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FEATURES OF INTELLECTUAL FUNCTIONS INHIBITION AMONG UKRAINIAN BOXERS

A Sociocultural Study

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The effects of boxing's extreme aggressive conditions in training and competitive activity in sportsmen's mental working capacity still remains under-explored. While the neurophysiological effects caused by micro traumas to the brain have been extensively studied, less attention has been paid to the psychological consequences. This article reports on our study of the features of mental operations efficiency in Ukrainian boxers. The study involved athletes ($n = 168$, gender: men, average age: 25.5 ± 6.2 years), who were engaged in boxing and kickboxing in the Ukraine's eastern region. A 'Classification' method was used: a set of 70 cards with the images of various objects, plants, and living beings was given with instructions to arrange the items into groups in such a way that the objects in each concrete group possess common properties. Athletes were divided into groups, depending on the level of their sport qualification. Adopting the Vygotskian perspective, this study shows correlations between the productivity of boxers' thinking processes and the level of their sport skills: highly qualified sportsmen have many more well-marked thinking process defects than the sportsmen of the 2nd and 3rd categories. We observed a decrease in the generalization level, reduction in speed, deterioration of neurodynamic characteristics and criticality processes nearly in all participants. Exhaustibility and decrease in mental working capacity, impulsiveness of thinking, and its unproductive transformation were marked more often among the highly skilled boxers. A discussion on the cultural redefinition of this sport and on the necessary rehabilitative treatments is then presented.

Keywords: Vygotskian perspective, aggressive sport, boxing, intellectual functions impairments, mental exhaustibility, psychological deterioration

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1. Introduction

The Vygotskian perspective (VYGOTSKY 1987; 1994) lays out the basic principles on the productivity of higher human mental functions, and puts forward the idea of regarding social mediation of a person's mental activity, the interrelation of different personal values both with each other and with the social, ethical, biopsychological factors of a person's vital activity, and thus allows us to predict his self-development. This interdependency does not only stimulate a person's self-realization and approach to his own *acme*, but also allows the enhancement of his creative life-orientation, gradually transforming into a dynamically growing deterministic process, the outcome of which is completely predetermined by personal fundamentals, the importance of life variables, and the algorithm of their interaction (IVANCHENKO 2017). Sport is a cultural space where the motivational-axiological factor is shaped by social instances, orienting goals and needs of people, as well as their self-development on the basis of moral values (TSEKHMISTER & LYSENKO 2018). It means that sports are practiced differently in different countries according to their history and the processes of education resulting from the socio-political condition. In Ukraine, young people have always been involved in sports activities (the success of Ukrainian boxers in recent years is indisputable and recognized all over the world). But the realities of life make their own adjustments to the minds of people, first of all, in the case of youths that now, by the way, are even more active in different kinds of sports. Ukrainian youth are experiencing great stress associated with various life and educational problems (decline in living standards, difficulties in finding employment for graduates, a sharp decrease in financial family income, etc.) that lead to an impaired life perception; considering all these, they do not use socioculturally acceptable and effective health stress protection means in due measure and in as required (IVANCHENKO et al. 2018). In this cultural context, sports require the search for new tools and methods of the athletes' psychological training, especially those that involve aggressive activities.

With regard to boxing, similar to other combat sports, literature has already emphasized the potentiality for acute neurologic concussions, brain injuries, and neuropsychological consequences as serious symptomatics after various injuries (HEILBRONNER et al. 2009; ORRISON et al. 2009; ZAZRYN et al. 2009). Amateur boxers perform better than professional boxers at psychometric tests, evidencing fewer cases of chronic traumatic brain injury and neuropsychological deterioration, with a better preservation of some neuropsychological skills (LOOSEMORE et al. 2008; PORTER 2003; ZAZRYN 2006).

Given the evident violence in boxing, researchers have proposed a study question on how boxers' brain damage and its long-term consequences affect the sportsman's health during his life (CRITCHLEY 1937; CRITCHLEY 1949; HARRISON & MARTLAND 1928). The first scientific studies had already confirmed various types of injuries, traumata, brain damages – ill effects on the health of boxers with special emphasis on neuropsychiatric deterioration, so the term 'chronic traumatic encephalopathy (CTE)' was introduced (CORSELLIS et al. 1973; CRITCHLEY 1957; MCCOWN 1959). Since then,

after having ascertained that the boxers receive a lot of repetitive head trauma, whose effects need to be studied in order to stabilize the boxers' brain functions (BERNICK & BANRS 2013; JORDAN 2009; UNTERHARNSCHEIDT & TAYLOR-UNTERHARNSCHEIDT 2003), it was confirmed that the CTE diseases led to the accumulation of different harmful aggregated proteins, appearance of abnormalities inside the nervous system, and diffused axonal brain injury (MCKEE et al. 2013; ZHANG et al. 2006; ZHANG et al. 2003). Furthermore, it has been found that the chronic traumatic brain injury in boxers might gradually become a progressive disease that manifests after the active boxing career (BAILEY et al. 2013; JORDAN & CAMPBELL 1988; LAMPERT & HARDMAN 1984), and it has also been confirmed that severe traumatic brain injury in boxers led to a grave decline in health, with cognitive deficits (that is, poorer performance in spatial, logic, visual, mathematics testing and impaired verbal fluency), mental deterioration (that has subsequently been linked to increased tau proteins in the brain), dementia syndrome due to the punch drunkenness effect, and a variety of neurodegenerative diseases, such as Parkinson's and Alzheimer's diseases (BUTLER 1994; CORSELLIS 1989; MENDEZ 1995). Further studies described the syndrome of 'chronic traumatic encephalopathy' (SOLOMON 2018; SOLOMON & ZUCKERMAN 2015). Indeed, the sport-medical surveys confirm that the number of serious injuries, suicides, depressions, and cognitive deficits among aggressive sports athletes is mind-boggling. In particular, a high percentage of serious injuries were recorded for boxing and a more pronounced risk of chronic brain pathologies (that is, Alzheimer disease and dementia) exists compared to other contact and non-contact sports (MCCRORY 2007; PORTER 2003; NESELIUS et al. 2012).

