Psychological adaptation in rotational oil and gas workers in High North

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Abstract. The study was performed with financial support from the RF Presidential Grants programme for Russian beginner researchers who are PhD holders (MK-6409.2018.6). This article provides description of the psychological adaptation mechanisms in Arctic oil and gas rotational workers belonging to different occupational categories. Although the mechanisms of human adaptation to harsh climate and rotational work in general have been addressed in numerous publications that give insights into their medical and psychological sides, they lack systematization and classification, in particular with regard to psychological and socio-psychological adaptation patterns in mining workers. Our study covered the oil and gas industry employees working on a rotation basis in Nenets Autonomous Area – a total of 70 individuals aged between 24 and 60. Such processes as self-regulation, psychological defense and socio-psychological adaptation have been found to vary in oil and gas belonging to different occupational categories.

1. Introduction

In the national policy of the Russian Federation, mining operations in the Arctic and High North constitute a priority.

With harsh climate and critical infrastructure dependency (low population density; remoteness from major industrial localities; highly resource-intensive economy and communal services that run on fuels, food products, and essential commodities imported from other Russian regions), the High North and the Arctic areas are where rotating scheme is common [16].

In High North, rotational team method sets higher standards to the environment and facilities enabling better physiological, psychological and social-psychological adaptation in employees.

Despite all efforts towards lower negative exposure, jobs in the High North remain among the most strenuous and demanding, focusing researchers not only on ways for ensuring adequate occupational conditions, but also on human adaptation mechanisms. Since bodily and psychic responses to negative influences are to a large extent personal, the most effective approach to dealing with the negative exposure in the North is the one that takes into account individual differences at psychological and physiological levels [19]. The intensity with which negative physiological changes occur in human body under different work/rest schemes in the High North, evidences their extreme nature – a fact to be considered by any psychological study in this field.

Although the mechanisms of human adaptation to harsh climate and rotational work in general have been addressed in numerous publications that give insights into their medical and psychological sides, they lack systematization and classification, in particular with regard to psychological and socio-psychological adaptation patterns in mining workers.
Our study aims to explore the mechanisms of psychological and social-psychological adaptation in oil and gas workers operating in the extreme conditions of the Arctic and High North.

2. Theoretical basis
The theoretical conceptions our study relied on include:
- subject- and system-based activity approaches commonly accepted in general psychology (A.K. Abulkhanova-Slavskaya, B.G. Ananyev, A.N. Leontiev, B.F. Lomov, S.L. Rubinstein) and occupational psychology (E.M. Ivanova, E.A. Klimov, Yu.K. Strelkov);
- theory of psychological adaptation to occupational activity in normal and extreme conditions (V.A. Bodrov, L.G. Dikaya, E.F. Zeyer, A.S. Shapkin);
- insights into various aspects of human self-regulation (O.A. Konopkin, A.B. Leonova, I.V. Morosanova, A.O. Prokhorov);
- job analyses and labour psychology concepts (V.A. Bodrov, E.F. Zeyer, E.P. Ilyin, A.V. Karpov, A.K. Markova, M.I. Maryin, A.A. Oboznov, K.K. Platonov, N.S. Pryazhnikov, V.P. Serkin, Yu.K. Strelkov, A.I. Fukin, B.I. Tsukanov, A.G. Shmelev, R. Cattell, R.J. Hackman, P. Kline, K.R. Parkes, A.N. Turner).

The adaptation in on/off rotation workers operating in the High North to social environment is defined as an open psychological system functioning to maintain the adequate levels of performance capacity and functional status whilst performing job-related duties (in a social environment with components ranging from physical and chemical to physiological and social-psychological), as well as the adequate levels of psychical and psychic health. This system incorporates the adaptation to the extreme occupational milieu (High North, rotation scheme), as well as the adaptation to its social-psychological setting, given that rotation workers are an isolated team [16].

In our study, occupational adaptation is defined as a multitude of psychological mechanisms conducive to efficient performance, job satisfaction, and balanced physiological and psychic ‘cost’.

