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THE TRANSFORMATION OF PSYCHOPHYSIOLOGICAL FUNCTIONS OF MILITARY PILOTS WITH DIFFERENT PROFESSIONAL QUALIFICATION AND AGE

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The paper presents the results of the investigations related to revealing the transformation peculiarities of a complex of psychophysiological functions of military pilots of supersonic, subsonic, transport and helicopter aviation with due respect to their qualification level and age. The authors outline the descriptive list of psychophysiological characteristics that change regularly because of improving professional competence. They also specify the regular decrease in the level of significance of the correlation relationship between qualification and a complex of psychophysiological functions in pilots of supersonic, subsonic and transport aviation. As far as helicopter pilots are concerned, the increase in the body compensatory abilities under carrying out less intensive work results in the natural increase in such relationships. Moreover, the availability of trustworthy correlation relationships between the qualification of pilots and their age is shown. Furthermore, this relationship in supersonic aviation pilots is manifested much stronger than in other categories.

Key words: aviation medicine, psychophysiological functions, military pilots.

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ТРАНСФОРМАЦІЯ ПСИХОФІЗІОЛОГІЧНИХ ФУНКЦІЙ ВІЙСЬКОВИХ ЛЬОТЧИКІВ З РІЗНОЮ ПРОФЕСІЙНОЮ КВАЛІФІКАЦІЄЮ ТА ВІКОМ

У статті представлено результати досліджень щодо виявлення особливостей трансформації комплексу психофізіологічних функцій військових льотчиків надзвукової, дозвукової, транспортної та вертолітної авіації з урахуванням рівня їх кваліфікації та віку. Виділено перелік психофізіологічних характеристик, що закономірно змінюються у результаті удосконалення професійної підготовленості. Встановлено закономірне зменшення рівня значимості кореляційного зв'язку між кваліфікацією та комплексом психофізіологічних функцій льотчиків надзвукової, дозвукової та транспортної авіації. У вертольотчиків зростання компенсаторних можливостей організму під час реалізації менш напруженої праці призводить до закономірного збільшення кількості таких зв'язків. Крім того, показано наявність достовірних кореляційних зв'язків між кваліфікацією пілотів та їх віком. Причому цей зв'язок у льотчиків надзвукової авіації проявляється значно сильніше, ніж у інших.

Ключові слова: авіаційна медицина, психофізіологічні функції, військові льотчики.

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Solving the problem of the human factor in aviation medicine is closely connected with determining the effects of psychophysiological abilities and the state of health of pilots [0]. References intensively highlight the role and importance of a pilot's flying hours and physical training for preventing flight accidents [0]. With the aim of lessening the effects of human factor the model and the technique of the automated diagnostics of a military pilot state of health are suggested [0].

In their paper D.A. Nikiforov et al. [0] maintain that the most significant factors of the pilot's professional activities are as follows: the organization of the processes of professional training (including the

organization, quality, conditions for flight and ground-based training), the convenience of operation materiel and equipment (duty station ergonomics and convenience of operating protection and special equipment included), as well as psychophysiological training (including the organization and quality of theoretical training organized by medical branch experts related to the problems of aviation medicine); the organization, quality, conditions of physical training; the organization and quality of psychophysiological training for various types of flights under command or direct participation of medical branch experts in psychophysiological training). Therefore, the most important factors of the military pilot's (MP) activities are his flight qualification, duty station ergonomics and his psychophysiological alertness for carrying out complicated tasks.

In other articles [0] ascertains that within the structure of a specialist's professional reliability one can single out separate components that determine it: the level of qualification, the state of health and the availability of the body functional reserves. The authors arrives at the conclusion that the appearance of predictable mistakes can be stipulated by the following reasons: insufficient professional training (instability of skills, insufficient training, the loss of skill after long work stoppage; the misuse of the skill etc.); the changes in the state of man (illness, fatigue, emotional tension, prelaunch «fever», performance impairment due to the effects of labor factors on the body etc.). Otherwise speaking, the qualification of the specialist and his psychophysiological state prove to be interrelated components providing for the reliability of his professional activities.

