so forth. Obviously, with such a method of selection of next trials the power of the subsets $M_1, M_2 \ldots$ will decrease, which ultimately, will lead to the unknown number, to which the system of relations (significance test) $A_1, A_2, \ldots, A_k$ will correspond. This method formed the basis for the algorithm of operation of the computer acting as man's opponent in the game. The experiment showed that the computer most often determined the number thought of by the person in five or six moves (whereas the person did this in 9 or 12 moves, on the average), which, even if indirectly, confirms the optimality of this algorithm (of course, owing to fully understandable reasons, this algorithm is beyond the power of man's "unequipped" intellect. However, its use by means of a computer can serve as one of the examples of the effect of a tool (computer) new for man on the "style" and structure of his thinking activity, which was discussed above).

This is the essence of the first approach to this problem. In our opinion, it reflects the understanding of the totality of trials in a game as a single whole. Viewing the next moves of a game as a series of unconnected problems is quite the opposite to this method. The tested individuals' methods of conducting a game actually observed in the experiment in all their diversity lie between these extreme approaches. With the exception of the above-mentioned single case of a "machine" solution of a problem by a tested individual, we did not observe an "integral" approach to it. At the same time, during the most unsuccesful game by a tested individual he connected at least three or four moves into a single system (apparently, there is no need to demonstrate that the unification of two moves as a minimum in a system is a necessary condition for a nonrandom solution of a problem).

It is easy to perceive a direct relationship between the singled out approaches and the theoretical and empirical types of thinking described in the literature /6/. It is well known that theoretical thinking "is realized by means of a substantive abstraction (singling out by means of an analysis of cognizable phenomena of the relation initial for them) and a substantive generalization (presentation of a number of phenomena as a system on the basis of the necessary connection)" /9/ in contrast to empirical thinking, of which formal abstractions and generalization are

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characteristic. In theoretical thinking a separate phenomenon appears as an element of a certain system of phenomena, which makes it possible to single out the general principle of solution of a problem. In case of the same types of problems this principle makes it possible to solve "on the spot" all similar problems. For the empirical type of thinking even the same types of problems seem relatively independent and new.

A comparison of the two extreme approaches to a problem with characteristic aspects of theoretical and empirical types of thinking, which were described above, determined our selection of the principles of the theory of two types of thinking as the principles of classification of the obtained experimental material and its substantiation and explanation. The correctness of our selection is confirmed by the data in the literature on various approaches to the solution of problems by representatives of the indicated types of thinking in various age groups /5/ and /8/, including those pertaining to one of the versions of the "Bulls and Cows" game with m-4 and n=10 obtained as a result of experiments with senior schoolchildren /4/.

Thus, the use of the experimental method proposed by us, whose basic characteristic is the inclusion of a computer in a game as man's opponent with a subsequent analysis of the data obtained on the basis of the theory of substantive generalization, makes it possible to hope for the detection of individual decision making characteristics in conflict situations and for their explanation with the characteristics of the type of thinking. At the same time, the further trend in research can be determined on the basis of the following considerations.

The detection of the characteristics of thinking of two extreme types (empirical and theoretical) in training and problem solution was the object of many investigations in the area of typology of thinking. Numerous works stress the need for a purposeful formation of the theoretical type of thinking /6/, /11/ and so forth. At the same time, V. V. Davydov also talks about its spontaneous formation, pointing out that it is not formed in everyone and, if it is formed, then with "considerable flaws" /6/. Various thinking defects in adults with their spontaneously formed types of thinking were investigated in a number of works /5/, /10/ and so forth. Our experiments have shown that only a negligible number of tested individuals from the beginning and end of a game follow methods characteristic of the theoretical type of thinking, whereas many of them, along with the use of the basic components of theoretical thinking (analysis, reflection and an internal plan of actions) during some moments of a game, manifest themselves as typical "empiricists." A reverse process was observed in some tested individuals. Beginning a game as "empiricists," they gradually arrived at the elements of theoretical generalization. The totality of these data makes it possible to set the task of investigation of individual characteristics of the "intermediary" type of thinking in conflict situations, in which, in our opinion, a significant number of the tested individuals participating in the experiment should be included, and, along with a study of the conditions of formation of the theoretical type of thinking, to make an attempt to detect the conditions under which its disintegration occurs. Hypothetically, it can include a limitation of the time for a game as a whole and for its every move separately, division of attention, increase in the volume of the material that must be retained in memory at the same time, increase in the objective and subjective difficulty of a problem, subjectively evaluated degree of the opponent's counteraction (his strength) and some other factors. In general

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form the experimental research on this plane can be characterized as the task of determining the level of the type of thinking on the scale "empirical"--"theoretical" and the stability of this level depending on the effect of subjective and objective factors.

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DEPENDENCE OF STRATEGY OF SEARCH FOR DECISION ON TYPE OF THINKING

Moscow VOPROSY PSIKHOLOGII in Russian No 4, Jul-Aug 81 pp 132-136

/Article by V. S. Goncharov/

/Text/ The investigation of the process of a search for a decision is of practical importance from two aspects. On the one hand, the study of the patterns and principles of a search for a decision is generated by the need for optimization of managerial labor, whose proportion in the total volume of occupational activity grows constantly. From this point of view the search problem, which lies in the selection of acceptable or optimal decisions, forms the basis for decision making. In this connection the problems of study of the process of a search for a decision are included in the problems of investigations of decision making /5/ and /7/.

On the other hand, the study of how man searches for a decision is generated by the need for improvement of computer programs. As is well known, a computer search for a decision, as compared with a search made by man, is still less economical. It is connected with the sorting of a large number of variants and alternatives. A clarification of effective principles of a search for a decision in man for the purpose of their realization in machine programs is an important research task.

The process of a search for a decision is characterized by a specific strategy. The strategy represents the form of a search and the method of its organization. Both the strategies of a machine search realized in computer programs and the strategies characterizing a search and decision making in man are now studied intensively /5/, /9/ and /11/.

Clarification of the dependence of the strategy of a search for a decision on the type of thinking is the object of our investigation. The establishment of such a dependence can expand the ideas of the possibilities of the two methods of orientation in reality and demonstrate the advantage of one over the other.

The investigation was conducted in two stages. A diagnosis of the type of thinking according to especially developed methods was made at the first stage. The characteristics of a search for a decision in tested individuals with a different type of thinking were studied by means of the game method at the second stage.

Before turning to a description of the methods diagnosing the type of thinking, we will dwell on some theoretical principles forming the basis for the division of thinking into two types and for the construction of diagnostic methods.

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The teaching of two types of thinking is developed in the works of V. V. Davydov and his associates /2/. V. V. Davydov singles out two types of thinking--empirical and theoretical. Empirical thinking is characterized by the fact that it reflects objects from the aspect of their external manifestations and connections. Empirical thinking represents a "method of obtaining and utilizing sensory data by people possessing the faculty of speech... /2; 266/ and its basic function "lies in the classification of subjects and in the construction of a firm scheme of definitions" /2; 179/. In contrast to empirical, theoretical thinking is considered thinking "reflecting the internal connections of objects and the laws of their movement" /2; 176/. Theoretical thinking has the area of objectively interconnected phenomena forming an integral system as its special content. Theoretical thinking is characterized primarily by a special type of generalization, to which the process of analysis as a specific component of theoretical thinking leads. Theoretical analysis is an "analysis, which, being performed on some one specific event or one problem, at the same time, discloses the internal connection forming the basis for many particular manifestations of this event or this problem. Owing to this, man seemingly "generalizes a certain range of events and problems on the spot" /2; 184/. Generalization through a long comparison of similar facts and their gradual unification into a certain category is characteristic of empirical thinking.

The characteristics of the described types of thinking are clearly revealed durring the solution of a number of the same types of problems. With the theoretical method of solution an analysis of the conditions and requirements of one problem of a certain category makes it possible to disclose the general principle of solution of all the problems of this category and then right away to correctly solve all the remaining problems. With the empirical method man solves each subsequent problem through trials and errors as a relatively new and independent problem.

Three basic components are differentiated in theoretical thinking: analysis, reflection and internal plan of action. A theoretical analysis of the content of a problem represents the process of singling out the principle of the general method of its solution, which then seemingly is transferred to the whole category of such problems "on the spot." Reflection lies in the subject's use of his own method of action and in an examination of the basis for it. An internal plan of action is man's ability to act "mentally," ensuring the planning and performance of actions without the use of external supports.

To detect the presence or absence of an analysis, a series of the same types of problems, from the nature of solution of which it is possible to judge the singling out by the tested individuals of its general principle, was used. The problems were made up according to the principle of increasing difficulty. Anagrams (anagram is a word transformed through a rearrangement of the letters forming it) were selected as problems. The following series of anagrams was offered to the tested individuals:

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1) ЛБКО	4) ЕРАВШН	7) ОКАМДНРИ
2) РАЯИ	5) РКДЕТИ	8) ЛГБУНИАК
3) УПКС	6) АШНРРИ	9) РБКАДОЛЕ

The following problem was given: "According to these anagrams to find the words from which they are formed."

These anagrams were obtained from some words through a place change of two neighboring letters in pairs. If the tested individual solves each such problem as a new one, not singling out the general principle of their structure, this indicates an orientation to their external, unessential criteria. However, if the tested individual discovers this principle during the solution of one or two problems and then immediately and correctly uses it during the solution of all the other problems, this means that he analyzed the first problems and during the solution of the remaining ones leaned on the found initial relation of their condition.

Two methods were devised for the detection of reflection. The first was a modification of the method used by A. Z. Zak /3/. Each of the methods represents three single-type problems, which the tested individual is asked to solve. The problems are made up so that the first and third have a common method of solution. The second problem differs from them in the method of solution. After a successful solution of all the problems the tested individual is asked to classify them. The problems were selected so that they presupposed a classification both according to their external criteria and according to the method of solution. If the tested individual determined that the method of solution of the first and third problems was common and the second differed from it, he made the following classification according to the method of problem solving. Such a classification points to the presence of reflection. Otherwise the classification was made on the basis of the external criteria of the problems, which were detected through a comparison of their conditions. Such a classification shows the absence of reflection.

The first method of detecting reflection was made up from the following problems:

1) АВГДЕКРС_____ГДАВРСЕК (four moves)
2) БНЛЗЖЛУФ_____ЗУПБФЛНЖ (four moves)
3) КБМСОВИР_____МСКБИРОВ (four moves)

At first the tested individual must transform in four moves the initial arrangement of the letters (group of letters arranged in the left part of the sheet) into the final arrangement (group of letters arranged in the right part of the sheet). A mutual rearrangement of two letters so that they change places is a move. Next the tested individual is asked to select one of the following views and to substantiate his selection:

1) All the problems are similar.
2) All the problems are different.
3) The first and second problems are similar.
4) The second and third problems are similar.
5) The second and third problems are similar.

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The second method of disclosing reflection represents the following three problems:

1)	Misha is heavier than Slava Borya is heavier than Misha	Who is the heaviest?
2)	Katya is darker than Vera Vera is darker than Nina	Who is the darkest?
3)	Nadya is more cheerful than Zina Lyuda is more cheerful than Nadya	Who is the most cheerful?

As in the first method, the tested individual at first is asked to solve these problems, answering the questions raised in them. After that the tested individual decides which of the next three views is correct:

1) All the problems are similar.
2) All the problems are different.
3) One problem is different from the other two.

To reveal the level of development of the internal plan of action, a method made up of three problems of increasing difficulty was used. A quick and correct solution of problems of the second and third degree of difficulty can indicate a high level of development of the internal plan of action corresponding to the fourth and fifth level (according to Ya. A. Ponomarev) /6/. However, the solution of the problem of the first degree of difficulty alone points to a low level of development of the internal plan of action corresponding to the third level (according to Ya. A. Ponomarev). In the offered assignments the tested individual is required in a specific number of moves to arrange the letters in the same way as the figures stand, that is, the same letters should be arranged in the squares where the same figures are. A simultaneous mental shift of any two letters is taken as one move.

Students in lower courses of the Moscow Oblast Pedagogical Institute imeni N. K. Krupskaya, students at the Smolensk Pedagogical School and seniors at the school No 10 in the city of Mytishchi (a total of 73 people) participated in the testing of the described methods. The test results showed the suitability of the developed methods for a division of the group of tested individuals into groups depending on the nature of solution of the given problems.

Seniors at Moscow schools and staff members and graduate students at one scientific research institute took part in the basic series. In all 60 people were examined in this series.

According to the results of the examination the tested individuals that participated in it were divided into three groups. Tested individuals who successfully fulfilled the assignments in respect to all the methods and, thus, revealed the presence of analysis, reflection and a developed internal plan of action, made up the first group including 18 people. This group was conventionally called the group of "theoreticians."

Tested individuals that did not fully perform the assignments for analysis and reflection and showed an unstable solution of the assignments for the internal plan of action formed the second group consisting of 32 people. This group received the conventional name of a group of "empiricists."

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The third group of the tested individuals consisting of 10 people included tested individuals who partially solved the given problems. The tested individuals of this group did not reveal a stable analysis or reflection and showed a different degree of formation of the internal plan of action.

For a clarification of the characteristics of the search for a decision in the tested individuals of the three given groups the game method was used. Games of a varying content and game problems are widely used in the investigation of man's thinking activity /8/ and /10/. They create conditions for conducting a search in maximally expanded forms and make it possible to fix its complex time and space dynamics.

The "Bulls and Cows" game was selected for the purpose of our investigation. The game consists in a correct guess by one player of the number thought of by another player with the smallest number of moves. A four-digit number is thought of in such a way that all the figures in it are different. In every move the guessing person names a certain number, which also has four digits and different figures. The partner compares the number he thought of with the one mentioned and reports the number of "bulls" and "cows." A situation when the numbers thought of and mentioned have common figures standing at the same places is called a "bull" in this game. If common figures stand at different places, this is a "cow" /1/.

The experiment was conducted by means of a computer. The computer "thought of" a number and advised the tested individual of the answer to his next move. Communication between the tested individual and the computer was carried out through a special terminal device.

The unknown number in the "Bulls and Cows" game can be represented in the form of an ordered set $M=\{a, b, c, d\}$, which is a subset of the set $N=\{1, 2, 3, 4, 5, 6, 7, 8, 9, 0\}$, $M \subset N$.

For purposes of investigation we decided to confine ourselves to an examination of games with the initial situations 0-1 and 0-2 (0 "bull," 1 "cow" and 0 "bull," 2 "cows"). These initial situations are the most indefinite in the game. The problem of a search for the elements of the set M from these initial situations is most difficult.

As an analysis of the obtained materials showed, substantial and most significant differences in the strategies of a search for a decision in various groups of tested individuals are revealed during the opening of the games. Subsequently, only the characteristics of a search for elements M during the opening, in the first three moves, were examined. This number of moves is sufficient in this game in order to obtain the first unambiguous conclusions on the belonging of specific elements N to the set M. We will confine ourselves to an examination of the search for the elements forming part of M, digressing from a search for the place of these elements in M. The obtained experimental material makes it possible to single out three types of search strategies during the opening of a game.

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Strategy A. A search for elements M is conducted without the establishment of their connection with each other. The relation H=K, where K is the total number of "bulls" and "cows" in response to a given move and H is the number of figures of this move transferred to the next move, is an expression of this strategy. On the whole, the search according to this strategy from the examined initial situations (0-1, 0-2) can be presented in the form of search trees (figures 1 and 2). The values H=K are indicated in the tree nodes.

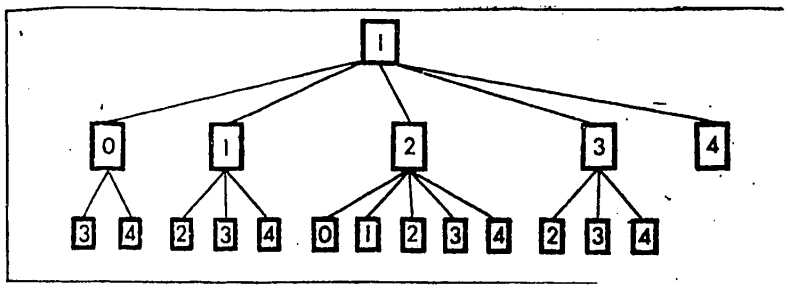

Figure 1

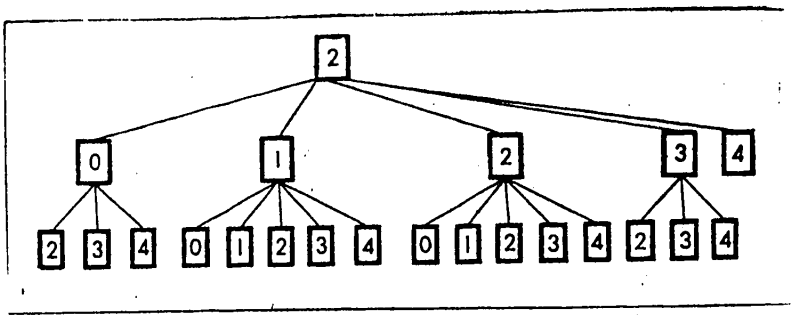

Figure 2

The following excerpts from the records of the experiment with the tested individual T. K. are an example of this strategy:

9541-02	2354-01
1264-01	5610-01
3475-01	7589-02

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Strategy B. A search for the elements of the set M is made through the establishment of a single connection among them. The equality H=3 is the expression of this strategy. The replacement of one element of this move, when the response to the next move is changed, presupposes a clarification of the belonging of both the replaced and replacing element to the unknown set. A strictly disjunctive connection established among these elements is the basis for this strategy. Examples of the described strategy are given in the excerpts from the records of the experiment with the tested individual K. N.

7890-01	9561-02	3456-01
7981-02	3561-02	3457-01
6718-02	4561-01	3458-00

Strategy C. A search for elements is made through the singling out of a system of connections among the elements of the game situation. This strategy is realized during the construction of a third move, if $K_1=K_2$. The establishment of a conjunctive connection between the replaced and replacing elements and a weakly disjunctive connection between these elements and three others forming part of the first and second moves is the basis for this strategy.

The following are examples of this strategy:

Tested individual B. A.	Tested individual D. S.
1234-02	4379-01
2346-11	4378-01
1346-01	4389-01
. . . .	. . . . .

The search strategies during the opening used by various groups of tested individuals are indicated in table 1.

Table 1.

Group of Tested Individuals	Strategy
1 "theoreticians"	B, C
2 "empiricists"	A
3	A, B

As can be seen from the table, the search for a decision in tested individuals who are "theoreticians" is characterized by strategies B and C and in "empiricists" by strategy A. Hence it can be concluded that the search according to strategies B and C requires an analysis and reflection and its performance presupposes a high level of development of the internal plan of action. However, the search characterized by strategy is made without an analysis or reflection and does not require a high level of formation of the internal plan of action. Analysis ensures the performance of a search according to the connections of the elements of game situations. At the same time, analysis most explicit in its own theoretical form is revealed in the realization of strategy C. Here the search is made on the basis of a system of connections constructed by the tested individual who is a "theoretician." Reflection, which is an aspect of theoretical analysis, makes it possible to examine the basis of the actions proper and to find the basis most acceptable under given conditions. Reflection is revealed most clearly during a

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transition from strategy B to strategy C. This transition is characterized by a destruction of the strictly disjunctive connection between the replaced and replacing elements and the construction of a new conjunctive connection between them. The high level of development of the internal plan of action provides for the "theoreticians" the creation of a wide search zone including the entire combination of connections among the elements of the game situation.

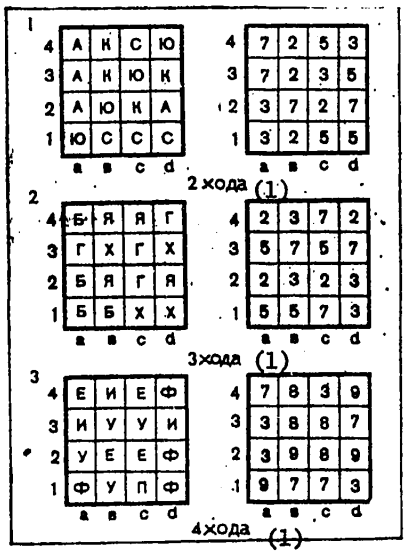

Figure 3

Key:
1. Move

Thus, as a result of the conducted investigation significant differences in the strategies of the search for decisions in tested individuals who manifested a different type of thinking were established. The presence of the basic components of theoretical thinking (analysis, reflection and a high level of the internal plan of action) significantly determines the nature and method of the search for a decision and its strategy.

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PSYCHOPHYSIOLOGICAL DESCRIPTION OF FATIGUE BASED ON ACTIVATION INDICATORS

Moscow VOPROSY PSIKHOLOGII in Russian No 3, May-Jun 81 pp 38-48

[Article by G. A. Stryukov, T. N. Dolgolenko and O. A. Konopkin]

[Text] Concern with the reliability of operators controlling complex technical systems has imparted new importance to a problem that is not at all new--that of diagnosing fatigue in man. Although studies devoted to psychophysiological description of fatigue number in the hundreds each year, the problem remains far from solved, both from the aspect of deep theoretical development and from the aspect of applied use of the obtained results. McFarland believes that "absence of an understanding and of control over what we call fatigue is one of the most confused problems of our life." He also adds that "the term fatigue may be likened to the word subconscious, which has become a convenient category by which to designate phenomena that are not altogether understood but nevertheless real" ((20), p 2).

Were we to analyze studies of fatigue, the first thing we would notice is the unreliability and variability of the "witnesses of fatigue," be they subjective symptoms of tiredness, shifts in work effectiveness or changes in psychophysiological functions (18). There are practically no indicators which would unambiguously signal the onset of fatigue, and at present it is impossible to describe fatigue as a clearly delimited syndrome having a limited set of mutually correlated parameters following specific laws. In reports given at recent all-union conferences on labor physiology (15,16), changes occurring in physiological functions during a work shift which are sometimes diametrically opposed (decrease-increase in pulse, arterial pressure, blood sugar, hormones, electrolytes; depression-exaltation of the α-rhythm, and so on) are nevertheless interpreted by different authors as signs of approaching fatigue. The reason for this is the rather arbitrary interpretation made of recorded changes, using terms implying "decrement of function" (inhibition, blockade, discoordination, stress, weakening, deterioration and so on), which creates the appearance of an explanation of the recorded changes.

Broad introduction of polyfunctional recording, improvement of the technical side of experimentation and introduction of computerized mathematical methods for analyzing experimental data have generated the hope that it is mainly along this road--complicating and refining the data processing methods--that reliable and sufficiently universal criteria of fatigue will be found. However, despite the certain amount of progress that has been enjoyed, this approach has not elevated the problem above empirical inquiry, and it has not led to a qualitative change in diagnosis of fatigue. Assessment of man's state in regard to fatigue symptoms remains within the province of more or less arbitrary interpretation by researchers.

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The idea that it is impossible to assess fatigue on the basis of some one function, that its diagnosis requires an integrated systems approach, is now gaining increasingly greater approval. However, the theoretical side of the question is often limited to too-general, though valid, conclusions appealing for assessment of the state of the body "as a whole," while practical applications of the integrated approach are reduced to attempts at recording as many functions as possible and subjecting them to summational mathematical treatment without any clear, theoretically grounded hypotheses concerning the principles of integrating different functional signs into a single indicator of fatigue. Thus the main accent in the effort to impart psychophysiological objectivity to fatigue is laid on building mathematical models which would "most adequately" synthesize data acquired by numerous measurements. Very great significance is imparted to the search for "the right formula" by which to process the empirical material.

While we do not reject the benefits of such research, we do not think that we can totally ignore pure psychophysiological research in this area and still come up with a satisfactory solution to the problem of assessing fatigue. It would be wrong to assume that the field of labor psychophysiology already possesses dependable methods by which to acquire raw data that simply need to be "correctly" processed in order to reveal stable components within the extremely unstable functional pattern of fatigue. There are few studies in the special literature devoted to the psychometrics of fatigue in the strict sense of this term (4). Most methods used to diagnose fatigue require standardization and testing for reliability and validity (5).

Discussing the physiological mechanisms of fatigue, we should distinguish two groups of phenomena.

On one hand there is the "initial deficit," which arises in the "weakest" link of the functional system and which imparts a certain degree of dissonance to the work of the system as a whole. The question of the functional essence of the initial deficit is at the basis of classical theories of fatigue, and it was the subject of acute debate during the time of initial development of labor psychophysiology (12,14). Contemporary data in physiology and biology support A. A. Ukhtomskiy's conclusion (14) that attempts to formulate a general theory of fatigue based on some universal mechanism of reversible disturbance of a chain of metabolic reactions are unfounded and unpromising. Depending on the individual psychological qualities of the worker and on the concrete working conditions, to include the entire set of occupational, hygienic, social and psychological factors, the particular location of disturbances will vary, and consequently the concrete physiological signs of the "initial deficit" will be different as well, or at least it would be difficult to reduce them to a limited number of classes. Both the pressing theoretical and practical problems of labor psychophysiology require a meticulous effort to compile a "psychophysiological catalog" of fatigue states.

On the other side of the functional pattern of fatigue we observe, concurrently with development of the initial deficit, adaptive alterations in the body aimed at compensating for the arising difficulties.

A typical example of a nonspecific compensatory reaction to the environment's counterhomeostatic influence is Selye's general adaptation syndrome, or the stress reaction, which expresses itself primarily in neuroendocrine alterations in the hypophyseo-adrenocortical system (11). Selye included fatigue among a number of factors

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provoking a stress reaction. The following question naturally arises in this regard: Can we not use the indicators of stress as a universal nonspecific physiological sign of fatigue? Practice fails to confirm such a hypothesis. The physiological pattern of fatigue may manifest itself within the limits of a broad range of functional changes: from typical signs of a stressful state to the typical symptoms of reduced activation and development of inhibitory processes--that is, fatigue cannot be interpreted as a state which automatically and uniquely elicits the general adaptation syndrome.

Nevertheless some authors (19) feel that "true fatigue," being a consequence of highly motivated labor characterized by stringent effectiveness parameters, is always a general stress reaction. According to this point of view signs of a decrease in activation are more a sign of a reluctance to become tired, than an indication of the depth and degree of fatigue.

However, this line of reasoning is far from undebatable, and it does not solve the problem. After all, the "reluctance to become tired" and the decrease in activation ascribed to this state are usually the consequence of work; they are usually a unique protective response to a work load. And there are no grounds for rejecting presence of a relationship between this reaction and fatigue.

Clarifying the question as to when and under what conditions a nonspecific compensatory reaction to fatigue acquires the nature of "negative inhibition" and when it becomes a form of stress (tension) is acquiring fundamentally important significance to general theoretical conceptualization of the fatigue diagnosis problem. Were we to achieve command over these conditions, and were we able to experimentally elicit either the "inhibitory" or the "stressful" manifestation of fatigue, we would have made a significant step forward in our understanding of fatigue, and of the fundamental difficulties associated with diagnosing this state. The very fact that the physiological symptoms of fatigue may be represented by the extreme poles of the scale of activation (inhibition, stress (1)) demonstratively emphasizes these difficulties.

In our opinion the explanation for the instability and uncertainty of functional expression of fatigue by activation parameters lies in the fact that activation level is not an indicator that is uniquely determined by the mechanisms of physiological regulation. But many studies on the psychophysiology of tiring in man implicitly contain the assumption that in a state of fatigue (initial deficit), delicate, intimate changes in intracellular regulation that cannot be detected directly by instruments automatically lead to compensatory change in the overall level of arousal of the central nervous system (the level of activation). To reveal the invariant components of this reaction means to find a universal algorithm of fatigue diagnosis.

The fact that despite the technological power of the modern physiological experiment these invariants cannot be revealed elicits fundamental doubt as to their existence. The fact is that the general physiological pattern of fatigue, in the way that it is represented by activation level indicators, depends not only and not so much on the magnitude and nature of the initial functional deficit, as on how the individual evaluates the situation in which he finds himself, how he interprets his state and relates it to the objectives of his activity, how he perceives and "overcomes" the unpleasant subjective sensations of fatigue, and so on. Thus this pattern reflects diverse, variable and whimsical processes associated with man's self-regulation of his state and activity (6).

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It would hardly be possible to find a single, clearly delimited fatigue syndrome by using, for this purpose, diagnosis of nonspecific activation parameters. Fatigue in the working individual is a state of ambivalent experiences and competing motives: On one hand we have the motives of recovery, self-preservation, reduction of activity, and rest, while on the other hand we have the motives of social responsibility and prestige, and maintenance of activity level, often at the cost of additional mobilization. And depending on the relationship among these motives, on the nature of the task and the subjective significance of the goals the worker pursues, and on his individual features, a highly variable, "conjunctural" pattern of organization of his activity and functional state evolves.

These considerations were the general theoretical background for the experimental study described below. The objective of the experiment was to test the hypothesis that the dynamics of some physiological functions proceeding during tiring mental work depend on factors associated with psychological self-regulation.

