

Research Article

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Configurations of collective mental models in solving service and combat tasks by cadets of the National Guard

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Annotation: Introduction. A collective mental model as an important component of a military team, whose members have different knowledge, experience, needs, values, can effectively explain, predict and improve the success of a military unit in the performance of combat missions. The novelty of this work lies in the use of a metasystem approach to develop the structure and methods for measuring the collective mental model of servicemen when they solve non-standard situations in peacetime and wartime. The purpose of the study was to develop a structure and method for measuring the collective mental models of military personnel. The assumption was tested that when solving various introductory cadets, different knowledge, abilities, emotions, needs and roles will be used. **Methods.** The study involved 71 cadets of the VOOVO of the troops of the National Guard of the Russian Federation aged 21 to 27 years. To study individual mental models, 10 cases were developed containing real everyday and service-combat situations. When solving each introductory cadet, it was necessary to determine the cognitive, motivational, emotional and role parameters. To identify role aspects, the Kaleidoscope technique was used, containing 10 figures divided by gender and age. To identify collective mental models for each input, an analysis of the contingency of the parameters under study was used according to the Pearson criterion. **R results.** When solving the introductory cadets, statistically significant associations were found regarding the presence of existing similar experience, met-cognitive knowledge, abilities, needs, emotions and roles ($p \leq 0.05$). About **the discussion of the results.** The results of the study confirmed the assumption that the obtained connections make it possible to build certain configurations of collective mental models when military personnel solve problematic everyday and service-combat tasks. **Conclusion.** In general, the data of the conducted study allow us to conclude that the formation of a common mental model of military personnel can improve the understanding of service and combat missions by the personnel of the unit, promote mutual understanding and support in the military team, and also increase its effectiveness in military professional activities.

Keywords: collective mental model, metasystem, metacognitive system, metamotivational system, needs, emotions, roles, military professional activity, service and combat missions

Highlights

- the metasystem approach is an effective tool for understanding the collective mental model in the form of a system, taking into account the interaction of its constituent entities and the features of their transformation, depending on the type of combat mission.
- the collective mental model of military personnel, includes individual mental models, which in turn integrate knowledge, needs, abilities, emotions and roles.
- the development and sharing of a generalized mental model facilitates the coordination of military personnel in the process of solving a specific combat mission.

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Introduction

The relevance of the study is related to the widespread and one of the main fundamental problems of labor psychology - the solution of problem situations by subjects of military professional activity, which requires intensive cooperation between members of the military team. Such interaction may involve the establishment of a sequence of events by military personnel when making decisions or the establishment of causal relationships between constructs representing mental models of cognitive content.

Mental models are considered as the basic structure of cognition for describing and representing thought processes in problem solving (Johnson - Laird, 1980). How these cognitive constructs are developed and modified depends on the contexts and conditions in which they are created and used (Marshall, 2007). The study of mental models plays an important role in team communication, coordination and team productivity in developing a joint decision (Klimoski, & Mohammed, 1994). Mental models are units of cognitive experience that reflect simplified representations of the world (Smyth , Collins, Morris, & Levy, 1994). The mental model refers to the sum of individual cognitive schemas (Wilson , & Rutherford , 1989). At the same time, in the process of social interaction with others, the mental model of an individual can be matched with the mental model of others so that the model can be raised from the individual level to the group level (Mohammed, Klimoski, & Rentsch, 2000; Jingwei, Jinxia, & Yanli, 2019).

Cannon - Bowers et al. (2001) for the first time modernized the mental model from the individual level to the group level and proposed the concept of a general mental model, which involves operating the knowledge of team members. More recently, Mohammed & Dumville (2001) pointed out that the collaborative mental model of a team includes values, beliefs, and attitudes towards the environment and towards themselves by team members. In this context, as research on team mental models deepens, most scholars believe that the connotation of a shared mental model includes group members sharing values and beliefs (Johnson, & Lee, 2008; Mathieu , Heffner , Goodwin , Salas , & Cannon-Bowers , 2000 Van den Bossche , Gijsselaers , Segers , Woltjer , &

Kirschner, 2011). In turn, a number of studies have shown that after the formation of a common mental model, team members are capable of a similar perception of professional tasks, situations, equipment, technology, etc., which leads to successful cooperation in making effective decisions (Mohammed, Klimoski, & Rentsch, 2000; Cooke, Salas, Cannon-Bowers, & Stout, 2000), so that shared mental models positively influence team productivity and creativity. Jianwei, Hui, Haihong, & Yongkang (2018) found that the level of similarity of collective mental models can predict team performance and job satisfaction. Gurtner, Tschan, Semmerb, & Nägeleb (2007) proved that the activation of metacognitive strategies, in particular reflexivity, can increase the effectiveness of collaborative teams. In some of our studies, a feedback was found between reflection and self-regulation of cadets (Karpov, Perevozkina, Fedorishin and Zinovieva, 2021). This reflects the fact that the higher the level of self-regulation, the more the student's ability to recognize and evaluate their own resources will be suppressed (Fedorishin and Andronov, 2018).