At present, the study of adaptive processes and coordinating methods in the individual's activity is of particular interest to scientists, since the correct adaptation allows disclosing and putting into action the natural resources of the person, inherent in him from birth – his natural potential. Recently, studies have evidenced the availability of adaptive resources, based on preparatory complex-coordination exercises for boxers during their training prebout period (KIPRICH & BERINCHIK 2015; PODRIGALO et al. 2017; QIANG 2015).

Unfortunately, there is a serious dearth of research that takes into account the intellectual functions of boxers, features of their cognitive processes and cognitive-logical impairments. Our previous research analyses showed that 99% of the boxers exhibit different impairments of the voluntary attention – which manifest in the following: a narrowing of attention capacity, concentration process disorders, and a redistribution of the attention functions and attention switching (MALYK 2017; MALYK 2018). Other studies showed that their performance is characterized by the dysfunction of the modal-nonspecific type, in the form of selectivity defects, an increased negative effect of the interference, as well as a narrow and decreased memorization strength (ANTIPOVA & KHARITONOVA 2014; GANT & MALYK 2015; MALYK 2016). Also, their voluntary motor activities and their perceptual operations are spoiled, and disorders of spatial, dynamic and posed praxis (according to the perceptual pattern) have been noted (GANT 2014; GAVETT et al. 2011).

Nowadays, in the science of sport psychology, no systematized ideas exist concerning boxers' intellectual deficit at different stages of their sport career. The problem of influencing the extreme conditions of training-competitive activity in the athletes' mental working capacity (during boxing) remains virtually unexplored. In order to consider how this complex problem should be managed, there is a need to carry out specific psychodiagnostic studies aimed at analyzing the mechanisms of the boxers' mental working capacity.

2. The research hypothesis

The fundamental aim of this research was associated with studying the effects of boxing on the productivity in the mental sphere of athletes (namely, the productivity of their mental operations), in order to see what type of cognitive dysfunctions could be detected and provide the guarantee of the athletes' health safety. In this paper, the main attention focuses for the first time on impairments of mental functions and changes in cognitive performance in boxers of various qualifications, studied by methods of psychological diagnostics in order to identify the precise psychological and social indicators involving the unproductive transformation of thinking in boxers. From the literature, the hypothetical assumption was that the mental operations' productivity of the boxers practicing the sport is characterized by a specific dynamic and depends on the level of the boxers' athletic skill. The hypothesis was that the productivity features of boxers' thinking operations change depending on the different level of sport qualification: the higher the qualification level, the lower the cognitive performance.

3. Participants

The study involved athletes ($n = 168$, gender: men, average age: 25.5 ± 6.2 years), who were engaged in boxing and kickboxing in Ukraine's eastern region: 70 athletes of the 2nd and 3rd categories, 58 athletes of the 1st category and 40 Candidates for the Master of Sports (CMS). The participants' socio-demographic data of theirs are given in *Table 1*; herewith, there were no Masters of Sports aged 19 to 21 years old in our study. All athletes were informed about the goals and objectives of this study, and they all gave a written permission to participate in it. The inclusion criteria were: men involved in boxing; active athletes; aged from 19 to 32 years; that is, the category of 'adults' in this sport, which according to the age classification of the World Health Organization, constitutes a young age. This age category of sportsmen does not imply the presence of age-related declines in cognitive functions; therefore, this sample is homogeneous by age. Any diseases of the psycho-neurological spectrum constituted the study's exclusion criteria. At this research stage, it was not necessary to use the traditionally employed ANOVA or ANCOVA methods for a statistical analysis of the data obtained: this study has a pathopsychological focus and according to the objective of the research, our sample is completely sufficient. Besides, this

work is a preliminary search study that does not aim for global theoretical constructions and detailed statistical generalizations. For a similar purpose, we used χ^2 to compare the empirical distribution with the theoretical (uniform) one. Due to the problem of different sample sizes, we did not analyze absolute values, but the percentages that were rounded, were rounded to the nearest whole number. To calculate the effect size (ES), we used the Cramer V test.