The tentative hypothesis was as follows: "Inhibitory" signs of fatigue (that is, signs indicating a decrease in activation level) would reveal themselves when the meaningfulness and objectives of activity are clearly delimited, and when they do not come into conflict with the natural tendency to reduce activity or with the dominant motives of economization of effort during development of fatigue. On the other hand, the "stressful" signs of fatigue (growth in activation level) would manifest themselves in situations where the content and meaning of the task facing the subject encourage him to actively mobilize his resources as the work goes on, in order to satisfy the requirements of his activity.

Methods

The following assignment was chosen as "tiring activity." A series of numbers 1.8 sec apart were played through a tape recorder loudspeaker to a subject in a soundproof room. The series of numbers was taken from a random numbers table, and it contained digits from 0 to 9. Somewhere in this series was the letter "*z*". Its distribution in the series was also random. The minimum interval between two successive letters "*z*" was three numbers, and the maximum was nine. On hearing the letter "*z*" the subject had to write down the third number before "*z*" on a special response sheet (for example on hearing the sequence ...,7, 5, 2, 0, *z*, 6, 5, 9, 2, 4, 8, *z*, 3,..., the subject had to write down the numbers 5 and 2). Thus the task was intended to impose a dynamic load on the working memory (this is a "running memory" model).

The preliminary experiments showed that 4 hours of continuous work resulted in intense mental tiring of the subject, who exhibited the typical symptoms of this state (growth in the number of errors, difficulties in concentration, the desire to stop working). Basing ourselves on these data, we interpreted a 4-hour load as a volume of work which would "guarantee" development of mental fatigue.

The experiments in the main series were performed in two variants. In the first variant the subject worked for a specific length of time. He was told beforehand that the experiment would last 4 hours, and he was able to adapt himself to the temporal dynamics of the experiment. In the second variant the subject worked until "breakdown." The subject had to work diligently until he felt unable to continue the

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work or to maintain the required effectiveness due to extreme fatigue. In this case he had the power to stop the experiment. In reality, however, the experimenters had no intention of working their subjects to the moment of "breakdown": The experiment was halted after 4 hours of continuous work (at which time an "equipment failure" was faked). Thus the actual volume of work done in both variants was the same--4 hours of continuous performance of the experimental assignment. A typical feature of the psychological atmosphere in which the experiments of the second variant were conducted was that the subjects were unable to accurately estimate the time since the experiment started.

All subjects reported intense fatigue after the end of the experiment in both the first and second variant.

An EEG was recorded continuously during the experiment with a Hungarian "Orion" eight-channel encephalograph (with a time constant of 0.3 sec and an amplification ratio of 10 mm/50 μv). Bipolar recordings were made by L. P. Pavlova's technique (10). Wideband filters were used to isolate theta (4-7 Hz) and alpha-rhythms (8-13 Hz) from the total EEG. These rhythms were subjected to integration. The readings of the integrator were recorded in parallel with the EEG recordings. The data of an EKG, recorded concurrently with the EEG, were used to determine pulse rate.

When analyzing the EEG recordings we counted the number of marks made by the integrator's stylus each minute. The number of marks was then averaged over a 30-minute interval. The material was subjected to statistical treatment with an "M-222" computer, and it included calculation of the arithmetic mean, the standard deviation and the error of the arithmetic mean. Confidence intervals were determined at the 95 percent level of significance ($p<0.05$).

Men 20-25 years old served as the subjects. Separate groups of subjects were formed for the first and second series of experiments. Seven persons participated in the first series of experiments (two of them were in an experiment twice). Six persons participated in the second series of experiments (three of them partipated in two experiments). Thus 18 experiments were conducted in all (nine experiments in each series).

Results and Discussion

The number of wrong responses by most subjects increased somewhat toward the end of the experiment in both variants; this may be interpreted as indirect evidence of developing fatigue. In this case the recorded changes in work accuracy do not reach the level of statistical significance, and in general the work quality of all subjects remains high throughout the entire experiment (not more than 10 percent of the possible quantity of errors). No significant differences were revealed between the first and second variants of the experiment in the dynamics of errors.

In terms of the objectives of this study, we are doubtlessly most interested in detailed analysis of the dynamics of physiological indicators. The latter were evaluated from the standpoint of activation theory, which interprets these indicators as ones of the general level of arousal in the central nervous system (1).

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According to the most universally accepted viewpoints on the nature and functional role of the principal EEG rhythms, growth in the power of the alpha-rhythm is an indicator of reduced activation. Although the special literature does contain reports of intensification (exaltation) of the alpha-rhythm in situations of selective attention and general stressing of the organism (22), most researchers tend to view synchronization of the dominant EEG rhythm and growth in its energy as evidence of inhibitory processes, while changes occurring in the opposite direction have been viewed, beginning with Magoun's works (7,21) as indicators of an activation reaction. In our analysis and interpretation of experimental data associated with the alpha-rhythm, we adhered to the commonly accepted conception that arousal of nonspecific subcortical structures (the reticular formation) plays the decisive role in reactions associated with blockade and desynchronization of the alpha-rhythm.

Our present ideas about the genesis and functional significance of the theta-rhythm are not as well defined. This is a rhythm of the profound structures of the brain, being maximally expressed in the hippocampus (2). The theta-rhythm is in the slow-wave portion of the EEG spectrum, which is traditionally associated with inhibitory processes in the central nervous system and with a low level of activation. At the same time, in recent years some authors have interpreted it as an indicator of emotional states, calling it the stress rhythm (3,13).

We interpreted cases of growth in energy of the theta-rhythm as a reflection of a decrease in the general level of activation.

As far as pulse rate is concerned, numerous data argue that this indicator is a sensitive and reliable indicator of the general tone of vital activities; in this case, intensification of hemodynamics (growth in pulse rate) uniquely indicates growth in the activation level.

The basic results of both experimental series are shown in tables 1 and 2. In them, the "plus" and "minus" symbols indicate cases of statistically significant changes in physiological indicators between the 1st and 4th hours of work, with the "minus" symbol standing for changes that may be interpreted as a decline in activation level, and with the "plus" symbol indicating an increase in this level. The "0" symbol indicates statistical insignificance of the recorded changes.

The most typical examples of the dynamics of physiological functions are shown in figures 1 and 2 (examples of decreasing activation are shown in figures 1 and 2 by continuous curves, growing activation is represented by dot-dash curves, and absence of a clearly pronounced dynamic trend is represented by broken curves).

It would not be difficult to note that the overall pattern of functional dynamics is more uniform in the first series than in the second. In the first series ("prescribed duration") the data for all indicators suggest either a decrease in the initial activation level in the course of the experiment (the usual case), or maintenance of that initial level. At the same time in the second series (work "until breakdown") we encounter cases of a distinct increase in activation level toward the end of work.

The complexity and the Achilles heel of the activation conception lie in the fact that the indicators of activation do not always exhibit mutual correlation, which

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Table 1. Change in Physiological Functions in the Dynamics of the Experiment ("Prescribed Duration" Series)

(1) Испытуемые	(2) θ-ритм (усл. ед./мин)			(5) α-ритм (усл. ед./мин)			(6) Частота пульса (уд./мин)		
	(3) 1-й час работы	(4) 4-й час работы		(3) 1-й час работы	(4) 4-й час работы		(3) 1-й час работы	(4) 4-й час работы	
Б-й$_1$	133.0±2.43	159.5±2.85	—	64.6±1.76	74.3±2.73	—	85.9±0.59	65.4±0.51	—
Б-й$_2$	120.9±2.42	136.9±2.67	—	53.1±1.79	55.8±2.02	0	72.6±0.57	60.6±0.53	—
В-в$_1$	113.4±1.81	145.1±2.82	—	173.8±3.32	301.1±14.04	—	99.9±1.05	101.9±0.98	0
В-в$_2$	89.7±1.10	102.2±1.65	—	109.2±3.01	125.8±4.02	—	96.8±0.87	98.3±0.71	0
П-н	78.4±0.98	133.5±6.63	—	67.6±2.55	118.7±4.48	—	77.8±0.34	63.7±0.45	—
К-в	145.0±2.30	154.5±2.29	—	101.1±2.29	172.1±4.13	—	77.1±0.35	70.7±0.37	—
Вл-в	47.6±0.79	66.6±5.73	—	49.1±1.66	43.9±4.41	0	80.1±0.40	66.5±3.76	—
Д-й	76.9±1.20	83.9±2.07	—	72.6±2.21	75.4±2.57	0	76.4±0.41	69.1±0.44	—
Д-в	68.2±1.85	72.5±2.54	0	33.5±1.72	35.1±0.98	0	83.1±0.42	73.0±0.34	—

Notes: 1. Tables 1 and 2 show the arithmetic means of the functions, with ± confidence intervals for evaluation of the averages of the general set, at a probability $p<0.05$ for the null hypothesis. The confidence intervals are equal to double the errors of the sample means. 2. Subscripts 1 and 2 beside the names of the subjects stand for experiments 1 and 2.

Key:

1. Subjects
2. Theta-rhythm (arbitrary units/min)
3. 1st hour of work
4. 4th hour of work
5. Alpha-rhythm (arbitrary units/min)
6. Pulse rate (beats/min)

Table 2. Change in Physiological Functions in the Dynamics of the Experiment ("Until Breakdown" Series)

Испытуемые	θ-ритм (усл. ед./мин)			α-ритм (усл. ед./мин)			Частота пульса (уд./мин)		
	1-й час работы	4-й час работы		1-й час работы	4-й час работы		1-й час работы	4-й час работы	
З-в$_1$	92.3±2.71	88.2±5.6	0	102.2±2.16	125.0±7.0	—	96.0±1.19	76.2±0.68	—
З-в$_2$	109.6±2.26	114.8±3.11	0	93.8±2.01	134.5±3.59	—	93.3±1.14	76.0±0.68	—
И-в$_1$	63.8±1.36	63.8±1.02	0	42.1±0.61	44.6±0.81	—	89.6±0.56	90.1±0.88	0
И-в$_2$	31.3±0.83	28.1±0.35	+	25.5±0.76	23.5±0.49	+	85.6±0.84	81.3±0.84	—
Б-в$_1$	177.7±3.88	164.2±3.39	+	206.9±6.60	177.0±3.83	+	86.8±0.59	92.2±1.2	+
Б-в$_2$	126.3±2.18	115.9±1.74	+	103.3±2.58	107.8±2.22	0	97.8±0.65	104.8±0.86	+
Э-т	115.1±1.14	115.8±1.18	0	79.2±0.81	79.1±0.78	0	69.7±0.52	62.4±0.50	—
С-в	78.5±1.03	89.1±1.12	—	90.8±3.34	42.4±1.65	+	66.2±0.64	58.0±0.66	—
Б-н	56.9±0.83	54.9±0.82	+	58.4±2.05	60.48±2.58	0	85.7±0.34	67.6±0.44	—

Note: See notes [and key] for Table 1.

naturally creates difficulties when we try to evaluate the activation state of the organism "as a whole". We encountered such difficulties in our experiments as well (see Table 1). Discussion of this problem is not within the purpose of our study. We will only note that discoordination of activation indicators revealed itself especially clearly in the second series of experiments.

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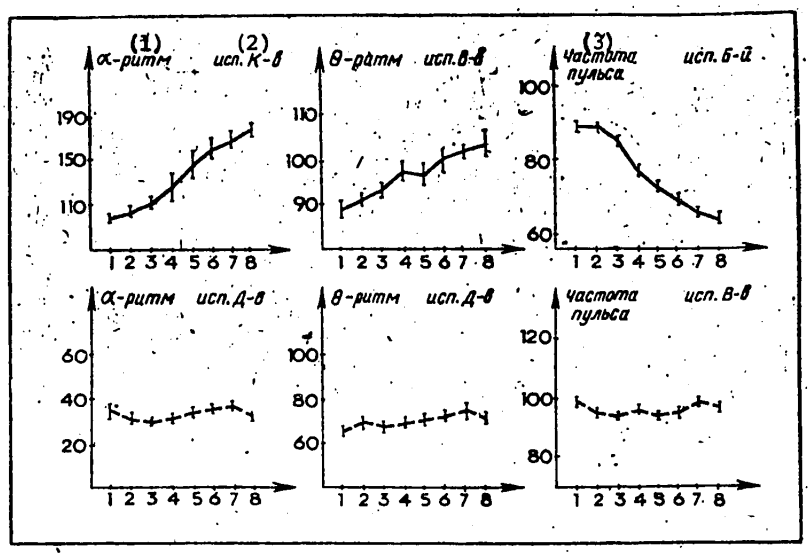

Figure 1. Typical Variants of the Dynamics of Physiological Functions in the First Series of Experiments ("Prescribed Duration")

Key:
1. Rhythm
2. Subject
3. Pulse rate

Increases in activation in the second series of experiments were not a surprise. On the contrary they were programmed by the nature of the experimental assignment. The aim of our experiments was to show that given an identical quality and volume of work, and given mental fatigue of comparable degree, the nature of changes occurring in activation parameters (they are precisely what are used most frequently in practical assessments of functional state) depends very strongly on factors associated with man's psychological self-regulation of his activity. These changes can in principle be diametrically opposite.

The psychological atmosphere of the experiments was planned in such a way that the resulting physiological pattern of fatigue would be "inhibitory" in the first series and "stressful" in the second. (The terms "inhibitory" and "stressful" are conditionally applied to changes in activation in relation to the initial level, irrespective of the absolute value of the physiological indicators. In general, the accent in this study is consciously made on analysis of dynamic trends, and not on the absolute values of the recorded indicators. This is explained by the fact that we do not presently have strictly standardized ideas about activation levels, and any discussions of them usually concern orders of magnitude.)

Our initial ideas can be summarized as follows. We hypothesized that the natural (normotonic) type of functional dynamics reveals itself in the course of tiring mental activity as a decrease in activation level. Two processes are the determinants here.

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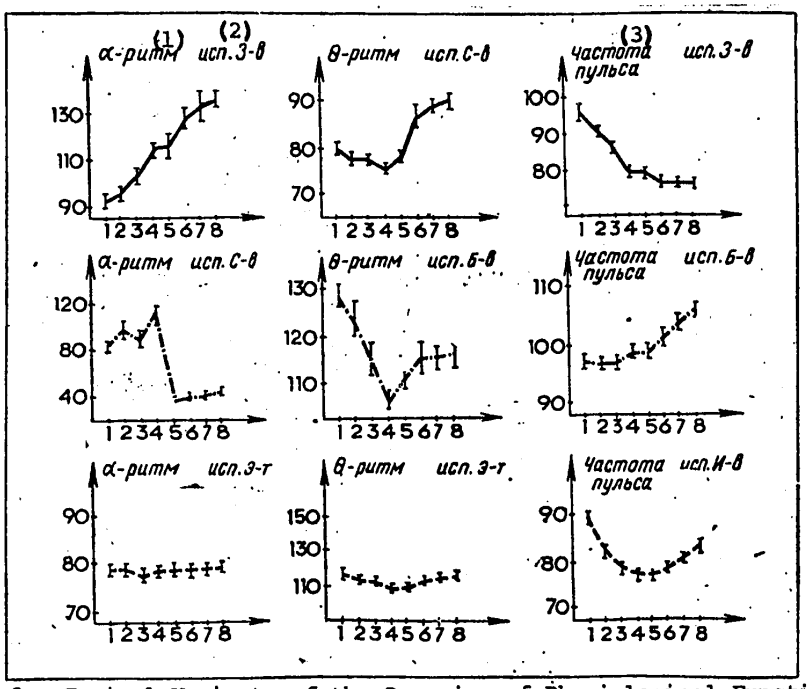

Figure 2. Typical Variants of the Dynamics of Physiological Functions in the Second Series of Experiments ("Work Until Breakdown")

Key:
1. Rhythm
2. Subject
3. Pulse rate

1. As the worker's potential is expended, the functional system responsible for recovery, which has the effect of inhibiting the functional system responsible for work, acquires increasing dominance (9). At the highest psychological level of self-regulation, this is manifested as a general decline in activity, a narrowing of the field of monitored parameters, and concentration of attention exclusively on the dominant, meaningful components of activity. It stands to reason that all of this leads to a certain decline in the reliability of the work; in practice, however, it does not usually manifest itself as obvious defects in activity (growth in the number of errors, inadequate reactions, a decrease in pace, and so on). The fact is that the demands imposed on the working individual in daily, routine work are far from the body's limits.

2. The second process is associated with a phenomenon referred to as "stabilizing retroactiveness" in the work of Wilder and Lacy (see (8)).

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The fact is that a fresh individual who is not tired begins work at a hypercompensatory level of energetic mobilization as a rule (this may be associated with the orientation reaction, with "warming up" for work), and a decrease in activation level as work goes on is evidence of preventive homeostatic actions by the body.

Although both of these processes are automatic to a certain degree, if they are to proceed and if the "inhibitory" pattern of functional dynamics is to manifest itself, the weakening of activity must "fit within" the structure of psychological self-regulation: It must be justified, in the eyes of the subject, as something not contrary to the goals of his activity.

In experiments of the first series we tried to create precisely such conditions (a clearly delimited goal of activity, work effectiveness parameters that yield easily to conscious monitoring, and an average work intensity that is far from maximum). The main goal of the subject was to work for a prescribed amount of time (4 hours). Movement toward this goal is consciously monitored throughout the entire time. In this situation initial mobilization--a manifestation of a set for lengthy, tiring work--becomes unsuitable as the end result is reached. The set for recovery--a desire to work at a minimum level of activity, one ensuring successful completion of the work--assumes the upper hand.

We believe that these factors of psychological self-regulation were decisive to determining the dynamics of physiological indicators of activation in the first series, in which, as was noted earlier, in most of the experiments the activation level decreases noticeably--that is, we observe "inhibitory" signs of mental fatigue.

A different situation is seen in the structure of psychological self-regulation in the second series of experiments (work "until breakdown").

Here, despite the finiteness and unambiguity of the assignment (the subjects were instructed to work "until complete exhaustion"), the subjects did not possess the appropriate objective criteria of success. The goal of activity is thus formulated very generally, and it does not allow the subject to regulate his functions in such a way as to achieve an end result. A situation is created in which subjects are encouraged to surmount their fatigue, they try to ignore their unpleasant subjective sensations, and at the same time they are forced to constantly heed these sensations, concentrating their attention on them as the main reference points of their activity. Absence of objective criteria for the successfulness of activity generates informational uncertainty and, as a consequence, an emotional overtone to the entire process of self-regulation. The subjects begin to experience difficulties in relating activity level to the demands of the activity, and they are compelled to assume a hypercompensatory reaction strategy.

We assumed that developing fatigue would manifest itself in the second series of experiments (at least among some of the subjects) as a rise in activation level and general stressing of function. The obtained results confirmed this hypothesis.

The following question arises: Why are the "stressful" manifestations of functional dynamics not revealed in all subjects, even though the psychological structure of activity was in principle the same in all experiments of the second series?

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We believe that the set for activity which we tried to "impose" upon the subjects by our initial instructions and by the entire psychological atmosphere of the experiment was not absorbed identically and in full volume by all subjects. The set presupposed maximum exhaustion of work potential. Some subjects responded with a readiness to immerse themselves into an extraordinary and rather uncertain state of maximum exhaustion, while others oriented themselves at achieving a state with which they were familiar, one which from their subjective scale of experience was known to them as "intense tiring." It may be expected that in the first case the unpleasant subjective symptoms of fatigue generated anxiety and mobilized the subject's potentials for work "beyond the limit," while in the second a typical "inhibitory" pattern of fatigue developed. Intermediate states expressed themselves through uncertain and unexpressive dynamics.

The line of reasoning here is based on the point of view that fatigue is a state consisting of complex mental experiences of conflicting content, one in which the individual is offered two variants of adaptive behavior: the path of self-preservation, economization of effort and inhibition of work activity, and the path of mobilization of resources and a set for maintenance of the activity level at the price of exhaustion. The choice of paths depends on the entire set of conditions of the activity and on the individual psychological traits of the worker, and it is precisely this choice which operates as the decisive organizing factor of activity, and consequently of the dynamics of work effort. It may be said that man subjects his functional state to psychological self-regulation in a situation calling for tiring work.

This fact inescapably leads us to specific problems associated with physiological diagnosis of fatigue. Fatigue doubtlessly has an influence on the body's activation level, but this influence cannot be determined or described from the standpoint of the conceptions of physiological automatism. It would be improper to interpret changes in activation level in a situation requiring tiring mental activity as a reflection of primary functional changes in those structures of the central nervous system which are responsible for realization of the given type of mental work. Such an interpretation would presuppose that the recorded changes are unambiguous and "mandatory," but this is precisely what we failed to observe in the experiment. As Khomskaya points out, "activation processes...experience the influence...of social factors. Were we to ignore this law, we would be unable to penetrate into the specific features of the human methods of regulating activation processes" ((17), p 6).

Changes in activation indicators occurring during tiring mainly reflect secondary compensatory adaptive reactions associated with the psychological level of activity self-regulation. Depending on the situation, compensatory reactions may assume the nature of "blockades" and "inhibition" or, on the other hand, "tension" and "stress," and all schemes for diagnosis of fatigue must account for the fundamental ambiguity of the functional expression of fatigue.

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COHESION AS FACTOR OF GROUP EFFICIENCY

Moscow VOPROSY PSIKHOLOGII in Russian No 3, May-Jun 81 pp 113-118

[Article by R. S. Nemov and A. G. Shestakov]

[Text] The theory of active mediation of interpersonal relationships in a collective, proposed by A. V. Petrovskiy (4,5,6), and the stratometric principle of hierarchical arrangement of subsystems representing interpersonal mutual relationships in a collective have permitted a new approach to describing the essence of psychosocial phenomena in a collective, and to their experimental study.

According to this theory mutual relationships within a collective assume three qualitatively unique levels or strata. The first or bottom stratum of the collective is represented by attitudes toward the content of joint activity, and mainly attitudes which affect motivation. They form the nucleus of the collective's social psychology, they evolve in the course of joint activity, and they serve as the prerequisites for formation of relationships in the two other strata, the second and third. The second psychological stratum of the collective includes interpersonal ties mediated by the content of the collective's activity. Among them, we have been able to isolate and study collectivistic self-determination, cohesion defined as unity in value orientations, effective group emotional identification, the reference group and a number of other phenomena. In contrast to the first stratum, which has to do with objective phenomena and motivations, these phenomena have to do specifically with interpersonal ties--ties of a special sort. What makes them unique is genetic and functional mediation of the content of group activity. Interpersonal ties in the second stratum arise and develop, as do attitudes in the first stratum, on the basis of joint activity, and they cannot form apart from it. In the developed collective, relationships of the second stratum dominate over interpersonal ties of the third, surface stratum. Direct interpersonal ties make up the third stratum of intragroup activity. They evolve apart from and independently of the joint activity of the collective's participants on the basis of known mechanisms of interpersonal perception: "the halo effect", the "implicit theory of personality" and so on. Forming the surface, nonspecific stratum of the collective, these relationships provide a way for revealing the origins of the collective as a random, diffuse group. The relationships in this stratum, in distinction from phenomena of the second stratum, may be revealed experimentally in practically any group, including a random one.

Numerous studies performed under Petrovskiy's supervision confirmed the basic premises of the stratometric conception and imparted to it the status of a special psychosocial theory of groups and collectives. In recent years the premises of this theory have

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been used actively to develop a number of particular problems of psychosocial science--the psychology of effective group activity for example (3,6). Using the stratometric approach, R. S. Nemov formulated and experimentally confirmed the hypothesis that groups at different levels of development exhibit differences in their emotional mutual relationships and in group effectiveness (1).

The theory of mediation by activity was also the basis for a new approach to analyzing some theoretical problems of group effectiveness, for example the question as to which psychosocial phenomena within a collective are the most significant to the successfulness of its work (6).

Our answer to this question is based on the following premises of the stratometric conception: 1. The collective is a group at the highest social and psychological level of development. This presupposes that the collective must also be the most effective group, and that its psychosocial phenomena are factors of group effectiveness. 2. According to the stratometric conception the principal psychosocial characteristics of the collective are represented by the mutual relationships existing in the second stratum of intergroup activity. Consequently these relationships must be important psychosocial conditions of the collective's successfulness. 3. Inasmuch as the second stratum of mutual relationships in the developed collective dominate over relationships in the third stratum, the second stratum must have a stronger influence on the successfulness of joint work than does the third stratum.

We formulated the following working hypotheses on the basis of these premises: 1. In groups at a high level of development, the correlation between the successfulness of activity and the level of development of relationships in the second stratum must be positive and more expressive than the correlation between successfulness and relationships at the third stratum. 2. In groups at a relatively low level of development, for which the second stratum of mutual relationships is poorly developed, correlations between the relationships at the second and third strata on one hand and the successfulness of the group's work on the other must be insignificant and about the same.

This hypothesis was tested by research performed on the collectives of rayon internal affairs divisions (ROVD's). Eighteen collectives containing a total of 186 persons participated in all.

Two forms of cohesion, defined as unity of value orientations, were experimentally studied as representations of relationships mediated by the content of activity: unity of group goals (UGG) and unity of group motivations (UGM). Relationships at the third stratum were represented in this research by interpersonal ties evaluated with the assistance of the traditional sociometric procedure, using the general interpersonal choice test. The successfulness of the collectives' activity was studied by the expert method using actual work indicators and a number of psychosocial indicators of successfulness which we derived specially.

Methods

The procedure we used to draw up sociometric questionnaires and conduct the interviews was typical to research of this sort. Making their choices, the respondents

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were instructed that they were "being appointed executives of a new subdivision." In this connection they were asked to name those friends in their collective whom they would wish to see in the new subdivision. The subjects had to rank the members of their collective in order of preference. The cohesion indicator, which was based on the sociometric data, was defined as the quotient of the quantity of mutual choices divided by their maximum possible number (CI). However, in view of the fact that the traditional cohesion index does not always provide a true picture of mutual relationships existing in a group (there are groups in which there are no mutual choices, even though all other choice variants are represented rather completely), we decided to introduce one more cohesion indicator, assessed on the basis of unity of choice and based on M. Kendel's well known statistic--the concordance factor (2).

The UGG and UGM indicators were determined by calculating the frequency with which individuals showed preferences for particular goals (motives), which were subsequently ranked on the basis of frequency. Using Kendel's formula, we arrived at indices for unity of goals and motives for each group.

Our procedure for studying UGG was based on the method of paired comparisons. Subjecting normative documents regulating the activities of the ROVD's to content analysis, we first selected 10 of the most important goals of their work: 1. Crime and criminal detection. 2. Crime prevention. 3. Interaction with the public in preventing and solving crimes. 4. Improvement of occupational proficiency. 5. Development of high moral and official qualities, and others. We then made 45 different pairs out of all 10 goals. Working with these pairs, which were written out on a separate sheet, the subjects had to note which of two paired goals was more important to them.

UGM was studied in similar fashion. Instead of goals, in this case we used the possible motives of joint activity, for example: 1. Achieving good results in joint work. 2. Maintaining good personal mutual relationships with each other. 3. Receiving job promotions, and so on.

The actual work results of the collectives were evaluated on the basis of the following nine indicators. 1. Crime solution. 2. Elimination of the causes and conditions of crime. 3. Pursuit of hiding criminals. 4. Surveillance of persons displaying antisocial behavior. 5. Work quality. 6. Legal education of the public. 7. Prompt examination of petitions by citizens. 8. Lawfulness of actions. 9. Utilization of the achievements of science and technology.

The psychosocial indicators of successfulness were based on the collective's degree of organization, its performance, its aggressiveness, and awareness. Each of these indicators was evaluated in turn by means of special questionnaires containing from 9 to 13 judgments characterizing the activity of the collective from different sides.

Experts who evaluated the successfulness of the work of the collectives fell into two categories: workers from a higher administrative level who, by the nature of their activity, had to inspect the appropriate collective and render assistance to it, and the leaders of the studied collectives. Each of these 18 collectives was evaluated by five experts. The relationship between the successfulness indicators on one hand and the different psychosocial characteristics of the group on the other was revealed by ranking and then correlating the ranked series of groups in relation to the appropriate indicators.

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Results

Table 1 shows the cohesion indicators for both unity of group goals and unity of group motivations as well as the sociometric cohesion indices of all of the collectives. The respective collectives are designated on the left by capital letters. Occurrence of the same letters indicates that the corresponding data are from the same ROVD subdivision.

Table 1. Cohesion Indicators for the Sample

(1) Коллективы	Показатели (2)			
	ЦЕГ (3)	МЕГ (4)	ЕСВ (5)	СП (6)
$А_1$	0,352	0,675	0,231	0,075
$Б_1$	0,150	0,375	0,208	0,066
$В_1$	0,393	0,696	0,509	0,300
$Г_1$	0,287	0,563	0,352	0,142
$Д_1$	0,327	0,340	0,270	0,047
$Е_1$	0,333	0,589	0,318	0,318
$Ж_1$	0,242	0,527	0,470	0,066
$З_1$	0,370	0,560	0,577	0,166
$И_1$	0,449	0,564	0,476	0,333
$А_2$	0,400	0,390	0,806	0,333
$Б_2$	0,441	0,625	0,266	0,238
$В_2$	0,158	0,721	0,323	0,266
$Г_2$	0,303	0,608	0,303	0,178
$Д_2$	0,227	0,509	0,394	0,368
$Е_2$	0,630	0,711	0,500	0,600
$Ж_2$	0,456	0,692	0,296	0,666
$З_2$	0,280	0,639	0,444	0,166
$И_2$	0,630	0,711	0,500	0,000
Средние по выборке (7)	0,357	0,583	0,402	0,240

Key:

1. Collectives
2. Indicators
3. UGG
4. UGM
5. USS
6. CI
7. Sample averages

We can see from Table 1 that the UGG coefficients vary from 0.150 to 0.630 while the UGM coefficients vary from 0.340 to 0.721. The overall variants in the unity of sociometric samples indicators (USS) are approximately within the same limits as for the UGG and UGM indicators--from 0.208 to 0.806. (We will not compare CI indicators with the UGG, UGM and USS figures because they were calculated by means of different statistical procedures.).