There is no doubt that the concept of command mental models can provide effective solutions for studying the military collective. However, we argue that it is necessary to take into account the limitations of this concept, since existing research on command mental models tends to be based on the assumptions of traditional cognitive psychology. In turn, we propose to consider mental models, based on a metasystem approach (Karpov and Perevozkina, 2019), as a more effective way of learning command mental models in action (Mekebaev, Perevozkina and Fedorishin, 2021a; Mekebaev, Perevozkina and Fedorishin, 2021b). Within the framework of this approach, any psychological phenomenon can be considered as an open system that has five hierarchical levels. The first, basic level is the level of elements, which involves the activation of social skills and abilities. At the component level, metacognitive processes (memory, attention, perception, thinking, representation, etc.) are included. Edwards, Day, Arthur, & Bell (2006) proved that when team members have high cognitive abilities, the team is more likely to form a shared mental model of a higher level of performance. In addition, its formation is influenced by the level of education of team members, position and experience of cooperation (Rentsch, Richard, & Klimoski, 2001). At the subsystem level, the following subsystems are represented: metacognitive, metamotivational, metaemotional, metarole. At the system level, an individual mental model of interaction is formed, which combines all the underlying components with the perception of the current situation. Finally, the metasystem level involves the integration of individual mental models into a single collective mental model (manifestation of collective ways of implementing activities and interactions). A number of studies have shown that the leadership style of a group leader has an impact on the team's overall mental model (Boies, & Fiset, 2018).

Thus, the present study has a dual purpose: on the one hand, we are interested in developing better measuring devices for the collective mental models of military personnel. On the other hand, an important aspect is the verification of the conceptual provisions of the metasystem approach in relation to the collective mental model of servicemen in solving service and combat tasks.

Methods

Subjects

The study was conducted on the basis of the Novosibirsk military, Order of Zhukov Institute. Army General I.K. Yakovlev of the troops of the National Guard of the Russian Federation. The study involved cadets of the fifth year of study in the amount of 71 respondents, aged from 21 to 27 years.

Equipment and stimulus material

In the process of achieving the goal, a study was conducted, which involved a number of stages. At the first stage, we were faced with the task of creating measuring methods for collective mental models in military personnel. To do this, based on the theoretical provisions of the metasystem approach regarding the structure of the collective mental model of military personnel, 10 cases were developed containing real everyday and service-combat situations, which were included in three blocks. The first block - "Interpersonal relations during the organization of the SBD": 3. Interaction with subordinates; 4. Failure to comply with an order; 8. Interpersonal conflict in the team; 9. Hostage rescue. The second block: "Injuries of personnel in military professional activity": 2. Injury of a limb during demining; 7. Plane crash of personnel; 10 Violation of safety requirements during grenade throwing. The third block "Non-standard situation in the performance of service and combat missions": 1. Loss of ammunition in combat service; 5. Critical situation; 6. Checking self-regulation.

To determine role identification, the Kaleidoscope projective technique was used (Perevozkina, Zinovieva, Andronnikova and Dmitrieva 2016). The technique contains 10 figures divided by sex and age: 2 figures relating to the period of childhood (boy and girl); 4 figures related to the period of youth and adolescence (boy and girl), of which 2 are creative figures, and 2 are destructive; 2 figures related to the period of adulthood (man and woman); 2 figures related to the period of old age (an old man and an old woman).

Procedure

The cadets had to offer a solution for each of the 10 introductory questions. In addition, according to the structure of collective mental models, the cadets had to determine what knowledge, skills and abilities they used in solving these problems. Did they have a similar experience, including civilian. They also had to note their needs and emotions, which are realized when solving a specific input. Also, out of 10 proposed figures (stimulus material of the "Kaleidoscope" methodology), the cadets chose their own role as a commander in a given situation and two roles subordinate to him.

When analyzing the contingency of the studied parameters, the χ^2 -Pearson criterion was used. Thus, the relationship between the decision of a particular introductory cadet, knowledge, experience, skills, abilities, needs, emotions and roles involved in this situation was studied.

Results

The data obtained demonstrate that when solving the input, statistically significant differences were found regarding the knowledge used, $\chi^2 = 18.49$, $p < 0.03$ (Table 1).

