

CADETS' PSYCHOMOTOR DEVELOPMENT AS A PREREQUISITE FOR THEIR PERSONAL READINESS TO ACT IN CONDITIONS OF UNCERTAINTY



Oleh Khmiliar^{a*}, Viktor Klymenko^b

^a *Ivan Chernyakhovsky National Defense University of Ukraine*

^b *G. S. Kostyuk Institute of Psychology of the National Academy of Educational Sciences of Ukraine*

Abstract

The problem of psychomotor development of a personality belongs to the category of those problems, that do not become relevant with time; nevertheless, these simply do not lose their relevance. Physical training at the military lyceum should be directed towards the development of professionally important psychomotor abilities of the students. Two series of a psychological experiments were conducted. Indicators of sensorimotor response of the investigated sample and the level of development of locomotor agility in the conditions of temporary and alternative uncertainty were established. The study used two patented devices "DIAGNOST-1 M" and a device for investigating human behaviour under stochastic conditions. The collected and analysed data were used to support the quantitative design adopted for this study. The study revealed that teenagers who attend only physical education classes at school and do not have sufficient physical activity, compared to their more active peers, cadets, are not as fast in the decision-making process, particularly in their reaction to the choice of a moving object. A high level of energy potential is the key to effective psychomotor actions in times of temporary and alternative uncertainty. Conditions of temporal and alternative uncertainty increase the effectiveness of the psychomotor actions of the students. We have shown that physical education classes, conducted in the aesthetic atmosphere of harmony, symmetry, rhythm, at the military lyceum enable the students to better develop their ability to overcome conditions of temporary and alternative uncertainty. Success in solving psychomotor problems depends on the anticorruption, sensory-perceptual and intellectual sphere of the students.

Keywords: Psychomotorics, physical education, cadet, teenager, sensorimotor reaction, energy potential, harmonious development

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*Corresponding author.

E-mail address: hmilar@ukr.net

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1. Introduction

The age of the cadet is one of the most important stages in the military professional activity of a future officer as this particular age contributes significantly to the development of the future officer's personality. At this age, the personality is unstable and vulnerable and faces difficulty in making the right decisions. At this age, which is associated with the pre-pubertal and then pubertal period, a significant leap in psychomotor development occurs (Maksimenko, Zajchuk, Klimenko, & Soloviienko, 2000; Murrihy, Bailey, & Roodenburg, 2017). Upon entering the military lyceum, the teenager begins to re-understand himself, to realise his spiritual "ego" in close connection with physical "ego". The place in the social structure (family, male environment, training group, sports team) is being reevaluated (Tofan, 2018).

In the Ukraine, the modern military lyceum is first and foremost an educational institution for teenagers who have ambitious plans and hopes, filled with the idea of explorational romanticism, seeking to master the system of knowledge and skills, and who are preparing to devote their lives to serving the Motherland. At a military lyceum, every assessment is the result of hard work, and the desire to learn is an indispensable condition of excelling in the lyceum. The only major factor in the recovery and promotion of health during the final formation of a student's organism, a means of eliminating defects in physical development, a powerful source of enhancing the general, intellectual capacity of the student and his readiness to act in uncertainty is his advanced psychomotor skills (Sopa & Pomohaci, 2019; Tomczak, 2015). Psychomotorics is inevitably present in a wide variety of manifestations of the student's activity: language, writing, emotional expression, locomotion, ballistics, semantics, and instrumental motor actions. It reflects both the mental state of the cadet and the characteristics of his nervous system (Il'in, 2003).

Notwithstanding the above-mentioned statement, as well as the fact that almost every military lyceum in the Ukraine has in its name the words "... with enhanced military-physical training", the issue of psychomotor activity in general and psycho-motor activity of cadets in particular has not been fully studied in the context of Ukrainian psychology. It seems that psychologists have forgotten that a person is a creature that not only perceives, analyses, and empathises, but also (physically) moves in order to meet his needs, in order to study, work, serve, exercise, and act.