Among the averages of the UGG, UGM and USS indicators, the highest were for the UGM characteristics--0.583. This indicates that of the three characteristics listed above, cohesion defined as unity of motivation is the most developed psychosocial characteristic of the sample, while cohesion defined as unity of sociometric choice is the least developed.

We can hypothesize on the basis of these data that the collectives we analyzed are not random, diffuse groups, but more or less developed communities. Particular evidence of this can be found in the rather high indicators for unity of motivation and

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goals. Significant variations of these indicators among different collectives imply that the sample contains groups at different--higher and lower--levels of psychosocial development.

To test the suggested hypotheses, we divided the sample into two subgroups: collectives at a higher level of development and collectives at a lower level of development. This division was based primarily on indicators characterizing relationships mediated by the content of activity, inasmuch as this characteristic is among the principal ones used to evaluate a group's level of development (A. V. Petrovskiy). There was no need to compare the studied groups on the basis of the second of the significant characteristics--the social value of joint activity, because there was no doubt as to the usefulness of the activities of all ROVD collectives.

For practical division of the sample into two subgroups, we selected the median of the sum of UGG and UGM indicators, equal to 0.920. Those collectives for which the sum of UGG and UGM indicators was higher than the median were treated as groups at a higher level of development, while those for which the corresponding sum was lower than the median were treated as groups at a lower level of development.

Table 2 shows the cohesion indicators separately for groups at the higher and the lower levels of psychosocial development.

Note that the average UGG and UGM indicators for the sample containing groups at the higher level of development surpass the corresponding indicators for the groups at the lower level of development; in this case the statistical differences between the average UGG and UGM indicators for the groups at different levels of development are significant: $t = 3.978$, $p<0.005$, and $t = 2.708$, $p<0.025$ respectively.

Table 3 shows the activity successfulness indicators for the corresponding collectives (the arithmetic means in a five-point system, for each block of successfulness characteristics and for all characteristics taken together).

Note that the data in Table 3 are based on an external criterion, independent of UGG and UGM, for dividing the sample into two subgroups--level of development, and thus they confirm the validity of the division made based on psychosocial indicators.

The mean of the actual activity successfulness indicator and all other means of the psychosocial indicators (except for degree of organization) and the overall integral successfulness indicator are higher in those groups which we categorized as groups at a higher level of development on the basis of UGG and UGM.

The next table, Table 4, shows Spearman's coefficients of rank correlation between cohesion and efficiency indicators for collectives at different levels of development.

The data in the upper part of Table 4 show that seven coefficients of correlation between successfulness, UGG and UGM--that is, actually more than half--are significant (for $n = 9$ and $p \leq 0.05$, $R_{cr} = 0.583$). The remaining five are also positive and sufficiently close to the critical value.

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Table 2. Cohesion Indicators for Groups at Different Levels of Development

(1) Группа	(2) Уровень развития	(3) Показатели сплоченности			
		ЦЕГ (4)	МЕГ (5)	ЕСВ (6)	СП (7)
$А_1$	(8) высокий	0,352	0,675	0,231	0,075
$В_1$	высокий	0,393	0,696	0,509	0,300
$Е_1$	высокий	0,333	0,589	0,318	0,318
$Б_2$	высокий	0,441	0,625	0,266	0,238
$З_1$	высокий	0,370	0,560	0,577	0,166
$Е_2$	высокий	0,630	0,711	0,500	0,600
$Ж_2$	высокий	0,456	0,692	0,296	0,666
$И_1$	высокий	0,449	0,564	0,476	0,333
$И_2$	высокий	0,630	0,711	0,500	0,000
(9) Средние по группам высокого уровня развития		0,450	0,647	0,408	0,299
$Б_1$	(10) низкий	0,150	0,375	0,208	0,066
$Г_1$	низкий	0,287	0,563	0,352	0,142
$Д_1$	низкий	0,327	0,340	0,270	0,047
$Ж_1$	низкий	0,242	0,527	0,470	0,066
$Е_1$	низкий	0,333	0,589	0,318	0,318
$З_2$	низкий	0,280	0,639	0,444	0,166
$А_2$	низкий	0,400	0,390	0,806	0,333
$В_2$	низкий	0,158	0,721	0,323	0,266
$Д_2$	низкий	0,227	0,509	0,394	0,368
(11) Средние по группам низкого уровня развития		0,267	0,517	0,398	0,197

Key:

1. Group
2. Level of development
3. Cohesion indicators
4. UGG
5. UGM
6. USS
7. CI
8. High
9. Averages for groups at higher level of development
10. Low
11. Averages for groups at lower level of development

Both coefficients of correlation between UGG, UGM and the integral successfulness indicators for collectives at the higher level of development are significant, while both coefficients of correlation between USS and CI indicators and the integral successfulness indicator are insignificant.

Not one of the twelve coefficients of correlation between successfulness and cohesion indicators determined on the basis of sociometric choices achieved the level of statistical significance, with half of these coefficients being negative.

Thus interpersonal mutual relationships mediated by the content of activity (unity of group goals and unity of group motivation in this case) in collectives at a higher

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Table 3. Activity Successfulness Indicators for Collectives at Different Levels of Psychosocial Development

(1) Группа	(2) Уровень развития	(3) Фактическая успешность	(4) Организованность	(5) Информированность	(6) Работоспособность	(7) Активность	(8) Общий, интегральный показатель успешности
$А_1$ (9)	высокий	3,38	3,56	3,72	3,58	3,75	3,69
$В_1$	высокий	3,54	3,50	3,75	3,96	3,68	3,68
$Е_1$	высокий	3,38	2,96	4,77	3,16	3,80	3,61
$Б_2$	высокий	3,50	3,54	3,75	3,70	4,10	3,71
$З_1$	высокий	3,55	2,70	3,55	2,41	3,75	3,19
$Е_2$	высокий	4,00	3,67	4,77	4,08	4,55	4,41
$Ж_2$	высокий	3,84	3,66	4,55	3,50	4,45	4,00
$И_1$	высокий	3,22	2,96	3,44	2,91	3,15	3,13
$И_2$	высокий	3,92	3,24	4,07	3,77	4,13	3,83
(10) Средние по группам высокого уровня развития		3,59	3,31	4,04	3,45	3,93	3,69
$Б_1$ (11)	низкий	3,52	3,65	3,75	2,83	4,10	3,77
$Г_1$	низкий	3,10	3,21	3,60	3,40	3,86	3,43
$Д_1$	низкий	2,96	2,98	3,35	3,10	3,30	3,13
$Ж_1$	низкий	2,77	3,93	3,88	3,16	3,30	3,20
$Е_1$	низкий	3,30	3,62	3,45	3,03	3,57	3,39
$З_2$	низкий	3,27	3,40	4,44	2,91	3,85	3,57
$А_2$	низкий	3,57	3,60	3,66	3,54	3,85	3,64
$В_2$	низкий	3,66	3,50	3,75	4,06	4,18	3,83
$Д_2$	низкий	2,95	3,03	3,00	2,83	3,00	2,96
(12) Средние по группам низкого уровня развития		3,23	3,44	3,65	3,21	3,67	3,44

Key:

1. Group
2. Level of development
3. Actual successfulness
4. Degree of organization
5. Awareness
6. Performance
7. Aggressiveness
8. Overall, integral successfulness indicator
9. High
10. Averages for groups at higher level of development
11. Low
12. Averages for groups at lower level of development

level of development--that is, in which the second stratum of mutual relationships is already formed--were found to be a significant factor of successfulness, being more important than mutual relationships appraised by means of traditional sociometric indices. This confirms the first of the suggested hypotheses.

Let us now examine the data shown in the bottom part of Table 4. Out of 24 rank correlation coefficients shown in it, not one achieved satisfactory statistical significance. This means that in groups at a lower level of development, there is generally no specific dependence between cohesion, evaluated on the basis of our indicators, and efficiency, which confirms the second of the suggested hypotheses.

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Table 4. Correlations Between Cohesion and Effectiveness Indicators for Collectives at Different Levels of Development

(1) Показатели успешности	(2) Уровень развития	(3) Показатели сплоченности			
		(4) ЦЕГ	(5) МЕГ	(6) ЕСВ	(7) СП
	(13)				
Фактическая успешность (8)	высокий	0,546	0,908	0,233	—0,121
Организованность (9)	высокий	0,442	0,667	—0,425	0,362
Информированность (10)	высокий	0,227	0,600	—0,066	0,283
Работоспособность (11)	высокий	0,488	0,888	0,054	—0,017
Активность (12)	высокий	0,567	0,633	—0,141	0,246
Общий интегральный показатель успешности (14)		0,638	0,838	—0,212	0,192
	(15)				
Фактическая успешность (8)	низкий	—0,116	0,267	—0,183	0,273
Организованность (9)	низкий	—0,116	0,117	0,117	0,180
Информированность (10)	низкий	—0,454	0,413	0,313	—0,227
Работоспособность (11)	низкий	0,346	0,305	0,330	0,030
Активность (12)	низкий	—0,408	0,367	—0,241	—0,033
Общий интегральный показатель успешности (14)		—0,383	0,334	—0,083	0,030

Key:

1. Successfulness indicators
2. Level of development
3. Cohesion indicators
4. UGG
5. UGM
6. USS
7. CI
8. Actual successfulness
9. Degree of organization
10. Awareness
11. Performance
12. Aggressiveness
13. High
14. Overall integral successfulness indicator
15. Low

The obtained data indicate that in groups at a comparatively lower level of development, in which the stratum of relationships mediated by the content of the activity is insufficiently developed, official relationships may be substituted by emotional interpersonal relationships. As had been demonstrated (1), in groups at a low level of development emotional interpersonal relationships may be neutral, or they may generally hinder successful joint work. But if we consider that in our research the groups at a lower level of development were represented by collectives actually in existence--that is, by communities exhibiting a level of development between a diffuse group and a formed collective, the reason why a statistically significant dependence between effectiveness and mutual relationships was not documented in this case becomes understandable. In them, the second stratum of relationships was probably developed only to an extent which would prevent negative manifestation of emotional interpersonal ties.

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On the whole, the results show that a collective's unity of goals and motivation is a condition of its successful work, and they demonstrate that the parameters of the second stratum of intragroup activity, isolated and described by the theory of mediation of interpersonal relationships in a collective by activity, are important factors of a collective's efficiency. This opens up new possibilities for considering practical ways for exerting an influence on the efficiency of collective labor, and it encourages the researcher to seek those conditions which promote formation, within a collective, of relationships mediated by the content of its activity.

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INVESTIGATION OF SITUATIONAL SOCIAL ATTITUDES OF POLAR EXPLORERS

Moscow VOPROSY PSIKHOLOGII in Russian No 3, May-Jun 81 pp 132-136

[Article by N. V. Yadov]

[Text] As Sh. A. Nadirashvili (4) and V. A. Yadov (6) have shown, social attitudes are contained within a more-general system of the subject's value orientations and attitudes--his personality dispositions. Analysis of the influence the conditions of activity have upon formation of recorded social attitudes, which can be distinguished into relatively general and concrete situational social attitudes, has important significance to the study of the regulatory functions played by social attitudes.

This article examines the influence of relative social isolation of a group upon situational social attitudes (SSA's).* What is unique about this level of the dispositional hierarchy is that in distinction from its highest levels (value orientations and the overall orientation of the personality's interests), determined relative to stable general social conditions and responsible for programming the individual's activities over significant periods of life, the function of SSA's is basically to support activity. The stability of the dispositional system is ensured by the highest dispositional constructs, while adaptation to the particular conditions of activity is supported by the lower levels of this hierarchy--general and, especially, situational social attitudes ((6), p 189).

Data in the Soviet and foreign literature indicate that the value orientations of people volunteering for lengthy polar expeditions have a specific structure (1,11).

We studied SSA's toward the work and personal qualities of workers having considerable experience in winter work at polar stations in the Arctic and Antarctic. We assumed that the relative social isolation of polar explorers (the unique features of such isolation were described well by N. Yu. Khryashcheva; see (8)) should have an effect on the nature of their situational social attitudes mainly because the latter promote adaptation of the individual to the concrete circumstances of his life.

*It would be more correct to refer to a recorded situational social attitude. We will drop the term "recorded" from the subsequent discussion because it will deal only with recorded dispositions of the personality, in contrast to actual dispositions studied in a laboratory experiment.

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We suggested the following two hypotheses:

1. Isolated conditions must have an influence on the means by which situational social attitudes toward occupational and personal qualities are generalized. That is, we expect that SSA's toward different occupational and personal qualities of polar explorers would group together into specific cognitive-emotional relationships differing from the conceptual structures of the similar SSA's of subjects working in conventional (not isolated) conditions.

2. We expect that isolated conditions influence the intensity of SSA's toward occupational and personal qualities in such a way that growth in subjective effort in work performed in isolation would cause an increase in the intensity of attitudes; it is also fully probable that weakening of attitudes depends on the normative pressure exerted by the social organization. This hypothesis is grounded on data indicating that people expect a "fair" relationship between expended effort and attained results (9,12). There are confirmations of such assumptions in the Soviet literature as well (3).

Methods

We used a method developed by A. A. Kissel' ((6), pp 223-226) to record the situational social attitudes of engineers toward different occupational and personality qualities. The method was modified for research on polar explorers. Occupational and personal qualities (13 qualities in all) were selected on the basis of two criteria. Qualities were divided in accordance with the first criterion into ones pertaining to work content and others pertaining to mutual relationships between individuals in the same collective. Occupational qualities were divided in accordance with the second criterion into those associated with the self-regulatory aspects of activity (for example creativity, initiative) and those required by socially prescribed functions (for example responsibility and diligence). In this case we took account of data obtained by the authors of a study of a large sample of engineers (7) which revealed correlations among 18 occupational and personal qualities; we isolated the most informative qualities from this set, and we added to them those qualities which are associated with communication and interaction in the collective.

The overall logic behind the SSA measurement procedure is as follows. We anticipated that certain stages (forms) of work were liked and disliked by workers at polar stations (seven were distinguished in all. For example: taking instrument readings, processing the day's observations, free time, crash programs and so on). A high evaluation given to a particular occupational or personal quality during a "liked" stage and a low evaluation given during an "unliked" stage implies a high positive attitude toward the given quality, while a lower evaluation of the quality during a "liked" form of work and a high evaluation during a "disliked" form of work implies a strong negative attitude toward the given quality. Each quality was evaluated on the basis of four bipolar seven-term scales: "recognition"--that is, the wish that this quality would be valued in the given stage; "realizability"--that is, an assessment as to the extent to which the given quality could be realized in the given stage; "effectiveness"--an assessment of the successfulness of the quality's utilization, and the "importance" of the given quality in the given stage. Correlations between the indicators derived in accordance with these scales assume values from 0.8 to 0.9; therefore the four measurements are summed and averaged.

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The overall indicator of an attitude toward a particular quality was calculated as the difference of the average evaluations, based on the four scales, between two of the most "liked" and two of the most "disliked" stages of work. The author of this method calculated the stability of the overall indicator. He found 85 percent agreement in evaluations based on the seven-term scale, made by a sample of 50 subjects in a repeat test 2 weeks after the first trial.

Forty workers of the Arctic and Antarctic Scientific Research Institute (geodesists, oceanologists, meteorologists, aerologists and so on) who had spent not less than two winters at research stations were selected for the experimental group; the average number of winters for the sample of 40 persons was 5.8. The control group consisted of 40 engineers working for planning organizations in Leningrad, studied earlier by Kissel' in accordance with the same procedure.*

The point sampling technique was used to select the control group (40 persons out of 1,000 studied)--that is, subjects were selected on a "one-to-one" basis, as a result of which a subject in the control group selected on the basis of four parameters simultaneously--sex, education, age and time of work in his specialty--corresponded to one subject in the main group. Consequently it could be expected that differences obtained in a comparison of the main and control group were the product of different working conditions. For the experimental group the working conditions were represented by a situation of relative social isolation at a polar station, while the control group experienced the typical psychosocial conditions of work and life in a large city.

Results and Discussion

1. Generalization of Situational Social Attitudes

The meaning which a subject of activity injects into a certain integral set of SSA's toward particular qualities of the worker was defined as the content of situational social attitudes.

Table 1 shows the correlation matrices for 13 occupational and personal qualities for the main and control samples; the acquired data permitted comparison of seven of these qualities, while the rest were recorded only in the polar explorer sample.

The qualities of responsibility and creativity ("a creative approach to work") can be adopted in both samples as primary to interpretation of the general meanings within the framework of which SSA's are generalized. For polar station workers, the same can be said for the quality of communicativeness. As far as the first two qualities are concerned, the basis for treating them as primary categories lies in the fact that as a property of the personality, responsibility expresses predominantly the social orientation of the individual, his obligations to the collective; effective fulfillment of work obligations is the object of responsibility (see (5), pp 94-95). Creativity

*The author expresses his deep gratefulness to colleagues of the Arctic and Antarctic Scientific Research Institute--comrades N. N. Glinskiy, O. K. Sedov, A. L. Matusov, I. F. Ryabinin and A. P. Bizyuk--for their benevolent assistance to the research, and to USSR Academy of Sciences ISEP [not further identified] colleague A. A. Kissel' for providing the data used for selection of the control group of engineers.

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is predominantly the preparedness and predisposition for manifesting one's individuality, one's dissimilarity to others--that is, one's desire for self-assertion.*

The matrix of paired correlations distinguishes a number of complexes of sets into occupational and personal qualities which correlate most closely to one another.

Two complexes of qualities were obtained in the polar explorer sample: responsibility ("responsibility," "punctuality," "attentiveness" and "conscientiousness") and communicativeness ("communicativeness," "reserve," "benevolence," and "strong will"). The attitudes of polar explorers toward all other qualities correlate positively with one or several attitudes toward qualities in the responsibility complex. Statistically significant negative correlations were discovered between SSA's toward qualities in the complex of responsibility and associated qualities on one hand and attitudes toward qualities in the communicativeness complex on the other.

Two complexes of qualities were also discovered in the control sample of engineers: creativity ("a creative approach to work," "independence," "experience and knowledge") and responsibility ("responsibility," "organization," "conscientiousness"). Significant negative correlation exists between situational social attitudes toward a creative approach to work and responsibility (the key qualities in these two complexes).

Thus all attitudes of polar explorers toward qualities having to do specifically with work (all with the exception of those in the communicativeness complex) are correlated with each other to a greater or lesser degree of statistical significance: They are all perceived as a certain unity of personality traits promoting successful occupational activity. Among engineers, meanwhile, we observe a clear contrast between creativity and responsibility.

This result may be explained within the framework of the suggested hypothesis by the fact that relative isolation causes polar explorers to seek consistency between subjective programs of activity and the external prescribed requirements upon the production organization, while in the activity of engineers, subjective programs and organizational requirements are in a unique sort of opposition.

The unique ways in which SSA's are generalized in different conditions lead to the conclusion that group isolation promotes more-active inclusion of the worker in joint collective activity as well as deeper interiorization of general collective goals than does work in stable and customary conditions. These results are consistent with our ideas about responsibility relationships in collectives ((5), p 95). They confirm the dominant role played by the objective conditions of activity in formation of social attitudes.

This conclusion is also confirmed by an analysis of the emotional attitudes of polar explorers and engineers toward different aspects of their work. The negative correlations between the responsibility and creativity complexes in engineers and between the responsibility and communicativeness complexes in polar explorers can be explained

*The diametrical opposition of the tendency to meld with the society and the tendency to isolate (single out) one's ego as the source of needs is examined by G. G. Diligenskiy (2), and it is the methodological grounds for the division made between the corresponding personality qualities revealed in our data.

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Table 1. Correlation Matrix of Attitudes Toward Occupational and Personal Qualities Expressed by Polar Explorers (Beneath Diagonal) and Engineers (Above Diagonal)

Qualities	1	2	3	4	5	6	7	8	9	10	11	12
1. Самостоятельность	—	0.654*	0.525*	0.088	0.036	0.064	−0.014					
2. Опыт и знания	0.104	—	0.656*	0.147	−0.047	0.156	0.082					
3. Творческий подход к делу	0.162	0.244	—	−0.408*	0.172	0.134	−0.020					
4. Ответственность	0.118	0.334*	−0.161	—	0.327*	0.273	0.237					
5. Организованность	0.146	0.032	0.058	0.385*	—	0.478	0.285					
6. Добросовестность	0.289	0.231	0.017	0.541*	0.252	—	0.243					
7. Пунктуальность	0.195	0.278	−0.190	0.413*	0.309	0.639*	—					
8. Оперативность	0.242	0.527*	0.020	0.353*	0.134	0.435*	0.221	—				
9. Внимательность	−0.098	0.237	−0.135	0.595*	0.174	0.554*	0.371	0.219	—			
10. Сдержанность	−0.239	−0.214	0.034	−0.197	−0.261	−0.222	−0.201	−0.283	−0.117	—		
11. Общительность	0.204	−0.320*	0.124	−0.274	0.163	−0.185	−0.318*	−0.263	−0.026	0.450*	—	
12. Доброжелательность	−0.075	−0.312*	0.164	−0.485*	0.246	−0.317*	−0.305	−0.318*	−0.100	0.463*	0.710	—
13. Сильная воля	−0.113	−0.237	0.157	−0.146	0.303	−0.200	−0.110	−0.511*	0.032	0.233	0.443*	0.423

Note: Both samples contain 40 persons. Attitudes toward qualities No 7-13 were not recorded for the engineer subsample.
*$p \leq 0.05$.

Key:

1. Independence
2. Experience and knowledge
3. Creative approach to work
4. Responsibility
5. Organization
6. Conscientiousness
7. Punctuality
8. Efficiency
9. Attentiveness
10. Reserve
11. Communicativeness
12. Benevolence
13. Strong will

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by their membership to opposite emotional zones. In this case negative or positive emotional zones are associated with negative or positive attitudes toward given forms of work.

According to our data the possibility for displaying one's occupational qualities is the principal criterion for awarding a positive emotional assessment to a given form of work by polar station workers. This conclusion agrees with the results of research conducted at American stations in the Antarctic, according to which professionalism is the main criterion by which an expedition member is evaluated (10).

2. Intensity of Situational Social Attitude

The second hypothesis presupposed revelation of a correlation between the strength of normative pressure and the intensity of effort invested into a particular form of activity on one hand and the intensity of situational social attitude on the other. This hypothesis was tested by comparing the average values for the situational attitudes of polar explorers and engineers (Table 2).

Table 2. Intensity of Situational Social Attitudes Expressed Toward Occupational and Personal Qualities by Polar Explorers ($N = 40$) and Planning Organization Engineers ($N = 40$)

Object of Activity	Polar Explorers	Engineers	Δ
Attentiveness	0.64	-	-
Experience and knowledge	0.59	0.56	0.03*
Organization	0.47	0.02	0.45
Independence	0.36	0.42	0.06*
Efficiency	0.34	-	-
Punctuality	0.31	-0.45	0.96
Responsibility	0.29	0.28	0.08*
Creative approach to work	0.20	1.42	1.62
Conscientiousness	0.20	-0.49	0.69
Reserve	0.10	-	-
Strong will	0.01	-	-
Communicativeness	-0.56	-	-
Benevolence	-0.67	-	-

*Differences are insignificant at $p \leq 0.05$.

Among engineers, attitudes of maximum intensity and positiveness are recorded in relation to creativity, weak attitudes are recorded in relation to organization, and sufficiently intense and negative attitudes are recorded in relation to the "punctuality" and "conscientiousness" qualities. Among polar researchers, the most intense attitudes are associated with the qualities of communication; moreover they fall within the zone of negative emotions (these attitudes were not measured for engineers). They are also associated with most occupational qualities, including those having to do with diligence. In contrast to the engineers, the latter qualities have an emotionally positive character. Low values were obtained for attitudes toward the

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"conscientiousness" and "creative approach to work" qualities, and the lowest were for the "reserve" and "strong will" qualities.

Two hypotheses were suggested to explain these differences: inverse dependence of attitude on the strength of normative pressure, and a direct dependence on the subject's volitional effort. According to the first hypothesis, the higher the normative requirement of organization (the pressure of "external" programs of activity), the weaker is the subjective attitude; the greater the room for making independent decisions, the more intense is the social attitude. This explanation, proposed by V. A. Yadov, is confirmed in relation to engineers. We find in fact that the stiffness of requirements imposed on diligence qualities is much higher than that of requirements imposed on qualities in the creativity complex ((7), p 116). In relation to polar explorers, however, this explanation is inconsistent with our data. Requirements imposed on precise execution of responsibilities, on punctuality and on organization are no lower than in the customary conditions of engineering production, being instead significantly higher.

The degree of volitional effort--that is, the amount of physical and mental outlays in support of realization of particular occupational and personal qualities--is the parameter which best distinguishes the circumstances of the activity of the two groups in the aspect of interest to us. This parameter depends on both subjective meaningfulness of the subject's activity and on its conditions, stimulating or inhibiting realization of a given behavioral strategy. The plausibility of this explanation is confirmed by the high values associated with attitudes toward the communicativeness and benevolence qualities. Being the most intense, these attitudes are negatively colored owing to the fact that they are associated with the emotionally negative zone of activity, which requires significant volitional effort to surmount the stressful state elicited by the great duration of group isolation. Finally, it should be clarified that low algebraic values for attitudes toward the "reserve" and "strong will" qualities can be explained by the emotional neutrality of these qualities in relation to different forms of work--that is, by the equally high scale evaluations given to these qualities in both attractive and unattractive stages of work (hence the difference in the evaluations is close to 0); on the other hand the sole significant positive correlationswere recorded for these attitudes mainly in relation to attitudes pertaining to maintenance of normal mutual relationships within the collective--communicativeness and benevolence (see Table 1).

Finally, the following question naturally arises: Is weakness of social attitudes not associated with a low level of subjective significance of the corresponding need on the basis of which the given social attitude is formed? In general, without a doubt, underdevelopment of needs should mean a weaker attitude. On this basis it could be hypothesized that weakening of the attitudes of engineers toward responsibility and of polar explorers toward the creativity complex can be explained by the fact that engineers are not very concerned about being responsible, while polar explorers do not experience an active need for creativity. However, this hypothesis has not been confirmed. Data obtained in research on engineers ((6), p 57) provide the grounds for categorically asserting that responsibility occupies an important place in their value orientations. At the same time, motivation for self-assertion occupies one of the first places in the general hierarchy of the motives of polar explorers (1,10).

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Consequently the needs that serve as the basis for formation of the special attitudes examined here are expressed rather clearly by both engineers and polar explorers, and therefore the hypothesis that volitional effort is significant to an explanation of the intensity of the described SSA's remains fully valid.

Conclusions

1. Relative social isolation has an influence on formation of social attitudes. Coincidence of collective and individual drives for activity that is more clearly pronounced than in normal conditions and more-active subjective involvement in joint activity are typical of polar explorers.

It was discovered that the unusual conditions of relative social isolation noticeably influence the means by which situational social attitudes, formed into complexes different from those typical of the control group of engineers, are generalized.

2. The intensity of a situational social attitude depends on the intensity of volitional effort expended upon the activity associated with the object of the attitude. The more intense the corresponding volitional effort is, the more intense is the situational social attitude toward the means of performing the given activity.

3. In the eyes of the specialized polar explorer, the attractiveness of his work is mainly the product of the possibility allowed for utilizing his occupational knowledge, while the zone of negative emotions is associated with jobs not specifically associated with the individual's occupation, time off, and self-service.

4. It may be hypothesized from the practical aspect that more-successful adaptation to working in isolation depends directly on the active occupational orientation of the specialist. On the other hand a weakened occupational orientation may serve as a destabilizing factor.

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FIFTH MANAGEMENT PSYCHOLOGY SEMINAR

Moscow VOPROSY PSIKHOLOGII in Russian No 3, May-Jun 81 pp 179-182

[Article by I. K. Valovaya, Khar'kov, and T. V. Mishina, Moscow]

[Text] The Fifth Seminar on Management Psychology was conducted 29-30 January 1981 in Riga on the initiative of the Order of the Red Labor Banner Scientific Research Institute of General and Pedagogical Psychology of the USSR Academy of Pedagogical Sciences, and the Latvian Division of the Central Scientific Research Laboratory (TsNIL) of the USSR Ministry of Internal Affairs. Its objectives included: discussing the present status and trends of research in management psychology; developing a unified position in relation to the definition of its subjects, methods and principals; exchanging experience in solving a number of theoretical, experimental and practical problems of management psychology.