Table 1

Conjugacy between the input and various structural components of the mental model

Related parameters	c	p
Introductory x Knowledge	18.49	0.030
Introductory x Experience	7.52	0.006

Related parameters	c	p
Introductory x Skills, abilities	159.27	0.000
Input x Needs	17.82	0.023
Introductory x Emotions	111.21	0.002
Introductory x The role of the commander	13.93	0.050
Introductory x Role subordinate 1	13.04	0.042
Introductory x Role subordinate 2	17.57	0.021

There are statistically significant differences between skills and abilities when solving various introductory cadets of both faculties $\chi^2 = 159.27$, $p < 0.001$. Also, cadets realize various needs $\chi^2 = 17.82$, $p < 0.023$ and emotions $\chi^2 = 111.21$, $p < 0.002$ when solving given problem situations. Statistically significant differences were found between the selected roles for subordinates $\chi^2 = 13.04$, $p < 0.04$ and $\chi^2 = 17.57$, $p < 0.02$.

Discussion

When solving the first, fifth, sixth and tenth introductory cadets, humanitarian knowledge is predominantly used (more than 40%), military-professional knowledge is in second place (more than 30%). This indicates that when solving these problem situations, cadets, first of all, need knowledge of medicine, psychology, and other humanities. When solving the third and seventh inputs, military-professional knowledge (more than 45%) is used, including such subjects as the management of daily activities, service and combat use, intelligence and the Charter of the armed forces, and humanitarian ones - to a lesser extent (more than 30%). When solving the second, fourth, eighth and ninth introductory cadets, they need knowledge of both the humanitarian cycle and the military professional (more than 40% of both types of knowledge).

For all problem situations, for the vast majority of cadets, when solving introductory questions, self-discipline is the determining skill (from 48% to 58%), which is consistent with the results of

other studies (Farina, & Johnson, 2021). At the same time, when solving the second and fifth introductory questions, 18% and 17% of cadets use such an ability as critical thinking. To solve the third introductory, communication skills are needed (17%). When solving the seventh introductory, the skill of oratory is important (21%).

For cadets, when solving the first input, the need for influence and establishing control over others is realized (22.54%). The second situation is characterized by the need for stable, long-term relationships in close relationships with a small team (19.72%). The third, fifth, seventh, ninth and tenth tasks are determined by the need for comfortable physical conditions (more than 22%). The fourth input is related to the need for social contacts at the level of easy communication with a large team (21.13%) and the need for power (19.72%). According to Odoard, Battistelli, Guardela, Mirko, Di Napoli, & Piccione (2021) the need for effective coordination of the military team among the personnel of the military units of the Italian Air Force is influenced by transactive memory, which is closely related to the values of innovation, perception and command skills and innovation.

The need for comfortable physical conditions (25.35%), for social contacts (19.72%) and for achieving and setting bold, challenging goals for oneself (18.31%) determine the sixth input. The dominant needs in solving the eighth task are the need for high earnings, material rewards (26.76%), as well as material goods and influence and control over others (21.13%).

