

## The influence of adaptive games on the psycho-emotional state of military personnel during rehabilitation

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### Abstract

**Purpose:** to evaluate the impact of classes using adaptive games on the psychological rehabilitation of military personnel in a health care facility.

**Material and methods.** The study involved 34 male military personnel who were undergoing rehabilitation in a health care facility after being wounded. The study involved determining the psychological state (using the standard TRANS test) and the speed of sensorimotor reactions (using the Visuomotor Choice Reaction and Reaction RMO Pro computer programs) of the military personnel undergoing rehabilitation at the beginning and end of the study. The study lasted three weeks, during which classes were held using adaptive games (Cornhole, Jacollo, Elastik, Kulbutto, Boccia, Paka laka). Classes were held three times a week, lasting 90 minutes each.

**Results.** It has been established that classes using adaptive games have a positive effect on the level of psychological state and the manifestation of a simple sensorimotor reaction of military personnel undergoing rehabilitation in a health care facility. According to the results of the study, it has been established that anxiety indicators have decreased, and indicators of performance, activity, mood and health have increased. In the course of determining the manifestation of a simple reaction of military personnel undergoing rehabilitation, it has been established that the use of adaptive games has a positive effect on the speed and accuracy of the sensorimotor reaction.

**Conclusions.** The obtained results prove the effectiveness of the implementation of the project "Ukrainian Center for Occupational Therapy with Adaptive Games" under the program "RITA - Region in Transition" of the Foundation "Education for Democracy". Thanks to the activities carried out using adaptive games aimed at motor activity, fine motor skills and attention, the psycho-emotional state and sensorimotor reaction of military personnel undergoing rehabilitation have changed positively. The presented results indicate the positive impact of adaptive games on the psycho-emotional state and the general process of rehabilitation of military personnel. Therefore, it can be argued that adaptive games are a powerful means of psychological rehabilitation, as well as psycho-emotional and social adaptation.

**Keywords:** adaptive games, rehabilitation, military personnel, "RITA - Region in Transition"

### Introduction

The state of war has a significant impact on human health in various aspects. Constant stress caused by danger, distance from home, physical and psychological challenges can lead to the development of various psychological problems such as anxiety, depression, post-traumatic stress disorder, which in turn affects the physical health of a person (Hajek et al., 2022).

Post-traumatic stress disorder (PTSD) is a consequence of experiencing a traumatic event during war, such as combat or a traumatic event (Ghaffarzadegan et al., 2016). People with PTSD may experience long-term psychological effects of the trauma, including re-experiencing symptoms, avoidance of similar stimuli, negative mood, and increased physical arousal (Solomon et al., 2015; Serbeniuk, 2023; Capizzi, 2020).

Military personnel deal with stress on a daily basis. The main dimensions of stress in military service are: danger, workload, isolation, ambiguity, powerlessness and sometimes boredom (Flood et al., 2022; Hall, 2023). Due to technological development, all military personnel are under constant threat to life. Participants in modern warfare face violation of global values and their own beliefs, which sometimes undermines the basic sense of humanity, despite the extensive training of military personnel, including psychological ones (Kostruba, 2023; Armour et al., 2017).

To date, more than 500 thousand Ukrainians have received the status of a participant in military operations in Ukraine. More than 75% of them already need psychological rehabilitation, and 32% need long-term rehabilitation measures (Abramov et al., 2020; Blinov, 2006). Traumatic combat experiences have a negative impact on the health of combatants. Many military personnel do not know how to cope with stress and other negative conditions. Even when returning to civilian life, they experience new stresses associated with social adaptation, difficulties in communicating with family and others, self-realization, etc.

Therefore, it is very important to provide support to the military personnel by finding new technologies so that they can better cope with psychological problems and maintain their own health.

A number of works reflect aspects of psychological rehabilitation of military personnel. For example, psychological factors of the influence of military operations on the condition of military personnel were analyzed in studies (Levchuk et al., 2023; Blinov, 2006; Lytvynovskiy et al., 2002), various aspects of rehabilitation work with military personnel were studied by Bazarnyi, 2020; Calhoun et al., 2006; Tkalych et al., 2023.