Seventeen reports and communications were heard in the seminar's sessions.

Organizing committee chairman V. V. Davydov (Moscow) emphasized in his introductory remarks that research on control processes is a matter of great practical importance aimed at producing an economic impact. The efforts of psychologists and specialists in associated sciences must be unified for such research.

B. S. Vaynshteyn (Moscow) noted that the relationship between economic and social impact is a relationship between resources and goals, and that increasingly greater significance should now be attached to the social impact. The speaker emphasized that management psychology is based not on "the power of command" but rather on manifestation of the will of the collective, and he proposed his own plan of further research in this area of science, to include analyzing the concept "psychosocial climate of the collective," developing the methods of forming and sustaining the psychosocial climate, studying direct and reciprocal ties between production and the psychosocial climate, and investigating the sychology of decision making.

In his report "Basic Problems of the Psychology of Managerial Labor," V. V. Davydov emphasized that according to Karl Marx, management "creates consistency between individual efforts, and it performs the general functions brought into being by the motion of the entire production organism" (Marks, K., and Engel's, F., "Soch." [Works], Vol 23, p 342). He noted that psychology has long been studying human labor, and mental labor in particular. Therefore the general laws of labor should also be extended to managerial labor as one of the forms of mental labor, performed in the course of an individual's activity. The study of the laws of the latter is within the province of psychology. In the speaker's opinion the structure of activity (as defined by A. N. Leont'yev) is also at the basis of managerial activity. The suggestion that

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a special need exists--the need for managing (the essence of which lies in the need for coordinating individual actions)--was made. The general task of management psychology is to plan the ways and means of producing the greatest impact. In general, mental labor begins with the ability to make plans. Imagination, reflection and analysis play a great role in this case. The speaker noted the need for creating role-playing methods of teaching managers.

A. I. Prokhorov (Moscow) and R. E. El'bur (Riga) described, in the report "Some Methodological Problems of Management Psychology," management psychology as a subdivision of applied psychology studying the psychological aspects of management with the purpose of raising management effectiveness. The main issue, according to them, is how and by what methods and resources the psychological factors are to be taken into account. Offering a general description of the present status of the problem, the speakers emphasized that Soviet management psychology had no right to take the roads already traveled by foreign management psychology, repeating its zig-zags and falling into the same dead-ends. The foundations of management psychology cannot be reduced to a limited number of formal logical principles; they must be defined by the principles of dialectical logic, with a consideration for the requirements of material realities and practical activity.

In his report "Problems of Managing Natural Resources" I. V. Davidenko (Moscow) turned attention to the fact that when we draw up general management programs we forget the most general and most important problem--that of managing natural resources. All power production is based, and will continue to be based, on the use of natural resources, which are exhaustible. Why, then, has the program for utilizing natural resources (and the subprogram for managing natural resources) found itself on the sidelines? The reasons have to do with psychology. Mankind, the speaker believes, is not philosophically prepared. This is why successful solution of the important problems of management psychology cannot rely only on mathematical support alone. Psychological support is no less important. The problem basically boils down to regulating the relationships between man and nature. And man must be taught to participate in these relationships--that is, the problem of man's ecological education arises.

A report given by I. I. Goley (Moscow), "Using the Energy Approach in Integrated Analysis of Organization Management Systems," discussed the fundamental possibility of such an approach. Its basic premises are presented in works by P. G. Kuznetsov analyzing the thermodynamic aspects of the phenomena of life. This approach ensures completeness of integrated analysis by bringing together the economic, organizational and psychosocial components of a system's expedient behavior. Practical application of this approach to analysis of concrete organizations made it possible, for the first time, to tie in the economic results of a system's activity with its morphological and functional structure, to reveal and estimate the internal reserves of the organization and to develop the general principles of evaluating the activities of the system's subdivisions and their directors.

The bulk of the report given by L. K. Karnozova (Moscow), "Integrated Research on Production Control Systems," is devoted to the experience of integrated efforts to raise the effectiveness of management by the Division of Applied Problems of the USSR Academy of Pedagogical Sciences Scientific Research Institute of General and Pedagogical Psychology. It is concluded that a transition must be made from an administrative-managerial form of organization of integrated scientific projects to a methodological

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form of organization. It is emphasized that despite the difficulty of achieving practical application of this conclusion, this problem must be solved right now, at the beginning of the new five-year plan when the plans for work extending into the rather distant future are being drawn up.

A report by V. S. Lazarev (Moscow), "Some Features of Psychological Analysis of the Effectiveness of Organization Management," examined an approach to simulating decision making processes based on interpretation of management as activity associated with writing and implementing plans. One important feature of problem solution in collective activity is the cyclic nature of this process: A decision concerning a means for resolving a problem situation may be changed many times in the course of its implementation. Therefore those approaches to studying decision making which use, as their unit of analysis, a single decision making act (irrespective of whether only a choice of one out of many alternatives is examined or formation of alternatives is included in the research) prevent a correct understanding of the mechanisms behind decision making in control systems.

A report by V. I. Chernenilov (Moscow), "Pressing Problems of Management Psychology," examines a number of methodological problems in management psychology: the history of the origin and the principles of isolating the starting unit of analysis of management, the level of coordination in control systems, integration of the work of functionally and organizationally isolated organizations, and the psychological postulates of management conceptions and practices. The results of research on the influence of the level of coordination of a control system's functions on the effectiveness of the organization's work are presented.

G. M. Breslav's report (Riga), "Correction of Emotional Deviations as a Problem of Management Psychology," discussed the fact that the most important direction of psychological research on management processes is isolation of those dynamic and material features of the development of motivations which may cause distortions in formation of the harmonic personality--that is, the report discussed pedagogical control. Methods of indirect influence upon a child's socialization in different forms of joint activity were proposed. It was emphasized that inadequate or insufficient control of the education process is not revealed until the adolescent stage; moreover, correction is more difficult than education.

It was asserted in a report by S. D. Neverkovich and G. P. Shchedrovitskiy (Moscow), "Development of Psychological Methods for Studying Processes Preparatory to Making Management Decisions," that the present level of development of science and technology requires intensification of production, which must be based on broad cooperation. The activities of the "Biokhimreaktiv" Scientific-Production Association in Olayne, Latvian SSR, was used as an example in an examination of fundamentally new forms and methods of making management decisions. The difference between functions of the enterprise aimed at plan fulfillment and efforts aimed at progressive development of collective thinking was emphasized. An assessment of broad cooperation must be based on the degree of development of production, which must be capable of reacting quickly and flexibly to new problems through new ways of collective thinking brought about by role-playing training methods.

In his report "A Psychological Model of the Activity of the Director of an Internal Affairs Agency," B. B. Kossov (Moscow) made it known that the personalities of

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entering students, students and fully qualified directors are being studied with the purpose of improving the selection and training of management organizers at the Academy of the USSR Ministry of Internal Affairs. The academy has developed the conception of the practical structure of the director's personality. General abilities determining the effectiveness and reliability of activity are the personality variables considered in this conception. A multidimensional questionnaire method for studying the personality and activity of a director (the MOMILD) has been used to create a number of structural models describing the work style of directors. The system-forming element of these models, which differ from one another, was the effectiveness of managerial activity. The models are multidimensional (branched) and multi-level (hierarchical).

B. Ya. Kuritskiy (Leningrad) noted that while the technical aspect of control systems is developing with sufficient intensity, efforts to solve the problems of psychological support to automated control systems are weak. The question of certifying directors for work with automated control systems was raised. Mention was made of the great amount of work done under the guidance of A. I. Prokhorov at the USSR Academy of Pedagogical Sciences Scientific Research Institute of General and Pedagogical Psychology to provide psychological support to automated control systems.

A report by A. V. Minayev (Moscow), "Use of Energy Models of Expanded Reproduction to Improve Control Systems," turned attention to creating the conditions for coordinating the actions of different subdivisions and services of a control system. The importance of information services and orientation functions in a control system operating on a relatively independent basis was emphasized in this connection. A criterion by which to assess the effectiveness of an organization's production activity was proposed. The formula for this criterion ties in indicators describing the activities of different subdivisions. It was obtained by combining and refining the basic mathematical models proposed by V. G. Afanas'yev and P. G. Kuznetsov as part of their energy approach.

V. V. Poluyanskiy (Kiev) described the potentials of a team leader as a director, and his influence upon the team. He distinguished blocks of traits important to a team's work (stability, job satisfaction and so on).

A report by V. I. Bashmakov (Moscow), "The Need for Sociological Support to Control Systems," emphasized that management of the society and its individual subsystems is also social management, with people--individuals making up the social community, groups, and individual personalities together with all of their biological, social and mental properties--being the basis of subjective relationships. Therefore no matter what levels and stages are discussed, the study of the human aspects of management is an inseparable part of efforts to make control systems and processes more efficient. However, the behavior of an individual in certain social situations cannot be sensibly described just by means of the categories of psychological science alone. Psychological analysis of control systems must be preceded by a complex of sociological studies. Two directions of this sort of studies are most important today: 1) development of the methodological principles of describing management systems as social systems; 2) study of social interaction in control systems and of the relationships and ties existing between the subject and the object of control, and within the subject and the object. Research on the sociological and psychological aspects of planning, viewed as the foundation of strategic management and as a continuous process characterized by self-regulation, has special significance.

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A report by Yu. N. Lepeskin and Z. B. Goryunova (Moscow), "One of the Methods of an Integrated Approach to and Improvement of a Control System," asserted that development of technical resources today and growth in the requirements on the quality of management have made it necessary to create different methods for raising the effectiveness of an organization. One such method now being used at industrial enterprises is to certify engineers, technicians, and office workers. The "Method of Certifying Enterprise Engineers, Technicians and Office Workers" developed by the authors under A. I. Prokhorov's guidance satisfies the following requirements: It promotes correct placement of management personnel, effective organization of management activity, creation of a dependable reserve for promotion and for improvement of the professional, occupational and personal qualities of workers, and objective evaluation of the needed qualities of an executive, it is coordinated with the integrated plan for socioeconomic development of the enterprise and with the "Personnel" automated control subsystem, and it promotes improvement of the psychological climate. Experience in using this method at a number of enterprises in Moscow and Moscow Oblast was described.

Discussions centered mainly on what the object of management psychology is and on the role and place of planning in managerial activity. Almost all speakers noted that the accent must be placed on the psychological aspects of management.

In his concluding remarks V. V. Davydov noted the significance of work done during the year (after the fourth seminar) in management psychology. At the same time he emphasized the shortcomings: On one hand few concrete studies were performed, while on the other hand there are things still unclear in relation to a number of methodological problems.

Recommendations to organizations and specialists engaged in research and development in management psychology were developed and adopted at the seminar.

On the whole the seminar was a demonstration of management psychology's confident movement along the path of its development, of the growing interest of specialists of different profiles toward this subdivision of psychological science and of its growing significance to the national economy.

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SCIENTIFIC-PRACTICAL CONFERENCE OF MGU SCHOOL OF PSYCHOLOGY

Moscow VOPROSY PSIKHOLOGII in Russian No 3, May-Jun 81 pp 182-183

[Article by V. S. Ageyev, Moscow]

[Text] On 16-17 February 1981 the MGU [Moscow State University] school of psychology conducted a scientific-practical conference attended by the department of social psychology and by the sociological laboratory of the Tiraspol' Sewing Association imeni 40-Letiye VLKSM, devoted to the activity of a psychologist at an industrial enterprise. Other participants of its proceedings included representatives of several Moscow industrial enterprises, colleagues of the departments of engineering psychology and labor psychology, graduates of the school of psychology employed by industry, and students of the school of psychology specializing in social psychology.

In his introductory remarks A. A. Bodalev, dean of the MGU school of psychology, emphasized the urgent need for introducing the results of psychological research into practice more and more broadly, and he gave the outlines of the basic directions of applied research in light of the decisions of the 26th CPSU Congress. A. F. Pavlova, Tiraspol' Sewing Association assistant director for management, social development and personnel, described this enterprise's achievements in relation to both technical-economic indicators and social development of the association's collective. Under the leadership of Hero of Socialist Labor V. S. Solov'yeva this association has now held first place in this sector's all-union socialist competition for 110 quarters. The speaker noted that the enterprise's successes were in many ways the product of applied research and the practical recommendations developed by colleagues of the enterprise's sociological laboratory, which employs four psychologists including three graduates of the MGU school of psychology. A. F. Pavlova also emphasized that the effectiveness of the enterprise's psychosocial service stems from the fact that the laboratory collective not only conducts specific applied studies and develops practical recommendations on their basis, but it also works actively together with the association's administration to achieve practical introduction of these recommendations in various areas of the life of the Tiraspol' Sewing Association's workers.

V. V. Chichilimov, chief of the association's sociological laboratory, described a complex of specific-purpose laboratory programs starting with statement of socially meaningful problems and ending with practical introduction of results obtained through empirical research. Because the laboratory takes an integrated approach to the subject matter of this research, it does not limit itself to traditional studies on the psychological climate in the enterprise collectives, optimization of the methods and forms of management and so on. The speaker emphasized the need for investigating

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more-universal psychosocial and social problems such as, for example, the relationship of different aspects of the life of the association's workers to the general infrastructure of Tiraspol', reconstruction of traditional forms of interpersonal communication and interaction, creation of general psychosocial comforts at the enterprise, and the influence of family, personal, housing and other factors on work effectiveness and satisfaction of workers in the association's collective. V. V. Chichilimov described some concrete instances of introducing the laboratory's applied research; in particular he acquainted the audience with a method for actively encouraging young people to participate in production management through temporary appointment (for 1 day a month) of young workers to the most important posts at the enterprise--as high as shop chiefs. The speaker persuasively demonstrated the tremendous educational potential contained in such role playing.

Colleagues of the sociological laboratory provided greater detail on some particular specific-purpose programs of the laboratory. V. M. Kashina presented the results of many years of research on adaptation of young workers to the conditions of modern industrial production, and she suggested placing this process under scientific control. I. R. Rudkovskaya analyzed various factors promoting or hindering attainment of psychosocial comfort at the enterprise. G. A. Dumitrashko pointed out the practical importance of studying interpersonal perception, the adequacy or inadequacy of which may play a significant role in the system of interpersonal relationships in general and in the system of leadership and subordination in particular.

The floor was then given to colleagues of the department of social psychology of the MGU school of psychology. I. G. Kokurina emphasized the significance of psychosocial research on the motivational structure of the personality in light of pressing practical problems. K. Ye. Danilin touched upon the problem of determining the functions of the practical psychologist . O. N. Chernysheva turned attention to a number of practical problems fully or partially within the competency of labor psychology and engineering psychology. E. V. Maruga emphasized the need for encouraging social psychologists to participate in the training of middle-level managers to the broadest extent possible.

A roundtable discussion was organized at the conference on a collective monograph prepared by the sociological laboratory of the Tiraspol' Sewing Association (V. S. Solov'yeva, V. M. Kashina, V. V. Chichilimov, "Vse o nas i o nashem kollektive" [Everything About Ourselves and Our Collective], Kishinev, 1980) and on the plan and prospects of further cooperation. Colleagues of the department of social psychology gave a high assessment to the monograph, which generalized the experience of many years of research and practical introduction of obtained results, and they ventured a number of constructive critical remarks about the book.

In conclusion G. M. Andreyeva noted the ever-increasing need for highly qualified practical psychologists, and she dwelled in detail on the pressing problems associated with preparing student psychologists for work at industrial enterprises and on the difficulties met along the way. She proposed concrete ways to improve the quality of the training afforded to practical psychologists specializing in the department of social psychology, to include: exposure to production practice earlier in the school career, preliminary occupational orientation of students, participation of leading practical psychologists in the development and presentation of individual

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lessons in a specialized practical course, and so on. G. M. Andreyeva noted the undoubted usefulness of the conference to both practical psychologists and the MGU school of psychology.

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UDC 158.1+62.506.23+154.4

RESEARCH METHODOLOGY IN ENGINEERING AND LABOR PSYCHOLOGY

Leningrad METODOLOGIYAISLEDOVANIY PO INZHENERNOY PSIKHOLOGII I PSIKHOLOGII TRUDA, CHAST' 1 in Russian 1974 (signed to press 5 Jul 74) pp 2-11, 39-59, 111-121, 148

[Annotation, preface, table of contents, Chapter I and excerpts from chapters II and III from book "The Methodology of Research in Engineering and Labor Psychology, Part I", edited by Doctor of Psychological Sciences A. A. Krylov, Izdatel'stvo Leningradskogo universiteta, 8,310 copies, 148 pages]

[Text] Annotation

This collective monograph deals with the basic problems connected with the methodology and methods of research in engineering and labor psychology. It examines the most important ways of studying the activity of an operator receiving and processing information, the methods of evaluating the status of the individual in various conditions of activity, and questions relating to training and to determining occupational fitness.

The book is intended for specialists in engineering psychology, labor psychology and ergonomics.

Editor's Preface

The need for simultaneous intensive development of all the fields of human knowledge is a characteristic feature of the current period of revolutionary changes in science and technology. Psychology is one of the sciences where the progress achieved in recent years enables us to talk about a characteristic "psychological boom." The "psychological boom" is not a chance phenomenon. The most diverse knowledge concerning man as a subject of labor, as a subject of cognition, and as a subject of communication was found necessary in the planning of new technology, in social planning, in development of new forms of instruction and methods of occupational training, etc. Among the psychological scientific disciplines which are of particularly great interest one would be justified in listing the psychology of labor and engineering psychology.*

*Engineering psychology, which formulates the principles of optimum human activity on the basis of a study of the brain's operation as an information system, is now characterized by the profound and specific nature of the methods of experiment and the theoretical concepts and approaches. Engineering psychology therefore actually represents an independent scientific discipline and is not a division of labor psychology although historically it is linked with precisely this field of the science of psychology.

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This is primarily due to the fact that the results of the research carried out in the field of labor psychology and engineering psychology are used at the "reification" level in material production.

To date the fields of engineering psychology and labor psychology have carried out an enormous number of research projects which, on the whole, have been directed at a search for optimum solutions in the designing of technical devices and equipment to be used by man; at creation of favorable environmental conditions; at improvement of the methods of occupational screening and training; at a search for ways of monitoring and controlling the status of the individual during his work, etc. These research projects vary as to level and direction. They are often based on a simplified perception of man and his activity when they stem from direct analogies with the function of the technical devices as, for example, automatic controlling machines. This sometimes generates mechanistic tendencies in comprehending the nature of the operation of the cerebral system and a dogmatic approach to the implementation of the psychological recommendations. If we bear in mind also that as things stand now the problem of providing qualified research psychologists is still a long way from a full solution, and that research in psychology and engineering psychology is now being carried out by specialists in various fields of knowledge, then we would have to recognize the special urgency of developing the methodological aspects of engineering psychology and labor psychology. There are now good resources for this purpose, engendered on the one hand by the achievements of the science of psychology in the field of theory and methodology and, on the other hand, by the wealth and diversity of the empirical material and the growing need for practical utilization of the results obtained.

The main purpose of the present collective labor is generalization and systematization of the knowledge concerning the object of research in engineering psychology and labor psychology, analysis of the basic methodological approaches and some of the methodological techniques, evaluation of the potentialities for utilization of the results of the research, etc. The authors make use of the results of their own experimental and theoretical research as well as the domestic and foreign published literature on the subject under study.

The nucleus of the author collective was comprised of associates of the ergonomics and engineering psychology departments and the engineering psychology laboratory of Leningrad University. In addition, for the writing of a number of the sections of the book we recruited scientists who had participated directly in the research done in the psychology department of LGU [Leningrad State University]. Part one of the author collective's work--this book--was written by the following: Chapter I (Introductory)--A. A. Krylov; Chapter II §1--M. A. Dmitriyeva, §2--M. A. Dmitriyeva and G. V. Sukhodol'skiy, §5--G. V. Sukhodol'skiy, §3--V. A. Ganzen, §2--A. I. Naftul'yev, §6--G. S. Nikiforov; Chapter III, §7 and §9--V. L. Marishchuk, §8--G. N. Khilova, §10--N. N. Obozov; Chapter IV, §11--A. A. Krylov and V. G. Naberezhnykh, §12 and §13--I. D. Rozhanskaya.

The editor and the author collective feel obliged to express their gratitude for the help given them in the preparation of this book by USSR Academy of Pedagogical Sciences corresponding member Professor B. F. Lomov, who provided direct supervision in the initial period of the creative activity of many of the associates of the ergonomics and engineering psychology departments and the engineering psychology laboratory of Leningrad State University.

Doctor of Psychological Sciences
A. A. Krylov

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Chapter I. Introduction. The Systems Approach as a Basis for Research in Engineering and Labor Psychology

The systems approach can be interpreted in modern science as "theoretical discussion of the methods and principles of research on objects as systems. The systems approach is thus a special direction of methodological analysis oriented at revealing the resources and prerequisites of systems research" ((1), page 148).

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On its academic side, the systems approach is associated with developing the principles of representing objects in the real world as systems. Expressing the aspiration of scientific thought to understand the real world, the systems approach forms a view of the world as a system. The act of representing an object as a system, of building a systemic picture of the world, is a cognitive process entailing synthesis on the basis of previous analysis. In this aspect the systems approach is a manifestation of the analytical-synthetic method of dialectical logic. In terms of the relationships between the systems approach (as a method) and the dialectical method of scientific research, we should note the following.

Being a union of logical and historical methods, the dialectical method is aimed at reflecting, without our system of knowledge, both the development of an object and its external and internal ties and dependencies (2,3, etc.). In this case the historical method deals with the causal relationships reflecting development of an object while the logical method presupposes investigation of functional relationships reflecting the qualitative certainty of the state of an object in each concrete moment in time.

In M. I. Setrov's opinion (3,4) the relationship between that which is logical and that which is historical is a more-general form of the relationship between the systems approach and the historical method. Thus the systems approach is viewed as a concrete form of just the logical method alone. But it would be difficult to agree with this opinion without reducing the systems approach to just the methodological principle of being systematic.

An analysis of the basic premises of the systems approach would show that they are based not only on the principle of being systematic, but also on the principle of dynamism, of system genesis. "On a philosophical plane," V. N. Sadovskiy and Ye. G. Yudin noted validly in our opinion ((5), page 10), "application of the systems approach means viewing the world as a system, one based on the ideas of integrity, a system in which the objectsof analysis are intricately organized, internally active and dynamic. These ideas are essentially borrowed by the systems approach from the dialectical-materialistic view of the world, and they are a particular development of both our philosophical understanding of the real world, and of the principles of its cognition." Consequently the systems approach is also an embodiment of the historical method.* And although the systems approach is now being used basically to reveal functional relationships allowing us to understand how an object is organized, revelation of causal relationships is not outside the realm of the systems approach. In this case the answer to the question as to why an object is organized in a particular way is extremely important both to theoretical studies and to solution of practical problems in different fields of science.

The dynamism principle, and the genesis principle in general, have very great significance to the systems approach in engineering psychology, which is abundant with various resources of formal analysis. This is associated first of all with the fact that automated control systems that contain a human operator have enjoyed tremendous development within a short period of time, typified by certain qualitatively new

*The binding link between that which is logical and that which is historical is, M. I. Setrov notes, the comparative method, inasmuch as "...causal relationships may be revealed if we know functional relationships. The genesis of a system may be uncovered only through a comparison of its individual, qualitatively different states" ((4), page 6).

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stages. And why certain functions are assigned to an operator in an automated system cannot be understood and the predictive requirements to be imposed on the system (as a means for controlling its development) cannot be worked out without studying the genesis of systems. As far as the work of an individual as an information system is concerned, it is only from the standpoint of man's genesis (in both the biological and social aspects) that we are able to understand the functional and structural organization of behavior control systems, or the role of individual psychophysiological mechanisms. A clear example in this respect would be the psychophysiological mechanism of emotional reactions. Of course, this does not mean that the principle of being systematic is displaced to a secondary plane when the systems approach is applied to engineering psychology. But it is entirely obvious that application of the systems approach, and incidentally any other approach, must not mean absolutization of some one method, some one principle. It is only on this condition that we can consider the question of making the systems approach the foundation of the theory and methodology of engineering psychology.

Formation of the fundamental positions of the systems approach is associated with development of cybernetics and general system theory, viewed as certain generalizing sciences.* Incidentally the fact itself that cybernetics was founded by a mathematician, N. Wiener, and that the fundamental principles of general system theory were developed by a biologist, L. Bertalanffy, is itself a noteworthy phenomenon, typical of modern science.

Cybernetics, defined as "all of the theory of control and communication in machines and living organisms" ((12, page 56), has its roots in the informational essence of control, in the fact that control proceeds in systems capable of receiving, storing and processing information. Inasmuch as we are referring, as Academician A. I. Berg emphasized (13), primarily to complex dynamic systems, we view the feedback principle as fundamental to organization, one promoting integrity, order and expediency in systems.

The main objective of general system theory, the basic principles of which were spelled out by Bertalanffy (14,15,16, etc.), is to clarify the principles of the formation, development, and behavior of systems. Or, in other words, revelation of laws permitting us to examine some set of elements existing in certain relationships with one another as a system. "In contrast to cybernetics, which analyzes the mechanisms of feedback," writes Bertalanffy ((17), page 41), "general system theory is interested in the dynamics behind interaction within a system with many variables." In this connection it deals with the open system--a system which exchanges matter and energy with the environment and which is capable, under certain conditions, of achieving a state of dynamic equilibrium typified by constancy of structure and continuous exchange and movement of matter. From this aspect, all living systems are defined as hierarchical open systems that sustain themselves or develop toward a state of

*In this aspect both cybernetics and general system theory have their prehistory (see for example (3,6,7)). Among the many generalizing theories and conceptions that had arisen in response to the needs of science and which had been indispensable factors in the logic of its development, we should name, first of all, A. A. Bogdanov's tectology (8,9,10) and L. Bertalanffy's "organismism" (11). And although Bogdanov's tectology never did transform, as "organismism" did, into a more-sophisticated theory, it does contain many of the ideas which are now being developed in cybernetics and general system theory.

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dynamic equilibrium. In Bertalanffy's opinion (17) the systems approach is in principle more-general than the cybernetic approach.*

Investigation of the mutual relationships and the "spheres of influence" between general systems theory and cybernetics, though it is doubtlessly interesting, is beyond our objective--that of analyzing the basic theoretical and methodological conceptions of engineering psychology from the aspect of the systems approach. We will therefore limit ourselves to the general remarks expressed above, and we will only note that a contribution is being made to development of the systems approach by information theory, automatic control theory, bionics, game theory, decision theory, etc. But as was noted earlier, research connected with the ideas spelled out in the works cited above by Wiener and Bertalanffy is playing the leading role in development of the systems approach (see for example 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, etc.). Works by M. I. Setrov (3,4) are a major contribution to the theory and methodology of the systems approach. In them, the author formulates the basic premises of the theory (which he calls the organizational or functional theory of organization), the concepts and principles of which are "stepping stones leading from general philosophical knowledge to concrete knowledge, from philosophy to the particular sciences" ((4),page 110).

In the opinion of V. N. Sadovskiy and E. G. Yudin (5), modern systems research has at least three aspects: theoretical, formal and applied. The theoretical aspect is associated with the sources, aims and tasks of systems analysis on the philosophical, logical-methodological and the concrete-scientific planes.

The formal aspect is connected with development of the analysis machinery (mainly conceptual and mathematical). In application to systems analysis, the conceptual machinery includes that complex of concepts which are directly related to the "system" concept; that complex of concepts reflecting the essence of system function; that complex of concepts revealing development of systems; that complex of concepts having to do with research on (and planning of) systems. Mathematical machinery is used in one form or another to build formal models of systems. Most indicative in this respect is application of the machinery of probability theory, set theory, game theory, etc.

The applied aspect of systems analysis has two directions. One is connected with development of the specific machinery of system theory in support of systems analysis. The second direction of the applied aspect is application of the general principles of the systems approach to concrete scientific analyses performed in different areas of knowledge. In Bertalanffy's opinion (17) the applied correlate of system theory (in the broad interpretation) is systems science, which is divided into three basic

*In Bertalanffy's interpretation, a number of the positions of general system theory are so general that they are comparable more to philosophical than to cybernetic principles. In their time, V. A. Lektorskiy and V. N. Sadovskiy (18) expressed quite valid critical remarks in this aspect, though Bertalanffy himself (17), responding to the criticism, writes that general systems theory has never claimed to play the role of the philosophy of modern science.

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areas: systems engineering, operations research and engineering psychology (human engineering).

It should be noted that engineering psychology has perhaps the greatest need for application of the principles of the systems approach as a means for developing its own theoretical and methodological foundations. It is precisely in view of the pronounced "systemic nature" of the objects of research in engineering psychology that the general provisions of the systems approach are predetermined and reflected in the very essence of the basic theoretical and methodological conceptions. It is especially important that all systems are studied in engineering psychology as information systems. Their physical nature, their structure (as things, as objects), and their physical, chemical and biological properties are analyzed only from the standpoint of supporting information relationships, from the standpoint of participation of these factors in information processing.* Consequently information processing is a reflection of the entire set of properties of the information system, viewed as a single whole. If we consider that information processing always occurs in a system, that it always proceeds by way of change in the state of this system (one ordered in space and in time), then we can reveal the content of one of the most important specific features of the systems approach in engineering psychology. This feature is that the information system is analyzed as a process reflecting the main essence of the system (in terms of its purpose)--that is, as one of information processing.