Table 1
 Characteristics of socio-demographic data of study participants

<i>Specifications</i>	<i>Boxers (n = 168)</i>					
	<i>2nd-3rd categories (n = 70)</i>		<i>1st category, CMS (n = 58)</i>		<i>MS (n = 40)</i>	
	<i>Absolute value</i>	<i>%</i>	<i>Absolute value</i>	<i>%</i>	<i>Absolute value</i>	<i>%</i>
<i>Age</i>						
<i>From 19 to 21 years old</i>	20	28.57	12	20.69	0	0
<i>From 22 to 25 years old</i>	31	44.29	26	44.83	25	62.5
<i>From 26 to 32 years old</i>	19	27.24	20	34.48	15	37.5
<i>Family status</i>						
<i>Not married</i>	9	12.86	7	12.07	0	0
<i>Married</i>	53	75.71	46	79.31	38	95
<i>Divorced</i>	8	11.43	5	8.62	2	5

5. Method

For studying the basic thinking processes (that is, for estimating the generalization processes, abstraction processes, and the sequence of judgments), the ‘Classification’ method – first developed by K. Goldstein in 1920 and later modified by L.S. Vygotsky and B.V. Zeigarnik – was used (SHUVALOV 2013). The procedure for carrying out the experiment was a standard one. First, we offered to the sportsmen-respondents a set of 70 cards with the images of various objects, plants, and living beings. Thereafter, they were given certain instructions to arrange the items into groups in such a way that the objects in each concrete group would have common properties (that is, to distribute them into groups of ‘clothes’, ‘furniture’, ‘animals’, ‘measuring instrument’, ‘people’). At each subsequent stage, the respondents had to enlarge these groups; that is combine, integrate, and unite the objects within the groups they had already created. We also estimated the number of attempts/efforts (that were required for the final classification of objects) and the classification principles needed. When

analyzing the research results, we divided the athletes into groups, depending on their sport qualification level. Within the framework of our research, we analyzed such mental activity features as: 1) weak criticality regarding their own actions and decisions, 2) low level of generalizing operations, 3) propensity to a concrete or situational thinking, 4) diversity of intellection and its elements, 5) reliance on unimportant/inessential attributes, 6) 'slipping' on the bright, impressive, unusual signs and attributes, 7) tendency to excessive detailing, 8) inertness of thinking, 9) irrationality judgments while laying out the items and explaining the reasons for uniting objects in one group, 10) features when choosing a generalizing word, 11) contrast between the ability to assemble a group and inability to designate it. While using this investigation method, we took particular attention in giving the athletes an exact explanation of the method, as well as to the corrections they made when the psychologist prompted them to.

5.1. Statistical analysis

For each of the indicators studied, the mean values and the standard deviation were calculated. The estimation of the authenticity of differences in the average values of indicators was carried out in accordance with the t-test of Student at 1% and 5% significance levels. Data processing occurred on a personal computer IBM-PC / XT, using the software package Statistica for Windows 4.3B, StatSoft Inc.

6. Results

The observation of the boxers' working style during their test and the application of the conversation method have shown that 30.95% of respondents had adequate motivation regarding the research (by adequate motivation for research, it is customary to understand a sufficient level of maximum psychological readiness, orientation, and willingness of respondents to participate in the study). Moreover, they considered it important and estimated it to be an intellectual examination, showing an informative-cognitive interest in the assignments; they easily started work with the tasks, did not pay much attention to errors or unsuccessful attempts, and characterized their mistakes with a sense of humor. The rest of the surveyed boxers (69.05%) had an egotropic motivation towards the research: the interest that such athletes had shown in their work with a psychologist was determined by self-centered fixations and self-affirmation motives (so called 'business interest' as to the methods, the aspiration to pay attention to oneself and to merit praise, sympathy, or empathy). Therefore, the psychodiagnostic examination of the boxers with egotropic motivation required some additional efforts, both from the psychologist and from the athletes themselves.

According to the results received from the 'Classification' method, the exhaustibility of the mental working capacity and a steady decrease of the latter was observed in the results of 88.69% of athletes (*Table 2*).

While classifying the subjects at the first stages of testing, the sportsmen-respondents achieved a sufficiently high level of generalization, highlighting the subjects correctly by the common characteristics. Furthermore, at the groups' enlargement stage, the boxers 'were straying' on the path of random combinations; they were also trying to finish the task sooner or were losing total interest in the quality of their work.

For the impairment of the operational side of thinking (in the form of a reduction as to the generalization level), we recorded the results of 58.33% of boxers. While performing the task, in the judgments of this athletes' group, the direct image of the objects/phenomena dominated, the establishment of strictly specific connections between the objects replaced the usage of common characteristics. Moreover, having all these available attributes of objects, the boxers still found it difficult to select those of them that most fully revealed and determined the subject; they created a large number of small groups on the basis, by the way, of an extremely detailed substantive connection between them.

Table 2
Characteristics of productivity of the boxers' mental functions

<i>Impairments of intellectual functions</i>	<i>Boxers (n = 168)</i>	
	<i>Absolute value</i>	<i>%</i>
<i>Criticality violation</i>	14	8.33
<i>Reducing the generalization level</i>	98	58.33
<i>Exhaustibility</i>	149	88.69
<i>Impulsiveness</i>	119	70.83
<i>Slowing down the speed characteristics</i>	35	20.83

For the impairment of thinking dynamics in the form of a debilitation of the speed characteristics of intellection processes, we noted 20.83% of the respondents in the result, and 70.83% of athletes were noted in the result in the form of impulsiveness. They also changed the methods of fulfilling the tasks. While performing the classification of items, the athletes, in some cases, achieved a sufficiently high level of generalization, but often created incorrect and unrequited combinations, replacing the logical connections by a set of random combinations, or (combining the items correctly according to their common characteristic) immediately began to form a similar group by its meaning. In this latter case, the impairments of criticality were observed only in the results of 8.33% of the boxers.

The study of the boxers' mental operations' efficiency, depending on the level of their sport skills, was the next stage of our research.