A classification of oil and gas employees has been developed by Ya.A. Korneeva and N.N. Simonova, which is based on the diversity of occupational conditions. It lists the following groups of oil and gas industry workers: oil and gas field operators, miscellaneous operators, drivers, engineering and maintenance personnel [15].

Group one includes oil and gas operators responsible for trouble-free performance of wells – drillers, driller assistants, rig fixers, rig mechanics, among others. These professions work mainly outdoors [15].

Group two includes miscellaneous operators. They deal with automated equipment and are responsible for tracking their performance and accuracy, and monitoring of malfunctions. The operators in this group monitor the performance of particular mechanisms and entire operational cycles. In case of an emergency they need to identify and report the cause as soon as possible. These operators are a crucial link that keeps all systems running in parallel. Their core professional qualities include good vision, attentional consistency and set-shifting, motor coordination, and exact memory. Also, operators are expected to have good knowledge of mathematics and engineering, be able to deal with emergencies, handle difficult sources of stress and act quick making decisions [15].

Group three are drivers of vehicles such as trucks and bulldozers. Their jobs are more routine, requiring little decision-making and coming down to freight and passenger transportation and vehicle maintenance. Drivers are expected to be able to think on their feet, handle monotonous operations, act quick depending on the road conditions. Important for drivers is also being able to maintain due levels of alertness, stay prudent and observant predicting road situation based on road users’ behavior. Professionally important are also good physical and psychological health, fast motor response, attention concentration skills, and emotional stability [15].

Group four includes engineering and maintenance personnel (oil treatment engineers, crude oil ship foremen and mechanics, among others). They are responsible for monitoring technical performance and related record keeping, as well as following up on newly introduced know-how. Among their core duties are maintenance and maintenance supervision, and treated oil quality control. As can be seen from the above, engineering and maintenance personnel perform a variety of duties that deal with control, performance evaluation, testing and diagnostics, trouble-shooting and maintenance. They are
expected to have a vision that enables a holistic view of the problem and its interrelated components [15].

Group five are service technicians working in covered spaces – electricians, fitter, mechanics, turners, among others. Their range of duties cover assembly, disassembly and repair operations on units and machinery; trouble-shooting; and operational quality control. They also do instrumentation testing and analysis for wear; and tuning up on remotely and automatically operated mechanical equipment. Group four workers are expected to have a wide awareness of mechanics, precise motor and manual coordination, exact sensory memory, ability to think on their feet, and technology aptitude [15].

3. Materials and methods

The study was conducted on one of the oil and gas fields in Nenets Autonomous Area (30 day on/off rotation) and covered a total of 70 workers aged between 24 and 60 (average 38.7±1.3). The following methods were employed:
1. Personal documents.
2. Work process observation.
3. Interviewing and opinion poll.
4. Questionnaire survey.
5. Psychological testing, designed to define mechanisms of adaptation.

The purpose of the study also involved the use of the following techniques:

1) Behavioral Self-Regulation Style, a diagnostics technique developed by V.I. Morsanova which targets individual patterns of self-regulation based on individual’s abilities to plan, model, schedule, evaluate, and such personal constructs as flexibility and self-sufficiency [11].

2) Social and psychological adaptation diagnostics (C. Rogers and R. Diamond, adapted by A.K. Osnitsky, 1954) [13].

3) Life Style Index (R. Plutchik, G. Kellerman and H.R. Conte, adapted by L.I. Wasserman, O.F. Eryshev, E.B.Klubova, N.N. Petrova, M.A. Bespalko, M.A. Berebin, M.I. Savelyeva, L.M. Taukenova, A.V. Shtrakhova, T.A. Aristova, I.M. Osadchiy), a diagnostics tool designed to assess various defense mechanisms.

6. Statistical methods: descriptive statistics; Pearson chi-square correlation; and multivariable dispersion analysis (MANOVA). The data was processed using IBM SPSS Statistics software (License Agreement № Z125-3301-14 (M.V. Lomonosov NArFU).