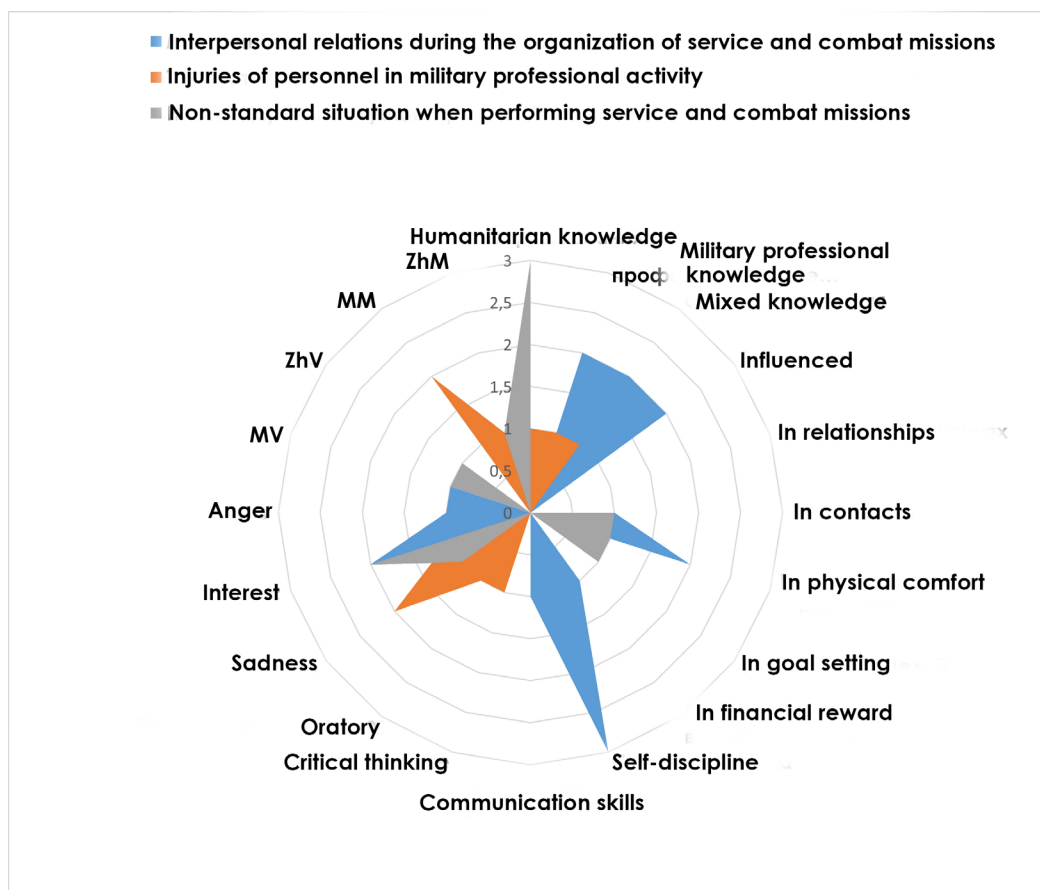
Sadness (more than 30%) is the predominant emotion among cadets when solving the second, third and seventh introductory questions. The emotion of anger dominates in solving the eighth problem situation (28.17%). Interest is activated among military personnel in solving most tasks - these are the first, fourth, fifth, sixth, ninth and tenth (more than 30%).

For the majority of cadets (more than 48%), the dominant role of the commander in solving all the introductory questions is the male role of the period of youth (Fig. 1). This role is characterized by such expectations as courage, confidence, the desire to overcome obstacles, to achieve a goal, to fight the enemy (Perevozkina, 2019). The main task of this role is to fight the enemy and protect civilians. However, for the third, fifth, ninth and tenth respondents, they also chose the male role of the period of adulthood (more than 40%). This role is distinguished by such features as control, team leadership, taking responsibility for subordinates (Perevozkina, 2019). Maden-Eyiusta (2021) notes that a leader who demonstrates acceptance of responsibility for subordinates has low values for role conflict and role ambiguity.

When choosing subordinates, there was a large differentiation of roles. So for the first and eighth problem situations, the role model of subordinates is the male role model of the period of adulthood (more than 28%). When solving the second, third and sixth tasks, a female role model related to the period of youth (more than 31%) with such characteristics as confidence, courage, vindictiveness was chosen as subordinates. For the fifth input, the female role model of the period of adulthood (25.43%) acted as a subordinate for the cadets, which is distinguished by kindness, care and mercy (Perevozkina, 2019). When solving the fourth, fifth, seventh, ninth and tenth inputs, the role of a young man is used as subordinates (more than 31%, Fig. 1). In this context, for the commander, from the point of view of most cadets, it is much easier to influence a subordinate of the same age and gender.

Thus, the obtained connections allow building certain configurations of collective mental models (Fig. 1).

Figure 1. Configurations of collective mental models when solving various inputs.



Conclusion

The conducted research allowed us to draw several conclusions. Firstly, the metasystem approach can be effective for developing the structure of the collective mental model of servicemen when solving inputs in military professional activity. The collective mental model of military personnel can be viewed as an open system that has five hierarchical levels.

Secondly, the developed structure of the collective mental model of military personnel made it possible to create methods for measuring individual mental models of cadets when they solve non-standard situations in peacetime and wartime.

Thirdly, despite certain results achieved in this work, at the same time, there are limitations in the study of the collective mental models of military personnel due to the fact that the general mental model is influenced by many additional factors that were not taken into account in this study. because the collective mental model is formed and evolves along with the dynamic changes in the military unit. Hence, topics related to the analysis of the mechanism of formation of a collective mental model, and what factors can contribute to its formation deserve further study in the future.

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Author Contribution

Nurzhan Saparkhanovich Mekebaev - selection of subjects, analysis of material for a literature review, design of the article, editorial correction.

Yulia Mikhailovna Perevozkina - preparation of the text of the article, scientific guidance, statistical data processing, interpretation of the results.

Mikhail Ivanovich Fedorishin - development of cases (introductory), organization and implementation of an empirical procedure, processing of primary data, preparation of the text of the article.

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Information about the conflict of interest

The authors declare no conflict of interest.