It follows from an analysis of basic theoretical and methodological conceptions that engineering psychology deals with information processing at two levels, the first being the human operator and the second being the automated control system as a whole. In correspondence with our general objective, we will devote our principal attention to organization and optimization of information processing at the "human operator" level.

In the broad sense, "optimum" means most in keeping with certain requirements, most in keeping with given criteria. Within the framework of the systems approach, the "optimum" concept is always applied to a particular system, and this places significant limitations upon the content of this concept, since what may be optimum for one system may not be optimum for another, and so on. We can conclude from a number of studies (31,32, etc.) that in relation to control processes, we can arrive at an optimum variant, by one way or another, with the assistance of a certain controlling procedure--optimization. Optimization boils down to seeking those values of controlling variables (within the bounds of the limitations imposed) which maximize or minimize the value of the target function.

Problems associated with optimizing information processing by a human operator--in terms of criterion selection and, all the more so, in terms of quantitative evaluations--have still not been studied sufficiently yet. The most significant studies in this direction were performed by Ye. P. Il'in. This author conducted interesting studies, but because his systems approach to evaluating the psychophysical system

*The opinion is now being expressed that living matter possesses certain physical properties that do not fit within the framework of our conventional ideas about the physical and chemical forms of movement of matter. Consideration is now being given to a "biological form" of movement of matter in this connection (29,30, etc.).

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of the human body as the highest expression of integrity and specific organization was not strict enough, we cannot make full use of his results to answer the questions associated with optimization of information processing.

Taking as our starting point the existing viewpoints on control optimization and basing ourselves on the circuit conception, which in our opinion reflects the most important positions of the systems approach in engineering psychology, we came to the conclusion that optimization of information processing by a human operator must be examined with a consideration for time outlays, the quality of results, and energy outlays. But when information is processed in the cerebral system, certain changes occur in the state of this system (and in the entire body), existing as both a material substrate and an organized physical environment. Therefore we would quite naturally raise the question as to precisely what the definition of an optimum state should be. Our assumption in regard to this question was that in general, an optimum state cannot exist apart from the objectives and conditions of activity, apart from a relationship with the qualities of the concrete performer of this activity.

The optimum working state of a system is that state which promotes performance of given activity in such a way that the actual results are most in keeping with the prescribed or required results. Thus we can express the integral characteristic of the optimum state by indicators representing productivity, the quality of results and energy outlays in the performance of the given activity. This definition is valid without restrictions only in relation to an ideal case, in which it is presumed that no readjustment within the system and no particular intensity of the system's work would have an effect on the system's possibility for sustaining a working state. Therefore in real conditions we always impose limitations predetermining the duration of activity and its influence on the system. Hence it follows that it would be best to define the optimum working state of an individual, existing as a unit in a control system, as that state which best supports information processing over a given time interval while meeting these mandatory conditions: a) performance of the activity does not elicit development of latent forms of fatigue capable of cumulative build-up; b) all undesirable functional changes in state arising in response to the activity being performed are completely eliminated during the activity itself or during prescribed breaks; c) the activity being performed does not elicit a negative attitude toward it on the part of the subject of activity. When these conditions are met, optimization of information processing is equivalent to attainment of the system's optimum state. It is from these positions that problems associated with research in engineering and labor psychology are examined in this work.

Chapter II. Methods of Describing, Analyzing and Evaluating Activity

§4. Analysis of an Operator's Tracking Activity From the Standpoint of Automatic Control Theory

Contemporary automatic control theory possesses a large arsenal of methods permitting analysis and design of the most diverse complex control systems. Many of these methods may be applied to the synthesis and analysis of closed control systems in which man performs all or some of the regulatory and monitoring functions. A block diagram of such a system is shown in Figure 5 for the general case. The task of the operator is to evaluate, on the basis of displayed information, deviation of the system's output $\overline{Z}(t)$ from the required value $\overline{y}(t)$ and to decrease this deviation

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by the appropriate controlling influence $\bar{u}(t)$, with a consideration for the requirements stemming from both the stability prerequisite and the dynamic characteristics of elements of the ergatic system $W_0(p)$ external in relation to the human operator. Tasks of this sort are called tracking tasks. If only error $\bar{\varepsilon}(t) = \bar{y}(t) - \bar{z}(t)$ is displayed to the human operator and if the function of the latter is to reduce $\bar{\varepsilon}(t)$ to zero, then the task is referred to as compensatory tracking. If $\bar{y}(t)$ and $\bar{Z}(t)$ are displayed to the human operator, the task is called pursuit tracking. If in addition to $\bar{y}(t)$ and $\bar{Z}(t)$ the operator is given $\bar{y}(\tau)$, $t<\tau\leqslant t+T$, the task is called predictive tracking.

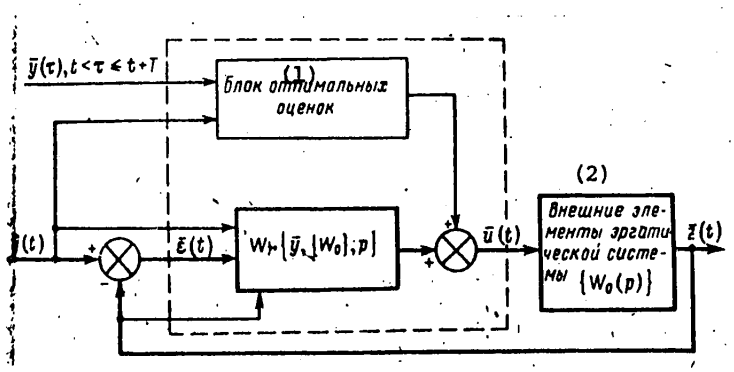

Figure 5. Block Diagram of a Tracking Loop for the General Case.

Key:
1. Optimum evaluation block
2. External elements of the ergatic system

If we are to develop a control system such as that shown in Figure 5, it would be desirable for us to possess a mathematical description of the human operator's characteristics. In other words it would be desirable to build a mathematical model of the operator's activity, one which would be compatible with the experimental data, which would be convenient to analysis and synthesis of a closed control system, and which would at the same time promote solution of some problems associated with planning the individual's activity in these systems.

Creation of an adequate mathematical model is a difficult task. The characteristics of activity depend significantly on many factors, among which we should note the type of tracking task (the form in which information is displayed, the dynamic characteristics of external elements, etc.), the environmental conditions (lighting, temperature, humidity, etc.), the operator's training level, motivation, tiredness, etc.. Numerous experimental studies have shown that factors typical of an individual performing a tracking task include a time delay, the frequency cut-off for the high-frequency components of the affecting function, the discreteness of perception of the input signal, extrapolation or prediction, adaptiveness, nonlinearity, and randomness. It would obviously be impossible to account for all of these factors and properties by a single model. The various models cited in the literature represent attempts to include these properties in the mathematical description to some extent or another.

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In this case the most diverse methods of automatic control theory have been used (and are being used) as the basis for creating the mathematical models.

Inasmuch as the areas of application of concrete methods are extremely broad and the number of problems arising is so great, it is impossible to treat them exhaustively in a single work. Consequently the material presented here must be viewed as just an introduction to the use of the methods of automatic control theory: Our main goals are, first, to provide a summary of the models most frequently employed and the methods of their acquisition, second, to examine the methods for developing models and to illustrate practical application of the models using a number of examples, and third, to note the basic directions of research in this area.

A Summary of the Most Popular Mathematical Models and the Methods of Their Acquisition

The roots of contemporary research on control systems involving a human operator from the positions of automatic control theory lie in the mid-1940's. The principal models proposed in this period and the methods used in their creation are shown in Table 3.

As we can see from the dated cited in this table, different methods of automatic control theory were used to develop models of a human operator's activity. However, the method of spectral analysis and the parameter tuning method were used most often. Methods created to solve the problems of optimum control are enjoying increasingly greater application today. Some results obtained with these methods are presented below.

Synthesis of Models by the Spectral Analysis Method

In the general case, as was noted, the human operator is represented as a nonlinear and nonstationary element of a control system. In many practical cases, however, his characteristics may be represented by a quasi-linear model. This model is the best suited to analysis of the compensatory tracking task. It was demonstrated in a number of studies that for trained operators, behavioral variability that may influence the general characteristics of this system is low. Part of the controlling influence may be correlated linearly with the displayed error, and referred to as the descriptive function (39). The remaining part is not linearly correlated with the input, and it is referred to as the remainder ("remnant").

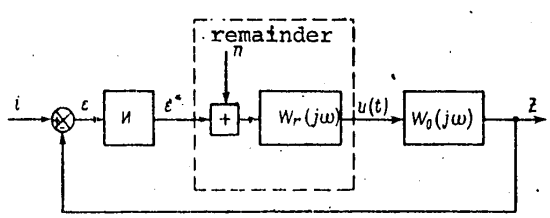

Figure 6. Block Diagram of a Compensatory Tracking Loop

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Table 3. Principal Mathematical Models of Tracking Activity and the Methods of Their Acquisition (From (38))

Input Signal	Control Object's Transfer Function	Mathematical Model of Tracking Activity	Model's Qualitative Criteria	Numerical Values of Parameters	Type of Tracking	Method of Model's Acquisition	Year of Model's Creation, Author
1. Superimposition of 4 sinusoids	$Y_c = K_1$	$Y_p(p) = \frac{K(1+Tp)}{p} \cdot e^{-\tau p}$	Not cited	K=3, 7 T=0.28 sec τ=0.38 sec	Unidimensional: compensatory, linear, continuous	Harmonic analysis	1951, Russel, L.
2. Sinusoid	$Y_c = K_1$	$Y_p(p) = \left(C_1 + \frac{C_2}{p}\right) \cdot e^{-\tau p}$	Autocorrelation function, error function of the model and the individual	C_1D*=0.35 rad/sec τ=0.30 sec C_2D=31.10 rad/sec	Unidimensional: compensatory, linear, continuous	Harmonic analysis	1954, Walston, C. E., Warren, C. E.
				C_1D=2.72 rad/ /sec, τ=0.3 sec C_2D=51.5 rad/ /sec *D--indicator's scale factor	Unidimensional: pursuit, linear, continuous		
3. Superimposition of 144 sinusoids	$Y_c = K_1$	$Y_p(p) = \frac{Ke^{-\tau p}}{1+T_1 p}$	$I = \frac{1}{T}\int_0^T \varepsilon^2 dt$	K=3.35 τ=0.139 sec T_1=0.88 sec	Unidimensional compensatory linear continuous	Spectral analysis	1956, Elkind, J.

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4. Random input	$Y_c = \frac{K_1}{p}$ $\frac{K_1}{p^2}$	$Y_p(p) = \frac{K(1+T_1 p)e^{-\tau p}}{(1+T_2 p)(1+T_3 p)}$	$I = \frac{1}{T}\int_0^T \varepsilon^2 dt$	K=0.078 τ=0.130 sec T_1=(0-5) sec T_2=(0-20) sec T_3=(0.1-1.0)sec	Unidimensional: compensatory, linear, continuous	Spectral analysis	1957, Krendel, E., McRuer, D.
5. Random input	$Y_c = \frac{K_1}{p^2}$	$Y_p(p) = \frac{K(1+T_1 p)e^{-\tau p}}{(1+T_2 p)(1+T_3 p)}$	$I = \frac{1}{T}\int_0^T (\varepsilon + q\varepsilon)^2 dt$	K=0.078; τ=0.142 sec T_1=3.0 sec T_2=0.21+0.03 j T_3=0.21-0.03 j	Unidimensional: compensatory, linear, continuous	Parameter identification (tuning)	1964, Bekey, G. Meissinger, I., Rose, R.
6. Quasi-random input	$Y_c = K_1$	$Y_p(p) = \left(\frac{1+T_1 p}{T_1}\right)\left(\frac{1-e^{-T_1 p}}{p}\right)\left(\frac{Ke^{-\tau p}}{1+T_N p}\right)$	$I = \left[\frac{1}{T}\int_0^T \varepsilon^2 dt\right]^{1/2}$	T_1=0.33 sec T_N=0.5 sec τ=0.06 sec K=3.35	Unidimensional: compensatory, linear, discrete	Spectral analysis	1962, Bekey, G.
7. Random input	$Y_c = \frac{K_1}{p+1}$	$Y_p(p) = \frac{K_1\tau\left(1+\frac{K_2}{\tau}p\right)}{(\tau+p)^2}$	$I = \frac{1}{T}\int_0^T \varepsilon\, dt$	K_1=6 K_2=5 τ=6 rad/sec	Unidimensional: compensatory, linear, continuous	Parameter identification (tuning)	1963, Adams, J., Bergeron, W.
8. Random input	$Y_c = \frac{K_1}{j\omega - 2}$	$Y_p(p) = Ke^{-j\omega\tau_d} \cdot \frac{(T_L j\omega + 1)(j\omega + 1/T_K)}{(T_1 j\omega + 1)(j\omega + 1/T'_K)} \cdot \frac{1}{(T_N j\omega + 1)\left[\left(\frac{j\omega}{\omega_N}\right)^2 + \frac{2\xi_N j\omega}{\omega_N} + 1\right]}$	$I = \frac{1}{T}\int_0^T \lvert\varepsilon\rvert dt$	K=1.9 τ_d=0.065 sec T_L=0.02 sec T_1=0 T_K=2.5 sec T'_K=25 sec T_N=0.063 sec ω_N=23 rad/sec ξ_N=0.1	Unidimensional: compensatory, linear, continuous	Spectral analysis	1965, McRuer, D.

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9. Random input	$Y_c = \frac{K_1}{p^2}$	$Y_p(p) = K(pT_L + 1)\exp\left(-\frac{\alpha}{p} - p\tau_e\right)$	$I = \frac{1}{T}\int_0^T \varepsilon^2 dt$	α=0.2 rad/sec τ_e=0.39 sec T_L=5.0 sec	Multi-dimensional: compensatory, linear, continuous	Spectral analysis	1966, Stapleford, R., McRuer, D., Magdalleno, R.
10. Random input	$Y_c = \frac{5,7}{p^2}$	$Y_p(p) = \frac{\omega_c e^{-p\tau_e}}{5,7} p$	$I = \frac{1}{T}\int_0^T \varepsilon^2 dt$	ω_c=3.2 rad/sec τ_e=0.39 sec	Unidimensional: compensatory, linear, continuous	Spectral analysis	1965, McRuer, D., Krendel, E.
11. Random input		$Y_p(p) = K\left[\frac{K_2}{K_0}p^2 + \frac{K_1}{K_0}p + 1\right]Ge^{-2p} \cdot \left[\frac{K_4(K_5 p + 1)}{M^2 p + N^2 p + Lp + 1}\right] + K_3 G_2 + \frac{\omega_0 + C}{\omega_0 + p^2}$	$I = \frac{1}{T}\int_0^T \lvert\varepsilon\rvert dt$	Not cited	Unidimensional: compensatory, non-linear, continuous	Parameter tuning method	1966, Goodyear Company
12. Random input		$Y_p(p) = \frac{K_2 p e^{-pt_2}[1 - e^{-p(t_3 - t_2)}]}{p(Tp + 1)K_1(1 - e^{-pt_1})}$	Not cited	K_1=1960 K_2=1960 t_1=0.3 sec t_2=0.4 sec t_3=0.7 sec T=0.1 sec	Unidimensional: compensatory	Regression analysis. Least square method	1969, Drozdov, S.O.
13. Random input	$Y_c = \frac{K_1}{p^2}$	$Y_p(p) = K_h \frac{1 + j\frac{\omega_2}{\omega}}{1 + \frac{\omega}{\omega_1}} e^{-j\omega\tau}$	Normal standard deviation	K_h=1 ω_1=1.0 ω_2=3.0 τ=0.25 sec	Unidimensional: compensatory, linear, continuous	Regression analysis with orthonormal filters	1967, Levison, W., Elkind, J.

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				$K_h=-2$ $\omega_1=2.0$ $\omega_2=3.0$ $\tau=0.25$ sec	Multi-dimensional: compensatory, continuous		
14. Random input	$Y_c=\frac{K_1}{p^2}$	$Y_p(p)=\frac{(T_L p+1)e^{-\tau p}K_h}{(T_i p+1)(T_1 p+1)(T_N p+1)}$	Normal standard deviation	$\tau=0.07$ sec; $K_h=-18$; $\frac{1}{T_N}=400$; $\frac{1}{T_L}=4.0$ $\frac{1}{T_i}=0$; $\frac{1}{T_1}=0$	Multi-dimensional: compensatory, continuous	Regression analysis with orthonormal filters	1966, Levison, W., Elkind, J.
15. Random input	$Y_c=\frac{5.15}{p(T_p+1)}$	$Y_p(p)=\frac{K(T_1 p+1)}{(T_2 p+1)(T_3 p+1)}$	$\varepsilon_N^2=\frac{\int_0^T \varepsilon^2 dt}{\int_0^T i^2 dt}$	$K=0.151$ $T_1=2.72$ sec $T_2=0.0557$ sec $T_3=0.85$ sec	Uni-dimensional: compensatory, continuous	Spectral analysis	1966, Todosiev, E., Rose, R., Summers, L.
				$K=0.167$ $T_1=2.71$ sec $T_2=0.0644$ sec $T_3=0.723$ sec	Two dimensional: compensatory		
16. Random input		$Y_p(p)=\exp(-pm)\cdot\frac{1}{1+\alpha^2(hp)+\alpha^2(hp)^2+\alpha^2(hp)^3+\alpha^2(hp)^4+(hp)^5}$	Not cited	$m=0.2$ sec $\alpha=1.9$ $\lambda=1/20$	Uni-dimensional: pursuit	Spectral analysis	1963, Neslen, P., Raul', D.

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17. Random input	$Y_c = \frac{K_1}{p}$	$T/T_0 = cf\tau \log_2 \frac{\overline{K^2}}{\overline{P^2}}$	Not cited	C=0.3 sec/bit $\log_2 \frac{\overline{K^2}}{\overline{P^2}} \approx 3$ bits/sec	Unidimensional: compensatory, nonlinear, continuous	Information theory	1968, Shveytser, G.
		$T/T_0 = \sum_{i=1}^{m} C_i f \tau_i \log_2 \frac{\overline{K_i^2}}{\overline{P_i^2}}$			Multidimensional: compensatory, nonlinear, continuous		
18. Random input	$Y_c = \frac{K_1}{p}$	$Y_p(p) = \frac{K_m}{T_m p + 1}$; $T_m = \frac{T}{2\xi}$; $K_m = \frac{1}{2K_1 \xi T}$; $T = \frac{t_0 \sqrt{1-\xi^2}}{\pi - \operatorname{arc\,tg}(\sqrt{1-\xi^2}/\xi)}$		ξ=0.5 T=0.23	Unidimensional: compensatory, adaptive (to object)		1967, Tsibulevskiy, I.A.
19. Two different input signals, each being a superimposition of 3 sinusoids	$Y_c = K_1$	$Y_p(p) = \frac{e^{-p\tau}}{T_m p + 1}$	Standard deviation	t_1 | T_m=0,26 sec, τ=0,40 sec t_2 | T_m=0,96 sec, τ=1,10 sec	Unidimensional: compensatory, continuous, adaptive to input signal	Least square method	1967, Robinson, N.
20. Random jumps	$Y_c = K_1$	$Y_p(p) = \frac{K}{e^{rp}(T_N p + 1) + K}$; $r = \tau + T$	Standard deviation	T_N=0.45 sec T=(0+10) sec τ=0.3 sec K=0.4-0.5	Unidimensional: pursuit with delay	Not cited	1968, Thompson, K., Leslie, L.

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Figure 6 shows a block diagram of a compensatory tracking loop for the case of a quasi-linear model. This is, from the standpoint of automatic control theory, a system with a single feedback loop. The important traits of such systems include a single stimulus (error $\varepsilon(t)$) and randomness of application of the affecting function $i(t)$. Taking account of these limitations, the diagram in Figure 6 represents the most widespread structure of real manual control systems. As we can see from Figure 6, the descriptive function $W_p(j\omega)$ is functionally dependent on the spectrum of the input signal S_i, the transfer function of the object of control $W_O(j\omega)$, frequency ω and, finally, time t. The first two are the principal variables of this task. The rest of the factors, such as training level, motivation and environmental conditions, are time-dependent factors.

Descriptive function $W_p(j\omega)$ may be obtained by a method that was developed practically simultaneously by I. Ye. Kazakov in the USSR and (Buton) in the USA to analyze nonlinear systems involving Gaussian random input signals. A detailed presentation of theoretical problems connected with acquisition of $W_p(j\omega)$ is contained in works by McRuer, Krendel, Elkind, (Bike) and others. We will briefly examine the basic results here.

Were the characteristics of a human operator to correspond to the characteristics of a linear element, a controlling influence (the operator's output) $u^0(t)$ may be obtained from the equation

$$u^0(t) = \int_0^\infty h(\tau)\,\varepsilon(t-\tau)\,d\tau, \qquad (2)$$

where $h(\tau)$ is a weight function. In real human activity, however, an operator's output inevitably differs from the ideal output $u^0(t)$ by an error

$$\varepsilon(t) = u^0(t) - u(t). \qquad (3)$$

Let us assume that the human operator tries to minimize the variance of the error:

$$\overline{\varepsilon^2} = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} \varepsilon^2(t)\,dt. \qquad (4)$$

It follows from Wiener's filtration theory that for function $h(t)$ to minimize the mean square error $M\{\varepsilon^2(t)\}$, it would be necessary and sufficient to represent $h(t)$ by a Wiener-Hopf linear integral equation:

$$K_{\varepsilon u}(t) = \int_0^t h(\nu)\,K_\varepsilon(\tau-\nu)\,d\nu. \qquad (5)$$
$$\tau > 0$$

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Here, $K_{\varepsilon u}(t)$ is the mutual correlation function of $\varepsilon(t)$ and $u(t)$, and $K_{\varepsilon}(t)$ is the autocorrelation function of $\varepsilon(t)$. Let us rewrite (5), introducing spectral densities. Considering the known dependence between the mutual spectral density between the input and output of a linear element and the spectral density of the input, and the fact that the transfer function of a stationary linear system is a Fourier expression of its weight function, we get

$$S_{\varepsilon u}(\omega) = W_r(j\omega) S_{\varepsilon}(\omega). \qquad (6)$$

Here, $S_{\varepsilon u}(\omega)$ is the mutual spectral density between $\varepsilon(t)$ and $u(t)$, and $S_{\varepsilon}(\omega)$ is the spectral density of $\varepsilon(t)$.

Let us find the mutual spectral densities between $i(t)$ and (t), and between $i(t)$ and $u(t)$:

$$S_{i\varepsilon}(\omega) = \frac{1}{1 + W_r(j\omega) W_0(j\omega)} S_i, \qquad (7)$$

$$S_{iu}(\omega) = \frac{W_r(j\omega)}{1 + W_r(j\omega) W_0(j\omega)} S_i. \qquad (8)$$

The values of (7) and (8) may be obtained experimentally. It follows from (7) and (8) that

$$W_r(j\omega) = \frac{S_{iu}(\omega)}{S_{i\varepsilon}(\omega)}. \qquad (9)$$

Were we to represent dependence (9) graphically, the approximation of the obtained curve would be a mathematical model of the human operator's activity. The complexity of the model would depend on the accuracy with which we desire to reproduce the characteristics of the human operator.

However, for many practically important cases we can limit our approximation to the following relationship:

$$W_r(j\omega) = \frac{K(T_L j\omega + 1)}{(T_1 j\omega + 1)} \cdot \left\{ \frac{e^{-j\omega\tau}}{T_N j\omega + 1} \right\}. \qquad (10)$$

The term $\{\cdot\}$ approximates the delay in reaction time and the transport lag in the neuromuscular system. The other term approximates man's capability for adapting his characteristics in accordance with the requirements of his task in such a way that the characteristics of the closed loop would correspond to the characteristics of a "good" control system. Here, K is the human amplification factor and T_L and T_1

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are, correspondingly, the time constants for human anticipation and delay. The numerical values for the parameters are given in Table 3 in relation to different conditions.

The transfer function of the object of control is an important variable, because it determines what the transfer function of the operator should be, at least within the range of working frequencies.

Table 4. Relationship of $W_0(j\omega)$ and $W_r(j\omega)$

$W_0(j\omega)$	$W_r(j\omega)$
K_0	$\frac{Ke^{-\tau_e j\omega}}{(T_1 j\omega+1)}$
$\frac{K_0}{j\omega}$	$Ke^{-\tau_e j\omega}$
$\frac{K_0}{(j\omega)^2}$	$K(T_L j\omega+1)e^{-\tau_e j\omega}$
$\frac{K_0}{j\omega(Tj\omega+1)}$	$K(T_L j\omega+1)e^{-\tau_e j\omega}$
$\frac{K_0}{\left(\frac{j\omega}{\omega_n}\right)^2+\frac{2g}{\omega_n}j\omega+1}$	$K(T_L j\omega+1)e^{-\tau_e j\omega}, \quad \omega_n \ll \frac{1}{\tau_e}$ $\frac{Ke^{-\tau_e j\omega}}{(T_1 j\omega+1)}, \quad \omega_n > \frac{1}{\tau_e}$

The effective lag time τ_e in Table 4 is a low frequency approximation of all high frequency delays in the system, to include delays arising due to transportation outlays and due to the dynamic characteristics of the object of control. To obtain the total value for the spectral density, we would need to consider the remainder, which may be represented as white noise operating on the input of the "human operator" unit. As an example the spectral density of error $\varepsilon(t)$ is

$$S_\varepsilon(\omega)=S_{\varepsilon_l}(\omega)+S_{\varepsilon_n}(\omega)=$$
$$=\frac{S_l(\omega)}{[1+W_r(j\omega)W_0(j\omega)]^2}+\left[\frac{W_r(j\omega)W_0(j\omega)}{1+W_r(j\omega)W_0(j\omega)}\right]^2 S_{n_\varepsilon}(\omega), \quad (11)$$

where $S_{n_\varepsilon}(\omega)$ is the spectral density of the remainder, treated as an input signal introduced into the loop before the operator's descriptive function.

In the derivation of (11), we accounted for the known result of spectral analysis that the spectral density of the output is equal to the spectral density of the input, multiplied by the square of the modulus of the complex transfer factor.

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The validity of the quasi-linear model rests on evaluation of that part of the spectral density of the output which is predicted by the model at different frequencies. This evaluation may be made by calculating the linear correlation of $u(t)$ and $i(t)$ using

$$\rho = \frac{|S_{iu}(\omega)|^2}{S_i(\omega)\,S_u(\omega)}. \qquad (12)$$

According to research data, $\rho \geqslant 0.9$ for a flat spectrum with cut-off frequency $\omega_c = 0.75$ Hz. Linear correlation decreases quickly with increase in the frequency contained in the input signal. When $\omega_c = 1.6$ Hz, $\rho = 0.75$, and when $\omega_c = 2.4$ Hz, $\rho = 0.6$ for a flat spectrum. Experimental data show that the remainder grows as the control object's amplification factor K_0 increases (for $K_0 > K_{0opt}$), as T_L grows, and as the object's instability increases.

Several ways for reducing the influence of this remainder are described in the literature. Perhaps the most important of them is to modify the dynamic characteristics of the object of control, ω_0, in such a way that little anticipation would be needed from the human operator ($T_L \ll 1$). It follows from this that in a region of frequencies corresponding to the conjugate (or fundamental) frequency of the control system, it would be desirable to have $\omega_0 = K_0/p$ or $\omega_0 = K_0$. Another method entails adaptation of the object's amplification factor K to its optimum value. Unfortunately the latter method is still basically empirical. Finally, low frequency filtration of the human operator's output has been proposed.

Use of the Parameter Tuning Method for Mathematical Description of a Human Operator's Activity

The parameter tuning method, created in the theory of adaptive control systems, has enjoyed broad application in the development of mathematical models of activity. In general form, the parameter tuning method may be stated as follows: A certain physical system P and a set M of potential models are given. By choosing the appropriate parameters, we are required to find a model $m \in M$ having an output which, in a certain sense, corresponds most fully to the output of P, given an identical input.

In our case the physical system is the object controlled by the human operator. Figure 7 shows the general block diagram of the parameter tuning method for the case of developing a mathematical model of activity. The same signal is fed to the input of the model and the human operator. The output of the model and the control system are compared, resulting in formation of an error signal. The latter is fed to the input of the parameter tuning mechanism. The tuning mechanism changes the parameters of the model in such a way as to minimize a certain criterion describing the quality of the model.* Thus when we use the parameter tuning method we must consider the problems of selecting the mathematical model, selecting the function for the quality criterion, and selecting the procedure for parameter tuning.

*In the particular case, when simple tasks are involved, the function of the tuning mechanism may be performed manually.