The study showed that 88.57% of the boxers of the 2nd and 3rd categories, 88.76% of the athletes of the 1st category and CMS, and 97.50% of the MS boxers, had an evident exhaustibility of the mental working capacity and a constant decrease of the latter. Exhaustibility is a progressive weakening of the intensity of attention in the process of working with a sufficiently high level of work involvement, but the depth, absorption, concentration suffer and the productivity drops (ZEIGARNIK 1962).

Exhaustibility is observed in organic diseases and asthenic conditions. . . as exhaustion increases, the responses (of respondents) become less productive.

(Our trans., STOJMENOV et al. 2003, 391)

Mental working capacity is defined as the ability of a person to carry out mental activity. It highly depends on mental health. And under normal conditions, mental working capacity is often a fluctuating quantity. It largely depends on the emotional state, on rest or fatigue, on the attitude to the work being done, and on many other factors.¹

(Our trans., STOJMENOV et al. 2003, 752)

Dysfunctions of the operating side of intellection (in the form of reducing the generalization level) were observed in the indicators of 34.28% athletes of the 2nd and 3rd categories, in 74.13% of the boxers of the 1st category and CMS, as well as in 77.50% of the MS boxers. Impairment of thinking dynamics (in the form of impulsivity) was noted in 10.00% of the athletes of the 2nd and 3rd categories, in 17.24% of the boxers of the 1st category and CMS, as well as in 80.00% of the MS boxers. Impairment of thinking dynamics (in the form a debilitation of the intellection processes' speed characteristics) was diagnosed in 17.14% of the athletes of the 2nd and 3rd categories, in 25.86% of the 1st category boxers and CMS, as well as in 20.00% of the MS boxers. The criticality process deterioration took place in 8.57% of the athletes of the 2nd and 3rd categories, in 8.62% of the 1st category boxers and CMS, as well as in 7.50% of the MS boxers.

As exhibited in the results of our study (*Table 3*), the dominant dysfunctions among the impairments of boxers' thinking processes are a depletion of the mental working capacity and a continuous decrease of the latter, defects in the intellection dynamics (impulsiveness), and defects in the operational side of thinking (reducing the generalization level).

¹ Original text: „Istoshhaemost' nabljudajetsja pri organicheskikh zabojevanijah i astenicheskikh sostojanijah. ... po mere uvelichenija utomlenija otvety [respondentov] stanovjatsja menee produktivnymi” (391).

„Psihicheskaja rabotosposobnost' opredeljaetsja kak sposobnost' lichnosti osushhestvljat' psihicheskiju dejatel'nost'. Ona sil'no zavisit ot psihicheskogo zdorov'ja. I v normal'nyh uslovijah psihicheskaja rabotosposobnost' chasto kolebljushajasja velichina. Ona v znachitel'noj stepeni zavisit ot jemocional'nogo sostojanija, otydha ili ustalosti, otnoshenija k provodimoj rabote i mnogih drugih faktorov” (752).

Table 3
Productivity characteristics of boxers' intellectual functions in various sports qualifications (according to the results of the 'Classification' method)

<i>Impairments of intellectual functions</i>	<i>Boxers (n = 168)</i>						χ^2	<i>p</i>	<i>ES*</i>
	<i>2nd-3rd categories (n = 70)</i>		<i>1st category, CMS (n = 58)</i>		<i>MS (n = 40)</i>				
	<i>Absolute value</i>	<i>%</i>	<i>Absolute value</i>	<i>%</i>	<i>Absolute value</i>	<i>%</i>			
<i>Criticality violation</i>	6	8.57	5	8.62	3	7.50	0.077	0.962	0.054
<i>Reducing the generalization level</i>	24	34.28	43	74.13	31	77.50	19.097	0.000	0.320
<i>Exhaustibility</i>	62	88.57	48	82.76	39	97.50	1.267	0.531	0.069
<i>Impulsiveness</i>	7	10.00	10	17.24	32	80.00	83.346	0.000	0.883
<i>Slowing down the speed characteristics</i>	12	17.14	15	25.86	8	20.00	2.000	0.368	0.178

Note: *ES is the effect size

It should be noted that the exhaustibility of the mental working capacity and a constant decrease of the latter act as markers of the athlete's emerging cognitive deficit. In general, it takes place at the earliest period of boxing practice, wherein it is more often fixed on the results of highly qualified MS boxers. Impairments of the operational side of the intellection process (reducing the generalization level) prevailed in the indicators of highly qualified athletes compared to those sportsmen in a lower sport category. Mainly, the MS boxers' results pointed to the impairments of thinking dynamics (impulsivity). At the same time, a debilitation of intellection processes' speed characteristics and criticality defects (namely, the errors while controlling one's own actions and the correction of errors already made, or a complete incapacity/impossibility to correct them) had approximately the same distribution in all groups of boxers, regardless of their sport qualification level.

7. Discussion

The hypothesis of our research was confirmed. Depending on the level of the athletes' sport skills, a polymorphism of various defects and a certain (regular) dynamic characterizes the boxers' thinking process productivity. In order to analyze the dynamic characteristics of mental processes and to study the regularity of the boxers' growing cognitive deficit, we divided the sportsmen-respondents into three groups, depending on the level of their athletic skills. Highly qualified boxers (1st category, CMS and MS)

demonstrated a more serious shortage of mental working capacity than the boxers of the 2nd and 3rd categories. The MS boxers exhibited more evident disorders of the intellection processes than the boxers of the 1st category and the CMS boxers.

