

## ATTENTION AS A CRITERIONAL PROPERTY OF PROFESSIONAL FITNESS OF PERSONS WORKING IN HAZARDOUS CONDITIONS

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### **Abstract**

The purpose of the study was to improve methodological approaches to determination of attention as a criterion of professional fitness of persons working in hazardous conditions. To determine attention, we evaluated productivity index of information retrieval by “Numeric Square” method. When analyzing the data obtained during the study of attention (including its switching) on the productivity of information retrieval in persons who perform different types of hazardous work and the difference between the type of work performed. The vast majority of surveyed persons working in hazardous conditions were found to meet professional requirements (70%) by psychophysiological function “attention” (including its switching). The group of “conditionally fit” included (25%) subjects and “unfit” – 5%.

**Keywords:** *hazardous work, productivity of information retrieval, professional selection, psychophysiological functions, high risk activities, attention.*

### **Introduction**

In Ukraine, as in the rest of the world, the problem of the impact of occupational hazards and peculiarities of the labor process on higher nervous activity and general health of the working contingent remains relevant. At the same time, the issue of the connection between changes in the psychophysiological state of the employee with his professional success, reliability and ultimately the results of professional activities in individual and social aspects, has been and remains extremely essential [1, 2].

Thus, on the one hand, employees under the stressful and frankly harmful effects of the labor process in the implementation of adaptive-compensatory mechanisms are subject to regular professional deformation and potentially are at risk of pathological changes in the body [3-8].

The issue of safety of workers, especially of hazardous, extreme risk professions is due to the extraordinary financial and economic [9], medical, social and psychological [10] urgency of the problem.

All this determines the need for special attention to health in general and psychophysiological parameters in particular, both at the

stage of professional selection and employment, and throughout the period of professional activity [11].

In high-risk work, it is obvious that the clear organization of all components of psychophysiological support is extremely important for successful performance and maintenance of general and mental health [12,13].

It is important to take into account the peculiarities of psychophysiological support for becoming a specialist in professions where the key stressor is human interaction [14].

**Purpose of the study:** to improve methodological approaches to the definition of attention as a criterion of professional fitness of persons working in hazardous conditions.

### **Object and methods of the study**

The object of the study was the psychophysiological state and health of employees working in hazardous conditions.

The study was conducted with the participation of persons working in hazardous conditions. According to the current legislation, a special criterion for attracting employees to the list of study participants was that they were subject to mandatory periodic (primary) medical check-ups [15] and psychophysiological examination [16]. The study group included representatives of 17 working professions that perform hazardous work. When studying such a psychophysiological indicator as attention, the following criteria were chosen: 1) the type of hazardous work performed; 2) a profession

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related to the performance of high-risk work; 3) the age of the employee; 4) the sex of the employee; 5) employment record of the employee.

To determine the attention, we studied the performance of information retrieval by “Numeric Square” method [17]. This method is based on detecting the amount of useful information that can be retained by the subject under conditions of active information retrieval in the shortage of time.

This technique is implemented as part of a self-developed computer software “Psychodiagnostic testing to determine the professional fitness of industrial employees for high-risk work by psychophysiological indicators “ProfRisk” [18]. Student's test in Excel was used to statistically process the results.

#### **Results of the study and their discussion**

Assessment of the data obtained during the study of attention (including its switching) on the productivity of information retrieval in persons who perform different types of hazardous work revealed the difference depending on the type of work performed.

Information retrieval productivity in employees who perform explosion-hazardous work was  $7.17 \pm 0.31$  numbers, in employees with nervous and emotionally stressful work  $6.96 \pm 0.35$  numbers, in those working with firearms  $9.00 \pm 1.22$  numbers, in those maintaining oil and gas pipelines  $3.17 \pm 1.42$  numbers, in persons performing fire-hazardous work  $7.07 \pm 0.47$  numbers, in those working at height  $6.12 \pm 0.14$  numbers, in those performing high-voltage work  $6.30 \pm 0.28$  numbers, in those driving transport  $6.14 \pm 0.86$  numbers, in those performing underground work  $8.50 \pm 0.99$  numbers (Table 1).

A comparative analysis of the value of information retrieval performance showed that the optimal number was observed in employees who by type of job perform work using firearms and underground work. The largest deviation from the optimal value of information retrieval performance was found in employees who maintain oil and gas pipelines ( $p < 0.05$ -  $< 0.01$ ), which requires attention from the representatives of these professions during psychophysiological examination and during direct implementation of their work. Maintenance of oil and gas pipelines is performed under the pressure of various gases, so employees who perform hazardous work in this field must

be especially careful to avoid accidents and explosions. Nine of the studied types of work associated with increased risk were performed by representatives of 17 surveyed professions and specialties. Given that one of the main psychophysiological functions in the performance of high-risk work is attention, a study of the indicator of the “productivity of information retrieval” criterion was carried out for each of the 17 professions. The control group included employees whose job was not related to hazardous work, namely accountants and economists.