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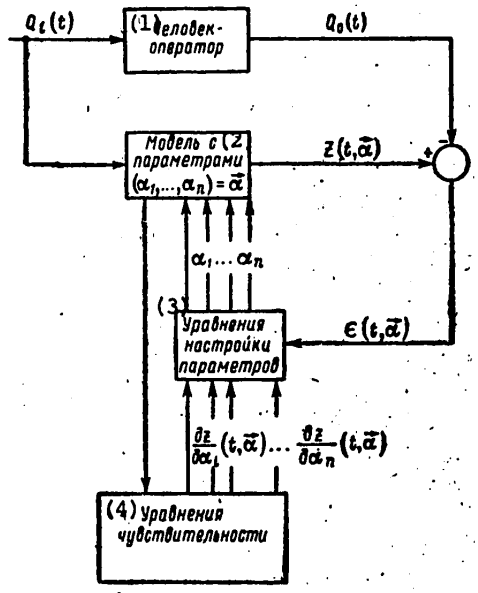

Figure 7. General Diagram for Acquisition of a Mathematical Model Describing the Activity of a Human Operator by the Parameter Tuning Method

Key:

1. Human operator
2. Model with parameters
3. Parameter tuning equations
4. Sensitivity equations

The form of the mathematical model must be selected depending on the tracking task involved. In the particular case of single-coordinate compensatory tracking, representation of the mathematical model by a second-order equation is fully sufficient (the model represented by equation (10) is an example).

The function for the quality criterion is usually selected in the form of a mean square error:

$$I=\int_{t_0}^{t_0+T} \varepsilon^2\,dt=\int_{t_0}^{t_0+T} [u_r(t)-u_M(t)]^2\,dt. \qquad (13)$$

The parameter tuning method is determined on the basis of the optimization algorithms involved, and it may entail procedures such as the Gauss-Zeidel procedure, the gradient procedure, the fastest descent procedure, and the extrapolation procedure. To create a mathematical description of activity, special studies show, it would be suitable to use the fastest descent procedure. The merit of the parameter tuning method lies in that it makes consideration of nonlinearity and change in the characteristics of human behavior over time possible in the mathematical description.

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In a number of cases parameters may be tuned manually within an acceptable period of time. A block diagram for this case is shown in Figure 8 (40). The human operator tracks input signal $Z(p)$ displayed on oscilloscope "И". Two signals are fed to the input of oscilloscope "O" (correspondingly to the vertical and horizontal deflector plate). One signal represents the reaction of the human operator $Y(p)$ to input signal $Z(p)$, while the other represents the model's reaction $Y_m(p)$. When the parameters are selected correctly, $Y(p) \approx Y_m(p)$ and a straight line is observed on oscilloscope "O". Otherwise we observe an ellipse. One shortcoming of this system is the absence of parameter variation laws. This shortcoming may be compensated partially by using weight coefficients when determining the parameters. Weight coefficients are read from a voltmeter.

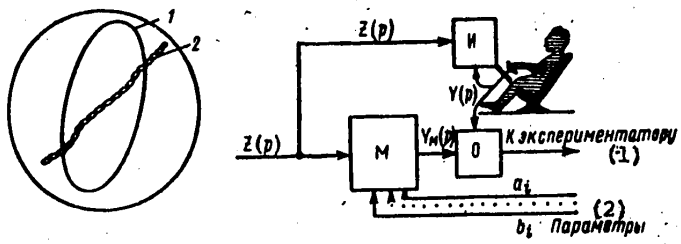

Figure 8. Diagram Showing Acquisition of a Mathematical Model of Activity in the Presence of Manual Parameter Tuning (From V. A. Taran and Yu. N. Kofanov (40): oscilloscope display: *1*--when disagreement with the model is significant; *2*--when there is agreement with the model

Key:
1. To experimenter
2. Parameters

Optimum Models of Activity

Development of the theory of optimum control had a significant influence on the methodology associated with mathematical modeling of activity. Optimum control theory has special significance to modeling in that by using its methods, we can obtain models for the activity of a human operator in complex multiple-loop control systems by utilizing the state concept . Activity models created with the methods of optimum control theory are called optimum models. The plausibility of optimum models has been confirmed by numerous experimental studies that have demonstrated the fact that when man performs tracking tasks, he operates with what might be called an optimum strategy.

It should be noted that very complex and cumbersome mathematical machinery is used to build optimum models. This prevents us from explaining, in detail and precisely within the limits of this book, the existing methods for building optimum models. Therefore we will examine, in the most general form, only one possible model building scheme based on certain results of the theory of optimum estimates.

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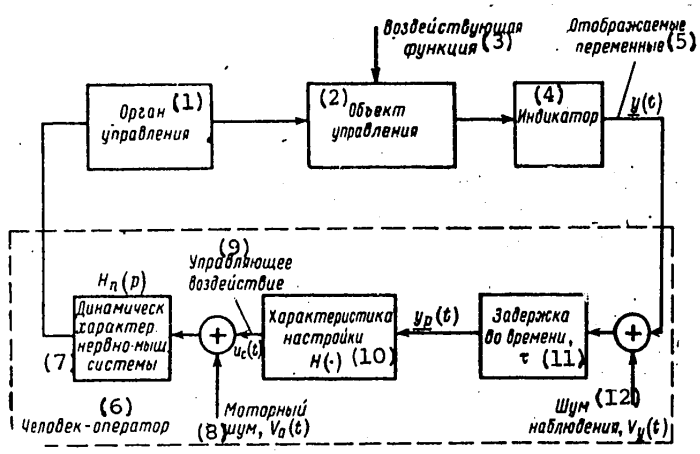

Figure 9. Block Diagram of a Control Loop Accounting for a Number of Characteristics of the Human Operator

Key:

1. Control fixture
2. Object of control
3. Affecting function
4. Display
5. Displayed variables
6. Human operator
7. Dynamic nature of the neuromuscular system
8. Mechanical noise
9. Controlling influence
10. Tuning characteristic
11. Time delay
12. Observation noise

Let us examine the control loop shown in Figure 9, containing a human operator. As we know, whenever we build a model we must account for certain limitations. In this case we assume that the human operator introduces a certain time delay associated with visual processes, information processing in the central nervous system and so on, and the time lag of the neuromuscular system; this lag, in the opinion of a number of authors, is approximated sufficiently well by the expression

$$H_n(p) = \frac{1}{T_N p + 1}.$$

Change in characteristics depending on the control tasks and the dynamic properties of the object is represented in Figure 9 by block $H(\cdot)$. In addition we assume that when a state variable is displayed, the individual will perceive both this variable and its first derivative.* In this case observation noise $V_y(t)$ would exist. One or several values of the system's output may be displayed for the individual, but for the sake of simplicity we will assume that he can perform only one controlling influence $u(t)$ together with a certain amount of noise $V_u(t)$ (mechanical). Special research has shown that $V_{y_i}(t)$, $t = 1, 2, \ldots, m$, and that $V_u(t)$ may be interpreted as Gaussian white noise.

*This assumption has been fully justified by experimental studies.

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The main task of the human operator is to control the system in a certain prescribed fashion. Consequently the moment we introduce the appropriate limitations and the noise contributed by the individual, selection of the appropriate optimization criterion becomes the main problem. In the case under examination here, the following functional was selected as the criterion:

$$I(u) = E\left\{\sum_{i=1}^{n} q_i x_i^2 + ru^2 + g\dot{u}^2\right\}. \qquad (14)$$

Then the task of the operator would be to select that $u^*(t)$ which would minimize functional (14). In (14), subjective weights satisfy the conditions $q_i \geqslant 0$, $r \geqslant 0$, $g > 0$. It should be noted that selection of the weight factors is far from a trivial task. The term containing $\dot{u}$ is introduced due to the need for approximating the dynamic characteristics of the neuromuscular system.

The system's movement is defined by the following state equations:

$$\left.\begin{aligned} \dot{\underline{x}}(t) &= \underline{A}\,\underline{x}(t) + b\underline{u}(t) + \underline{W}(t), \\ \underline{y}(t) &= \underline{C}'\underline{x}(t), \end{aligned}\right\} \qquad (15)$$

where the n-dimensional vector $\underline{x}$ represents the state of the system, $\underline{u}$ represents the operator's controlling influence (a scalar), and $\underline{W}$ represents external perturbations. Considering the limitations noted above, at a current moment in time the individual would have the following at the input:

$$\underline{y}_p(t) = \underline{C}'x(t-\tau) + \underline{V}_y(t-\tau). \qquad (16)$$

Selection of functional (14) as the criterion in the presence of motion equations (15) results in the presence of linear feedback. Then, if we accept the general assumptions concerning the controllability and observability of the control system with regard to the conditions named above, development of the model would boil down to solving a problem that has been worked out well and which has been illuminated with sufficient detail in special studies--that of analytical design of regulators characterized by a time delay and presence of observation and output noise. An optimum estimate may be arrived at and the controlling influence may be selected with a combination of a (Kalmen)-Wiener filter and an optimum predictor.

It should be noted that a Kalmen filter includes a model of the dynamic characteristics of the object of control--that is, this approach may also be used to describe activity in the case where the characteristics of the system change with time. Considering the fact that almost all limitations significant to quasi-linear models are removed from an optimum model, we feel that the latter will soon assume a leading place in the mathematical modeling of tracking activity.

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Example of Using a Mathematical Model

The first task of an engineering psychologist in planning a certain form of activity is to work out the requirements to be imposed on the displays and controls. Mathematical models of activity must be the main tool he uses for this task. Let us illustrate the possibilities of modeling with a concrete example.

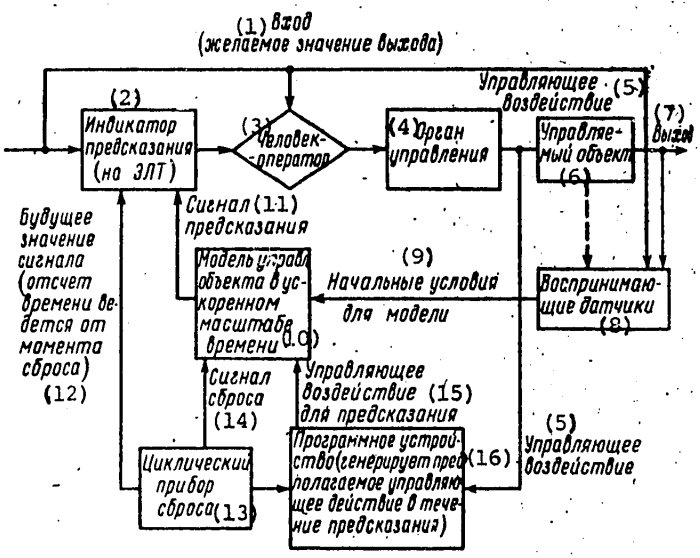

Figure 10. Block Diagram of a Control Loop Containing a Prediction Display

Key:

1. Input (desired output value)
2. Prediction display (CRT)
3. Human operator
4. Control fixture
5. Controlling influence
6. Object of control
7. Output
8. Sensors
9. Initial conditions for the model
10. Model of object of control in accelerated time
11. Prediction signal
12. Future value of signal (time is reckoned from moment of reset)
13. Cyclic reset unit
14. Reset signal
15. Controlling influence for prediction
16. Programming unit (generates suggested controlling action during prediction time)

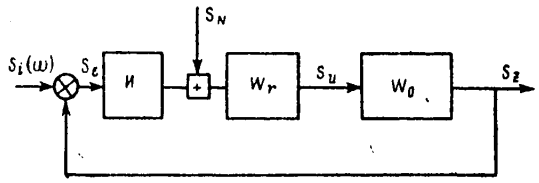

Figure 11. Diagram of a Control Loop Used to Calculate the Difficulty Index

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A so-called prediction display, a block diagram of which is shown in Figure 10, has recently been enjoying increasingly broader application. Such displays have been found to be an extremely effective means of controlling complex dynamic objects. Development of prediction displays requires, in particular, an answer to the question as to what is the optimum prediction time. The choice of prediction time not only determines the requirements to be imposed on technical components, but it also has a significant influence on the characteristics of human activity.

Let us try to calculate optimum prediction time using certain modifications of the general quasi-linear model represented by expression (10), and the calculation scheme proposed by Hollister (41). Let us assume that an individual is included in the control system as shown in Figure 11, and that an ordinary compensatory system is used to display the error signal to him. Let us assume furthermore that the anticipation time T_L contributed by the individual must correspond to an optimum prediction time. (This assumption may be justified with McRuer's "intersecting" model (see Table 3)). At frequencies at which the individual introduces the element of anticipation, the value of the controlling influence $u(t)$ is greater than the error produced by amplification $K_p\varepsilon$. At frequencies at which the individual introduces a time delay, $u(t)$ is less than $K_p\varepsilon$.

Let us introduce the anticipation coefficient:

$$L = \frac{\overline{u^2}}{\overline{(K_p\varepsilon)^2}}. \qquad (17)$$

As we can see from (17), if anticipation time T_L dominates, then $L>1$; if time delay T_1 dominates, then $L<1$; when $W_r(j\omega) \approx K_p$, $L \approx 1$. Next let us introduce difficulty index D:

$$D = \frac{(L-1)^2}{L}. \qquad (18)$$

As we can see from (18), difficulty grows as T_L and T_1 increase, and it is equal to zero at $L=1$, which generally agrees with the empirical data. Let $W_0(j\omega) = K_0/(j\omega)^2$. As follows from Table 4, for an object with such a transfer function,

$$W_r(j\omega) = K_p(T_L j\omega + 1). \qquad (19)$$

It is assumed in (19) that by introducing T_L, the individual also compensates for the effective lag time--that is, $\tau_e \approx 0$.

Let $x = \text{const}$; then the system would be influenced by noise $n(t)$, which we can treat as white noise with spectral density $S_N = A/\pi$ without sacrificing the model's generality. Applying the known procedure of spectral analysis, we can obtain

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$$\overline{u^2} = \frac{A(K_p K_0 T_L^2 + 1)}{T_L}, \tag{20}$$

$$\overline{\varepsilon^2} = \frac{A}{K_p^2 T_L}. \tag{21}$$

Then the anticipation factor would be

$$L = \frac{\overline{u^2}}{(\overline{K_p \varepsilon})^2} = K_0 K_p T_L^2 + 1. \tag{22}$$

Substituting for K_p and T_L in (20), (21) and (22), we get

$$\overline{\varepsilon^2} = \frac{A^4 K_0}{(u^2)^3} \cdot \frac{L^3}{(L-1)^2}. \tag{23}$$

Let us assume that the quality criterion that is minimized by the human operator is a linear combination of the root mean square error and the root mean square deviation. Then activity would be optimum at $L = 3$ (Figure 12). Assuming that $T_{L_{opt}}$ corresponds to the optimum value of L in (22),

$$K_c K_p T_{L_{opt}} = 2. \tag{24}$$

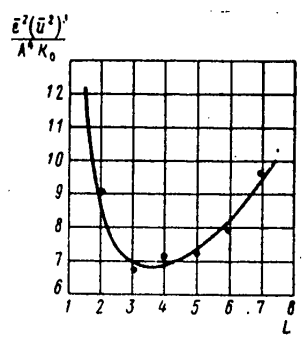

Figure 12. Dependence of Tracking Quality on the Difficulty Index for a Second-Order Object

For simple cases, K_p may be determined from (17), if we assume that $L = 3$. Substituting for K_p in (24) and (17), we get

$$T_{L_{opt}}^2 = \frac{2\sqrt{3}}{K_0}\left(\frac{\overline{\varepsilon^2}}{\overline{u^2}}\right)^{1/2}. \tag{25}$$

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The optimum prediction time, $\tau_{L_{opt}} = T_{L_{opt}}$, is calculated using formula (25). A more-accurate estimate of τ_L may be obtained by building an optimum tracking model allowing for prediction. For planning purposes, however, the agreement between data calculated with formula (25) and the data obtained in our experiments was satisfactory, the discrepancy not exceeding 12 percent.

* * *

Thus study of operator tracking activity from the positions of automatic control theory opens up new possibilities for optimizing automated systems.

Further development of the methods of automatic control theory in application to the activity of a human operator inescapably needs psychological interpretation and models that take stricter account of behavioral properties such as adaptiveness. nonlinearity, discreteness, randomness, and so on. This is important both to solving the problems of human factors planning and to deeper and stricter analysis of the function of the mechanisms of mental regulation.

Chapter III. Investigation of Functional State With the Purpose of Evaluating Performance, Occupational Selection and Group Compatibility

§10. Effectiveness of Group Work and the Principal Methods of Its Evaluation

Assessing the effectiveness of group work as well as selecting and composing the group are a natural continuation of occupational selection. Occupational selection has the purpose of determining an individual's capability to perform activities associated with the job, while group selection accounts for the additional capability of effective interaction.

Many works have been devoted to comparative analysis of individual and group work (122,123,125,126,127). The variability seen in the behavior of individuals performing various group tasks in groups of different quantitative and qualitative composition stems not only from external causes but also from internal ones, manifesting themselves in individuals engaged in group work and influencing the nature of the work of other members of the group performing joint activity.

The authors of the collective monograph "Inzhenernaya psikhologiya" [Engineering Psychology] (128) name, among other basic problems of engineering psychology, optimum interaction of operators in a control system. Organization of optimum interaction among operators presupposes composing the group with regard to the individual features and personalities of the operators. Sensible composition of small groups presupposes experience in prediction of group results on the basis of information describing the typical individual features of the subjects. The group must be composed in such a way that the results of its work would be most in keeping with the objectives of the joint activity. Concrete solution of problems associated with making up groups of operators, crews and so on requires meticulous analysis of group phenomena such as imitation and suggestibility, group conflict, intragroup subordination-coordination relationships, psychophysiological and psychosocial compatibility of group members, the group's learning ability, intragroup communication and so on.

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It is a universally recognized fact in social psychology that the formal organization of a group must correspond to its informal organization, and conversely, the internal psychological relationships among individual members must correspond to the external objective organization. While the informal principle of unification of the members of a group manifests itself through mutual satisfaction of the needs of the interacting members, the second, formal principle of organization often operates independently of the wishes of the interacting members. This condition creates the need for considering the correspondence existing between the internal psychological (and even psychophysiological) relationships among group members and the external objective organization. Consequently we encounter the problem of considering, selecting and composing optimally operating groups with regard to the psychosocial and typical individual features of the interacting individuals.

Researchers developing projective tests have noted that when human behavior is rigidly controlled by an external program, personality characteristics are manifested to a lesser extent than if such a program provides a certain freedom of choice in the particular variant of behavior. Consequently the concrete conditions of joint activity and the type of operator functions involved dictate the program for selection and composition of small groups.

Examining the effects of interaction of people, and especially the results of their joint activity, we may reveal their work to be identically effective, but the price of this effectiveness may vary. Differences in outlays may be revealed both within a functioning group and between groups. This is why some methods for evaluating the effectiveness of joint actions reveal the operational side of interaction while others concentrate on the functional side (the energy expenditures required to complete group tests). The former include all integrative and some individual methods, and the latter include individual methods used to evaluate functional states of individuals working together (changes in mental and psychophysiological characteristics: sensory-perceptual, psychomotor, hemodynamic, tremor, GSR, body temperature etc.).

Of the different forms of groups in M. A. Novikov's classification (129)--nominal, associative, consolidated and homphoteric, the last two variants are of interest to engineering psychology. In addition to common goals, a consolidated group presupposes distribution of functional responsibilities, while a homphoteric group additionally presupposes high occupational preparedness for a concrete activity and psychophysiological compatibility of the members.

Inasmuch as psychophysiological compatibility of operators performing joint work is one of the key conditions of the group's effective work, this issue must be considered in detail. Compatibility is an effect of combining individuals which produces the maximum possible results under the given conditions with minimum energy outlays by the interacting members of the group. Greater or lesser compatibility may be evaluated both on the basis of the output data for the work of the entire "operators-machine" system and on the basis of results of interaction between operators specifically.

Compatibility may be evaluated on the basis of: work results; energy outlays (psychophysiological changes occurring during joint work); subjective satisfaction with the joint activity (the activity itself, and interaction). Optimum compatibility presupposes that combination of interacting elements which promotes

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the greatest degree of possible interchangeability of elements within the system (interacting individuals) and the best mutual complementation of elements within the system as a whole. Optimum compatibility presupposes not only joint work but also any other form of interaction, communication, joint relaxation etc. It creates the groundwork for mutual sympathy, conformity and unification of mental and psychophysiological functions.

Interaction of operators in an automated control system may be direct (visual, manipulative and verbal); it may be indirect (by way of displays); it may proceed through the entire time of joint work; it may manifest itself in the end product of joint actions, and so on. All methods used to evaluate the joint work of a group of operators may be divided into two large groups: integrative, evaluating the work of a group as a whole, and individual or differential-psychological, evaluating the successfulness of joint work on the basis of individual characteristics (individual and personal).

Here are the integrative methods:

1. The homeostat method (allowing for discrete and continuous regulation, and for stabilization and tracking).

2. The cybernometer method (used to exercise psychomotor action, to solve perceptual and mental problems, and to determine "leader-group" coordination).

3. The sociometric method.

4. Methods used to study conformity of members in a small group.

5. The method of determining the "conflict resistance" of the participants of joint work.

Integrative methods of evaluating the effectiveness of group work allow us to determine: the psychological structure of the group (equal and authoritarian relationships); the emotional nature of relationships (the sympathies and antipathies of the group members); types of communicative behavior; the conformity of group members; conflict resistance in extreme conditions of interaction; the ability to work well together, psychophysiological and psychosocial compatibility.

The differential-psychological methods of evaluating the effectiveness of group work presuppose examination of candidates during joint work. For this purpose we determine the various typical individual features of individuals who will participate in joint activity as operators in the future. We determine specific temporal (speed) and accuracy characteristics of the operators depending on the concrete form of joint activity involved. In subsequent selection of the candidates for particular groups, we consider the following basic parameters: the individual characteristics of performance speed and accuracy; the individual range of these characteristics; the degree of similarity exhibited by the speed and accuracy characteristics of the future participants of joint work; the degree of resistance to interference exhibited in relation to the principal operator functions.

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Individual methods of evaluating the ability of group members to work together consider: occupational fitness; the typical individual features of neurodynamics, psychomotor, sensory-perceptual and memory functions; characterological features; psychosocial characteristics (structure and orientation of interests, relationships, attitudes).

The unique ways in which habits are developed and material is learned, the orientation of tracking reactions (anticipation and tardiness), and work stability (variability of indicators) are subject to special consideration. In addition to the directly applied parameters of a human operator listed above, special consideration must be given to the typical individual features of neurodynamics as well as to specific character features such as extraversion, neuroticism and so on.

Homeostatic methods are used to reveal a group's capability for balancing interactions within the group (129,130,131 etc.). Each member of a group working with a homeostat is provided with indicators and control levers. Between the levers and indicators there are amplification units which regulate (set) the mutual relationship existing between the lever and the indicator of both every individual operator and of all members of the group.

Operators participating in the joint activity are given the task of using their levers to set the pointers on the indicators in a certain position. The homeostat can work in stabilization or tracking mode. In stabilization mode the task is said to be complete when all indicators have been set at the required position. The work time is the principal indicator of the group's ability to work together. In tracking mode this ability is defined by the group's tracking precision.

The mutual dependence among members of the group is one of the principal factors defining the effectiveness with which joint tasks are completed. The homeostatic method produces an integral assessment of the effectiveness of a group's work in the presence of changing mutual relationships among its members; the behavioral characteristics of the members of a small group; the overall psychosocial characteristics of a group having a "leader-followers" structure.

Roget Lambert's cybernometer, and its modifications developed in our laboratory,* have some similarity with the homeostat (132,133). Some variants of the instrument can also be used for individual examination of future participants of joint activity. A knowledge of individual psychomotor data as well as other typical individual features of operators to be participating in joint activity permits us to compose the group more sensibly. The principal component of the device is the working field, having the form of mazes of different complexity (with paths varying in configuration and width) through which a slide is moved about by means of levers. The overall trajectory and the oscillatory movements of the hands during work with the levers are recorded by potentiometric sensors and a special device. In one case the slide is controlled with a rigid kinematic linkage, and in another case the cybernometer is operated with a nonrigid linkage. The nonrigid kinematic linkage restricts the degrees of freedom of each lever and thus increases the mutual dependence of the members of the group doing joint work.

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The main condition governing the successfulness of group actions with a cybernometer is distribution of functions of the same kind between the subjects in accordance with the spatial relationship of different zones of the maze. While in the zone closest to him the subject carries the main burden associated with moving the slide through the maze (providing the driving force, making corrections and so on), in a zone away from him he only helps another operator, performing a passive function. In the final analysis, the successfulness of the group's work depends on the degree of passiveness and activeness exhibited at each moment in time as well as on the way participation in the work is alternated. Consequently there should be a certain balance between activeness and passiveness.

Besides studying the unique features of psychomotor compatibility, the cybernometer can be used to study the effects of optimum interaction in the performance of various perceptual and mental tasks by the group. It can be used to record the time of work, the total number of moves and the solution strategy, and the overall motor activity of each group member taken separately. The verbal reactions of working group members are recorded, and their subjective opinion as to the way the solution to the problem is sought and as to the convenience of joint work is taken into account. Effective completion of operational tasks by a group of subjects is possible when there is optimum correspondence between the psychomotor characteristics of the individuals and the methods for completing the operational task, and when communication between members is sensibly organized.

We created a special technique using a cybernometer to analyze the activity of a controller and evaluate the effectiveness of his interaction with a group of working operators. This system models the basic functions of group interaction and control. The principal activities of the supervisory controller include management of the resources used in joint activity and acquisition of the most important information on progress in completing the group task. The proposed technique may be used in the selection and composition of groups for a subordinate control system, and for special training of controllers. Psychosocial training presupposes exercising not only the entire group as a whole and its members, but also the supervisor specifically (134). In addition to managing the basic information and resources used in the joint activity, the controller regulates the time the group works on the task. All group members except for the controller perform identical functions. As an example every operator must determine a letter of the Russian alphabet. He is presented a checkerboard consisting of 25 squares. If the operator touches a square making up part of a letter, a red lamp lights up on his panel. Counters in the possession of the controller record both the number of moves made by each operator separately and the total number of moves made by the entire group. A stopwatch indicates the time of task completion. Using a special plotting board, the controller can observe the progress made by each individual operator on the problem. If the group, which also includes the controller, exhausts its time limit and its number of moves, the experimenter turns the system off and the task is said to be unfinished. As necessary, the controller can temporarily exclude any operators from the work with the purpose of keeping the group from using up all of its possible moves and helping operators determine the letter. The controller may be given the task of determining a word consisting of three letters (a trigram). This allows the controller a possibility for observing the task at a more-general level than what each operator sees on his own.

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Additional diagnostic methods of evaluating the effectiveness of joint work are used to determine convergence of value judgments (conformity), convergence of sensory-perceptual characteristics (attention switching rhythms, attention volume) and the consistency of orientation in physiological reactions (pulse, GSR, encephalogram), and they provide objective indicators of the compatibility of interacting operators. We developed a special technique to measure sensory-perceptual characteristics that undergo change as a result of the joint work of a group of operators. It affords a possibility for graphically recording the entire process associated with switching, distributing and maintaining attention. In one variant each subject is examined individually by this technique, before and after a group experiment, while in a second variant a pair of subjects are examined concurrently. When members of a small group working with a cybernometer exhibit optimum compatibility, we are able to observe convergence of the rhythms of their search activity and, consequently, convergence of attention parameters such as volume, switching and stability. M. A. Novikov discovered the effect of compatibility and convergence in physiological characteristics. Persons interacting effectively exhibit coincidence of variations in pulse, and an identical orientation of encephalographic indicators. All of this indicates that physiological characteristics that come into interaction indirectly, through joint activity, manifest themselves at many levels. Without a doubt each of these characteristics manifests itself differently in joint work, and each is associated both with individual features and with their "doubles" in the interacting members of the group.

By first studying a group of operators in experimental conditions to determine their conformity and measuring the individual potentials of each operator for work accuracy, we can make up the group in the most sensible fashion, with a consideration for the specific features of the joint activity of the operators. Conformity of operators may be studied both in structured groups, in which the action of each group member is predetermined by the experimental conditions (the method of substitute groups) (135) and in unstructured groups, where the mutual influence among group members evolves spontaneously--that is, it depends on internal causes (individual and group) (136,137,138). Study of the conformity of group members is especially important when the collective task is sufficiently complex and when it must be completed in strictly limited time.

Three basic forms of reactions to a conforming influence should be distinguished: a) conformity (where a value changes over a succession of trials, approaching the value judgment of partners), b) absence of conformity or its low degree, c) negative reactions (when a value changes in successive trials but drifts away from a partner's value judgment). While we do not mean to diminish the significance of conditions that mainly cause subjects to seek conformity in their reactions (the complexity of the task, the entropy of the valued signals, the quantitative composition of the group etc.), we should dwell especially on internal causes that produce differences in the behavior of group members. The degree of conformity depends on sensory-perceptual possibilities (the individual's potentials for precision); on other individual-personal features of the group members that are not specific--that is, ones which do not have a direct bearing on the functions by which tasks are carried out (temperament, character); on the degree of similarity of the sensory-perceptual characteristics and of other individual and personal features of members in a small group.

