



Salutogenic outcomes and their personality predictors in participants of year-long Antarctic expeditions

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Abstract: Prolonged stays in extreme living and working conditions at Antarctic stations can result in both negative psychological manifestations and possible positive, salutogenic effects. The aim of this study was to check an assumption about existing salutogenic outcomes and their personality predictors in expeditioners who participated in year-long expeditions. We examined 62 expeditioners who participated in expeditions to the Ukrainian Antarctic *Akademik Vernadsky* station between 1996 and 2021, including 59 men and three women aged 27 to 68 years. We used the Posttraumatic Growth Inventory—Expanded, the General Self-Efficacy Scale, the Eysenck Personality Questionnaire, the Sixteen Personality Factor Questionnaire and the Professional Hardiness Questionnaire. The majority of expeditioners (55–71%, on various grounds) recorded personal growth following Antarctic deployment, at a level from moderate to high. Based on personality characteristics diagnosed in the abovementioned questionnaires, we created an informative prognostic model explaining 30–45% of the variation in several indicators of expeditioners' post-expedition growth. The most important predictors of expeditioners' post-expedition growth were indicators of professional hardiness. Our findings provide additional opportunities to improve psychological evaluation and training for Antarctic expedition personnel.

Keywords: Antarctica, Wilhelm Archipelago, personal growth, personality characteristics, expedition personnel.



Introduction

Human work in extreme environments, involving social isolation, limited opportunities for interaction with the outside world, narrow spaces, possible dangerous situations, limited possibilities for evacuation and high workload, has attracted special attention of researchers worldwide (Palinkas and Suedfeld 2008; Zimmer *et al.* 2013; Smith *et al.* 2017; Węśławski 2020). Examples of such work are work of expeditioners during long-term expeditions at the Antarctic station, as well as work on space stations or submarines (Rothblum 1990; Blight and Norris 2018; Tortello *et al.* 2018).

Stressors related to the extreme conditions of life and work in Antarctic stations can be divided into three groups: natural, from living conditions and socio-psychological stressors. Natural stressors include: low temperatures and atmospheric pressure, the effects of polar days and polar nights, increased solar radiation, geomagnetic disturbances and stormy winds (Wood *et al.* 1999; Belkin *et al.* 2016; Nicolas *et al.* 2016; Lewandowski 2022). Stressors related to living conditions for Antarctic expedition personnel involve life in close premises, the monotonous environment and landscape, and hypodynamics (Roberts 2011; Sandal *et al.* 2018; Suedfeld 2018). The main socio-psychological stressors are caused by prolonged participation in a small, closed group, difficulties of individual adjustment to such a group, intergroup and interpersonal conflicts, impossibility of obtaining emotional satisfaction by usual ways (Mullin 2006; Chen *et al.* 2016; Nirwan *et al.* 2020; Kokun and Bakhmutova 2021).

The above stressors can lead to such consequences in expeditioners as negative psychological manifestations such as increased tension, irritability and anger (Bhargava *et al.* 2000; Chen *et al.* 2016). Depression symptoms and mood disorders (Palinkas and Suedfeld 2008; Khandelwal *et al.* 2017), negative personality changes (Kokun and Bakhmutova 2022), as well as deteriorating mood, well-being, sleep, concentration, and performance (Leon *et al.* 2011; Collet *et al.* 2015) are also possible. However, in addition to these negative psychological manifestations in expeditioners due to long stay at Antarctic stations, many researchers discussed possible positive psychological effects. In particular, Leon *et al.* (2011), Mehta and Chugh (2011), Zimmer *et al.* (2013), Blight and Norris (2018), Suedfeld (2018), and Kokun and Bakhmutova (2020) pointed on possible salutogenic changes.

The main idea of the salutogenic approach initiated by Antonovsky (1979) is to answer the question why some people under stress influence become ill while others remain healthy. This approach is based on fundamentally different positions than those of the pathogenic approach, as it focuses on positive outcomes of challenges and crises, and individual and collective resources that support such changes (Mana *et al.* 2021). The most important facet of the salutogenic approach is the concept of a sense of coherence, providing the answer to the main 'salutogenic question' (Rajkumar 2021). This concept is based on Frankl's (1954)

earlier work and refers to a well-known saying that ‘life is worth living’, giving motivation to positive adaptation to one’s environment, as well as finding a life meaning even if circumstances are unfavourable. The sense of coherence reveals how a person perceives certain challenges throughout life (Huss and Samson 2018). The concept of general resistant resources is another important component of the salutogenic approach. It describes a person’s capability to successfully cope with the inherent stressors of human existence (Johansson *et al.* 2021).