Asthenic syndrome is a health status that manifests in the form of increased fatigue, exhaustion, loss of ability to resist prolonged mental and physical stress. It ranks very high in the clinical picture of craniocerebral trauma (CCT) in all severity levels. Among the characteristics of the boxers' individual traits, it is possible to distinguish a set of common features that do not depend on the level of athletes' qualifications, but which are generic and overall for the sportsmen of all qualifications in this kind of sport, namely: mood instability, behavior impulsiveness, impairments in the areas of attention, memory and response speed (BELCARO et al. 2014; WILDE et al. 2016). The results of our study confirmed all this, demonstrating the reduction of their generalization level ability and their exhausted mental working capacity. We have shown that the majority of athletes-respondents had the impairments (that is, unproductive transformation) of the thinking dynamics in the form of impulsivity; namely: the boxers' impulsiveness manifested itself as an instability in the process of choosing the means/ways by which they fulfill their mental operations. In ordinary life, this characteristic is expressed by the tendency to act in three different ways: without clear conscious control, under the influence of external circumstances, or due to emotional anxiety. The aforementioned variations of boxers' behavior can be characterized and defined as a frontal syndrome; that is, a syndrome of the impaired function of programming, regulating, and controlling the mental activity. When the frontal syndrome is evidently manifest, the following behavioral and cognitive characteristics are retained, namely: the fulfillment of specific operations, the ability to perform mental acts, the storage and use of the available knowledge base; however, it becomes impossible to adequately apply one's knowledge base in accordance with a consciously stated intent.

According to our results, the impairments of intellection processes were more obvious and serious among highly qualified boxers: these showed a marked decrease in the productivity of mental operations and intellectual activity in general, as well as a criticality decline. The criticality deterioration (being a consequence of defeating the brain frontal lobes) can lead to the formation of such boxer behavior as an exaggeration or disparagement/belittling of real details and facts, jealousy, and a tendency to lie. In this regard, it should be noted that this dissimulation has been registered in the results of 42.86% of the boxers we surveyed: they demonstrated a conscious concealing of the symptoms for various personal physical/mental disorders and dysfunctions.

Furthermore, it should be clarified that during the testing-conversation with the boxers-respondents, they made no complaint about their own health problems; most of the sportsmen denied having not only the CCT, but even the suffering of minimal cognitive disorders. In addition, the athletes asserted that the people (they meet) often misunderstood their behavior.

We often noticed boxers' unusual behavior during our research. It consisted of the following: (a) the participants begin to fulfill the task only after additional

stimulating motivation; (b) they themselves behave aggressively during the test; (c) they seek some excuse for themselves and do not aim to achieve a better result at any unsuccessful attempt in the course of testing; (d) or after making mistakes, they often refuse to accomplish the task at all. It should be noted that while carrying out the psychodiagnostic examination of such 'problematic' boxers, additional efforts were required from both the psychologist and the athletes themselves.

In addition, our study made it possible to identify slight, nonspecific (pre-clinical) defects in the intellection processes of boxers; this fact is in agreement with such points of view that declare the psychopathological manifestations occurring as a result of CCT are often very subtle and peculiar (NESELIUS et al. 2012; FÖRSTL et al. 2010).

8. Conclusions

The results of our investigations reveal a fairly wide range of impairments and changes in the boxers' mental functions; namely: a reduction of the generalization level, a deterioration of speed characteristics, exhaustion of mental activity, as well as impairment of criticality, and impulsiveness. By analyzing the intellection disorders thus revealed, we can say that the degree of their severity was not the same in the different groups of athletes. The impairments of intellection processes and thinking functions of the highly qualified boxers (of the 1st category, CMS and MS) stood out as more evident and explicit than the same symptomatic manifestations of the athletes in the 2nd and 3rd categories. The thinking defectiveness of boxer-respondents (who were at the stage of achieving the best sport results) appeared even more severe: we have fixed on a marked decrease in the productivity of athletes' thinking operations and intellectual activity in general, as well as some great criticality violations. However, it should be noted in this case that in the early stages of sport activity, the boxers manifested a mild or moderate exhaustibility in mental working capacity, a slight decrease in generalization, and small disorders of intellection dynamics.

The results of our study showed that professional boxing impacts significantly on athletes' productivity of cognitive functions. Minimal cognitive dysfunctions (namely: reducing the level of generalization, a debilitation of speed characteristics, an exhaustion of mental activity, and a worsening of criticality, impulsiveness of mental operations) already occurred in the early years of boxing, which affected not only the sports career of the athletes, but other spheres of their activities as well.

The differences in the productivity of cognitive functions, identified as a result of the study, indicate a directly proportional relationship between sport qualifications and the intellectual effectiveness of boxers (the sample of participants by age was uniform). Our study's results clearly state the factual presence of intellectual impairments during a boxing career. The potential risks to the physical and mental health of athletes should be taken into account before this sport is chosen. Therefore, these results can be useful and interesting for parents of children when choosing a sport for them, for the athletes themselves, as well as for doctors.

