

## Dynamics of Indicators of Expeditioners' Psychological States During Long Antarctic Stay

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### ABSTRACT

This study examines the dynamics of expeditioners' psychological states during one year of work at the Antarctic station. It included twelve expeditioners of Akademik Vernadsky Ukrainian Antarctic Station. Thirteen series of monthly studies were carried out using the modified methodology of the scaled psychological state self-assessment. The states were assessed for the psycho-physiological (well-being, activity, mood, performance, health status) and social-psychological (satisfaction with relations with colleagues, satisfaction with the environment and work performed, life satisfaction) components. In general, the self-assessed indicators of expeditioners' psychological states rise significantly during the first four months of the year-long expedition. Further, their average self-assessments begin to decline gradually, reaching the lowest values in the last two months of staying at the Antarctic station. However, some indicators showed dynamics slightly different from the general tendency, and psychological states of some expeditioners remained quite stable during all expedition. The results of this study can be used for better psychological selection of Antarctic expedition participants and psychological support for them.

*Key words:* expeditioners, Antarctic station, Antarctic expedition, psychological states.

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### *Novelty and Significance*

*What is already known about the topic?*

- A long stay at the Antarctic station is a severe test for one's psyche, moral qualities and human health.
- Psychological research should help to increase working efficiency and maintain expeditioners' mental and physical health.

*What this paper adds?*

- The 12-section dynamics of a set of psychological state indicators of the expeditioners participated at year-long Antarctic expedition is shown.
- The comparative dynamics of various psychological state indicators of the expeditioners during one year of stay at the Antarctic station was determined.

Changes in a person's psychological state during a long stay and work in extreme conditions attract always a special attention of researchers. A striking example of such extreme work is the work of expeditioners during long Antarctic expeditions (Tortello, Barbarito, Cuiuli, Golomber, Vigo, & Plano, 2018; Rothblum, 1990; Zimmer, Cabral, Borges, Côco, & Hameister, 2013). After all, work at polar expeditions is characterized by significant difficulties. Extreme conditions of human life are caused by low air temperature, low atmospheric pressure, storm winds, increased solar radiation, geomagnetic disturbances, effects of polar day and polar night, hypodynamia at the

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same time (Belkin, Dyurgerov, Finaev, & Soroko, 2016; Nicolas, Suedfeld, Weiss, & Gaudino, 2016; Wood, Lugg, Hysong, & Harm, 1999).

Mullin (2006), Palinkas, and Suedfeld (2008), Roberts (2011) and many other researchers emphasize that organisms of expeditioners are also affected by other negative factors of life and work: uniformity of environment and landscape, long stay in a closed group. At the same time, it is often noted that the long isolation from the outside world of small groups working at Antarctic stations or field bases, absence of usual external stimuli and comfortable living conditions, isolation from traditional media, families and other nearest and dearest cause emotional stress of the personnel, which can have even deeper negative impact on their physical, physiological and psychological states than severe natural conditions (Khandelwal, Bhatia, & Mishra, 2017; Sandal, Leo, & Palinkas, 2006; Smith Kinnafick, & Saunders, 2017). In particular, Mullin (2006) refers to the most important psychological stresses of expeditioners: problems of individual adjustment to the group; more subtly acting, the relative “sameness” of the milieu; the absence of certain accustomed sources of emotional satisfaction.

It is noted that as a result of being at an Antarctic station, expeditioners are characterized by impaired well-being, mood, sleep and performance (Chen, Wu, Li, Zhang, & Xu, 2016; Collet *et alia*, 2015), by increased tension, irritability, anger and confusion (Chen, Wu, Li, Zhang, & Xu, 2016; Zimmer, Cabral, Borges, Côco, & Hameister, 2013). Persistent mood disorders with signs of depression are formed at a part of the personnel (Khandelwal, Bhatia, & Mishra, 2017; Palinkas & Suedfeld, 2008; Roberts, 2011). Anxiety and tension rise the most pronouncedly during the final phase of Antarctic residence (Bhargava, Mukerji, & Sachdeva, 2000; Khandelwal, Bhatia, & Mishra, 2017).