Observations in the study of the value of the productivity of information retrieval (Table 2) showed that in the representatives of management, whose work is associated with great responsibility and often requires nervous and emotional stress, it was  $7.50 \pm 0.37$  numbers. In the following study groups, work was associated with other risk factors and the corresponding values were: technicians  $6.23 \pm 0.54$  numbers, locksmiths  $5.16 \pm 0.34$  numbers, shop assistants  $6.52 \pm 0.52$  numbers, painters  $5.65 \pm 0.37$  numbers, engine-drivers  $7.00 \pm 0.33$  numbers, craftsmen  $6.13 \pm 0.43$  numbers, engineers  $7.28 \pm 0.33$  numbers, electric generator repairmen  $5.91 \pm 0.32$  numbers, electro-mechanical technicians  $5.91 \pm 0.47$  numbers, electric gas welders  $4.68 \pm 0.61$  numbers, electricians  $6.38 \pm 0.82$  numbers, drivers  $5.50 \pm 1.19$  numbers, security guards  $9.00 \pm 1.22$  numbers, utility operators  $6.93 \pm 0.35$  numbers, fighters  $7.67 \pm 0.55$  numbers. Representatives of the control group, which included accountants and economists, had an average of  $7.60 \pm 0.45$ .

Comparative analysis of the obtained data showed that none of these representatives had the highest productivity of information retrieval. Besides, significant differences were observed in locksmiths, electric gas welders and drivers where ( $p > 0.05$ - $< 0.01$ ) indicated a certain feature of this psychophysiological function in these subjects. This is an indicator of their inability to concentrate and switch attention to full speed, which is an essential requirement for successful and quality work in these professions.

The next step in conducting a comparative analysis of the value of the productivity of information retrieval was to study the dependence of concentration and speed of its switching on professional experience, age and sex of employees (Fig. 1, 2, 3).

Table 1

Information retrieval productivity in employees performing various types of high-risk work  
( $\bar{M} \pm m$ , numbers;  $n = 810$ )

Types of work	Indices
Explosion-hazardous work	7.17±0.31
Nervously and emotionally stressful work	6.96±0.35
Work with the use of firearms	9.00±1.22
Maintenance of oil and gas pipelines	3.17±1.42
Fire-hazardous work	7.07±0.47
Work at height	6.12±0.14
High voltage work	6.30±0.28
Transport driving work	6.14±0.86
Underground work	8.50±0.99

Note: statistical significance of differences at  $p > 0.05 - < 0.01$

Table 2

The value of information retrieval productivity in representatives of various professions whose work is associated with high risk  
( $\bar{M} \pm m$ , numbers;  $n = 810$ )

Profession	Indices	p
Management staff	7.50±0.37	>0.05 - <0.01
Technician	6.23±0.54	
Locksmith	5.16±0.34	
Shop assistant	6.52±0.52	
Painter	5.65±0.37	
Engine-driver	7.00±0.33	
Master	6.13±0.43	
Engineer	7.28±0.33	
Electric generator repairman	5.91±0.32	
Electromechanical technician	5.91±0.47	
Electric gas welder	4.68±0.61	
Electrician	6.38±0.82	
Driver	5.50±1.19	
Security guard	9.00±1.22	
Utility operator	6.93±0.35	
Fighter	7.67±0.55	
Accountant*	7.60±0.45	
Economist*	7.60±0.45	

Note: \* – representatives of the comparison group

The study established that the value of “productivity of information retrieval” in persons with different experience in hazardous occupations ranged from  $6.58 \pm 0.13$  numbers in the first group (employment record up to 10 years) to  $5.53 \pm 0.32$  numbers in the group with experience of more than 30 years, which indicated a decrease in attention and switching attention with increasing professional experience, as an indicator of fatigue (Fig. 1).



Fig.1. The value of information retrieval productivity depending on employment record ( $\bar{M} \pm m$ , numbers;  $n = 810$ ).

However, the lack of significant differences between different groups of experience ( $p > 0.05$ ), indicated stability throughout the whole term of work and leading functions that ensure efficiency and safety.

Evaluation of the dependence of indicators of key professionally significant functions of employees in hazardous professions showed a clear pattern on the age of workers.

The studied psychophysiological indicators tended to decrease. In employees aged 20 to 29 years, this figure was  $6.77 \pm 0.25$  numbers, in the age group from 30 to 39 years  $6.89 \pm 0.23$  numbers, in 40-49 years  $6.47 \pm 0.25$  numbers, 50-59 years  $5.61 \pm 0.29$  numbers, in 60 years and over  $5.61 \pm 0.31$  numbers.

The absence of statistically significant differences between age groups ( $p > 0.05$ ) indicated the normal physiological process inherent to older age groups and associated with reduced mobility of nervous processes on which the value of information retrieval productivity depends (Fig. 2).