The analyses of the latest researches and publications makes it possible to conclude that in the last half a century only a low number of monographs on psychomotor issues have been published: Il'in (2003); Klimenko (1997); Kossov (2004); Ozerov (2002); Roze (1970); Surkov (1984); Khmiliar (2019); Shinkariuk (2005). For the past 50 years, psychomotorics has been studied by the physiologists and sports professionals, so it's no wonder that the psychological

mechanisms underlying motive activity were generally disproved, and the very concept of "psychomotorics" was replaced by the notions such as the "physiology of movements", "physical activity", and "motor activity" (Os'odlo & Khmiliar, 2002).

There is no need to prove the role of psychomotorics in such areas of the cadet's activity as training, service and sports. In many developed countries of the world, psychomotor development of teenagers is carefully monitored. That is why, in France, for example, among the group members of the psychological service of the school, sports team, type of military units, in addition to specialists in general psychology and psychology of training there is also a specialist in psychomotorics (Ajumunisha & Tholappan, 2018; Korol'chuk, 2012).

Let us consider the psychomotorics of a cadet as an aesthetic phenomenon and athletics. Klimenko (1997) exploring the mechanisms of psychomotor activity shows what any mechanism in a living human body turns into, if it has been motionless for years. He wrote: "If the muscle is not active for at least two weeks, it loses three-fourths of its strength; if it is not active for two months, it will atrophy. If the joint is fixed immobile for a long enough time (due to illness, severe trauma) – it will become stiff and cease to act as a joint" (Klimenko, 1997).

This law had already been recognised by the ancient Greeks, who in every way glorified those people who mastered the art of psychomotor exercises to maintain and develop the harmony of the body from childhood till the old age. Even then, athletics was studied along with philosophy and the exact sciences. Archimedes, for instance, viewed psychomotorics as a kind of human lever aimed not at treating illnesses, but at preserving, strengthening health and improving productivity. According to him, the main tasks of the society include the formation of psychomotor consciousness of the humanity, stimulation of the body's defenses with non-medication methods, along with improving the environment and basic health resources.

Plato, called children, who neglected athletics, lame, because the body, movement and action are the aesthetic properties of a man. Aristotle in this case stated: "Nothing destroys a child so much as a prolonged psychomotor inactivity." It is physical movement that stimulates the growth and development of a teenager (during this period, boys grow by an average of 4-7 cm and girls by 3-6 cm during these years). In an adult, physical movement enhances the functionality of all body systems, increases productivity, while in the elderly, physical movement maintains the body's functions at an optimal level and slows down the aging process. The culmination of the development of these thoughts were the Greek Olympic

Games, which are, nowadays, gaining more and more social influence on the culture of the mankind (Klimenko, 2013).

Psychomotorics is an integral part of a student's harmonious development. The main task of psychomotor training of a military student should be to develop a nimble and courageous future officer. In our view, agility provides maximum productivity with minimum energy consumption, and agile movements are movements that always reach their goal. If agility is the expediency of movements, then the education of the student's agility should be implemented simultaneously with the education of his mind: an agile individual is reasonable, though not always vice versa. Therefore, a smart and courageous person is no less valuable to the society than an educated person (Khmiliar, 2019).

In many leading countries of the world, the development of psychomotor ability is considered as one of the most important life values. In France, 55% of adults regularly improve their psychomotor skills, in the USA – 60%, in Japan – 80% (Korol'chuk, 2012; Cucui, 2017). Additionally, life expectancy in these countries (79-84 years) proves the benefits of psychomotor training. In the Ukraine, according to recent studies (Manojlenko, Dorokhina, Cizh, & Reven'ko, 2019), only 9-11% of adolescents – future cadets and 6-8% of adults regularly do psychomotor exercises. According to Manojlenko et al. (2019) with such disregard for health, financial health care support will never be sufficient.

Modern medicine connects a number of serious diseases with the lack of psychomotor activity in adolescence. It is enough to recall the consequences of the well-known disease of the century – hypodynamy (physical inactivity). As a result of hypodynamy, the functions of the teenager's protective mechanisms are reduced: a) they are more often ill; b) every third teenager in the Ukraine has a poorly trained heart (Manojlenko et al., 2019). In this context, an important condition for preserving the health of a teenager and his or her harmonious development, is physical education, the perception of which is quite controversial in today's school programme. At the same time, it is the culture of each person's body, the culture of motions and actions, the culture of psychomotor activity, the culture of thought, feelings and imagination, which are expressed explicitly by psychomotorics, the human organ that supplies them with energy (Klimenko, 2013).