Emotions are one of the main mechanisms of internal regulation of mental activity and human behavior. Emotions are a variety of human experiences that reflect life relationships with the outside world and other people. Prib et al., 2023

devoted their research to studying the manifestations of emotions of military personnel during wartime.

Positive emotions can have a significant impact on the mental state of military personnel, both in military service and during rehabilitation. Positive emotions reduce stress and anxiety, which helps in coping with military challenges and difficulties; improve mood and emotional state, which helps maintain the mental health of military personnel; increase motivation and internal strength to overcome difficulties and achieve goals. That is, cultivating positive emotions among military personnel can be useful for their overall well-being and coping with the feasible challenges of military service.

Therefore, our study is devoted to identifying the impact of adaptive games on military personnel undergoing rehabilitation. Adaptive games influence the socialization and integration of the individual, which allows them to actively engage in various social environments, participate as much as possible in the work and social life of the team, and arrange their daily life in accordance with the norms and rules of society. The main objective of adaptive games as a means of occupational therapy is the implementation of psychological, pedagogical, rehabilitation and social functions, including the function of physical education, both for citizens with disabilities and able-bodied persons, and for society as a whole.

**The aim of the study** is to evaluate the impact of classes using adaptive games on the psychological rehabilitation of military personnel in a health care facility.

### **Material and methods**

#### *Participants*

The study involved 64 male military personnel who were undergoing rehabilitation in a health care facility after injuries of various types: musculoskeletal system damage (35.3%), partial amputation of the upper limbs (5.9%), traumatic brain injuries of varying degrees, including contusions (58.8%). All study participants were motor-active, i.e. they moved independently around

the territory of the health care facility. The average age of the participants was  $49,1 \pm 9,82$  years. The military personnel were divided into two groups: control ( $n=30$ ) and experimental ( $n=34$ ). The groups were homogeneous in terms of the general characteristics and health status of the study participants. The control group consisted of military personnel who attended only rehabilitation classes. The experimental group included military personnel who, for three weeks, in addition to the rehabilitation process, took part in classes using adaptive games (Cornhole, Jacollo, Elastik, Kulbutto, Boccia, Paka laka). Classes were held three times a week, lasting 90 minutes each. Classes were conducted by volunteers of the Polish-Ukrainian Adaptation Center of the Kharkiv State Academy of Physical Culture, created within the framework of the implementation of the project "RITA - Region in Transition" and under the supervision of doctors of physical and rehabilitation medicine and psychologists of the medical and health institution.

The research was conducted in compliance with WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects, 2013.

#### *Procedure*

The study lasted three weeks and included determining the psychological state and speed of sensorimotor reaction of military personnel undergoing rehabilitation at the beginning and end of the study. The characteristics of the psychological state were assessed using the standard TRANS test, which made it possible to determine the dynamics of such indicators as anxiety, performance, activity, mood and well-being. The instrument for self-assessment of personality is presented in the form of a registration form consisting of 40 lines, each of which contained two adjectives, opposite in meaning, and numbers indicating the degree of expression of each feature: 3 (strongly expressed), 2 (expressed to a moderate degree), 1 (weakly expressed).

To assess the sensorimotor reactions of military personnel undergoing rehabilitation, computer

programs for determining the reaction of choice were used – Visuomotor Choice Reaction (<https://apps.apple.com/ua/app/visuomotor-choice-reaction/id1635928963>); determining the reaction to a moving object – Reaction RMO Pro (<https://pcappcatalog.com/1666660660/reaction-rmo-pro>), which was developed by Romanenko V., 2017 and installed on tablet computers running iOS.