Ranging the significance of the potential unreliability of an MP activities carried out by D.A. Nikiforov and his co-authors [0] testifies to the fact that professional training and the state of health prove to be a number-one priority.

Therefore, the data suggested make it possible to ascertain that the problem of the interrelation between an MP flight qualification and age and the level of manifestation of professionally significant qualities appears insufficiently highlighted in the present-day literature sources. The above refers mostly to the problem of determining such relationships in MPs operating various types of aerial vehicles.

The purpose of the study was to revealing the transformation peculiarities of the complex of psychophysiological functions of military pilots of various types of aerial vehicles with respect to their professional qualification and age.

Material and methods. The investigation has been carried out with the help of PFI-2 software and hardware complex (the state registration certificate No. 13988/2014 of June 27, 2014 [0]. A number of indices connected with psychophysiological functions have been registered: a latent period and a standard deviation of simple (SHER) and complex (CHER) hard-eye reactions; the functional mobility of nervous processes (FMNP); the power of nervous processes (PNP); the quantity of correct answers (OinS ca) and the duration of correct reactions under testing orientation in space (OinS); the quantity of quickening reactions (RMOq) and time lag reactions (RMOl) under testing movability of nervous processes; the duration (ShTMd) and quantity (ShTMq) of correct answers under testing memory; concentration of attention (CA); the critical frequency of flicker fusions (CFFF).

On the premises of the Military Medical Clinical Centre of the Central Region the psychophysiological examination of 400 MPs of various qualification levels was carried out. The MPs were divided into 4 groups (100 people each) according to the types of aerial vehicles: supersonic, subsonic, transport and helicopter aviation.

The data statistical analysis was carried out by means of the correlation method (Spearman rank correlation coefficient); univariate analysis of variance and recursive multiple correlation and regression analysis, as well as by means of STATISTICA 13.3 software package (license AXA 905192422FAACD-N).

Results of the study and their discussion. First and foremost, one has to admit that the professional activities of MPs of various types of aerial vehicles differ considerably. The same concerns the intensity of their work. The above has made it possible to formulate the hypothesis according to which the list and regularities of changes in the characteristics of psychophysiological functions of MPs must be connected with types of aerial vehicles. For this reason, the research was carried out for various contingents of pilots whose professional activities were connected with supersonic, subsonic, transport aerial vehicles and helicopters.

The primary analysis of data was made by means of the recursive multiple correlation and regression analysis which made it possible to reveal the relationship between the qualification level of an MP (dependent variable) and a complex of psychophysiological characteristics. As far as supersonic aviation MPs are concerned, it has been revealed that the above dependent variable with high fidelity is connected with the specific complex of indices of psychophysiological functions which is characteristic of this category ($R=0.56$; $p<0.0001$). The following indices were taken as variables singled out by means of this analysis: the functional mobility of nervous processes (FMNP), the latent period of the complex hand-eye reaction (CHER) and the quantity of correct answers (OinSca). With the aim of investigating the changes of every psychophysiological index in the process of improving an MP's skills, a univariate dispersion analysis was made. The authentic results of the analysis are presented in fig. 1.