In an effort to find answers to the questions outlined in a number of modern theories, as well as guided by the own research interest in this issue, the purpose of the article is to clarify the role and place of psychomotor activity in the life of a student, as prerequisites for his readiness to act in the uncertain conditions. It also involves research of what school lessons,

that are aimed at the effective psychomotor development of the student's personality, should be like.

2. Purpose of the Study

Through our psychological experiments, we wanted to find out to what extent the psychomotor development of the student is necessary for his readiness to act in uncertain conditions. We were also interested in the effect of sports on the development of sensory motor reactions of the cadets and the nature of the education for the effective psychomotor development of the cadet's personality.

3. Research Questions

The questions that we investigated in this study covered

- 3.1. the extent, to which the psychomotor development of the student is a prerequisite for his readiness to act in conditions of uncertainty;
- 3.2. how sports affect the development of sensory motor reactions of the cadets; and
- 3.3. what should lessons, aimed at the effective psychomotor development of the cadet's personality, be like.

4. Material and Methods

4.1. Subjects

Taking into account the specificity of the study, the groups were formed on the basis of voluntary participation in a psychological experiment. The group of investigated individuals consisted of cadets of the municipal institution "Ostroh Regional Lyceum with enhanced military-physical training named after Konstantin Ivanovich Ostrohsky" (n=34) and students of secondary school № 27 of Shevchenko district in Kyiv (n=34), who were practically healthy and regularly worked on their psychomotor development. The sample included in the study was aged between 15–16.

4.2. Procedure

In order to eliminate the factor of sensory fatigue, the laboratory experiment was conducted in the course of two weeks. Two series of psychological experiment were conducted. During the first series, we compared the indicators of sensorimotor responses of the subjects, who were divided into two groups. The first group included students (n=34) who study in the secondary school where physical education classes are conducted according to the traditional program. The second group was formed from the cadets of the municipal institution

"Ostroh Regional Lyceum with enhanced military-physical training named after Konstantin Ivanovich Ostrohsky" (n=34). During the physical training classes, conducted with the cadets, elements of the military-applied game were actively used. The study was conducted using a computer device "DIAGNOST-1 M", developed by academicians Makarenko and Lizogub at the Mikhailo (2012) Bosch Research Institute of Physiology of Bohdan Khmelnytsky Cherkasy National University, which allows for measurement of the time of sensorimotor reactions with an accuracy of 0.001 s. The study was "naturally" incorporated into the process of physical education classes, not changing their structure, but focusing only on their content.

In the second series of the psychological experiment, the focus was on the effective development of locomotor agility in uncertain conditions. To model the uncertain conditions, we used the developed and patented device for studying human behavior under stochastic conditions (Klimenko & Khmiliar, 2005) (Figure 1), which is able to harmonise personality movements. We also took into account the so-called stress factor and energy potential level (Khmiliar, 2005), which had a significant influence on the actions of the subjects in the given conditions.