Chen, Wu, Li, Zhang, and Xu, (2016), and Wood, Lugg, Hysong, and Harm (1999) indicate that expeditionary teams are typically characterized by formed micro-groups and emergence of intergroup and interpersonal conflicts, which negatively influence interpersonal relationships and personnel performance. In this regard, serious psychological selection and preparation of expeditioners is emphasized (Grant *et alia*, 2007; Leon, Sandal, & Larsen, 2011; Domuschieva-Rogleva & Iancheva, 2017).

For example, research performed by Mehta and Chugh (2011) has found that positive personal characteristics such as high enthusiasm, adaptability, optimistic future orientation and determination and need for achievement are important for adaptation of expeditioners to difficult conditions. Namely, the results of psychological research should become the base for preventive approaches, such as psychological training and support in order to reduce symptoms and generate satisfactory adaptation to Antarctica (Zimmer, Cabral, Borges, Côco, & Hameister, 2013).

In particular, we believe that improvement of efficiency in the extreme Antarctic conditions and maintained psychological and physiological health of the expeditioners can be ensured by the continuous monitoring of self-assessments of their psychological state. The monitoring opens additional opportunities to improve efficiency, since information received from it, on the one hand, provides real opportunities for individualization, and on the other hand, allows us to determine precisely a time, character and scope for necessary corrective measures (Karpoukhina, Kokun, & Zeltser, 2008; Kokun, Korobeynikov, Mytskan, Cynarski, & Korobeynikova, 2019).

Thus, the main purpose of our study was to determine the peculiarities of the dynamics of expeditioners' psychological state indicators during a long (12 months) Antarctic expedition.

## METHOD

### *Participants*

The study involved twelve expeditioners of *Akademik Vernadsky Ukrainian Antarctic Station* (all men aged 29 to 60 years, average age 41.2 years). Three months after the study start, one expedition member was evacuated from the station due to illness. The studies were conducted with the approval of the National Antarctic Scientific Center of Ukraine and the personal consent of its participants.

### *Procedure*

Thirteen series of monthly surveys were conducted from March 2018 (the first series was done in Kyiv before travel to the Antarctic station) to March 2019 (12 series at the Antarctic station; the last in March 2019 one week before the expedition end). At the Antarctic station, the diagnosis was performed by the expedition doctor (who was also a study participant) according to the plan and instructions developed by the article authors.

For the research, we used a modified method of scaled self-assessments of expeditioners' psychological states, based on the Scaled Self-Assessment of Psycho-physiological State (Kokun, Korobeynikov, Mytskan, Cynarski, & Korobeynikova, 2019). This technique allows a researcher to evaluate quickly and accurately various components of psychological states (by choice of the researcher). In particular, it has been shown that it can be used to investigate a person's psychological state at operating in complex and extreme conditions (Karpoukhina, Kokun, & Zeltser, 2008; Kokun & Shamich, 2016).

In our study, the first five scales of the method characterize the psycho-physiological component of psychological states (well-being, activity, mood, performance, health), and next four scales do the socio-psychological component (satisfaction with relations with colleagues, satisfaction with the environment, satisfaction with the performed work, life satisfaction).

### *Data Analysis*

For statistical analysis, we used SPSS 22.0.0 programming package. Paired Sample *t* test was used. The data obtained in the study have the normal distribution of studied data (One-Sample Kolmogorov-Smirnov Test).

## RESULTS

First, let us analyze the year-long dynamics of the five indicators revealing the psycho-physiological component of the expeditioners' psychological states (well-being, activity, mood, performance, health) presented in Table 1.

The results show that all five self-assessment indicators of the psycho-physiological component of the expeditioners' psychological states (well-being, activity, mood, performance and health) rise significantly during the first four months of year-long expedition (April-July) compared to the result obtained before the travel to the Antarctic station. This is especially clear for self-assessment of well-being, but this tendency is the least for mood. Further, starting from August, the average self-assessment of these

Table 1. Year-long dynamics of self-assessment of the psycho-physiological component of the expeditioners' psychological states.