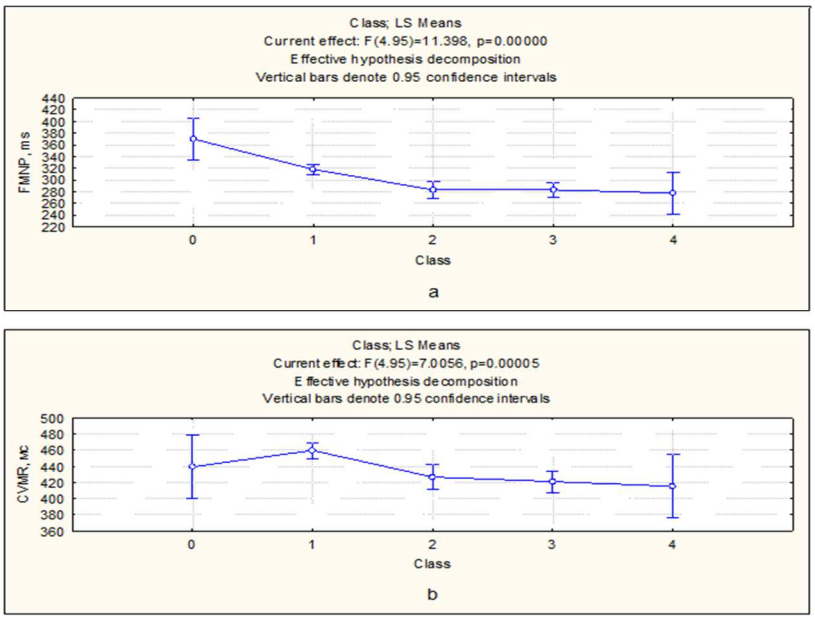

Fig. 1. The changes in the level of indices of psychophysiological functions of supersonic aviation military pilots under the formation of their professional qualification ;a – the transformation of functional mobility of nervous processes (p<0.0001); b – the transformation in the level of complex hand-eye reaction (p<0.0001).

The research results show that supersonic aviation MPs are characterized by the regular deterioration in the level of FMNP and the latent period and the latent period of CHER under the change in qualification. In separate cases, the quantity of examined MPs with 0 and 4 qualification levels was insignificant which resulted in the increase of trustworthy oscillation intervals of these indices. Nevertheless, in this case the availability of the above tendencies related to the effects of the "qualification level" factor appears statistically proved.

The psychophysiolo-gical characteristics in subsonic aviation MPs were also connected with their qualification level (R=0.49; p<0.0002. In this case one can observe the relationship of this factor with the following five indices: FMNP, OinSca, ShTMq, the latent period of SHER and RMOq.

Yet another set of qualities, as well as the increase in their quantity, as compared to those characteristic of supersonic aviation MPs, can be accounted for not only by different work intensity of this category, but also by the compensatory possibility of regulating progress in professional activities under the process of changing the complexity of flight tasks to be solved by subsonic aviation MPs. For this category of pilots only one psychophysiological index was revealed, the latter changing under raising the qualification of MPs (fig. 2).

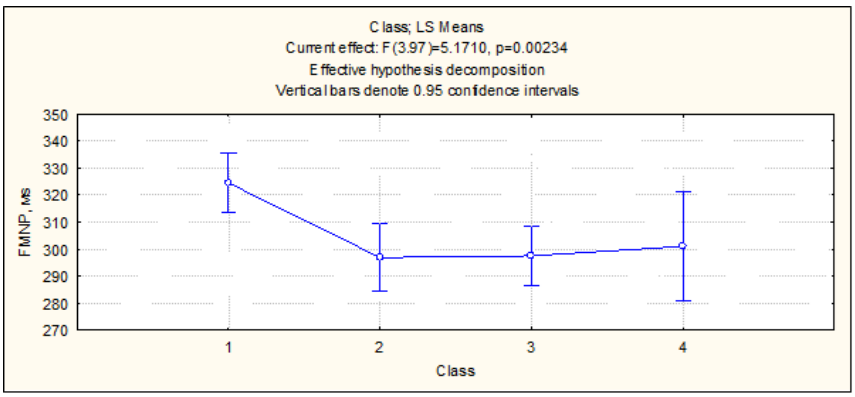

Fig. 2. The change in the level of indices of psychophysiological functions of subsonic aviation military pilots under the formation of their professional qualification (p<0.002).

The research proves that "qualification" factor definitely affects FMNP which is vividly displayed in pilots of class 1. The decrease in the quantity of adequately changing indices also testifies to great possibilities of compensating the changes in the level of psychophysiological functions under a lower level of work intensity in the investigated category of MPs.