References

- ANTIPOVA, O.S. & L.G. KHARITONOVA (2014) 'Osobennosti sensomotornogo reagirovaniya i kognitivnykh funktsij u sportsmenov 9–16 let, zanimajushhijhsja ciklicheskim i aciklicheskim vodami sporta' [Features of sensomotor response and cognitive functions in athletes, aged 9–16 years and engaged in cyclic and acyclic sports], *Voprosy funkcional'noj podgotovki v sporte vysshih dostizhenij* 2, 83–91. Retrieved 5 April 2020 from <https://elibrary.ru/contents.asp?id=34030366>.
- BAILEY, D.M., D.W. JONES, A. SINNOTT, J.V. BRUGNIAUX, K.J. NEW, D. HODSON, C.J. MARLEY, J.D. SMIRL, S. OGOON & P.N. AINSLIE (2013) 'Impaired Cerebral Haemodynamic Function Associated with Chronic Traumatic Brain Injury in Professional Boxers', *Clinical Science* 124, 177–89 (<http://dx.doi.org/10.1042/CS20120259>).
- BELCARO, G., R. LUZZI, M. DUGALL, E. IPPOLITO & A. SAGGINO (2014) 'Pycnogenol® Improves Cognitive Function, Attention, Mental Performance and Specific Professional Skills in Healthy Professionals Age 35–55', *Journal of Neurosurgical Sciences* 58:4, 239–48.
- BERNICK, C. & S. BANRS (2013) 'What Boxing Tells us about Repetitive Head Trauma and the Brain', *Alzheimer's research & therapy* 5:3, 23 (<http://dx.doi.org/10.1186/alzrt177>).
- BUTLER, R.J. (1994) 'Neuropsychological Investigation of Amateur Boxers', *British Journal of Sports Medicine* 28, 187–90; retrieved 5 April 2020 from <https://bjsm.bmj.com/content/bjssports/28/3/187.full.pdf>.
- CORSELLIS, J.A. (1989) 'Boxing and the Brain', *BMJ: British Medical Journal* 298, 105–9 (<http://dx.doi.org/10.1136/bmj.298.6666.105>).
- CORSELLIS, J.A., C.J. BRUTON & D. FREEMAN-BROWNE (1973) 'The Aftermath of Boxing', *Psychological Medicine* 3, 270–303 (<http://dx.doi.org/10.1017/S0033291700049588>).
- CRITCHLEY, E. (1937) 'Nervous Disorders in Boxers', *Medical Annual*, 318–20.
- CRITCHLEY, M. (1949) 'Punch-Drunk Syndromes: The Chronic Traumatic Encephalopathy of Boxers' in C. VINCENT, ed., *Neurochirurgie: Hommage à Clovis Vincent* (Paris: Maloine) 161–74; retrieved 4 April 2020 from <https://www.scienceopen.com/document?vid=083c71bd-7145-4942-a8ce-ea63ab0fe043>.
- CRITCHLEY, M. (1957) 'Medical Aspects of Boxing, Particularly from a Neurological Standpoint', *BMJ: British Medical Journal* 1:5015, 357–62 (<http://dx.doi.org/10.1136/bmj.1.5015.357>).
- FÖRSIL, H., C. HAASS, B. HEMMER, B. MEYER & M. HALLE (2010) 'Boxing-Acute Complications and Late Sequelae: From Concussion to Dementia', *Deutsches Ärzteblatt International* 107, 835–39, (<http://dx.doi.org/10.3238/arztebl.2010.0835>).
- GANT, O.J.E. (2014) 'Diagnostika perceptivno-gnostichnoï sferi sportsmeniv na nachal' nih etapah pidgotovki, jak umova zberezhenja ih psihologichnogo zdorov'ja' [Diagnosis of the athletes' perceptive-gnostic sphere at the initial stages of preparation as a condition for the preservation of their psychological health], *Naukovyj visnyk Xersons'koho derzhavnoho universytetu. Seriya: Psyxolohichni nauky* 2:2, 95–102; retrieved 5 Apr 2020 from http://pj.kherson.ua/file/psychology_02/ukr/part_2/20.pdf.
- GANT, O.J. & J.K. MALYK (2015) 'Harakteristika funkciï zorovoi pam'jati bokseriv z riznimi sportivnim stazhem' [Characteristics of the visual memory functions of boxers with different sports experience], *Naukovyj visnyk Xersons'koho derzhavnoho universytetu. Seriya: psyxolohichni nauky* 6, 17–21; retrieved 5 Apr 2020 from http://pj.kherson.ua/file/2015/psychology_06/ukr/4.pdf.
- GAVETT, B.E., R.A. STERN & A.C. MCKEE (2011) 'Chronic Traumatic Encephalopathy: A Potential Late Effect of Sport-Related Concussive and Subconcussive Head Trauma', *Clinics in Sports Medicine* 30:1, 179–88 (<http://dx.doi.org/10.1016/j.csm.2010.09.007>).