N°	Series	Indicators									
		well-being		activity		mood		performance		health state	
		M	SD	M	SD	M	SD	M	SD	M	SD
1	March 2018	71.5	22.1	72.1	17.8	76.8	15.6	74.4	17.7	71.9	23.1
2	April 2018	78.1	9.9	73.8	10.3	80.1	10.9	80.9	11.3	80.6	10.3
3	May 2018	76.8	10.3	76.3	9.1	77.5	10.7	76.3	9.1	81.6	7.8
4	June 2018	77.0	10.9	78.4	12.0	79.2	12.8	79.2	12.8	79.8	14.2
5	July 2018	78.8	12.1	77.1	13.7	78.2	14.4	77.5	15.2	78.0	11.7
6	August 2018	73.9	15.8	72.8	15.7	74.4	15.9	73.7	17.6	76.6	14.5
7	September 2018	74.4	16.1	70.1	15.1	73.8	15.7	73.0	16.4	73.7	14.5
8	October 2018	74.5	15.2	73.8	15.2	74.5	17.4	73.9	17.8	78.5	13.6
9	November 2018	71.9	13.6	71.6	17.2	70.9	16.9	71.9	17.6	73.1	18.4
10	December 2018	70.0	19.4	70.5	15.0	70.4	16.3	69.9	14.3	70.7	16.7
11	January 2019	67.3	17.3	69.5	20.6	70.3	19.6	63.1	16.5	69.5	14.2
12	February 2019	63.6	18.5	66.6	21.6	67.6	23.2	62.9	18.8	68.3	18.9
13	March 2019	65.5	21.8	62.6	25.8	62.5	23.3	65.0	23.5	63.3	20.8
<i>p</i> ≤		.05		.05		.01		.01		.01	

Note: *p*≤ are indicated for the differences between the highest and lowest average values of each indicator.

indicators begins to decrease gradually, reaching the lowest values during the last two months of staying at the Antarctic station. The most significant decrease is for self-assessment of well-being, performance and health ( $p \leq .05$ ) compared to the highest average data for the examined group.

The stable and optimal level of the psycho-physiological component indicators of the expeditioners' psychological states during the first third of the year-long expedition, in our opinion, can be explained by the mobilization of their mental and physical resources, as well as by a sufficiently high-quality selection of the expeditioners. Further deterioration of these indicators occurs quite naturally due to the gradual exhaustion of mental and physical resources, the onset of the polar night and influences of a set of other negative natural factors, factors of life and work, referred to in the Introduction to this article.

The year-long dynamics of four assessed indicators of the social-psychological component the expeditioners' psychological states was quite close to the above analyzed, but far from being identical. These indicators are: satisfaction with relationships with colleagues, satisfaction with the environment, satisfaction with work performed, life satisfaction (Table 2).

Table 2. Year-long dynamics of self-assessment of the social-psychological component of the expeditioners' psychological states.

N°	Series	Indicators							
		satisfaction relationships colleagues		satisfaction environment		satisfaction work performed		life satisfaction	
		M	SD	M	SD	M	SD	M	SD
1	March 2018	76.8	18.3	74.1	19.6	77.0	11.5	80.9	11.7
2	April 2018	79.2	11.2	70.5	22.5	83.8	8.1	84.9	9.3
3	May 2018	82.8	9.4	80.3	9.7	79.0	11.1	85.7	9.3
4	June 2018	80.8	10.2	76.1	17.4	77.9	12.4	80.8	12.4
5	July 2018	78.0	15.5	77.0	13.8	75.0	19.3	73.5	18.6
6	August 2018	75.1	16.8	73.0	16.4	70.1	21.0	71.3	21.0
7	September 2018	76.7	15.2	69.9	19.9	68.8	19.5	71.7	18.4
8	October 2018	75.5	15.0	73.7	17.0	65.5	19.1	72.5	20.0
9	November 2018	69.2	16.1	72.8	20.2	69.9	21.4	69.5	19.8
10	December 2018	73.8	15.4	70.5	18.5	71.3	22.5	71.2	20.1
11	January 2019	72.9	18.0	72.0	11.9	68.6	15.0	68.4	20.8
12	February 2019	69.8	22.7	64.5	24.1	63.4	29.5	70.5	23.8
13	March 2019	69.5	23.7	62.1	25.3	54.1	35.1	64.5	23.0
<i>p</i> ≤		.05		.01		.01		.01	

Note: *p*≤ are indicated for the differences between the highest and lowest average values of each indicator.