#### Statistical analysis

The results obtained were subjected to statistical processing to determine the difference reliability criterion. Processing of research results was carried out with the calculation of the following indicators: sufficient sample size (n); arithmetic mean value of indicators (X); standard error of the arithmetic mean (m); probability of differences (t), which was calculated using the Student formula 1; reliability of differences in

indicators (p). All received data were processed using the Descriptive Statistics.

$$t = \frac{X_1 - X_2}{\sqrt{m_1^2 + m_2^2}} \quad (\text{formula 1})$$

#### Results

The TRANS test results showed that classes using adaptive games have a positive effect on the psychological state of military personnel undergoing rehabilitation in a health care facility. All indicators showed positive changes, but to different degrees. Thus, in the experimental group, anxiety indicators decreased by 25,9 points ( $t=2,23$ ;  $p<0,05$ ); activity indicators increased by 31,7 points ( $t=2,90$ ;  $p<0,01$ ); mood by 17,2 points ( $t=2,89$ ;  $p<0,01$ ) and well-being by 22,0 points ( $t=2,73$ ;  $p<0,05$ ); working capacity indicators also improved, but reliability was not revealed ( $p>0,05$ ) (Table 1).

**Table 1. Indicators of anxiety, performance, activity, mood and well-being of military personnel in the experimental and control groups at the beginning and end of the study (according to the TRANS method), points**

Indicators		At the beginning of the study	At the end of the study	Assessment of reliability	
		X1±m1	X2±m2	t	p
Anxiety	EG(n1=n2=34)	74,1±9,61	48,2±6,48	2,23	p<0,05
	CG (n1=n2=30)	73,2±8,79	64,8±5,04	0,83	p>0,05
		t=0,07; p>0,05	t=2,02; p<0,05		
Working capacity	EG(n1=n2=34)	14,8±7,53	34,9±6,42	2,03	p>0,05
	CG (n1=n2=30)	15,3±6,29	29,6±5,39	1,73	p>0,05
		t=0,05; p>0,05	t=0,63; p>0,05		
Activity	EG(n1=n2=34)	25,0±8,08	56,7±7,36	2,90	p<0,01
	CG (n1=n2=30)	24,6±7,93	32,4±6,92	0,74	p>0,05
		t=0,04; p>0,05	t=2,41; p<0,05		
Mood	EG(n1=n2=34)	30,6±5,07	47,8±3,12	2,89	p<0,01
	CG (n1=n2=30)	29,7±6,23	36,9±4,27	0,95	p>0,05
		t=0,11; p>0,05	t=2,06; p<0,05		
Well-being	EG(n1=n2=34)	20,1±6,28	42,1±5,03	2,73	p<0,05
	CG (n1=n2=30)	21,4±5,93	30,7±4,62	1,24	p>0,05
		t=0,15; p>0,05	t=1,67; p>0,05		

Military personnel in the control group also had positive changes in indicators of anxiety, working capacity, activity, mood and well-being,

but significance was not found ( $p>0,05$ ). At the same time, at the end of the study, intergroup differences were found in the indicators of anxiety

( $t = 2,02$ ;  $p < 0,05$ ), activity ( $t = 2,41$ ;  $p < 0,05$ ) and mood ( $t = 2,006$ ;  $p < 0,05$ ) in favor of the experimental group.

In the course of determining the manifestation of a simple reaction of military personnel undergoing rehabilitation, it was established that the use of adaptive games has a

positive effect on the speed and accuracy of sensorimotor reactions. Thus, thanks to training using adaptive games, the reaction time decreased by 25,8% ( $t = 3,18$ ;  $p < 0,01$ ), and the quality of the reaction improved by half ( $t = 2,53$ ;  $p < 0,05$ ) (Table 2).

**Table 2. Results of the reaction time of choice of military personnel of the experimental and control groups at the beginning and end of the study**

Indicators		At the beginning of the study	At the end of the study	Assessment of reliability	
		X1±m1	X2±m2	t	p
Reaction time, ms	EG(n1=n2=34)	302,9±22,19	224,7±10,63	3,18	p<0,01
	CG (n1=n2=30)	308,2±23,14	273,4±17,53	1,20	p>0,05
		t=0,17; p>0,05	t=2,38; p<0,05		
Number of accurate reactions, %	EG(n1=n2=34)	9,2±1,37	4,6±1,26	2,53	p<0,05
	CG (n1=n2=30)	8,9±1,32	6,3±1,22	1,45	p>0,05
		t=0,16; p>0,05	t=0,97; p>0,05		

Choice reaction time indicators also showed positive changes among military personnel due to adaptive games (Table 3). The most significant changes were found in the response indicators to

color stimuli and the response to figures. Thus, the response indicators to color stimuli improved by 23.6% ( $t = 3.10$ ;  $p < 0.01$ ), and the response to figures decreased by 21,2%. ( $t = 2,87$ ;  $p < 0,1$ ).