In the concept of Calhoun and Tedeschi (1999), personal growth is understood as personal gains achieved via overcoming traumatic events or major life crises and manifested in certain positive psychological changes. The authors substantiated three broad areas of personal growth – changes in perception of self, changes in philosophy of life, and changes in interpersonal relationships (Tedeschi and Calhoun 2004). Five more discrete factors were determined within these three areas at lower levels of analysis, relating to others, personal strength, new possibilities, spiritual change and appreciation of life (Taku *et al.* 2008).

Researchers have previously made attempts to investigate possible salutogenic effects among members of Antarctic expeditions. Zimmer *et al.* (2013) indicated an existing trend for positive effects, noting that such effects were highlighted in 65.9% of publications. Zimmer *et al.* (2013) observed different positive effects promoting expeditioners’ psychological health. These positive effects were noted in a rather wide range – from individual characteristics to professional and social support. In particular, these effects included improved mood and emotion, satisfaction with professional performance, personal growth, and reduced disturbances in psychological functioning.

Palinkas and Suedfeld (2008) noted that salutogenic outcomes are the result of expeditioners’ successful coping with stress and they can be manifested in enhanced self-sufficiency, improved relationships and health, and personal growth. Expeditioners also experienced enjoyment and pleasure (Suedfeld 2018). Blight and Norris (2018) examined expeditioners’ personal growth due to Antarctic deployment and determined that such growth in expeditioners was the strongest in the category of ‘personal strength’ and the least in the category of ‘spiritual and existential change’. Leon *et al.* (2011) stressed that many expeditioners repeatedly deliberately returned to Antarctica, in order to once again having an opportunity to experience transformation of personal values and personal growth. Mehta and Chugh (2011) determined that such positive personality characteristics as need for achievement, optimistic future orientation, high enthusiasm, and adaptability were actualized in the participants of Indian expedition teams.

Overall, possible salutogenic outcomes in Antarctic expedition participants appear to include personal growth; enhanced self-sufficiency; improved satisfaction with professional performance; developed ability to cope successfully with stress; improved relationships, emotion and mood; and increased appreciation of life. Nonetheless, purposeful post-expedition growth following Antarctic

deployment has only been explored in a study organised by Blight and Norris (2018), which involved expeditioners from about ten countries with deployment experience ranging from one month to three years or more. This variation in country of origin and experience made data systematisation quite difficult.

Meanwhile, possible personality predictors of expeditioners' post-expedition growth have not yet been determined in any study. Although some studies with other samples (Schmutte and Ryff 1997; Grant *et al.* 2009; Sun *et al.* 2018; Anglim and Horwood 2021) showed that personality measures could be strong predictors of personal growth. In particular, such personality traits as extraversion, conscientiousness, openness to experience, and agreeableness. The work performed by Kokun (2023) has showed that the main personal resources for the personal growth of the civil population under war stress are self-efficacy and such components of professional hardiness as professional commitment, professional control and professional challenge acceptance.

In particular, for our study, the importance of high self-efficacy for successful adaptation and work in the Antarctic station can be determined by the fact that this property ensure an individual's capacity to exercise control over the nature and quality of one's life (Bandura 1997) and that self-efficacy means a belief in one's competence and capability to solve problems and execute actions to manage life situations (Slone *et al.* 2013). The recent studies performed by Wallace *et al.* (2020) indicated the great importance of high self-efficacy for participants in Antarctic expeditions.

The importance of hardiness for expeditioners is determined by the fact that this multidimensional personality trait helps protect people against negative effects of stress. The value of hardiness as a possible predictor of expeditioners' post-expedition growth is determined by its content as a set of attitudes and beliefs that provide people with the courage and motivation to turn difficult situations into growth opportunities (Kobasa 1979; Bartone 2012). After all, professional (occupational) hardiness refers to a pattern of attitudes and strategies that enable employees to perceive stressful work situations as controllable, worth dealing with, and contributing to professional development (Grala and Baka 2022).

Therefore, in this study, we formulated two research questions. (1) How pronounced are possible salutogenic outcomes in expeditioners who participated in year-long expeditions to the Ukrainian Antarctic *Akademik Vernadsky* station organized over a 25-year period (1996–2021)? (2) Do such salutogenic outcomes depend on expeditioners' personality characteristics?