As it can be seen from the table results, "satisfaction with relationships with colleagues" at the beginning of the expedition increased insignificantly compared to the first series of the study, but the lowest data were not during the 11th or 12th month of the expedition, like that for all other indicators, but significantly earlier, during the 8th month. This, in our opinion, indicates that staying and working in a closed group was a factor that had a negative impact on the expeditioners' psychological state.

"Satisfaction with the environment", unlike all other indicators did not increase but even decreased in the second series of the study during the first month of being at the Antarctic station. That is, this indicator determines the most sensitively a certain internal stress of expeditioners, appeared during the first-time adaptation to the difficult life conditions.

"Satisfaction with work performed" showed the greatest decrease of all nine indicators, having reached a critical value of  $M= 54.1$  in the last month of the expedition, compared to  $M= 83.8$  in the first month. In our view, this is naturally explained by the continued fulfilment of the work by expeditioners in quite uniform conditions with limited choices of switching to other activities as well as limited choices of recreations, exhaustion of the expeditioners' psycho-physiological resources and the growing desire to return home as quick as possible by the end of the year-long expedition.

The expeditioners' "life satisfaction" began to decline substantially not in August, like all other indicators, but the two months before, since June. This indicator is the most sensitive concerning increased mental fatigue during the expedition.

It is also worth noting the significant increase of SD for all indicators of the expeditioners' psychological states in last series of studies. This indicates that psychological states of some expeditioners remained fairly stable (or with only a slight deterioration) during the expedition, but as for other such deterioration was significant. The analysed individual dynamics of the expeditioners' psychological states showed that five expeditioners out of eleven have stable states during the entire expedition period.

## DISCUSSION

On the basis of the study of expeditioners worked at *Akademik Vernadsky Ukrainian Antarctic Station*, the dynamics of the indicators revealing their psychological states during the year-long Antarctic expedition have been determined.

All self-assessed five indicators of the psycho-physiological component of the expeditioners' psychological states ("well-being", "activity", "mood", "performance" and "health") increased significantly during the first four months of the year-long expedition. Further, the average self-assessment of these indicators by the expeditioners begins to decrease, reaching the lowest values during the last two months of stay at the Antarctic station. Self-assessments of mood, performance and health decreased most significantly, compared to the highest average group values.

The year-long dynamics of four assessed indicators of the social-psychological component the expeditioners' psychological states was quite close to the above analyzed, but far from being identical. Thus, the lowest values for "satisfaction with relationships with colleagues" appeared significantly earlier (by 3-4 months) in comparison with all other indicators. Namely during this period of the group social isolation, the individual and psychological characteristics of each expeditioner is fully revealed. This confirms that the long stay and work within a closed group is a factor primarily affecting the expeditioners' psychological states.

“Satisfaction with the environment”, in turn, determine the most sensitively the expeditioners’ internal stress, which emerged during the first adaptation to difficult life conditions. This is the only indicator that, unlike all others significantly increased at the beginning of the Antarctica stay, decreased in the second series of studies. This is due to the fact that the so-called “euphoria” of being in the “new” Polar Antarctic conditions for the newly-arrived expeditioners subsided quickly, the place became gradually usual and eventually even boring.

The most significant and deep decrease was shown for “satisfaction with work performed”; this indicator reached the critical value of  $M= 54.1$  in the last month of the expedition, compared to  $M= 83.8$  in the first month. This is naturally explained by the continued fulfilment of the work by expeditioners in quite uniform conditions with limited choices of switching to other activities as well as limited choices of recreations, exhaustion of the expeditioners’ psycho-physiological resources and the quick-rising desire to return home by the end of the year-long expedition. The most sensitive indicator revealing the expeditioners’ gradually increasing mental fatigue was “life satisfaction”, which began to decline substantially two months earlier.

Significant increase of *SD* for all indicators of the expeditioners’ psychological states in the last series of studies shows that the psychological states of some expeditioners remained relatively stable (or only slightly deteriorated) during the expedition, and those of the others deteriorated significantly. The analysed individual dynamics of the expeditioners’ psychological states allowed us to find five expeditioners with relatively stable psychological states from the eleven people stayed at the expedition during all its term.