**Table 3. Choice reaction time results for military personnel of the experimental and control groups at the beginning and end of the study, ms**

Indicators		At the beginning of the study	At the end of the study	Assessment of reliability	
		X1±m1	X2±m2	t	p
Reaction to color stimuli	EG(n1=n2=34)	1078,7±78,31	824,2±24,78	3,10	p<0,01
	CG (n1=n2=30)	1085,2±63,90	975,2±54,71	1,31	p>0,05
		t=0,04; p>0,05	t=2,51; p<0,05		
Response to color stimuli during counteraction to distracting stimuli.	EG(n1=n2=34)	1034,1±70,93	819,7±36,49	2,69	p<0,05
	CG (n1=n2=30)	1048,4±72,47	961,6±62,75	0,91	p>0,05
		t=0,14; p>0,05	t=1,95; p>0,05		
Reaction to figures	EG(n1=n2=34)	1202,1±85,60	946,7±28,24	2,87	p<0,01
	CG (n1=n2=30)	1194,7±74,36	1062,8±45,81	1,51	p>0,05
		t=0,07; p>0,05	t=2,16; p<0,05		
Reaction to figures when counteracting to distracting stimuli	EG(n1=n2=34)	1191,5±87,23	974,6±30,41	2,35	p<0,05
	CG (n1=n2=30)	1182,3±74,36	1075,4±46,93	1,22	p>0,05
		t=0,08; p>0,05	t=1,80; p>0,05		
Average value for the entire test	EG(n1=n2=34)	1126,6±80,52	891,3±29,98	2,74	p<0,05
	CG (n1=n2=30)	1105,2±79,40	1003,4±46,73	1,10	p>0,05
		t=0,19; p>0,05	t=2,02; p<0,05		

The reaction of the military personnel to colors and figures with distracting effects also produced positive changes. The reaction rates to colored stimuli when counteracting distracting stimuli decreased by 20,7% ( $t=2,69$ ;  $p<0,05$ ), and to figures when counteracting confusing stimuli – by 18,2% ( $t=2,35$ ;  $p<0,05$ ). The overall test result also has reliable differences ( $t=2,74$ ;  $p<0,05$ ).

Indicators of sensorimotor reaction in military personnel of the control group also had positive changes during rehabilitation, but significance was not found ( $p>0,05$ ). At the same time, at the end of the study, reliable ( $p<0,05$ ) differences were found between the indicators of the control and experimental groups in favor of the latter.

### Discussion

Psycho-emotional support for military personnel is extremely important because it helps to ensure their mental well-being and support them in difficult situations that they may face during their military service. The main reasons why psycho-emotional support for military personnel is very important: mental health support (psychological support helps military personnel manage stress, feel supported and develop stress resistance, which helps to maintain mental health); support during traumatic events (providing important support and assistance to service members who are experiencing traumatic events or post-traumatic stress disorder); improving mutual understanding and communication (psycho-emotional assistance helps improve interpersonal relationships and positive communication in a team); increasing motivation and performance (helping military personnel maintain high levels of motivation and concentration in completing tasks). Thus, psycho-emotional assistance to military personnel is a key element in ensuring their well-being, mental health and successful service.

Misiura et al., 2023, studied the rehabilitation process of men aged 25-42 with the consequences of combat wounds. Kerestei et al., 2024, studied the dynamics of recovery of walking, balance and quality of life of individuals after acute

cerebrovascular accident in a long-term rehabilitation period.