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In contrast to conforming conditions that elicit convergence in the reactions of group members, a conflict situation creates the situation for divergence of reactions. By modeling these two contrasting conditions and inspecting the behavior of the members of the small group, we can supplement our basic predictions of the effectiveness of joint work carried out by a group of operators. The conditions of the group experiment are created by a model of an elementary extreme stimulus eliciting corresponding reactions in the group members. Addition of stressful stimuli to the initial conditions of stress (in the group experiment) produces a clearer picture of individual differences.

By subjecting group conflict situations to experimental analysis we can predict the reliability of the work of group members in extreme conditions, when the tension of each operator taken separately reflects not only upon his own work but also upon the work of other participants of joint activity contained within a common control system. A homeostatic device can be used to study the unique features of the behavior of each member and the group as a whole in a conflict situation. This homeostat is unique in that it permits us to introduce interference into the control system at particular times.

A conflict situation is a qualitatively new condition eliciting a more-complex behavioral and autonomic reaction from the subject. By simulating extreme and conflict situations in the laboratory, we can predict the behavior of a given operator in the complex conditions of his occupational activity. In addition to specifically behavioral changes, autonomic changes going as far as neurotic breakdowns have been observed. Many facts have been accumulated in psychology, and incidentally in physiology as well, indicating that as a task being carried out by an individual grows in complexity, individual differences in both the results and the methods by which the tasks are carried out increase. The same pattern is observed when group tasks are made more complex, the one difference being that the method by which the group task is carried out grows more complex as well. The time and accuracy of assignment completion increase in both individual and group experiments.

Investigations into the ability to work together against the clock and in emergency situations deserve special attention. Tension arising in group members under these conditions abolishes previously established norms of interaction and deepens individual differences, which in normal situations are less pronounced and which are kept under control in conformity with the plan and the structure of the joint activity. G. S. Antipina noted: "The work of a small group of people in extreme conditions places priority on the problems of psychological compatibility" ((139, page 58). The less similar (the more contrasting) group members are, the more extreme conditions pull them apart. It might seem that selection according to the "similarity-contrast" principle would solve the compatibility problem, but the real problem lies with determining which characteristics of the human operator should be taken into account. Moreover, as the data of differential psychology show, all human characteristics manifest themselves so diversely that for practical purposes it is almost impossible to select people who are the "same." Therefore the main task of researchers is to distinguish those properties and characteristics of a human operator which would have a significant bearing on the given concrete form of joint activity.

Evaluation and consideration of the psychosocial qualities of operators working together, and of their mutual sympathies and antipathies is a prerequisite that must be

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considered when making up small groups (139,140,141). Sociometric questionnaires* are used to determine formal (official) and informal (intellectual-emotional) relationships. Consideration of the first type of communication, which reflects official mutual relationships and is regulated more by individual and characterological features, has great significance to selection of a group of operators. The second type of relationships is governed to a greater extent by the psychosocial features of value orientations, interests and various moral attitudes. Assessment of the way operators perceive and understand one another and of their mutual actions must also be made a part of research in group engineering psychology.

Special consideration should be given to evaluation of the verbal reactions of the members of the group. Communication among the participants of joint activity serves as an additional regulator of the effectiveness of group work. By considering verbal reactions and communicative behavior, and by optimizing the function of information outside and inside the group, we can design more-effective "operator-operator-machine" systems and select and bring operators together for group work more sensibly. We can make some brief conclusions on the basis of published information (141,142,144,145,146,147):

The total number of verbal reactions is not always associated with the successfulness of the work of a subject in a group;

the volume of communication increases when the tasks of the group grow in complexity, and it has a greater influence on the effectiveness of joint actions;

out of the whole set of verbal reactions (commands, instructions, suggestions, opinions, questions and information), "opinion" and "information" reactions have the greater significance to the accuracy of group work. In cases where "command" and "instruction" reactions dominate, the group's speed indicators change to a greater extent;

communication may be maintained with words or with arbitrary symbols depending on the conditions of the task and the technical possibilities afforded to communication. Use of the auditory or the visual channel depends on the burden of other information each channel carries.

Indicators of individual characteristics that may be used to evaluate and predict the effectiveness of group work may be determined from an analysis of data obtained by B. V. Belyayev (127) and of our data (133,141,148,149). They include: a) the magnitudes of individual characteristics (speed, accuracy, efficiency, successfulness factor); b) the individual range of characteristics, as determined from the difference between the maximum and minimum indicators of the subject's work. Besides specifically individual characteristics, the degree of similarity exhibited in the characteristics of individuals participating in joint work (the difference between average individual indicators), and the degree to which the ranges of the characteristics coincide have no less significance. It would be important here to make a distinction between the zone within which these ranges coincide and the zone of their noncoincidence.

*A detailed description of all of the procedures of sociometry can be found in I. P. Volkov's training manual (143).

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Depending on the work speed and accuracy parameters considered, the indicators for the magnitude of individual characteristics, individual ranges, the degree of similarity of characteristics and the degree of coincidence of ranges may play different roles in evaluation and prediction of the successfulness of group work (133, 140,141,148,149). The degree of similarity and the magnitude of individual characteristics of members of a small group of operators predetermine the probability of correct prediction of the effectiveness of joint actions. The better the individual indicators and the "more similar" the members of a small group are, the higher the probability of a correct prediction.

The opinion of A. A. Leonov and V. I. Lebedev can be cited as a confirmation of our experimental conclusions as to the important significance individual ranges have to optimum compatibility of group members. They write: "...a pilot who flies with different navigators and a navigator who flies with many pilots have a broad range of capabilities for understanding, leading and adapting to different individualities. This is what promotes arisal of the needed coordination in joint activity and attainment of high results in flying" ((150), page 46). Thus the significance of teaching an individual to interact in optimum fashion with other people is obvious. But in this case we do need to consider precisely who it is that acquires this experience and who it is that learns to interact--that is, what the individual and personal features of the person are. The lability and variability of the functional possibilities of individuals participating in joint activity are found to be significant to compatibility and to the ability to work well together.

The level of resistance to interference can be determined as a special individual method of predicting the behavior of individuals in extreme and conflict situations (128). This can be done, for example, with the "leadership test" (a variant of the associative experiment) (146). The task is for the operator to adequately react to verbal stimuli when interfering words of an "imaginary partner" are introduced into his reactions. The "leadership test" may serve as an approximate model of a conflict situation for the purpose of determining the conflict resistance of operators that are to participate in joint work in the future.

It should be noted in conclusion that investigation of group compatibility and the selection and composition of groups of operators have important significance to raising the reliability of complex automated control systems. (128,129,130,131 etc.).

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PSYCHOLOGY

EMOTIONAL REGULATION OF VERBAL BEHAVIOR

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/Article by N. V. Vitt/

/Text/ During the last decade the problem of regulation of human behavior has attracted ever greater attention on the part of researchers. Special significance is attached to it in the psychology of emotions, where the problem of regulation of one's own behavior and the behavior of other people, that is the problems of its internal and external forms, arises. At the same time, despite the fact that the emotional component of these forms of regulation of human behavior is not examined especially, it is implicitly present in the context of investigation of each of them. Thus, the emotional component, obviously, should be taken into account in the analysis of the forming and regulating effects of social relations and systems of man's social norms /29/, because they, like any other effects, are refracted through internal conditions. Nor can the emotional component of regulation be excluded from the investigation of internal personality regulation, be it the vastest area of voluntary regulation of the work of the sensory system /14/, or involuntary and partially perceived regulation of the dynamics of emotional states during the performance of a complex activity /17/ and /20/, during the perception of images /2/ and music /26/ and during verbal communication /18/. The "sensory" level of internal regulation equated with the incentive level (in contrast to "conscious" and "performance" levels), at which independent functions of emotions, for example, of the initiator and controller, are differentiated /1; 27/, is singled out in the context of the study of personality as the subject of activity.

The investigation of the nature of emotions and their functions in the structurization of the mental image /28/ and in the regulation of the subject's activity /16/, /7/ and /5/ stresses the need for the study of the mechanisms, criteria and objects of internal emotional regulation.

The emotional regulation of human behavior is investigated mainly in two directions, that is, in terms of analysis of the role of emotions in the formation and behavior of the integral personality and in terms of detection of the place and functions of emotions in man's intellectual activity. The formation of the "emotional direction" of personality is due to the emotional regulation of man's stable inclinations and formed interests and his orientation in the selection of objects meaningful to him /11/. A special psychological mechanism of emotional correction coordinating selectivity with respect to emotion producing objects and

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the dynamics of anticipated behavior with the "sense" of the problem situation for the subject was singled out experimentally /13/. Undoubtedly, this mechanism forms an important link in the emotional regulation of behavior. Investigations of intellectual activity have shown that the subject's intellectual and evaluative activity proper is largely determined by the nature of emotional regulation /4/. Recently the problem of the study of emotional regulation of thinking activity has been raised /6/ and the heuristic function of emotions has been investigated.

Thus, most investigators consider emotions a special, "partial" form of reflection of reality and their participation in the psychic regulation of the direction and dynamics of behavior is made a separate and special system of emotional regulation of human behavior.

In our opinion, the investigation of the functioning of emotional regulation in verbal behavior is one of the promising approaches to the study of emotional regulation. Verbal behavior, in which both the characteristics of man's verbal and thinking activity and his emotional states are manifested, makes it possible to analyze concrete verbal material with sufficient accuracy. This material was previously used by many authors for the determination of the verbal correlates of man's current emotional states /10/, /18/, /19/ and so forth. It opens up wide possibilities for the study of emotional regulation, because it also gives information on emotionality as one of general personality characteristics.

Emotionality, which "forms part of the structure of personality" /24; 413/ and is considered with sufficient substantiation its constant characteristic in the psychological literature /21/, /23/ and /27/, is one of the determinants of verbal behavior. At the same time, we proceed from the fact that emotionality has a double expression: a) in emotions presenting the subject's needs to consciousness /8/ and b) in the dynamics and quality of man's emotional states and emotional-evaluative attitude toward reality. The presentation of needs to consciousness can be made not only by "current" emotions, but also by previously experienced emotions forming part of the individual's subjective experience and affecting the selectivity of his attitude toward the objects and situations of reality /2/. As a consequence, any of the two forms of man's behavior--verbal or nonverbal--should manifest a tendency toward the formation of a certain group of emotional states and of a certain type of emotional-evaluative behavior. The formation of emotional states determined by emotions predominant in his subjective experience is most probable. Since emotions are characterized primarily by quality (modality) and orientation to objects of reality, the individual structure of emotionality /21/, domination of the elements of its "basic stock" /25/ and selectivity with respect to emotion producing objects perform a regulatory function in the individual's view of concrete situations of reality. Man's verbal behavior can manifest both the basal emotions of joy, fear (=anxiety) and anger and their selective direction expressed in the emotional coloring of the subject's response to signals of reality most meaningful to him. Presumably, the dominating emotion can "color" both the perception of situations (conditions) of generation of verbal utterances and the substantive and dynamic aspects of the verbal communications themselves. At the same time, the level of emotionality, that is, the frequency of occurrence of emotional states in man (without differences according to the emotional criterion and modality) determines a greater or smaller number of situations marked by him as emotion producing situations.

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Thus, the emotional regulation of verbal behavior is connected, first, with the individual's inclination for experiencing the group of emotional states that realize the zone of the dominating emotion /9/, second, with the level of emotionality and, third, with individual experience in the realization of verbal communications in concrete situations, which largely determines the selective orientation of emotional reaction.

Individual characteristics of the emotional regulation of verbal behavior are formed in the process of development of personality in society, when, as K. Marx pointed out, man's notions of himself as a personality and of his behavior are mediated by his attitude toward other people, that is, toward society at large. Both emotions proper and the methods of expressing them, including verbal, are transformed under the effect of external means of regulation of behavior /16/. At first a child's behavior is regulated by an adult and only after a period of internalization of a certain set of norms and instructions can the child himself exercise a partially perceived control of the manifestation of his emotional reactions and regulate their external expression in accordance with the demands of the social environment. The characteristics of social contacts and communication have a decisive effect not only on the development of man's emotional sphere /3/, but also on the formation of the emotional regulation of the verbal form of behavior. Under the conditions of verbal communication man develops the standards of verbal expression of emotions, the "masking" of the expression of his individual emotional states and even the utilization of emotional reactions, which lend themselves to control with difficulty, for the purpose of influencing others /27/.

A detailed study of these problems evokes considerable interest. However, the emotional regulation of man's integral typical verbal behavior was not subjected to an experimental investigation, although in-depth investigations were performed on the diagnosis and evaluation of verbal expression of emotional states. In the examination of emotional regulation of verbal behavior the following aspects can be singled out: 1) control of one's own verbal behavior under concrete conditions; 2) effect by means of one's own verbal behavior on other people, when, in N. I. Zhinkin's words, "communication controls the partner's behavior" /12; 7/; 3) verbal interaction, when each of the people involved in communication can "become attuned to the appropriate action and counteraction" /24; 459/. In this article the first aspect of the problem--control of one's own verbal behavior--but with due regard for the two others, is the object of examination. A theoretical examination of the concept of emotional regulation makes it possible to assume that it is manifested in the substantive aspect of the text reflecting the domination of emotions and their orientation to certain elements of concrete situations.

To check the advanced hypothesis, we investigated emotional regulation on the material of the substantive aspect of verbal behavior with the use of a model of verbal communication in education /15/. This model realized under the conditions of university training of specialists in the area of foreign languages seems adequate to the task of investigation owing to the fact that potential emotion producing situations of verbal behavior exist during studies. They occur in connection with the significance for the speaker of the quality of his verbal communication and expectation of the evaluation of this communication by listeners, as well as the teacher's authoritative influence.

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Two series of a special experiment were conducted with 136 tested students, of whom 86 participated in the first series and 50, in the second. The object of the first series was to reveal in every tested student dominating emotions and orientation to the component of situations ("stressor"), in which he had to speak, that are basic for him. For this purpose it was suggested that the tested students describe the largest possible number of various situations during practical language studies, when they experienced emotions having a positive or negative effect on speech. Then the tested students were asked to name the emotional states developed in them in each of these situations. The object of the second series was to observe the manifestation of the subject's dominating emotions and his orientation to stressors in the texts formed as a result of his solution of two verbal problems. The first verbal problem was to complete an unfinished story in a freely selected emotional modality and in the second verbal problem the tested students were asked to form another variant of conclusion of the same story, but in another emotional "key."

The experimental material was obtained in the form of texts presenting detailed descriptions of various emotion producing situations (more than 500) and texts--conclusions of unfinished stories (100). This material was processed qualitatively and quantitatively with the use of content analysis /22/ and /30/, which was made as a check on the hypothesis on the manifestation in speech of the subject's dominating emotions and their orientation to the objects of real situations. The texts of the first series took into account the existence and frequency of lexical units naming and evaluating the subject's emotional states and the emotion producing components of a situation and the texts of the second series took into account both lexical units and the context giving information on the emotional modality of a verbal utterance. We shall present an example of situation texts obtained in the first series (record of the tested female student M. S.). (In the text of the record words pertaining to emotional states are emphasized with one continuous line, words pertaining to their qualitative characteristics in terms of frequency and intensity, with a dashed line, words pertaining to emotion producing components of situations, with two continuous lines and words designating their qualitative characteristics, with two dashed lines).

a) What situations during practical speech studies usually produce in you positive or negative emotions affecting your speech?	b) What emotional states do you experience most often in these situations?
1. I always experience a great confusion if I have to speak in front of an unfamiliar audience, or even in the presence of students of another group.	A state of confusion and fear.
2. I am greatly disturbed when my speech is interrupted, supplemented or corrected. The instructor's questions on "Praktika Rechi" /Speech Practice/ are an especially big disturbance for the fluency and coherence of my speech, because I know that this means that I made a mistake.	Mostly irritation and anger.

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3. An interesting subject usually helps me to express a thought and attitude toward a problem more easily and freely. In this case one forgets that, nevertheless, one must receive a grade for the answer	(Joyous) animation and enthusiasm.
4. I feel especially constrained if I have to speak in a new and unfamiliar situation. I am lost and I am afraid of a hostile attitude.	A state of constraint, confusion and fear.
5. In order for my speech to be logical and expressive it is very important that I be supported, even if with individual remarks or a facial expression and gestures.	Pleasant emotions and satisfaction.
6. A situation of goodwill and interest on the part of my friends in what I say. In such a situation I want to speak, although "I am pressed for words," make mistakes and get excited because of this, but I try to keep up this interest.	A state of joyous excitement, a kind of fervor and a sense of risk.
7. Noise, whispering and laughter when I answer-- this is the most unpleasant situation. I become confused, lose the thread of the story and it is difficult for me to collect my thoughts.	A state of complete confusion.
8. During studies we have so-called game situations. Of course, they evoke pleasant emotions. But the lack of artistic talent makes me not only rejoice, but get greatly excited.	I experience a kind of joyous excitement.
9. The mocking tone of some instructors creates an anxious atmosphere.	Expectation of something unpleasant; an anxious state.

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10. An unexpected appearance of new people during studies usually does not evoke negative emotions in me, but the attempt of the entire group "to show off" also affects me.	The same--expectation and, perhaps, some uneasiness.
11. A frequently repeated situation: The instructor taps his pencil when one answers. Of course, one doubts the correctness of the answer.	Doubt and a sense of uncertainty.

As a result of an analysis of the situation texts presented above it was revealed that in most of them (8 out of 11) the state of the tested student was anxious. The presence of the words "confusion," "sense of uncertainty," "to get excited" and so forth attests to this. The intensity and frequency of occurrence of this state are shown in the subjectively evaluative lexical units "always," "greatly" and so forth. The repeated use of words and word combinations denoting the main orientation of the emotions of this tested student to individual components of situations made it possible to determine the main stressor for her. Such components of situations as "audience," "instructor," "group," "atmosphere" and "subject" are mentioned in her texts, but the most frequently found words and word combinations show that this tested student is oriented to a stressor, which we conventionally call "group," that is, people present during the realization of her verbal communications.

On the basis of the results of analysis of the situation texts prepared by all the tested students three groups were singled out according to the criterion of domination of emotions. A description of the conditions of occurrence of pleasant emotions and joy predominates in the texts of 24 percent of those tested. A total of 38 percent of those tested mostly report anxious states. A total of 28 percent of those tested name mainly situations in which they are angry. The domination of two emotions is revealed in 10 percent of those tested.

The data of the analysis of these texts also made it possible to determine three types of basic stressors. They were conventionally called as follows: group, that is, "listeners" of the verbal utterances of those tested; official communication leader, who in these situations was the instructor, initiator and active participant in communication; activity--substantive and organizational characteristics of the performed work. Furthermore, a fourth type of stressor--the functional state formed in the tested student before the beginning of the situation presented by him--was outlined. An analysis of the texts has shown that the majority of the tested students, that is, 36 percent, emotionally react to the official communication leader, 30 percent are oriented to the performed activity and for 28 percent of those tested the group's attitude toward them is emotionally significant. (In 5 percent of those tested an analysis of the texts did not reveal an orientation to any specific type of stressor).

A comparison of the nature of connection between the domination of emotions in the tested individuals and their orientation to types of stressors has shown that the emotions of certain modalities predetermine, as it were, the fixation on the main

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and secondary stressor. When joy dominates, the majority of the tested students are oriented to the group and a slightly smaller number, to the activity. In tested individuals with dominating anxiety orientation to the official leader is in the first place and to the group, in the second. For the majority of the tested students with the domination of anger the activity is the basic stressor and a smaller number of them are oriented to the official communication leader (table).

Table. Dependence Between the Modality of Dominating Emotions and Orientation to Types of Stressors (in %)

Modality of dominating emotions	Orientation to types of stressors		
	activity	official communication leader	group
Joy	33	17	50
Anxiety	15	53	32
Anger	57	36	7

The table shows that orientation to any of the types of stressors is realized in their ranked order. Thus, the orientation of the dominating emotion of joy can be represented by the order Gr (group)--A (activity)--L (official communication leader), the orientation of anxiety, by the order L--Gr--A and the orientation of anger, by the order A--L--Gr. Apparently, the disclosed connection between the domination of emotions and orientation to the type of stressor reflects not only the characteristics of this sampling of the tested students, but also a deeper internal dependence between the quality of the emotion dominating in the subject and its selectivity with respect to elements of real situations. This "ranking" of types of stressors manifests not only the criterion of orientation of emotions, but also one of the characteristics of emotional regulation of verbal vehavior. The domination of joy is mostly connected with such a personality feature as sociability and the desire to establish contacts with people, as well as with the inclination to states of interest in and enthusiasm for activity. This is quite clearly manifested in the preferred orientation of the "joyous" tested students to the group and activity. As is well known, the dominating emotion of anxiety can predetermine the hyperbolization of fear, in particular fear of a negative external evaluation. The data obtained indicate that the states of anxiety of the tested individuals are connected primarily with the expectation of an evaluation on the part of the official communication leader. When anger dominates, the person is mostly characterized by a great "rejecting" and "reconstructing" activity. In fact, according to the data of the analysis of these texts, these tested students often subjected various elements of educational activity to criticism and expressed dissatisfaction with the remarks and instructions of the official communication leader.

Orientation to a specific type of stressor was manifested in the substantive aspect of situation texts. The texts of the tested studuents oriented to the activity and to the official leader are the most striking examples. A considerable number of lexical units denoting various nuances of emotional states and attitudes toward situations in which verbal communications were prepared and realized (for example, "interest," "expectation of something new," "feeling of disappointment," "desire to restructure boring work," and so forth) are revealed in the texts of the tested individuals oriented to the activity. Along with this,of interest is

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the fact that twice as many emotions of a positive than of a negative emotional criterion are mentioned in the texts of these tested students. Tested individuals characterized by the domination of anger and oriented to the official communication leader mentioned intensive and clearly contrasting emotions; for example, "enthusiasm," "despair," "pride" and "feeling of humiliation." "Anxious" tested individuals oriented to the same stressor cited in their texts the maximum number of the same and similar emotional states in this sampling; for example, "constraint" "feeling of uncertainty," "state of joyous excitement" and so forth.

The data of the first series confirm the assumption on the functioning of emotions as a "mechanism" of marking subjectively significant elements of situations in the process of goal formation in intellectual activity /5/ and /6/. At the same time, an analysis of the texts--products of the verbal and thinking activity of the tested students--made it possible to observe the regulative role of the combination of the dominating emotion and orientation to the components of emotion producing situations that are basic for the tested individuals.

The second series of the experiment was aimed at checking the hypothesis that these combinations can have a regulating effect on the emotional coloring of freely produced texts representing conclusions of unfinished stories. (The stories taken from those usually used during the study of the flexibility of thinking were presented in the native tongue of those tested for auditory perception). The object of analysis of the texts prepared by the tested individuals was to determine the characteristics of the selection and verbalization of the emotional modalities imparted to the texts. Lexical units denoting the emotional states of personages, the emotional attitude of the tested authors toward them and toward the events described in the text and opinion-suggestions and evaluations expressed in the context were recorded. The analysis made for each of the two text versions made it possible to reveal the emotional modality unintentionally imparted by the tested students to the first version and the modality that they selected for the second version so that it may differ from the former.

The nature of the changes in these modalities was especially examined on the basis of the data on the emotional modalities of the text versions prepared by every tested student. This examination was made in accordance with the most numerous groups of tested students singled out according to the criterion of combination of certain dominating emotions and orientation to the same stressor. It was revealed that in the texts of tested students with the domination of the emotion "joy" and orientation to the group mutual transitions between the modalities of joy and anxiety were made more often than between any of them and the modality of anger. The authors' concentration on the importance of the unfolding events for personages and an expression of interest in how these events can affect the fate of personages in the future are observed in the content of these texts. For example: "This evening no one will leave the house: It is terrible!" Or, "this will be a happy holiday for all." The large number of words denoting emotional states and attitudes lends expressiveness to the presentation. At the same time, however, the subjects are rather standard or represent obvious borrowings from fiction. Almost the same number of mutual transitions between emotional modalities are revealed in the texts of tested students with the domination of anxiety and orientation to the official communication leader. The main characteristic of these texts lies in the authors' emphasis of the role of emotionally significant external circumstances. For example: "They will frighten all the wild fowl and there will be nowhere to hunt."

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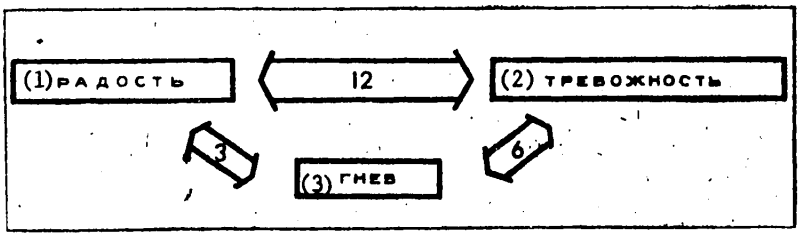
"Someone will be on the watch for you and will catch you." "You attract the attention of enemies!" The lexical units used in the texts are characterized by minor emotional coloring. It resides in the context. The subjects of the texts often exceed the limits of the "conditions" prescribed by the presented study. In the texts of tested individuals with the domination of anger and orientation to the activity it was revealed that most mutual transitions were made between the modalities of joy and anxiety. An analysis made it possible to reveal in these texts a large number of lexical units denoting the author's emotional-evaluative attitude toward personages and events. For example: "Ah, how good!," "this is a disgrace," "how happy she is," "how little one needs to be happy" and so forth. Almost all the texts are distinguished by a diversity in subject lines, a complete restructuring of the content presented for a conclusion of the story and introduction of additions and refinements. It is of interest that, along with the description and forecasting of events of a positive emotional criterion, initiative and "offensive" elements with an obvious expression of reproach or punishment of personages, as well as a certain edification characteristic of fables, are often verbalized.

The results obtained in the second series of the experiment make it possible to assume that verbal behavior depends to some extent on the combination in the tested individuals of dominating emotions and orientation to the type of stressor. This dependence is expressed in the specific selection of an emotionally colored vocabulary, in the nature of subjects and in the attention of the authors of the texts to the emotional makeup of personages or to emotion producing situations. At the same time, a more general characteristic of the verbal behavior of the tested individuals was also detected. It consisted in the fact that in the texts mutual transitions between the emotional modalities of joy and anxiety were more frequent than between each of them and anger. The relative number and direction of mutual transitions between the basal emotions expressed in the texts are presented in diagram 1. The basic emotional modalities of the texts are depicted in the form of rectangles, arrows point the directions in the change of modalities and the width of arrows and the figure symbolize the relative frequency of the mutual transitions of modalities during the production of the second text version.



The direction and relative number of mutual transitions of emotional modalities imparted to the first and second text variants

Key:
1. Joy
2. Anxiety
3. Anger

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The characteristics of performance of the change in the emotional coloring of verbal communications can be considered the manifestation of voluntary emotional regulation of verbal behavior. This regulation is more flexible in tested individuals characterized by the combination "joy-orientation to the group" and "anxiety-orientation to the communication leader." The combination "anger-orientation to the activity" is manifested in the fact that it is more difficult for the tested individual--author of the texts--to perform the assignment for a change in the emotional modality of his ready text. A more flexible regulation is also observed during the operation of joyous and anxious modalities in the texts. Difficulties in the reconstruction of the texts to which the emotional modality of anger was imparted earlier show the lesser plasticity of this modality. Tested individuals often seemed to be attached to the first text version, in which anger was expressed, and could not or refused to fulfill the assignment.

Results have confirmed the hypothesis that the emotional regulation of verbal behavior is manifested in the substantive aspect of the text reflecting man's dominating emotions and their connection with stressors. At the same time, the experimental data obtained show the prospects for an investigation of the emotional regulation of verbal behavior. Thus, an analysis of the texts made it possible to observe the characteristics of interaction between the quality of emotions and the selective orientation to the signals of reality and to disclose the picture of functioning of the emotional regulation of man's behavior in his direct contact with the social environment. The singling out by the subject of external and internal stressors (social environment, activity and the subject himself), orientation to which lends itself to voluntary and involuntary regulation to a varying degree, is connected with partiality and selectivity inherent in emotions. Thus, the essence of emotional regulation of verbal behavior lies in the voluntary and involuntary emotional "coloring" of acts of verbal behavior and selective orientation to various objects of reality. This article examines certain characteristics of manifestation of the emotional regulation of verbal behavior, which, in our opinion, are of interest for the problem of emotions, as well as for teaching practice and for an increase in the efficiency of various communication systems.

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BOOK ON URGENT PROBLEMS OF PSYCHOLOGY OF PERSONALITY REVIEWED

Moscow VOPROSY PSIKHOLOGII in Russian No 4, Jul-Aug 81 pp 175-176

/Review by K. Tikhomirov, Moscow, of book "Ocherki po psikhologii anomal'nogo razvitiya lichnosti" /Outlines on Psychology of Abnormal Development of Personality] by B. V. Zeygarnik and B. S. Bratus', Izd-vo MGU, Moscow, 1980, 169 pages]

/Text/ It is hardly necessary to convince anyone that the elaboration of the problems of psychology of personality is of paramount importance both for the development of theoretical psychology and for a more intensive solution of applied problems by psychologists. At the same time, we quite often encounter a disappointing substitution of a list of overall problems of interdisciplinary investigations of personality and of the formulation of only general sociological premises for its study, or even accumulations of correlations among individual differences, for the psychology of personality proper. The significance of the reviewed book lies primarily in the confirmation of the psychological approach proper to the study of personality and abnormalities in its development. The book is written in the genre of outlines, which reflect a single research trend and are unified by the general methodological basis and general task connected with the "search for new possibilities of gaining knowledge of the psychological nature of personality" (p 4). The authors selected the theory of activity as the methodological basis for their research.