- HARRISON, S. & H.A. MARTLAND (1928) 'Punch Drunk', *JAMA: Journal of the American Medical Association* 91:15, 1103–07 (<http://dx.doi.org/10.1001/jama.1928.02700150029009>).
- HEILBRONNER, R.L., S.S. BUSH, L.D. RAVDIN, J.T. BARTH, G.L. IVERSON, R.M. RUFF, M.R. LOVELL, W.B. BARR, J.R. ECHEMENDIA & D.K. BROCHEK (2009) 'Neuropsychological Consequences of Boxing and Recommendations to Improve Safety: A National Academy of Neuropsychology Education Paper', *Archives of clinical neuropsychology* 24, 11–19 (<http://dx.doi.org/doi:10.1093/arclin/acp005>).
- IVANCHENKO, A.A. (2017) 'The Positive Summarized Effect of the Creative Life-Orientation Phenomenon', *Fundamental and Applied Researches in Practice of Leading Scientific Schools* 21:3, 100–107; retrieved 4 Apr 2020 from <https://farplss.org/index.php/journal/article/view/186>.
- IVANCHENKO, A., O. TIMCHENKO & E. ZAIKA (2018) 'How to Get around the Stress-Traps in the Students' Life and Avoid the Stress Acute Angles', *Science and Education* 3, 12–19 (<http://dx.doi.org/10.24195/2414-4665-2018-3-2>).
- JORDAN, B.D. (2009) 'Brain Injury in Boxing', *Clinics in Sports Medicine* 28, 561–78 (<http://dx.doi.org/10.1016/j.csm.2009.07.005>).
- JORDAN, B.D. & E.A. CAMPBELL (1988) 'Acute Injuries among Professional Boxers in New York: A Two-Year Survey', *The Physician and Sportsmedicine* 16, 87–91 (<https://doi.org/10.1080/00913847.1988.11709407>).
- KIPRICH, S.B. & D.Y. BERINCHIK (2015) 'Specific Description of Functional Providing of the Special Endurance of Boxers', *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports* 3, 20–27 (<http://dx.doi.org/10.15561/18189172.2015.0304>).
- LAMPERT, P.W. & J.M. HARDMAN (1984) 'Morphological Changes in Brains of Boxers', *JAMA: Journal of the American Medical Association* 21, 2676–79 (<http://dx.doi.org/10.1001/jama.1984.03340440034023>).
- LOOSEMORE, M., C.H. KNOWLES & G.P. WHYTE (2008) 'Amateur Boxing and Risk of Chronic Traumatic Brain Injury: Systematic Review of Observational Studies', *British Journal of Sports Medicine* 42:11, 564–67 (<http://dx.doi.org/10.1136/bmj.39342.690220.55>).
- MALYK, J.K. (2016) 'Harakteristika produktivnosti mnesticnih funkcij u bokseriv na raznih etapah trenuval'no-zmagal'nogo procesu' [Characteristics of the boxers' mnemonic functions productivity at different stages of their training-competitive process], *Problemy ekstremal'noyi ta kryzovoyi psyxolohiyi: Visnyk Nacional'noho universytetu cyvil'noho zaxystu Ukrainy* 20, 135–49; retrieved 5 Apr 2020 from http://nuczu.edu.ua/ukr/science/y_pkp/archive/2016_20/.
- MALYK, J.K. (2017) 'Psihologichni osoblyvosti produktivnosti kognitivnih funkcij u sportivnij dijat'nosti bokseriv' [Productivity of the boxers' attention features with different levels of athletic skill], *Naukovyj visnyk Xersons'koho derzhavnoho universytetu. Seriya: psyxologichni nauky* 2:2, 32–36; retrieved 5 Apr 2020 from http://pj.kherson.ua/file/2017/psychology_02/ukr/part_2/7.pdf.
- MALYK, J.K. (2018) *Psyxologichni osoblyvosti produktyvnosti kohnityvnyx funkcij u sportyvnyj diyal'nosti bokseriv* [Psychological features of cognitive functions in sport activity of boxers] (Ph.D diss., Kharkov, Ukraine) retrieved 5 Apr 2020 from http://nuczu.edu.ua/images/top-menu/science/spetsializovani-vcheni-rady/diss_Malynewk.pdf.
- MCCOWN, I. (1959) 'Boxing Injuries', *The American Journal of Surgery* 98, 509–16 ([https://doi.org/10.1016/0002-9610\(59\)90545-8](https://doi.org/10.1016/0002-9610(59)90545-8)).
- MCCRORY, P. (2007) 'Boxing and the Risk of Chronic Brain Injury', *BMJ: British Medical Journal* 335:7624, 781–82 (<https://doi.org/10.1136/bmj.39352.454792.80>).