Studies of the psycho-emotional state of military personnel are reflected in the works of other authors. Thus, Flood et al., 2022 found that constant changes in technology and the nature of war lead to certain transformations of the stress factors that military personnel face. Scientists emphasized that existing theoretical models remain relevant for understanding cognitive resilience in military conditions, as well as the importance of assessing and overcoming the subjective experience of stress.

Hall et al., 2022, examined the impact of complicated grief and moral injury on veterans' recovery from combat trauma. They hypothesized that the interaction between comorbidities is twofold: cumulative anger arising from military life and combat experience has a major impact on recovery from comorbidities, and avoidance of distressing emotions is detrimental to military recovery.

A similar study design is quite common in science. Piatysotska et al., 2020, 2021 investigated the level of sensorimotor reactions (simple visual-motor and auditory-motor reactions, choice reaction, reaction to a moving object, sense of tempo, discrimination reaction) of taekwondo athletes.

Kozhyna et al., 2014 proposed a battery of tests to determine psychological state, including the TRANS test, which allows determining the dynamics of such indicators as anxiety, working capacity, activity, mood and well-being.

This study examined the effectiveness and relevance of the implementation of the project "Ukrainian Center for Occupational Therapy with Adaptive Games" under the program "RITA - Region in Transition". Thanks to the implementation of this project, Polish experience in the field of occupational therapy using the adaptive game method was transferred to Ukraine by opening Polish-Ukrainian adaptation centers. The analysis of the implementation of projects under the program "RITA - Changes in the Region" was

covered in previous studies (Mulyk at al., 2022; Zalewski at al., 2024).

The purpose of classes using adaptive games is to develop such psychophysiological qualities as: self-interest; self-awareness as a person; self-management; respect for other people's opinions; curiosity and involvement in activities; emotional stability; motivation for actions and deeds.

Scientists (Ivakhnenko et al., 2010) have proven that adaptive games have a huge impact on neuropsychic development and form important personality traits (will, intelligence, courage, honesty, endurance, solidarity). They also contribute to the development of intuition, the ability to foresee the trajectory of movement, concentration, thinking, orientation in space in a constantly changing game situation. Thus, regular classes give people the opportunity for maximum adaptation, harmonious development, contact with spiritual and moral values and integration into society.

Therefore, it is very important to use adaptation games among socially vulnerable groups of the population, such as war veterans, people with disabilities, internally displaced persons, orphans and children deprived of parental care, elderly people and pensioners.

### Conclusions

The obtained results prove the effectiveness of the implementation of the project "Ukrainian Center for Occupational Therapy with Adaptive Games" under the program "RITA - Region in Transition" of the "Education for Democracy" foundation. Thanks to the events held using adaptive games aimed at motor activity, fine motor skills and attention, the psycho-emotional state and sensorimotor reaction of military personnel

undergoing rehabilitation have changed positively. The presented results indicate a positive impact of adaptive games on the psycho-emotional state and the overall rehabilitation process of military personnel. Therefore, it can be stated that adaptive games are a powerful means of psychological rehabilitation, as well as psycho-emotional and social adaptation.

Therefore, the obtained results allow us to continue the implementation of the project "Ukrainian Center for Occupational Therapy with Adaptation Games" under the program "RITA - Region in Transition" and recommend similar projects for implementation in other countries.

### Acknowledgments

The authors express their gratitude to the Polish-American Freedom Foundation within the framework of the program «RITA - **Region in Transition**», which is implemented by the Education for Democracy Foundation for help in funding.

### Author's contribution

Conceptualization, A.S. and K.M.; methodology, A.S. and T.S.; check, T.G. and K.M.; formal analysis, T.G. and K.P.; investigation, T.G.; data curation, T.S.; writing – rough preparation, K.M.; writing – review and editing, A.S. and K.M.; supervision, K.M.; project administration, A.S. All authors have read and agreed with the published version of the manuscript.

### Conflict of interest

The authors declare that there is no conflict of interest.

### Funding

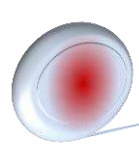
This article didn't receive financial support from the state, public or commercial organizations

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*Published: 30.09.2024*