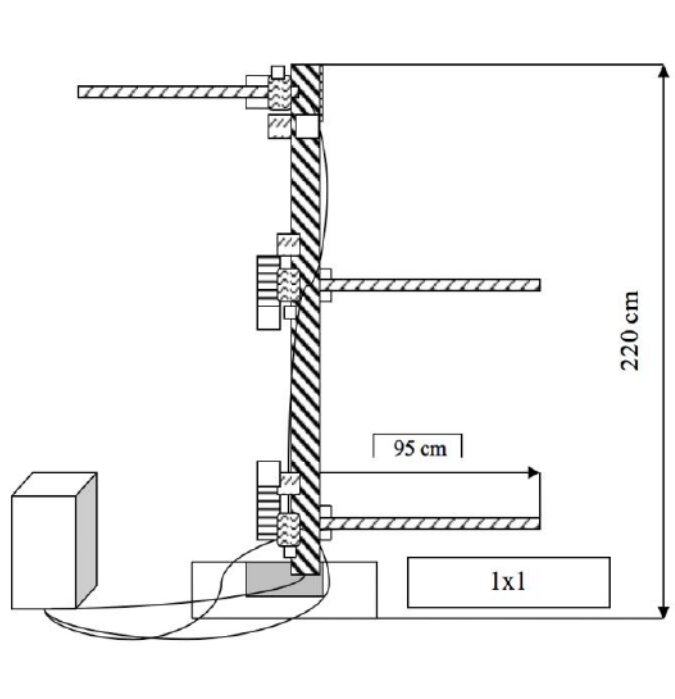


Figure 1. Device for studying human behavior under stochastic conditions

In terms of its construction, the device is analogous to the device used by the soldiers of Ancient Sparta. The originality of it lies in the fact that the subject, because of the situation he is in, with the help of various movements (bending, squats, jumps), overcome the obstacles, that come in the form of bars, which rotate in a horizontal plane at different heights. The time of occurrence of the obstacles and their nature, which determines the course of action, may be either known or unknown to the subject in advance.

The programme (depending on the nature of tasks, includes from 12 to 24 stimuli) is set with the help of a control panel. Accordingly, the device operates in automatic mode. Stochastic conditions of uncertainty are created by changing the direction of rotation of bars as a result of the sudden acceleration or suspension of their motion with the simultaneous two stimuli (obstacles). The height of the obstacles is set according to the growth of the participant: the first bar which is at

the level of the ankle joint, requires the subject to jump to overcome the obstacle; the second - at the level of the breast, needs the subject to do a deep squat to overcome it; the third, at chin level, requires the subject is simply move the head in a particular direction to overcome the obstacle. Bar rotation speed is one turn per second. In one task, the subject has to overcome each obstacle 6 to 18 times. Two or three attempts are made. The best result is taken into account - the smallest number of errors associated with the touch and hold of the bar. The time when the subject touches the bar is recorded by an automatic device (Klimenko & Khmiliar, 2005).

In the course of the psychological experiment, the bars were operational at different time intervals, with sudden acceleration and deceleration of rotation; two obstacles could occur simultaneously, with different speed and sequence of rotation. Such a number of challenges makes it possible to comprehensively investigate the psychomotor mechanisms of agility and comprehensively model the conditions of uncertainty.

In the course of the second series of the psychological experiment, the group of subjects consisted only of students of the military lyceum ($n = 34$). With the help of the "Energy Potential technique" (Khmiliar, 2005), all the subjects were divided into two groups with high ($n = 17$ people) and low ($n = 17$ people) levels of energy potential.

The peculiarity of the uncertain conditions also lay in the fact that one of the participants of the simulated situations was in more "comfortable" conditions. All other members of the group encouraged him, with an aim to decrease the number of mistakes he made. Another subject ("opponent" of the first), was forced to overcome the emerging obstacles in conditions of complete "discomfort" (at this moment all members of his group were in a different room). The individual was clearly aware that he or she was surrounded by a group of "opponents" and

therefore, should be as attentive and focused as possible. In general, the study of locomotor agility in the uncertain conditions was designed in such a way, that each student performed in both “comfortable” and “uncomfortable” conditions.

4.3. Statistical Analyses

Statistical processing of the data, obtained in the course of the study, was analysed using “Statistica 8.0” (StatSoft, USA) and spreadsheets “Microsoft Office Excel 2010” (USA), which made it possible to analyse the measurements and calculate basic magnitudes. In the process of mathematical processing of the obtained data, the mean value approach and the sample method were used, which allowed to obtain the arithmetic mean (\bar{x}); standard deviation (σ); representativeness error (m); mode; median; coefficient of variation (CV). The sample correctness of the normal distribution law was tested on the basis of the Shapiro-Wilk test. During the analysis of statistically significant differences between the samples, the reliability level $P = 95\%$ was set. Values of $p < 0.05$ were considered significant.

5. Results

The data obtained during the psychological experiment made it possible to define the main difference: teenagers studying at military lyceum differ in the better development of psychomotor abilities, as well as their stability, in comparison with their peers – teenagers, who have physical education classes twice a week in accordance with the school programme.

It was found out that teenagers who attend only physical education lessons at school and do not have sufficient physical activity (which is typical for most students of the present generation, regardless of their place of residence), compared to their more active peers, cadets, are less fast in the decision-making process, which is mainly associated with the individual features of the lability of the nervous processes. Particularly significant differences are observed in the rate of their reaction to the choice of the moving object, according to which the cadets (834.0 ms) noticeably outperform their peers, who were secondary school students (1372.0 ms), in terms of the accuracy of the reaction to the moving object (Table 1).