4. Results and discussion

In order to compare the parameters of social-psychological adaptation in oil and gas workers under rotation scheme in the Arctic, multivariate dispersion analysis was performed, where the belonging to either of the five occupational categories (oil and gas field operation; boiler operation; truck driving; engineering; service and maintenance) served as an independent variable, and the parameters of social-psychological adaptation, measured according to C. Rogers and R. Diamond (adapted by A.K. Osnitsky), as dependent variables.

The multivariable tests (Table 1) have revealed a number of statistically significant differences within the “occupational category” parameter, that influence the degree of manifestation of the parameters of social-psychological adaptation in rotational shift workers (p<0.05).

| Effect              | Value | F          | Hypothesis degree of freedom | Error | Value |
|---------------------|-------|------------|-----------------------------|-------|-------|
| Pillai trace        | 1,756 | 4,177      | 35,000                      | 270,000 | <0,001 |
| Wilks’ Lambda       | 0.84  | 4,875      | 35,000                      | 212,761 | <0,001 |
| Hotteling trace     | 3,855 | 5,331      | 35,000                      | 242,000 | <0,001 |
| Roy’s Largest Root  | 2,198 | 16,954c    | 7,000                       | 54,000  | <0,001 |
As can be seen from Figure 1, most pronounced in oil and gas workers are such parameters of social-psychological adaptation as ‘self-acceptance’ and ‘acceptance of others’. Since oil and gas workers are isolated teams doing shift work far away from their homes, these two parameters serve as core resources in their adaptation potential.

Especially manifest is ‘self-acceptance’ in operators and engineering personnel, as their need in adequate self-assessment is posed by the complexity of their job-related duties.

‘Acceptance of others’ is most prominent in oil and gas field operators, miscellaneous operators, and engineering personnel, as their jobs require them to ensure trouble-free performance and, hence, suggest contact with workers of all specializations. Least manifest is ‘acceptance of others’ in drivers and service personnel, because their daily tasks do not require them to contact workers of specializations other than their own: the low performance in this parameter indicates that drivers and service personnel have difficulty adapting to others, leading to conflicts and failure to compromise, as was shown by questionnaires and observations.

Such parameter as ‘dominance’ prevails in oil and gas field operators, miscellaneous operators, and drivers, being least dominant in engineering and service personnel and a risk factor in their social-psychological adaptation as managers.

‘Escapism’ is found more often in drivers, indicating their tendency to keep their problems to themselves rather than show or talk about them. Least evident is ‘escapism’ in service personnel and engineers, meaning that they do tend to display their dissatisfaction.

Figure 1: Parameters of social-psychological adaptation in oil and gas workers of different occupational categories.

In order to define the differences in regulatory processes and self-regulation in oil and gas workers under rotation scheme in the Arctic, multivariate dispersion analysis was performed, where the belonging to either of the five occupational categories (oil and gas field operation; boiler operation; truck driving; engineering; service and maintenance) served as an independent variable, and the regulatory processes and the self-regulation level, measured according to V.I. Morosanova, as dependent variables.

The multivariable tests (Table 2) have revealed a number of statistically significant differences within the “occupational category” parameter, that influence the degree of manifestation of the regulatory processes and the self-regulation level in rotational shift workers (p<0.05).
Table 2: Multivariable test results.

| Effect            | Value | F   | Hypothesis degree of freedom | Error | Value |
|-------------------|-------|-----|-------------------------------|-------|-------|
| Pillai trace      | 1,337 | 3,755 | 35,000                       | 360,000 | <0.001 |
| Wilks’ Lambda     | 0.171 | 4,301 | 35,000                       | 288,480 | <0.001 |
| Hotteling trace   | 2,518 | 4,776 | 35,000                       | 332,000 | <0.001 |
| Roy’s Largest Root| 1,601 | 16,468 | 7,000                        | 72,000 | <0.001 |

As can be seen from Figure 2, such process within self-regulation as “planning” is most manifest in service personnel, oil and gas field operators, and drivers, as their job-related duties suggest a set of targets that can only be attained through sequenced actions. Least manifest is “planning” in engineering personnel, because engineers mostly deal with modeling: being in charge of the entire field production process, they may have to deal with unforeseen situations and non-conventional tasks.