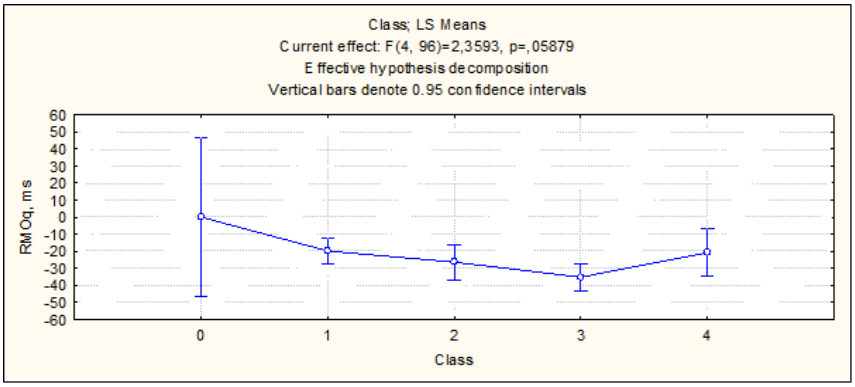

Fig. 3. The change in the level of indices of psychophysiological functions in transport aviation MPs under the formation of their professional qualification (p<0.06).

As compared to previous cases, a considerably different character of professional activities affects the relationship between the pilot's qualification level (class) and his professionally important qualities characteristic of transport aviation MPs. In this case one can only observe the tendency to such relationship (R=0.33; p<0.09). The list of psychophysiological indices related to this class changes considerably. One can single out six psychophysiological indices: RMOq, FMNP, OinS, RMOl, PNP and ShTMq. Their significant quantity testifies to the availability of considerable compensatory abilities of the body in transport aviation MPs.

The investigation into the effects of «the qualification» factor on the specified psychophysiological functions of pilots testifies to the absence of trustworthy shifts of these indices. One can only observe a tendency to changing RMOq indices which is presented in fig. 3.

In this case the decrease in the pilot's qualification level (class) is accompanied by the tendency to deteriorating his ability to timely react to the displacement of a movable object.

Proceeding from the analysis conducted, the decrease in the work intensity affects not only the relationship power of the MP qualification level (class) with his psychophysiological functions. The decrease in the work intensity results in the increase of such relationships. On the other hand, one can observe the decrease in the quantity of trustworthy changing indices, as well as in the level to which they are affected by the pilot's qualification.

A separate group of analysis covers helicopter aviation MPs. This can be accounted for by a considerable decrease in flight speed, as well as by the content of their professional activities. In this case, the level of the relationship between the pilot's qualification and his psychophysiological functions differ considerably from those of the pilots that were already examined.

In this case, the multivariable correlation coefficient is at a rather high level ($R=0.51$; $p<0.002$), and the quantity of the indices revealed amounts to 10: PNP, ShTMq, the latent period of FMNP, the latent period of CHER, the standard deviation of CHER, ShTMd, CA, RMOq, CFFF, the standard deviation of SHER. The list suggested makes it possible to conclude that the compensatory abilities of the body of helicopter pilots prove the most significant from the list of the investigated contingents of pilots. However, the factor of "the pilot qualification" does not affect adequately any of the indices revealed. This fact again testifies to the availability of the ultimate adaptation abilities in the contingent of helicopter pilots.

The investigation into the effects of «the qualification» factor on the transformation of psychophysiological functions in MPs makes it possible to admit that this factor is to some extent related to age. Actually, the pilot's professional formation is carried out gradually, though with different rate. Achieving the corresponding qualification levels takes some time. Hence, in this paper it appears expedient to answer the question related to the level of relationship between the pilot's qualification and his age. A number of correlation coefficients have been calculated. These coefficients differed considerably for various contingents of pilots, though their authenticity level amounted to $p<0.05$; supersonic – 0.76; subsonic – 0.37; transport aviation – 0.54; helicopter aviation – 0.49.