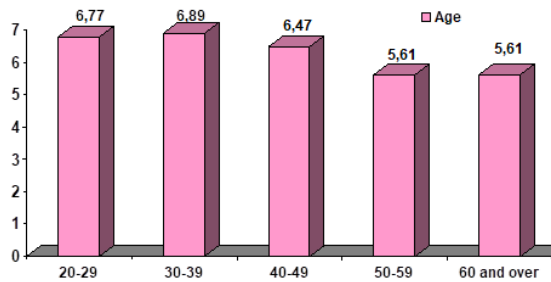


Fig. 2. The value of information retrieval productivity depending on age ( $\bar{M} \pm m$ , numbers,  $n = 810$ ).

Indicators of the “productivity of information retrieval” criterion in women slightly exceeded its value than in men ( $6.30 \pm 0.28$  numbers and  $6.27 \pm 0.12$  numbers, respectively), which indicated a slightly greater tension in the psychophysiological state of women who perform hazardous work.

But the lack of probable differences between the two groups of comparison showed a special role that belongs to professionally important functions in the performance of hazardous work, regardless of the sex of the employee (Fig. 3).

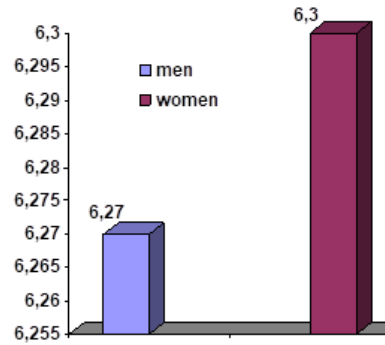


Fig.3. The value of information retrieval productivity depending on gender ( $\bar{M} \pm m$ , numbers,  $n = 810$ ).

A generalized individual analysis of the material obtained during the study (9 types of work, 17 professions and specialties, 810 surveyed persons), allowed to establish quantitative parameters for assessing the professional fitness of persons performing hazardous work on the basis of productivity of information retrieval. The fitness to perform these works by the psychophysiological function of “attention” was determined by the value of this indicator from 12 numbers to 7 numbers. Conditional fitness to work was determined by the value of this indicator in the range from 6 to 1 number. Unfitness to perform these types of work was determined by the value of less than 1.

Based on this, it was found that among the total number of performers of various types of hazardous work, 70% of respondents met the requirements of professional fitness on the criteria of “productivity of information retrieval”, 25% were conditionally fit, which determined a reduction in time for the next check-up from two (for unconditionally fit) to one year (Fig. 4). The number of professionally unfit among all the studied subjects was 5%.

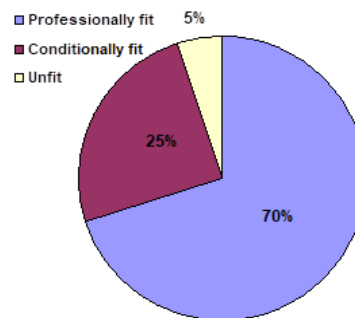


Fig.4 Professional fitness of employees who perform hazardous work on the basis of productivity of information retrieval ( $P\% \pm p\%$ ,  $n = 810$ ).

### Conclusions

The following conclusions can be drawn according to the results of the study of attention (including its switching), as an important psychophysiological function, which an employee must have when performing hazardous work:

1. Quality and safe performance of hazardous work is ensured by the presence of attention and speed of switching attention.

2. According to the indicators of the “productivity of information retrieval” criterion the worst indicators were observed in employees who maintain oil and gas pipelines ( $p < 0.05-0.01$ ), which requires attention from representatives of these professions during psychophysiological examination and in execution of the work itself.

3. Significant differences were observed in the representatives of the following professions and specialties: locksmiths, electric gas welders and drivers where ( $p > 0.05- < 0.01$ ). The set of preventive measures for the representatives of these groups of workers should include the improvement of the functional state by training professionally significant psychophysiological functions, as well as careful professional selection for these professions.

4. Experience, age, gender are signs in which the value of the “productivity of information retrieval” criterion directly depends on the physiological process of the population norm and are not reflected in the implementation of leading psychophysiological professionally important functions of persons performing hazardous work.

5. The vast majority of surveyed persons working in hazardous conditions meet professional requirements (70%) by psychophysiological function “attention” (including its switching). The group of “conditionally fit” included (25%) subjects and “unfit” – 5%.

### Declarations

#### Statement of Ethics

The authors have no ethical conflicts to disclose.

#### Consent for publication

All authors give their consent to publication.

#### Disclosure Statement

The study was conducted at the Research Institute of Labor Hygiene and Occupational Diseases as part of the mandatory medical check-up and psychophysiological examination of employees who perform work in harmful and hazardous working conditions. Administrative settlement agreements were concluded with enterprises in accordance with the Order of the Ministry of Health of Ukraine No.246 of 21.05.2007 “On approval of the procedure for medical examinations of certain categories” and the Order of the Ministry of Health of Ukraine and the State Committee of Ukraine for Labor Protection No. 263/121 of 23.09.1994 “On approval of the list of jobs where with a need for professional selection”.

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#### Data Transparency

The data can be requested from the authors.

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