Methods

Participants and procedure. —The study involved 62 of 176 expeditioners (32%) who had participated in year-long expeditions to the Ukrainian Antarctic *Akademik Vernadsky* station over a 25-year period (1996–2021). Of these

62 participants, 59 were men and three were women. Individuals' ages at the time of this study ranged from 27 to 68 years ($M = 48.10$, $SD = 10.61$). Each participant took part in from one to eight expeditions ($M = 2.29$, $SD = 1.52$). Specifically, 26 expeditioners had been on one expedition, 14 had been on two, nine had been on three, eight had been on four, three had been on five, one had been on six and one had been on eight. The time passed from their return from their last expeditions for the participants ranged from 7–8 months to 24 years ($M = 9.04$, $SD = 7.16$).

Study participants were recruited via email. We reached out to the 64 expeditioners with whom it was possible to re-establish contact, for example, at least six participants out of the total number of Ukrainian expeditioners over the past 25 years have since passed away. Of these 64 expeditioners, only two (3.12%) refused to participate in the study. After receiving the expeditioners' consent to participate in the investigation, all questionnaires were sent to their email addresses in word format. Participants then completed the questionnaires and returned them to us via email. The investigation was carried out from November 2021 to January 2022.

The Ukrainian Antarctic *Akademik Vernadsky* station (65°15'S, 64°16'W; the former *Faraday* station of United Kingdom) is located on Galindez Island in West Antarctica. The station conducts measurements of surface meteorology, ultraviolet radiation, geomagnetism, tides, ozone, ionosphere, and seismic waves. A year-long expedition includes 12 to 13 people, who communicate only with each other during the seven to eight months, because for this period contacts with the outside world are ceased due to weather conditions.

The authors declare that all procedures contributing to this work complied with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The study was conducted with the participants' consent. All involved expeditioners were informed that their participation in the study was voluntary and that they could refuse to participate or withdraw from the study at any time. Complete confidentiality was assured, and only deidentified data were used in the statistical analysis.

Measures. — The participants' *salutogenic outcomes* were assessed using the Ukrainian adaptation of the Posttraumatic Growth Inventory—Expanded (PTGI-X; Tedeschi *et al.* 2017). The inventory comprises 25 items designed to measure personal strengths, relations to others, spiritual and existential change, new possibilities, and appreciation of life. The measure provides an opportunity to reveal the aforementioned salutogenic outcomes without limiting the time that has passed since a certain event or events. In this case participants, were asked to indicate the degree to which each statement reflected their experience after Antarctic Expeditions on a Likert scale of 0 (I did not experience this change as a result of my experience in Antarctica) to 5 (I experienced this change to a very great degree). Possible post-expeditions change scores ranged

from 0 to 125. The PTGI-X includes statements such as ‘I more clearly see that I can count on people in times of trouble’, ‘I have a greater sense of closeness with others’, ‘I can better appreciate each day’ and ‘I have greater clarity about life’s meaning’.

The Ukrainian adaptations of four instruments were used to measure participants’ *personality characteristics*. The first, the General Self-Efficacy Scale (GSE; Schwarzer and Jerusalem 1995) is a 10-item psychometric scale designed to evaluate a person’s optimistic self-beliefs to cope with a variety of stressful situations. The scale using a Likert scale (1 = *not at all true* to 4 = *exactly true*). Possible scale scores range from 10 to 40. The GSE includes statements such as ‘It is easy for me to stick to my aims and accomplish my goals’, ‘I can usually handle whatever comes my way’ and ‘Thanks to my resourcefulness, I know how to handle unforeseen situations’.

The second measure, the Professional Hardiness Questionnaire (PHQ; Kokun 2021), a 24-item self-report measure that relates to respondents’ occupational activities. PHQ evaluates eight indicators of professional hardiness. The integral indicator is a general level of professional hardiness (score range 0–96). It consists of three components: professional commitment, control, and challenge acceptance; score range 0–36 for each component. Additionally, four aspects of professional hardiness are highlighted: emotional, motivational, social, and professional aspects; score range for each of them is 0–24. Respondents were asked to rate each question on a five-point Likert scale (0 = *no*, 4 = *yes*). The PHQ includes questions such as ‘Do you agree that effective professional growth is impossible without the constant solution of non-standard and responsible tasks?’, ‘Do you think that constant mutual control over colleagues’ activities (within reasonable limits) is good for work?’, ‘Do you think you need constant monitoring of (your own, colleagues’, organizational) work progress?’, and ‘Do you agree that every employee should be able to work in conditions of uncertainty?’.