Table 1. Response rates in the moving object experiment among teenagers attending military lyceum and secondary school

Indicators	Total	Exactly	Proactive actions	Delayed actions
<i>Cadets of a military lyceum</i>				
The best attempt	6	12	9	9
The amount of deviations (ms)	228,0		126,0	102,0
The average deviation (ms)	7,6		14,0	11,3
Three best attempts	6, 5, 2	26	28	36
The amount of deviations (ms)	834,0		369	465
The average deviation (ms)	9,3		13,2	12,9
<i>Students of a secondary school</i>				
The best attempt	17	4	11	15
The amount of deviations (ms)	658,0		432,0	226,0
The average deviation (ms)	21,9		39,2	15,0
Three best attempts	17, 8, 21	11	46	33
The amount of deviations (ms)	1372,0		883,0	489,0
The average deviation (ms)	15,2		19,2	14,8
Object movement time (ms)	1500			
The number of attempts	30			

It seems an interesting experimentally established fact, that in the group of teenagers enrolled in the traditional school program, the increase in the options for one alternative leads to a proportional increase in the response time, and in the group of cadets, who are studying at military lyceum and are using military-applied games during the physical training classes, the increase in alternatives has little effect on the response speed.

As we can see, the military training at the lyceum enables the students to develop the ability to overcome and counterbalance alternative signal uncertainty. According to the indicators of the reaction with stopping differentiation, the cadets are also ahead of the students of the secondary school. Probably military-applied games that dominate the military lyceum's physical training system are simultaneously refining nerve processes that involve temporal differentiation and develop the ability to timely withhold "forbidden action." Game activity also improves the accuracy of anticipation reactions, especially in the time interval of 0.5 s: the more systematically the cadets are engaged in a game, the stronger their anticipation ability is.

Thus, the first series of experimental research revealed some patterns of the dynamics of cadets and secondary school students' sensorimotor qualities, as well as defined the

effective influence of factors of military-applied game activity on the formation of psychomotor skills.

The analysis of experimental data obtained in the second series of psychological experiment revealed significant differences in the actions of cadets with high and low energy potential. The lowest rates were shown by the investigated cadets with low energy potential, who were in the conditions of discomfort: "I am head-to-head with the enemy", and "I am surrounded by the enemy group", that is, in the conditions of the greatest discomfort (Table 2). This is evidenced by the average magnitude of the errors, recorded while dealing with the obstacle: in the first case, their average value was 18.42 ", and in the second - 21.57 " (with $P < 0.05$).

The highest results of the second group were shown in the environment "I am surrounded by my group members". The average error in these circumstances is 18.68 " (with $P < 0.05$). During the control measurement, when each cadet acted only "for himself", the mean error was 19.02 " (with $P < 0.05$).

Table 2. Dynamics of the expression of locomotor agility of cadets in the uncertainty conditions

Category of complexity	Modeled conditions	Stress factors	Groups	Mean value of an error (s)	Other statistical data			
					σ	Mode	Median	CV
Actions of increased complexity	Uncertainty conditions	"I am head-to-head with the enemy"	1	13,18*	0,22	12,24	12,20	1,80
			2	18,42	1,03	17,24	15,05	6,76
		"I am surrounded by the enemy group"	1	11,45	1,13	10,57	10,51	10,82
			2	21,57	2,26	19,07	18,98	12,19
		"I am surrounded by my group members"	1	10,99*	0,74	10,06	10,02	7,41
			2	18,68*	2,08	14,35	14,73	13,98
		The control measurement	1	11,07*	1,04	10,23	10,46	10,37
			2	19,02	1,82	15,31	15,64	12,08

Notes: 1 – participants with high energy potential (n = 17).

2 – participants with low energy potential (n = 17).

* – the probability of difference in a group with $P < 0,05$.

The average error rate of the subjects with high energy potential in the conditions of discomfort "I am head-to-head with the enemy" was 13.18 " (with $P < 0.05$), and 11.45 " in the conditions "I am surrounded by an enemy group", that is in the conditions of greatest discomfort.