Thus, in general, the stable and optimal, in our opinion, level of the self-assessed indicators of the psycho-physiological component of the expeditioners psychological states during the first third of the year-long expedition can be explained by the mobilization of their mental and physical resources and by a sufficiently high-quality selection of the expedition participants. Further deterioration of these indicators quite naturally occurs due to the gradual exhaustion of mental and physical resources, the onset of the polar night and the influence of other negative natural factors, factors of life and work at the Antarctic station.

Our results are consistent with those of other studies concerning extreme Antarctic expeditions. The gradual deterioration of the expeditioners’ psychological and psycho-physiological states similar to ours was recorded in the year-long study performed by Wencheng, Wen, and Yongzhong (1995). Sandal, Van de Vijver, and Smith (2018) also noted a marked deterioration in the expeditioners’ psychological states after six months of the expedition. Bhargava, Mukerji, and Sachdeva (2000), and Khandelwal, Bhatia, and Mishra (2017) indicate that the most pronounced increase in anxiety and tension levels is during the final phase of Antarctic residence.

Blight and Norris (2018), Norris, Paton, and Ayton (2010), Zimmer, Cabral, Borges, Côco, and Hameister (2013), and Mehta and Chugh (2011) emphasize that prolonged work at the Antarctic station results in far more than just negative effects for psychological status, interpersonal relationships and wintering personalities, but also have «Positive Effects», such as salutogenic results arising from successful adaptation to environmental adversities, personal growth, «spiritual and existential change», high enthusiasm, adaptability, optimistic future orientation and determination, need for achievement.



Therefore, it is worth mentioning that in our study, some expeditioners maintained a good level of psychological adaptation throughout all term of the expedition, becoming emotional and professional leaders of the station personnel.

In conclusion, given that not all of the selected participants at the Antarctic expedition showed their psychological states sufficiently stable within 1-year life at the Antarctic station, the future research should be aimed at improving the psychological selection of Antarctic expedition participants, special psychological training to the expedition personnel as well as to working conditions, communications and rest at the Antarctic station. Psychological training and support of expeditioners should promote the creation of positive interpersonal relationships by improving the personal emotional and appraisal attitudes of individuals and all group to the Antarctic environment and the conditions of relative isolation.

### REFERENCES

- Belkin VS, Dyurgerov MB, Finaev AF, & Soroko SI (2016). Bioclimatic evaluation of the human discomfort level for several Antarctic regions. *Human Physiology*, 42, 119-127. Doi: 10.1134/S0362119716020043
- Bhargava R, Mukerji S, & Sachdeva U (2000). Psychological Impact of the Antarctic Winter on Indian Expeditioners. *Environment and Behavior*, 32, 111-127. Doi: 10.1177/00139160021972450
- Blight S & Norris K (2018). Positive psychological outcomes following Antarctic deployment. *The Polar Journal*, 8, 351-363. Doi: 10.1080/2154896X.2018.1541552
- Chen N, Wu Q, Li H, Zhang T, & Xu C (2016). Different Adaptations of Chinese Winter-Over Expeditioners During Prolonged Antarctic and Sub-Antarctic Residence. *International Journal of Biometeorology*, 60, 737-747. Doi: 10.1007/s00484-015-1069-8
- Collet G, Mairesse O, Cortoos A, Tellez FH, & Neyt X, Peigneux P, Macdonald-Nethercott E, Ducrot, Y, & Pattyn N (2015). Altitude and Seasonality Impact on Sleep in Antarctica. *Aerospace Medicine and Human Performance*, 86, 392-396. Doi: 10.3357/AMHP.4159.2015.
- Grant I, Eriksen H, Marquis P, Orre I, Palinkas L, Suedfeld P, Svensen E, & Ursin H (2007). Psychological Selection of Antarctic Personnel: The "SOAP" Instrument. *Aviation, Space, and Environmental Medicine*, 78, 793-800.
- Domuschieva-Rogleva G, & Iancheva T (2017). Coping Strategies for the Participants in the Antarctic Expedition. *Revista de Psicología del Deporte*, 26, 45-50.
- Karpoukhina AM, Kokun OM, & Zeltser ML (2008). *Monitoring of Human Psychophysiological Condition as a Method of Increasing of Activity's Efficiency*. In Conference Proceedings AHFE International Conference 14-17 July 2008 (pp. 254-264).
- Khandelwal SK, Bhatia A, & Mishra AK (2017). Psychological Adaptation of Indian Expeditioners During Prolonged Residence in Antarctica. *Indian Journal of Psychiatry*, 59, 313-319. Doi: 10.4103/psychiatry.IndianJPsychiatry\_296\_16
- Kokun OM & Shamich OM (2016). Psychological characteristics of Paralympic athletes' self-realisation. *Social Welfare. Interdisciplinary Approach*, 6, 138-147. Doi: 10.21277/sw.v2i6.273
- Kokun O, Korobeynikov G, Mytskan B, Cynarski WJ, & Korobeynikova L (2019). Applied aspects of improving pupils' and students' adaptive capacity. *Ido Movement for Culture. Journal of Martial Arts Anthropology*, 19, 38-45; Doi: 10.14589/ido.19.3.5
- Leon GR, Sandal GM, & Larsen E (2011). Human Performance in Polar Environments. *Journal of Environmental Psychology*, 31, 353-360. Doi: 10.1016/j.jenvp.2011.08.001
- Mehta M & Chugh G (2011). Achievement Motivation and Adjustment in Members of Indian Scientific Expedition to Antarctica. *Psychological Studies*, 56, 404. Doi: 10.1007/s12646-011-0109-7
- Mullin JR (2006). Some Psychological Aspects of Isolated Antarctic Living. *American Journal of Psychiatry* 117, 323-325. Doi: 10.1176/ajp.117.4.323
- Nicolas M, Suedfeld P, Weiss K, & Gaudino M (2016). Affective, Social and Cognitive Outcomes During a 1-year Wintering in Concordia. *Environment and Behavior*, 48, 1073-1091. Doi: 10.1177/0013916515583551
- Norris K, Paton D, & Ayton J (2010). Future Directions in Antarctic Psychology Research. *Antarctic Science*, 22,