‘Performance evaluation’ is more prominent in oil and gas field operators, miscellaneous operators, and service personnel, as these professions are result-oriented and, hence, pre-figure their performance. Least prominent is ‘performance evaluation’ in drivers and engineers, as these professions are more process-oriented.

Such regulatory process as ‘flexibility’ is prominent in drivers and operators, as flexibility is what these professions require in emergencies in order to make adequate decisions.

‘Self-sufficiency’ is most manifest in drivers and service personnel: these professions are more independent and indifferent in fulfilling their daily tasks, following clear instruction and enjoying the freedom of acting on their own in emergencies. In other occupational categories, ‘self-sufficiency’ is less prominent because they need to work as a team, depending on each other’s actions as crucial to the overall performance.

Figure 2: Regulatory processes in oil and gas workers of different occupational categories.

In order to define the differences in psychological defence in oil and gas workers under rotation scheme in the Arctic, multivariate dispersion analysis was performed, where the belonging to either of the five occupational categories (oil and gas field operation; boiler operation; truck driving; engineering; service and maintenance) served as an independent variable, and the psychological defense, measured according to R. Plutchik, G. Kellerman and H.R. Conte, adapted by L.I. Wasserman as dependent variables.

The multivariable tests (Table 3) have revealed a number of statistically significant differences within the “occupational category” parameter, that influence the degree of manifestation of such psychological defense mechanisms in workers under rotation scheme as suppression, substitution, and reaction formation (p<0.05).
Table 3: Multivariable test results.

| Effect          | Value | F   | Hypothesis degree of freedom | Error      | Value |
|-----------------|-------|-----|------------------------------|------------|-------|
| Pillai trace    | 1,147 | 2.270 | 40,000                      | 350,000    | <0.001|
| Wilks’ Lambda   | 0.226 | 2.551 | 40,000                      | 251,252    | <0.001|
| Hotteling trace | 2.037 | 2.822 | 40,000                      | 277,000    | <0.001|
| Roy’s Largest   | 1.289 | 9.831 | 8,000                       | 61,000     | <0.001|

As can be seen from Figure 3, reaction formation, as a psychological defense mechanism, prevails in oil and gas field operators, indicating that in extreme situations these professions are more prone to letting steam off. Least manifest in this psychological defense mechanism is operators other than field, as they enjoy occupational conditions that are safer.

Drivers, known to be more prone to facing the conflict rather than avowing it, probably turn to such mechanisms as suppression and substitution, in which they have scored high. Drivers turn to defense mechanisms mainly due to their difficult occupational conditions. Suppressed, their problems remain untackled and can therefore cause conflicts and overt dissatisfaction.

Suppression and substitution are also evident in engineering personnel, as their tasks, too, are rather complex, requiring engineers to turn to defense mechanisms. Least evident are the defense mechanisms in oil and gas field operators, as their occupational conditions – outdoor environment – allow more freedom to respond to negative emotions.

5. Conclusions
Out of all the occupational categories studied, the most-at-risk one is drivers, as they tend to resort to adaptation mechanisms that are least productive. At risk are also engineering and service personnel – due to the fact that they frequently employ psychological defense mechanisms and have a low score in self-sufficiency as a process of self-regulation, which is indicative of their tendency towards escapism. Therefore, there is a need in psychological counselling programmes for the most-at-risk categories, which would target cultivating in them such more productive mechanisms as self-sufficiency and performance evaluation. It is advisable that the results of this study are taken into account with regard to personnel screening and developing recommendations and action plans for better adaptation in employees.

![Figure 3: Psychological defense in oil and gas workers of different occupational categories.](image-url)
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