The highest results of the first group were shown in the environment "I am surrounded by my group members" (average error was 10.99").

6. Discussion

The results, obtained during the psychological experiment, show that conditions of uncertainty have two opposing outcomes: it can either reduce or increase productivity of the cadet's psychomotor action. This statement clearly confirms Bernshtejn's (1991) hypothesis regarding the "law of rationality", which states, that it is in the zone of excessive stress, when the nerves and muscles are "on the verge", the body simply cannot afford unfocused costs and movements, and as a result it "works" in the best way. In this case, Pavlov (1951) noted that the highest increase of the spiritual and physical strength of a human occurs precisely in a situation of uncertainty.

Possessing high energy potential, each movement and action of the cadets of the first group, unlike their "opponents", were maximally rational, which made it possible to show results that are not achievable in normal circumstances, and confirmed the role of energy potential as the main prerequisite for effective locomotor agility in conditions of uncertainty (Khmiliar, 2005; Stanciulescu, 2016).

The results of this experiment confirm Gellershtejn's (1966) view: the specificity of any psychomotor task is largely determined by sensory-perceptual and intellectual spheres of activity that define the conditions of the decision-making process. As we can see, executive activity itself is less specific.

When solving psychomotor problems in well-known conditions, the effectiveness of actions is determined mainly by the requirements for the level of psychomotor skills (in our case - the speed of movement), whereas in conditions of alternative and temporal uncertainty, the correlational dependences are mainly influenced by the degree of identical requirements for mental processes and abilities (Anglin, Novell, Murphy, & Goodwin, 2017).

Thus, physical education classes, with the use of a device for the study of human behaviour in stochastic conditions, can be transformed into a lesson of applied aesthetics, active thinking, feelings and imagination. To do this, the existing goal should be changed. The development of body culture, culture of movements and actions should be made the desire, motive and purpose of each cadet (teenager). After all, in the psychomotor development of the cadet (teenager), a source of positive feelings is the need to improve themselves (Sopa & Pomohaci, 2019). Based on the above-mentioned facts, we want to admit that the criterion of physical culture at a military lyceum (at school) should neither be a stopwatch, a roulette, nor kilograms. Applied aesthetics should be the basis of physical education, and muscular joy should be a measure of success - a particular delight in psychomotor activities (Ciomag, 2015).

Similar to the works of literature and art, the beauty of the cadet's body and movement affects the senses and the mind. They detect, reinforce and perfect, above all, aesthetic feelings,

train thinking, improve imagination. Therefore, physical education should be conducted in the aesthetic atmosphere of harmony, symmetry, rhythm (Prodan, 2017). Only in this case, will it positively influence both health and psychomotor (mental, moral and aesthetic) development of the cadet's personality.

Physical education conducted in this way will allow the cadet:

- 1) to acquire an ability to master their psychomotor abilities through exercises;
- 2) to preserve and strengthen the natural harmony of body and soul;
- 3) to increase the capacity to act to the limit: mental, moral, aesthetic and action;
- 4) act effectively in times of temporary and alternative uncertainty.

Physical education classes at the lyceum (school) should also systematically include:

a) maximum actions; b) minimal capacity improvements of individual mechanisms; c) optimal time for rest to be ready for the next action with no less power. Regular use of the proposed device for the study of human behaviour under stochastic conditions will provide a more effective psychomotor development of the teenager, compared to the traditional methods of physical education. It is likely that this improvement will come at the expense of the advancing formation of psychic mechanisms for managing motor activity.

7. Conclusion

The psychomotor development of a cadet should not only be viewed as the initial functional level of the development of his mental and motor skills, but also as a complex, multifaceted process. During the development of the content of the physical education class at the lyceum, school, the psychomotor content should be taken into account, along with the logical, physical, biomechanical components of the material. The responsibilities of the physical education teacher should include the development of thinking of the cadet (teenagers), the formation of their ability to regulate the development of psychomotor abilities. In such circumstances, each lesson will open up new opportunities for the students to learn more complex psychomotor systems and related activities.

As to the results (implying the athletic performance that somehow became the only criterion of physical culture), we can assume that the development of psychomotor abilities will grow imperceptibly, almost continuously, leading to a more holistic development of young people.

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