- 335-342. Doi:10.1017/S0954102010000271
- Palinkas LA & Suedfeld P (2008). Psychological Effects of Polar Expeditions. *Lancet* 371(9607), 153-163. Doi: 10.1016/S0140-6736(07)61056-3
- Roberts R (2011). Psychology at the End of the World. *Psychologist*, 24, 22-25.
- Rothblum E (1990). Psychological Factors in the Antarctic. *The Journal of Psychology*. 124. 253-273. Doi: 10.1080/00223980.1990.10543221
- Sandal G, Van de Vijver F, & Smith N (2018). Psychological Hibernation in Antarctica. *Frontiers in Psychology*, 9(2235). Doi: 10.3389/fpsyg.2018.02235.
- Smith N, Kinnafock F, & Saunders B (2017). Coping Strategies Used During an Extreme Antarctic Expedition. *Journal of Human Performance in Extreme Environments*, 13, Article 1. Doi: 10.7771/2327-2937.1078
- Sandal GM, Leon G, & Palinkas L (2006). Human Challenges in Polar and Space Environments. *Environmental Science and Biotechnology*, 5, 281-296. Doi: 10.1007/s11157-006-9000-8
- Tortello C, Barbarito M, Cuiuli JM, Golombek D, Vigo DE, & Plano S (2018). Psychological Adaptation to Extreme Environments: Antarctica as a Space Analogue. *Psychology and Behavioral Science*, 9, 555768. Doi: 10.19080/PBSIJ.2018.09.555768.004
- Wencheng Z, Wen W, & Yongzhong Y. (1995). Analyses on the Physio-Psychological State of the Expeditioners in Antarctica. *Chinese Journal of Polar Science*, 6, 72-75.
- Wood J, Lugg DJ, Hysong SJ, & Harm DL (1999). Psychological Changes in Hundred-Day Remote Antarctic Field Groups. *Environment and Behavior*, 31, 299-337. Doi: 10.1177/00139169921972128
- Zimmer M., Cabral JCCR, Borges FC, Côco KG, & Hameister BR (2013). Psychological changes arising from an Antarctic stay: systematic overview. *Estudos de Psicologia (Campinas)*, 30, 415-423. Doi: 10.1590/S0103-166X2013000300011

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