- McKEE, A.C., R.A. STERN, C.J. NOWINSKI, T.D. STEIN, V.E. ALVAREZ, D.H. DANESHVAR, V.E. ALVAREZ, H.-S. LEE, G. HALL, S.M. WOJTCOWICZ, CH.M. BAUGH, D.O. RILEY, C.A. KUBILUS, K.A. CORMIER, M.A. JACOBS, B.R. MARTIN, C.R. ABRAHAM, T. IKEZU, R.R. REICHARD, B.L. WOLOZIN, A.E. BUDSON, L.E. GOLDSTEIN, N.W. KOWALL & R.C. CANTU (2013) 'The Spectrum of Disease in Chronic Traumatic Encephalopathy', *Brain*, 136, 43–64 (<http://dx.doi.org/10.1093/brain/aws307>).
- MENDEZ, M.F. (1995) 'The Neuropsychiatric Aspects of Boxing', *International Journal of Psychiatry in Medicine* 25, 249–62 (<http://dx.doi.org/10.2190/CUMK-THT1-X98M-WB4C>).
- NESELIUS, S., H. BRISBY, A. THEODORSSON, K. BLENNOW, H. ZETTERBERG & J. MARCUSSON (2012) 'SF-Biomarkers in Olympic Boxing: Diagnosis and Effects of Repetitive Head Trauma', *PLoS ONE* 7:4, e33606 (<http://dx.doi.org/10.1371/journal.pone.0033606>).
- ORRISON, W.W., E.H. HANSON, T. ALAMO, D. WATSON, M. SHARMA, T.G. PERKINS & R.D. TANDY (2009) 'Traumatic Brain Injury: A Review and High Field MRI Findings in 100 Unarmed Combatants Using a Literature Based Checklist Approach', *Journal of Neurotrauma*, 26, 689–701 (<http://dx.doi.org/10.1089/neu.2008.0636>).
- PODRIGALO, L.V., A.A. VOLODCHENKO, O.A. ROVNAYA, L.A. RUBAN & K.M. SOKOL (2017) 'Analysis of Adaptation Potentials of Kick Boxers' Cardio-Vascular System', *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports* 21, 185–91 (<http://dx.doi.org/10.15561/18189172.2017.0407>).
- PORTER, M.D. (2003) 'A 9-Year Controlled Prospective Neuropsychologic Assessment of Amateur Boxing', *Clinical Journal of Sport Medicine* 13, 339–52 (<http://dx.doi.org/10.1097/00042752-200311000-00002>).
- QIANG, L.Y. (2015) 'Experimental Substantiation of Methodic of 11–13 Years Old Boxers' Coordination Development', *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports* 19:6, 14–22 (<http://dx.doi.org/10.15561/18189172.2015.0603>).
- SOLOMON, G. (2018) 'Chronic Traumatic Encephalopathy in Sports: A Historical and Narrative Views', *Developmental Neuropsychology* 43, 279–311 (<http://dx.doi.org/10.1080/87565641.2018.1447575>).
- SOLOMON, G.S. & S.L. ZUCKERMAN (2015) 'Chronic Traumatic Encephalopathy in Professional Sports: Retrospective and Prospective Views', *Brain Injury* 29, 164–70 (<http://dx.doi.org/10.3109/02699052.2014.965205>).
- SHUVALOV, Y.N. (2013) *Patopsihologija* [Pathopsychology] (Tula: Izdatel'stvo Tul'skogo gosudarstvennogo universiteta) retrieved 5 Apr 2020 from <https://studfile.net/preview/3616780/>.
- STOIMENOV, J.A., M.J. STOIMENOVA, P.J. KOEVA, G.M. KOEV, P.L. POPOV & L.TS. STOIMENOVA, eds. (2003) *Psihiatricheskij jenciklopedicheskij slovar* ' [Psychiatric Encyclopedic Dictionary] (Kiev: Mezhrizional'naja Akademija upravljenja personalom) retrieved 4 May 2020 from http://maup.com.ua/assets/files/lib/book/ps_18.pdf.
- TSEKHMISTER, YA. & O. LYSENKO (2018) "Formuvannja profesijnoi kompetentnosti majbutnih provizoriv u vishnih medichnih navchal'nih zakladah" [The Process of the Future Pharmacists' Professional Competence Formation at the Higher Medical Educational Establishments], *Fundamental and Applied Researches in Practice of Leading Scientific Schools* 25:1, 70–76; retrieved 5 Apr 2020 from <https://farplss.org/index.php/journal/article/view/275>.
- UNTERHARNSCHEIDT, F. & J. TAYLOR-UNTERHARNSCHEIDT (2003) *Boxing: Medical Aspects* (Amsterdam etc.: Academic).
- VYGOTSKY, L.S. (1987) 'Lecture 6. The Problem of Will and its Development' in R. RIEBER & A. CARTON, eds., *Collected Works* 1 (trans. N. Minick; New York: Plenum) 351–58.
- VYGOTSKY, L.S. (1994) 'The Problem of the Environment' in R. Van der VEER & J. VALSINER, eds., *The Vygotsky Reader* (trans. T. Prout ; Blackwell Cambridge: MA) 338–54.

- WILDE, E.A., J.V. HUNTER, X. LI, C. AMADOR, G. HANTEN, M. R. NEWSOME, T.C. WU, S.R. MCCAULEY, G.S. VOGT, Z.D. CHU, B. BIEKMAN, & H.S. LEVIN (2016) 'Chronic Effects of Boxing: Diffusion Tensor Imaging and Cognitive Findings', *Journal of Neurotrauma* 33, 672–80 (<http://dx.doi.org/10.1089/neu.2015.4035>).
- ZAZRYN, T., P. CAMERON & P. MCCRORY (2006) 'A Prospective Cohort Study of Injury in Amateur and Professional Boxing', *British Journal of Sports Medicine* 40, 670–74 (<http://dx.doi.org/10.1136/bjsm.2006.025924>).
- ZAZRYN, T.R., R.R. MCCRORY & P.A. CAMERON (2009) 'Neurologic Injuries in Boxing and other Combat Sports', *Physical Medicine and Rehabilitation Clinics of North America* 20, 227–39 (<http://dx.doi.org/10.1016/j.pmr.2008.10.004>).
- ZEIGARNIK, B.V. (1962) *Patologija myshlenija* [Pathology of thinking] (Moscow: Izdatel'stvo Moskovskogo universiteta) retrieved 5 Apr 2020 from <https://www.twirpx.com/file/1591638/>.
- ZHANG, L., L.A. HEIER, R.D. ZIMMERMAN, B. JORDAN & A.M. ULUG (2006) 'Diffusion Anisotropy Changes in the Brains of Professional Boxers', *American Journal of Neuroradiology* 27, 2000–04.
- ZHANG, L., L.D. RAVDIN, N. RELKIN, R.D. ZIMMERMAN, B. JORDAN, W.E. LATHAN & A.M. ULUG (2003) 'Increased Diffusion in the Brain of Professional Boxers: A Preclinical Sign of Traumatic Brain Injury?' *American Journal of Neuroradiology* 24, 52–57.