The problem of personality development is one of the central problems of this book. Correctly stressing that contradictions are the sources of personality development, the authors soundly maintain that the patterns in the development of a healthy personality should not be directly and immediately derived from the patterns in the development of diseases and that it is necessary to differentiate the concepts of contradiction and neurotic conflict, which "is a special type of contradiction and its perverted form, leads to the creation of a distorted activity, destroys the structure of personality created before the sickness and deprives it of mediation and control" (p 11). The development of personality of the person that became ill with neurosis occurs not because of the neurotic conflict, but despite it.

The book convincingly substantiates the thesis that a mental collapse is not the negative of development and that different types of the pathological process lead to qualitatively different pictures of a collapse. The authors see the task of the true theory of personality in explaining both cases of normal personality development and cases of its abnormal development. The very concept of norm, as the

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authors note, "should not be an enumeration of the merits of personality, but an indication of the general principles of the best course of development, of the basic contradictions arising there and of the characteristics of overcoming them" (p 130). Contradictions between the motivational and operative-technical aspects of activity also arise in a normal mature personality, but this personality is capable of perceiving and resolving contradictions, which leads to its further development.

The problem of the methods of personality study also pertains to the most important problems. The principles formulated in the book are of a fundamental nature. It is shown convincingly that it must matter to the psychologist what methods he brings to practice. "The proposition on the relative independence of a specific research method of the initial theory... is unacceptable in the study of the phenomena of man's psychic life" (p 14).

The authors quite soundly maintain that the theoretical and methodological principles of psychology are realized through specific research methods and suggest that functional psychology is the theoretical basis for the methods of measuring abilities in foreign psychology and that the use of these methods "discloses only the final results, while the entire qualitative aspect of the tested individual's activity remains beyond the scope of research" (p 15). The authors' own position lies in stressing primarily the need for an analysis of the qualitative characteristics of the subject's mental activity. The book presents an interesting analysis of character traits, goal assumption, suggestibility, criticality and sense formations of personality.

Much attention is given to a description of the specific methods of investigation of personality disturbances. It is stressed that an observation of the patient's general behavior during an experiment is a special and effective method of investigation. The possibilities of analyzing personality changes according to the data of case histories are disclosed. A description of methods both directly aimed at the detection of personality characteristics and connected with an indirect detection of personality changes by means of experiments in which cognitive processes are investigated is presented. The need to study the onset of psychological phenomena is stressed constantly.

Today ever greater importance is attached to the use of psychological knowledge for the solution of practical problems. The book by B. V. Zeygarnik and B. S. Bratus' is instructive in this respect, because psychiatric practice is a field where psychological knowledge was first introduced. The authors' position is also quite definite here: Applied research must have a clear theoretical basis and, in turn, make a contribution to the development of the general theory of psychology. In particular, the significance of pathopsychological research of personality lies in disclosing the role of the personality (motivational) component in the structure of cognitive activity. This is connected with the fact that mental illness "primarily affects man's motivational sphere and his emotional manifestations and value orientations" (p 6). The formation of new motives, goals and aims and the structure of self-consciousness and self-regulation--the data of pathopsychology are of great importance for the study of these problems. The authors see the prospects for the development of applied pathopsychological research proper in an expansion of the participation of professional psychologists in the system of rehabilitation and prevention work.

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The book by B. V. Zeygarnik and B. S. Bratus' enriches the psychological teaching of personality, makes a contribution to the development of pathopsychology and will be read and studied with benefit and interest both by professional psychologists and specialists in related fields of knowledge interested in an alliance with psychologists.

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MONOGRAPHS ON PROJECTIVE METHODS IN PERSONALITY STUDY REVIEWED

Moscow VOPROSY PSIKHOLOGII in Russian No 4, Jul-Aug 81 pp 176-178

/Review by A. A. Kronik, Kiev, of monographs "Issledovaniye lichnosti v klinicheskoy psikhologii (na osnove metoda Rorshakha)" /Personality Study in Clinical Psychology (on the Basis of the Rorschach Method)/ by L. F. Burlachuk, Vyshcha shkola, Kiev, 1979, 176 pages, and "Proyektivnyye metody issledovaniya lichnosti" /Projective Methods of Personality Study/ by Ye. T. Sokolova, Izd-vo MGU, Moscow, 1980, 176 pages/

/Text/ The possibility of obtaining objective knowledge of personality and its inner world hidden from an outside view has always excited researchers' minds and made them search for new ways leading to the solution of one of the fundamental problems of psychological science. Therefore, the first monographs devoted to projective methods of personality study in our country cannot be ignored.

One of the oldest projective methods--the Rorschach method--is in the center of L. F. Burlachuk's study. The problem of its experimental possibilities is solved on a specific clinical basis. Ye. T. Sokolova's book, along with the Rorschach method, also gives a detailed description of the thematic apperception test (TAT). However, the importance of the reviewed monographs is not limited only to the area of specific psychodiagnosis. The special chapters devoted to the problems of methodology of the projective approach to personality study (Burlachuk, chapter I) and to the theoretical substantiation of projective methods (Sokolova, chapter II) contained in both works attest to the above.

Projective methods of personality study are unique phenomena in modern psychology. The persistent interest in them on the part of various psychological schools, which has lasted for more than half a century, has produced a special field--projective psychology. At the same time, from the moment of its appearance to this day projective methods and the practice of their use raise many questions for researchers. Here are some of them. What does the psychological mechanism realized in projective methods represent? What relationship do these methods have to the concept of projection developed by psychoanalysis? To what extent are the characteristics of interpretation of incentives connected with real behavior? From what theoretical positions should the results obtained be interpreted?

In an attempt to answer these questions the authors of both monographs reveal the essence of various approaches to understanding projection and its mechanism. This enables them to draw the same conclusion on the unsoundness of the concept of projection developed by psychoanalysis for an explanation of the mechanism realized

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in projective methods. Supplementing each other, the authors discuss various aspects of the concept of "projective method," single out the characteristic features and existing classifications of these methods of personality study and show the great importance of the characteristics of the used stimulation.

The problem of theoretical substantiation of projective methods is the most complex and debatable. Presenting a critical analysis of the attempts at substantiation from the point of view of psychoanalysis, holistic psychology and gestalt psychology, the representatives of the "new view" and investigators of the cognitive style, Burlachuk and Sokolova raise an important methodological problem in their works--substantiation of the projective method on the basis of the principles of Soviet psychology and the development on this basis of specific schemes of analysis and interpretation of the results of projective research. This general problem is solved by the authors, but in different ways.

In Burlachuk's opinion, the principle of activity and personalization of perception is fundamental for understanding the phenomenon of projection. On the basis of this principle projective methods are interpreted by the author as "methods of indirect personality study based on the construction of a specific, plastic stimulus situation creating, owing to the activity of the process of perception, conditions most favorable for the manifestation of the aims, emotional states and other characteristics of personality" (Burlachuk, p 31).

The position of Ye. T. Sokolova and V. V. Stolin, with whom the corresponding paragraph was jointly written, is that the "manifestations of personality disclosed in projective tests (primarily interpretative, of course) can be adequately understood in terms of personality meanings and the subject's corresponding activity in the search for or concealment and masking of personality meanings" (Sokolova, p 65).

Thus, Burlachuk's position can be designated as an "aim" position and that of Sokolova and Stolin, as an "activity" position. Do they contradict each other? In our opinion, no.

The point is that the experimental situation specified by the Rorschach method, essentially, models only the initial stage of any activity--the stage of perception and knowledge. At the same time, as Burlachuk rightly stresses, the subject's activity is directed toward eliminating the uncertainty of a situation through the projection of personality characteristics (Burlachuk, p 31). Another activity is provoked by the thematic apperception test. Owing to the life reality of the situations (pictures) presented to the tested individual, as well as the special instruction "to invent a story (what happens, what was and what will be...)," his behavior is not limited only to cognitive activity, but can turn into a purposeful (not obligatorily, however, perceived) activity, in which using Sokolova's and Stolin's terminology, interrupted actions associated with various inner barriers are realized.

Thus, in our opinion, the Rorschach method and TAT touch on various stages in activity, that is, the former, primarily on the cognitive stage and the latter, primarily on the executive stage. We would like to stress that it is only a matter of a preferential connection of the method and stage. Thus, interpreting ink blots,

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the tested individual can get so involved in a picture that he begins to predict the possible behavior of the imagined picture. On the other hand, making up a story from TAT pictures, the tested individual can "get stuck" at the stage of perception and instead of a dynamic story give only a description of the present or imagined situation. However, such cases are not typical.

The above-stated makes it possible to conclude that the initial principles upheld by Burlachuk and Sokolova do not contradict, but only supplement, each other. In an attempt to give a universal substantiation to projective methods as a whole, the authors, essentially, give substantiations only to particular methods: The former, to the Rorschach method and the latter, to the TAT method. At the same time, in our opinion, such a way is fully justified theoretically and feasible in practice. To substantiate projective methods, it is first of all necessary to reveal the unit and stage in the structure of activity that are mainly touched on by a specific method and to find the specific psychological mechanisms of regulation of activity "provoked" by this method. Only in this case will it be possible to "remove" A. M. Etkind's caustic, but accurate, remark about the analogy between a horoscope and projective methods (quoted according to Sokolova, p 119). In addition to the possibility of substantiating existing methods such a way opens up prospects for the development of new projective methods diagnosing other stages in activity, which previously have not been touched on.

We have examined only the theoretical problems raised by the authors of the reviewed monographs. The basic content of these monographs is something else, that is, a detailed description of the methods themselves.

Burlachuk's book contains the most complete description of the Rorschach method in Soviet literature (chapter II). Without dwelling on details, we will stress the most important. The sections pertaining to the prehistory of the Rorschach method and to the biography of its developer are successful. What is the least debatable and experimentally verifiable was selected from the variants, different in their theoretical positions, of interpretation of the indicators of this method known abroad. The last, third chapter is assigned to clinicopsychological research. The results of the most important foreign clinicodiagnostic studies (schizophrenia, epilepsy, neuroses and organic brain lesions), as well as the results of the clinical investigations of the author himself, are examined there. As a result, previously unknown ideas of the characteristics of personality defects in various patients are examined closely and the place of the Rorschach method in a pathopsychological investigation is outlined. Three supplements are given at the end of the monograph: The basic symbols of the Rorschach method in different language systems of designation, auxiliary tables for the localization of the answers of tested individuals and a brief description of the 10 most known projective methods. The bibliography contains 284 names. All this makes it possible to use the book as a practical manual for those beginning to work with this method.

Sokolova's monograph also contains the most complete description of TAT and of the history of its development in Soviet literature. The experimental procedure and various schemes of analysis are examined in detail (according to G. Murray, D. Rapoport, L. Bellak, S. Tomkins and M. Arnold (chapter III). A description of the Rorschach method, which slightly supplements Burlachuk's book with an analysis of the methods of diagnosis of conflicts and mechanisms of psychological defense, is

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given in the last, fourth chapter. Unfortunately, this study does not contain specific experimental data obtained by means of the described methods by foreign and Soviet researchers. The monograph also contains three supplements, that is, characteristics of needs according to Murray, diagnostically significant subjects according to TAT tables and a list of popular answers in the Rorschach method. The bibliography has 83 names.

The reviewed monographs are the first experiment in a critical interpretation of the largely contradictory theoretical concepts of projective methods. One sees in them not only the desire to show the possibilities of projective methods, but also to try to "transplant" them to the soil of Soviet psychology and to remove the distinctive halo of "accessibility to few only," with which they have been surrounded for a long time. Although, in our opinion, a number of the propositions of these monographs should be subjects of debate, there is no doubt that the reader has received interesting and necessary books making a significant contribution to the development of the theory and practice of psychological diagnosis.

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FOURTH ALL-UNION COORDINATING CONFERENCE ON PROBLEMS OF SOCIALIST COMPETITION

Moscow VOPROSY PSIKHOLOGII in Russian No 4, Jul-Aug 81 p 182

/Report on conference by O. I. Zotova, Moscow/

/Text/ The Fourth All-Union Coordinating Conference of the Scientific Council on Problems of Socialist Competition of the USSR Academy of Sciences and the AUCCTU was held in the House of Unions of the AUCCTU on 20-21 April 1981. Ye. I. Kapustin, chairman of the scientific council, corresponding member of the USSR Academy of Sciences, presented the accountability report "Results of Fulfillment of the Coordinating Plan of Scientific Research on Problems of Socialist Competition for 1976-1980 and the Tasks of Scientific Research Organizations Working out Problems of Socialist Competition in the Implementation of the Decisions of the 26th CPSU Congress." He gave a profound analysis of the present stage of research on socialist competition both in our country and in the countries of the socialist camp.

The Scientific Council on Problems of Socialist Competition of the USSR Academy of Sciences and the AUCCTU was organized in 1974. It coordinates all the scientific research on the study of socialist competition.

The coordinating plan of the scientific council envisaged investigations of the economic, social and social-psychological aspects of socialist competition. Two topics--"Competition and Socialist Collectivism" and "Social-Psychological Problems of Competition"--were developed by the Institute of Psychology of the USSR Academy of Sciences during the 10th Five-Year Plan. The results of these investigations are reflected in two collective works published by the Institute of Psychology of the USSR Academy of Sciences ("Sotsial'no-Psikhologicheskiye Aspekty Sotsialisticheskogo Sorevnovaniya" /Social-Psychological Aspects of Socialist Competition/, Ye. V. Shorokhova, editor-in-chief, Moscow, Nauka, 1977, 176 pages; "Sotsial'no-Psikhologicheskiy Klimat Kollektiva: Teoriya i Metody Izucheniya" /Social-Psychological Climate of the Collective: Theory and Methods of Study/, Ye. V. Shorokhova, editor-in-chief, and O. I. Zotova, Moscow, Nauka, 1979, 176 pages). In all, the workers and coexecutors of the Institute of Psychology prepared more than 100 scientific publications on these topics.

Along with the theoretical aspects of socialist competition concrete research at base enterprises made it possible to prepare practical recommendations, which were approved and accepted for introduction by the board of Glavmosmontazhspetsstroy. These recommendations formulate proposals on the levels of organization of socialist competition, change in its forms, participation of managers and evaluation of their contribution to the organization of socialist competition.

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On the basis of the decisions of the 26th CPSU Congress Ye. I. Kapustin formulated problems, to the solution of which the efforts of scientific research organizations must be directed.

The sector for the study of the social-psychological climate and socialist competition headed by B. D. Parygin, which has been recently organized at the Institute of Social-Economic Problems of the USSR Academy of Sciences, performs the functions of a head organization for the elaboration of social-psychological problems of socialist competition. In the coordinating plan of the scientific council for the 11th Five-Year Plan the topic "Social-Psychological Aspects of Socialist Competition and its Effect on the Social-Psychological Climate of the Primary Labor Collective" was assigned to this institute. Within the framework of this topic the Institute of Psychology of the USSR Academy of Sciences will develop one of its aspects--"Effect of the Inclusion of Personality in Socialist Competition for an Increase in the Efficiency of Labor Activity (Based on the Materials of the Brigade Form of Labor Organization)."

During the 11th Five-Year Plan the scientific council faces the tasks of further development of the system of counterplanning of the correlation of competition and plans for the economic and social development of labor collectives, sectors and regions.

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SEMINAR ON PROBLEMS OF SOCIAL-PSYCHOLOGICAL TRAINING

Moscow VOPROSY PSIKHOLOGII in Russian No 4, Jul-Aug 81 pp 183-184

/Report on seminar by A. Ya. Varga, Moscow, Kh. Kh. Mikkin, Tallinn, L. A. Petrovskaya, Moscow, and D. V. Ronzin, Leningrad/

/Text/ The school seminar "Social Psychological Training: Methodology, Theory, Procedure and Technique" was held in Novosibirsk from 29 March through 1 April 1981. About 80 people from the country's various cities, that is, Moscow, Leningrad, Novosibirsk, Tallinn, Vilnius, Riga, Donetsk, Cherkassy, Sochi and so forth, took part in the work of this first scientific seminar organized by the Siberian Department of the Soviet Sociological Association in the country. The participants included specialists in the field of psychology, philosophy, economics, pedagogy, psychotherapy and so forth. The first two days were devoted to a theoretical discussion of problems. During the following days the participants exchanged practical experience in conducting social-psychological training.

At present the practice of social-psychological training represents an actively developing branch of applied psychology. Various terms for its designation, for example, laboratory training, active social-psychological training, active social training and so forth, appear in Soviet and foreign literature. The term "social-psychological training" introduced by psychologists in the German Democratic Republic into scientific usage has become most established.

The content of this field is very multifaceted and fits into one definition with difficulty. The most important point is that in this case it is a question of a certain form of psychological effect in the process of intensive communication in a group context. The effect is directed toward an increase in the psychological competence of the participants in communication.

The reports and the debate that developed touched mainly on three theoretical problems: the subject and tasks of social-psychological training, the concept of personality development and the practice of social-psychological training and the role of the leader (manager) in the process of training. The report by N. M. Koryak and V. I. Shalyapin (Novosibirsk) stressed the need for a philosophical-methodological substantiation of the new area of applied psychology. In the authors' opinion, during the development of criteria of evaluation of the changes accompanying training it is not enough to confine ourselves to psychological theory. Training oriented to a mechanical mastering by participants of the patterns of behavior not so much contributes to the development of personality as it blocks it.

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I. M. Rebeyko and N. P. Shtentsova (Novosibirsk), proceeding from the idea that the development of personality is the main objective of training, in their report placed emphasis on the special nature of activity of the manager of social-psychological training. In its essence his work represents a creative process, not the realization of a set of algorithms. Yu. N. Yemel'yanov's speech (Leningrad) singled out and described three functions of social-psychological training, that is, training, diagnosis and correction. In the set of methods special attention was paid to an analysis of such components as nonverbal means of communication.

L. A. Petrovskaya (Moscow) stressed that social-psychological training now includes a wide set of various methods and in connection with this noted the inadmissibility of reduction of the methodological complex of social-psychological training to one method, for example, to sensitivty training. In particular, methods can vary depending on whether they are oriented to the rendering of psychological help to an individual or a group as a whole, are applied to a contingent of healthy or sick people and so forth. She touched upon the following urgent problems in this area: principles of staffing training groups, vocational training for managers and methods of measuring effectiveness.

N. S. Govorov (Leningrad) substantiated the need for the realization of the system approach to social-psychological training. In particular, this presupposes an effect on various aspects of personality and on diverse behavioral situations. He expressed doubt as to the fruitfulness of an isolated use of individual methods. Social-psychological training must lean on a new scientific and artistic discipline named psychologics by the author.

At the seminar much attention was given to problems of the methods and techniques of social-psychological training. Kh. Kh. Miktin (Tallinn) discussed the results of development and problems of use of videotraining. Owing to operative feedback on the characteristics of behavior in specific situations videotraining makes it possible to make a correction in individual skills and habits of professional communication. The method of the participant's confrontation with himself, realized by the use of videofeedback, is the central unit here. In the speaker's opinion, success in training depends to a large extent on the development of empirical sociological and social-psychological investigations disclosing the difficulties and contradictions in a certain occupation, branch and enterprise. In this case an important task of training is to model these contradictions under labor conditions.

E. M. Vernik (Tallinn) analyzed the theoretical and practical aspects of the social-psychological training conducted in the German Democratic Republic. Special emphasis was placed on the logical principles and psychological foundations for the preparation of training programs. More than 20 such programs have been developed by now.

T. S. Yatsenko (Cherkassy) reported on the experience in the use of social-psychological training as an element of the vocational training of future teachers. The program includes two stages, that is, general training for communication (sensitivity training) and special training (development of special occupational skills). For now the first stage has been approved. A number of difficulties in work are connected with the factor that this experience is at variance with some established training standards.

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A. Ye. Alekseychik (Vilnius) familiarized the audience with the experience in improvement of professional skills of medical psychologists and psychiatrists in the field of medical psychology and psychotherapy through intensive group communication along with traditional theoretical training through a system of lectures, reports and so forth. E. F. Laurinaytis (Vilnius) discussed the use of training in the system of training medical students. S. D. Kazartsev (Leningrad) made a brief report on the varieties of social-psychological training abroad.

On the whole, the work of the school-seminar has shown that at present social-psychological training is used for training specialists in different fields (teachers, managers, physicians, medical psychologists, salesmen and musician performers), correcting the dynamics of marital conflicts, improving the relations between parents and children, correcting the social maladaptation of adolescents and so forth. Social-psychological training includes a wide spectrum of methods, that is, video-training, sensitivity training, role training, methods of theatralization, group analysis of evaluations and self-evaluations, nonverbal methods and so forth. The participants in the seminar became acquainted with some of the enumerated methods in practice. A. Ye. Alekseychik (Vilnius), L. A. Petrovskaya (Moscow), I. M. Rebeyko (Novosibirsk), Yu. N. Yemel'yanov (Leningrad), B. A. Barash (Leningrad) and E. F. Laurinaytis (Vilnius) shared their experience in the management of training groups.

A concluding document generalizing the work of the school seminar was drawn up at the final meeting. It stresses the urgent need for the substantiation of social-psychological training on the basis of the principles of Soviet psychology. It is noted that the use of these methods places high demands on the leader's personality and his moral, psychological and professional qualities. This raises with special acuteness the problem of a search for organizational forms of training managers of social-psychological training. The available experience makes it possible to create the basis for such training. The rapid popularization of methods and the increasing needs for their practical use require a regular exchange of experience by specialists. The participants in the school seminar elected an organizational office for the coordination of subsequent work in this area.

The school seminar held was not only interesting, but, undoubtedly, useful and very productive. It made it possible to become acquainted with the theoretical views and practical methods of work of those that now use and develop social-psychological training in our country--active methods of increasing the psychological competence of workers in many branches of production, domestic services and trade and methods of psychotherapy and nonmedical correction of man's psychological difficulties.

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SUBJECTS OF DISSERTATIONS FOR DEGREE OF CANDIDATE OF PSYCHOLOGICAL SCIENCES

Moscow VOPROSY PSIKHOLOGII in Russian No 4, Jul-Aug 81 pp 186-187

/List of authors and subjects of dissertations for the academic degree of candidate of psychological sciences coordinated with the Council for the Coordination of Scientific Research in the USSR in the specialty 19.00.07 and 19.00.01/

/Text/

Amatuni, I. L., (Moscow State Pedagogical Institute imeni V. I. Lenin). Formation of Value Orientations in Preschoolers and Junior Schoolchildren.

Volkov, Ye. S., (Moscow State Pedagogical Institute imeni V. I. Lenin). Characteristics of Value Orientations and Social Activity of Personality in Early Adolescence.

Galyautdinova, S. I., (Leningrad State Pedagogical Institute imeni A. I. Gertsen). Correlation of the Cognitive and Emotional in the Process of Development of Moral Convictions in Junior Schoolchildren.

Kadayas, Kh. M., (Scientific Research Institute of General and Pedagogical Psychology of the USSR Academy of Pedagogical Sciences). Characteristics of Spatial Thinking of Students With Artistic and Mathematical Inclinations.

Karandashev, V. N., (Leningrad State Pedagogical Institute imeni A. I. Gertsen). Psychological Conditions of Formation of the Need for Labor in Students.

Kislenko, V. Ya., (Moscow State Pedagogical Institute imeni V. I. Lenin). Psychological Characteristics of the Mastering of Moral Norms at a Preschool Age.

Larionova, L. P., (Irkutsk State Institute of Physical Culture). Psychological-Pedagogical Aspects of Retention of Graduates of Vocational and Technical Schools in Production.

Maralov, V. G., (Moscow State Pedagogical Institute imeni V. I. Lenin). Individual Characteristics of the Level of Senior Students' Claims (Based on the Material of Educational Activity).

Myrsabekov, A., (Scientific Research Institute of Pedagogy of the Kirgiz SSR). The Role of Psychological Factors in Music Instruction in Primary Grades.

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Uzbekova, G. K., (Moscow State Pedagogical Institute imeni V. I. Lenin). Characteristics of Moral Ideas and Concepts in Older Preschool-Age Children.

Shamayeva, V. F., (Leningrad State Pedagogical Institute imeni A. I. Gertsen). Psychological Basis for the Correction of Relations Between Pedagogically Neglected Adolescents and Adults.

Yurov, I. A., (State Twice Decorated Institute of Physical Culture imeni P. F. Lesgaft). Express Diagnosis of the Sportsman's Mental States Under Conditions of Activity.

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Moscow VOPROSY PSIKHOLOGII in Russian No 4, Jul-Aug 81 p 192

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YOUNG PSYCHOLOGISTS HOLD REGULAR CONFERENCE

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[Article by V. A. Barabanshchikov, Moscow, and A. V. Karpov, Yaroslavl': "In the Youth Section of the USSR Society of Psychologists"]

[Text] The Bureau of the Youth Section of the USSR Society of Psychologists held its regular meeting in Yaroslavl' on 4-5 February. The following items were discussed at the conference: the report on the work of the youth section in 1979-1980 (V. Semenov); the results of a competitive exhibition of projects created by young scientists and psychological specialists in the Estonian SSR (T. Niyt); the results of the second school of young psychologists in Minsk (A. Gostev); participation of young psychologists in the Eighth Transcaucasian Conference of Psychologists (S. Sedrakyan); the work of the editorial council of the Young Scientists' Council of the USSR Academy of Pedagogical Sciences Institute of General and Pedagogical Psychology (M. Ginzburg); the basic directions and plan of the work of the youth section for 1981-1982 (A. Asmolov, V. Semenov, V. Barabanshchikov); a report on the work of the youth section of the Yaroslavl' division of the USSR Society of Psychologists (A. Karpov).

The conference participants devoted special attention to the basic directions and plan of work of the youth section for 1981-1982. The principal items in the work of the youth section of the USSR Society of Psychologists in the 11th Five-Year Plan are to be coordination of the activities of young psychologists, promotion of their professional growth and their inclusion in the solution of the national economy's practical problems. In this connection the principal tasks of the youth section are: coordination of the planning of the section's work with the long-range planning carried out by the central council of the USSR Society of Psychologists; provision of assistance to the USSR Society of Psychologists in communist indoctrination of young scientists and psychological specialists and in preparation of a generation of scientists capable of ensuring progress in psychology and introducing scientific achievements into practice; provision of assistance to young psychologists in organizing and conducting scientific research and in improving their professional skills; achievement of broader participation of young psychologists in the development of long-range psychological problems, and promotion of the development and conduct of joint research by different psychological associations; participation in congresses, conferences and seminars sponsored by the USSR Society of Psychologists; improvement of efforts to publicize psychological knowledge.

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These tasks predetermine the basic forms and methods of the youth section's work. In order to encourage wide participation of young psychologists in its work, the youth section is improving the organizational structure and the work of youth sections in the different divisions of the USSR Society of Psychologists and the young scientists' councils of the country's leading psychological centers; it is participating in the organization and conduct of symposiums, conferences, schools and seminars sponsored by the USSR Society of Psychologists; it is promoting publicity on scientific works by young scientists, and it is recommending the best works for competitions sponsored by the Komsomol Central Committee; it is conducting a questionnaire survey with the purpose of studying the work of young psychologists in educational institutions, scientific research institutes and industrial and national economic enterprises; it is maintaining constant ties with associated youth sections (philosophers, psychiatrists and so on); it is organizing and conducting scientific-theoretical and scientific-practical conferences, schools and seminars of young psychologists on the pressing problems of psychology; it is organizing and conducting meetings and discussions with leading psychologists with the purpose of promoting deeper study of philosophical problems of psychology by young scientists and an understanding of the trends in development of psychology within the system of modern science; it is organizing consultation centers with the purpose of optimizing the scientific and practical work of young psychologists; it is providing instruction on teaching methods with the purpose of coordinating the training programs and the laboratory courses in psychology of the country's various institutions of higher education. It is mobilizing young psychologists to actively publicize the achievements of modern psychology.

The plan and the basic directions of the work of the Youth Section of the USSR Society of Psychologists for 1981-1982 were approved at the conference. A decision was made to organize and conduct the Seventh All-Union Competition of Projects of Young Psychologists, "Psychology and Social Practice," dedicated to the 26th CPSU Congress. The active work being done by the youth sections of the Estonian and Yaroslavl' divisions of the USSR Society of Psychologists was noted. The bureau turned the attention of the chairmen of youth sections of the USSR Society of Psychologists to the need for encouraging young psychologists to participate more actively in the All-Union Competition of Projects of Young Scientists in the General Sciences. The bureau also feels it necessary to increase the activity of information services in the divisions of the USSR Society of Psychologists.

The next conference of the Bureau of the Youth Section of the USSR Society of Psychologists will be held 5-6 October 1981 in Minsk.

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