The list suggested shows that the highest relationship level between the indices under study is observed in supersonic aviation MPs. It is not surprising, since these pilots are characterized by the highest work intensity which testifies to a much closer link between their professional formation and age. This contingent of pilots also possesses a broader list of significantly changing separate psychophysiological functions under the change in their qualification levels.

Indeed, given the existence of a strong social and economic effect of the introduction of psychophysiological technologies [0, 0], in modern literature there are examples of scientific justification and the introduction of certain elements of psychophysiological support in aviation [0, 0, 0]. However, the problem related to the interrelation between the pilot's qualification and the level of his professionally important psychophysiological function is not so frequently highlighted in the present-day sources. This refers mostly to MPs of various types of aerial vehicles.

Thus, O.N. Sivash revealed the relationship between the professional qualification index (two qualification levels: low and high) and a complex of individual peculiarities [0]. Particularly, the author concludes that age and the qualification level are definitely connected with the level of extroversion ($r = -0.46$ and $r = -0.30$ respectively), rivalry ($r=0.31$ and $r=0.31$ respectively), avoidance behavior ($r=0.31$ and $r=0.31$ respectively), dissatisfaction ($r=0.27$ and $r=0.24$ respectively) and personal detachment ($r=0.38$ and $r=0.31$ respectively). Nevertheless, the relationship between psychophysiological characteristics and these parameters is not studied yet. Anyway, it is the psychophysiological qualities that are most closely connected with the pilot's qualification level, as well as with his age.

Though E.A. Shcherbakova's research [0] is aimed at revealing the content and relationship among personal characteristics of a contemporary MP of highest qualification category, it only highlights a brief summary of separate psychophysiological qualities of his personality. Particularly, it is hypothesized that an MP of high qualification level does not appear aggressive, but possesses an internal source of functional tension in the form of «voltage difference» of the indices of aggressiveness and hostility. This internal tension can fulfil two functions simultaneously – a positive and a potentially negative one for the pilot's personality and success of his professional activity. A positive function envisages the induction of functional tension which is necessary for carrying out military professional activities. A potentially negative function covers the possibility of neuropsychic breakdowns, the risk of which can be prognosticated as the result of fatigue, work overloads or social tension. Similar statements only provide a partial and absolutely incomplete insight into the correlation of professional quality of a highly qualified MP.

The present paper shows that the relationship between the pilot's age and qualification differs considerably in various contingents. Thus, the correlation level of these indices in supersonic aviation pilots proves significantly higher than that of subsonic aviation pilots ($p<0.0001$), transport aviation ($p<0.007$), helicopter aviation ($p<0.002$), which testifies to the availability of active negative processes in the body of supersonic aviation pilots.

The given effect testifies to the availability of the largest quantity of separate psychophysiological characteristics of such pilots which depend on the "qualification" factor. The results obtained prove that when carrying out the psychophysiological expertise and monitoring the psychophysiological state of military pilots, it appears necessary to take into account both the type of aerial vehicle and the dependence of some psychophysiological and psychological characteristics on the pilot's qualification and age. This refers especially to supersonic aviation pilots, since the intensity of their work is the highest among all the investigated contingents [0].

Conclusions

1. The authors have made up a list of psychophysiological characteristics that change regularly under the process of improving the qualification of MPs of various types of aerial vehicles.

2. The significant correlation relation between the professional qualification of military pilots of various types of aerial vehicles and a complex of their professionally significant psychophysiological characteristics is established. A regular decrease in the role of this relationship significance in military pilots of supersonic, subsonic and transport aviation as compared to helicopter pilots is shown.

3. The hypothesis formulated runs that a gradual increase in the quantity of psychophysiological functions connected with the military pilot's qualification can be accounted for by the increase in compensatory abilities of their body under the process of carrying out their intensive professional activities.

4. The availability of the trustworthy correlation relationship between the qualification of pilots and their age is shown. This relationship in supersonic aviation military pilots is manifested considerably stronger than in military pilots of subsonic, transport and helicopter aviation.

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