The third measure, the Eysenck Personality Questionnaire-revised (EPQ-R; Eysenck and Eysenck 1991) is a widely used instrument which has demonstrated generally good psychometric properties in various cultural contexts, providing a reliable and valid measure of personality traits. The EPQ-R is based on Eysenck’s theory of personality, which posits that personality can be described in terms of three major dimensions: (1) Extraversion *vs.* Introversion; (2) Neuroticism *vs.* Emotional Stability; and (3) Psychoticism. Extraversion is seen as manifestations of such traits as assertiveness, sociability, and a preference for stimulation and activity. Introversion is characterized by a person’s tendency to be reserved, quiet, and reflective. Neuroticism reflects how individuals prone to experiencing negative emotions – anxiety, fear, and mood swings. Emotional stability reflects a more even-tempered and less reactive emotional style. Psychoticism is seen as manifestations of such traits as tough-mindedness, aggressiveness, and a lack of empathy. The EPQ-R has also a validity scale – lie scale and consists totally of 100 selective response items (yes-no).

The last measure, the Sixteen Personality Factor Questionnaire, form C (16PF; Cattell *et al.* 1993) is a comprehensive self-report questionnaire designed to assess personality based on the sixteen primary factors identified by Raymond B. Cattell. The 16PF is one of the earliest and most well-known trait-based personality assessments which provides a detailed and multidimensional understanding of an individual's personality. The 16PF consists of 105 statements and is used to measure the following primary traits: (1) warmth, (2) reasoning, (3) emotional stability, (4) dominance, (5) liveliness, (6) rule-consciousness, (7) social boldness, (8) sensitivity, (9) vigilance, (10) abstractedness, (11) privateness; (12) apprehension, (13) openness to change, (14) self-reliance, (15) perfectionism, and (16) tension. These primary traits are also united into Global Factors: (1) anxiety, (2) extraversion, (3) independence, (4) tough-mindedness, and (5) self-control. The 16PF has been used in research, counseling, educational and occupational settings to gain insights into individual differences, career choices, and interpersonal dynamics.

Thus, the four measures used in the study covered a sufficiently wide list of personality traits, *i.e.*, included in two personality models – three-factor and 16-factor, each of which was actively used in studies organized in the occupational sphere; and two multidimensional personality traits important for individuals' personal growth and effectiveness of activities in stressful conditions – self-efficacy and professional hardiness.

Statistical analysis. —The Statistical Package for the Social Sciences, version 22.0.0.0 was used for statistical analyses. The data were analysed using descriptive statistics (mean, standard deviation, skewness and kurtosis), single-sample and paired-sample t-tests, Spearman's correlation coefficient and a multiple linear regression analysis (forward method).

Results

Descriptive statistics, distribution and comparison of indicators of perceived growth following Antarctic deployment are presented in Table 1. The expeditioners were distributed by three levels of perceived growth (Lo, Moderate, or Hi) according to the quantitative assessment of their answers to the PTGI-X questions proposed by Blight and Norris (2018). The PTGI-X indicators were approximately normally distributed according to skewness and kurtosis values, which were both > 1 . Of the five indicators of the perceived growth following Antarctic deployment, new possibilities and personal strengths had the highest values ($M = 2.92$ and 2.80 , respectively), significantly exceeding the other three PTGI-X indicators ($p < 0.05$ – 0.001). In turn, appreciation of life ($M = 2.59$) was significantly higher ($p < 0.01$) than relations to others ($M = 2.35$), which was the worst indicator of perceived growth in our sample. Overall, the majority of Ukrainian expeditioners (55–71%) showed

Table 1.

Descriptive statistics, distribution and comparison of PTGI-X indicators.

Scale/Subscale	<i>M</i>	<i>SD</i>	<i>Skewness</i>	<i>Kurtosis</i>	Perceived growth (N%)		
					Lo (0–2.5)	Moderate (2.51–3.5)	Hi (3.51–5.0)
Overall PECE-R	2.63	1.08	-0.35	-0.82	24 (38.7%)	24 (38.7%)	14 (22.6%)
Relations to others	2.35	1.27	-0.36	-.081	28 (45.2%)	23 (37.1%)	11 (17.7%)
New possibilities	2.92	0.95	-0.45	-0.51	18 (29.0%)	23 (37.1%)	21 (33.9%)
Personal strengths	2.80	1.11	-0.42	-0.56	22 (35.5%)	22 (35.5%)	18 (29.0%)
Spiritual and existential change	2.50	1.28	-0.19	-0.97	28 (45.2%)	16 (25.8%)	18 (29.0%)
Appreciation of life	2.59	1.25	-0.38	-0.92	28 (45.2%)	14 (22.6%)	20 (32.2%)
<i>p</i> <			0.001 _{1-2,3; 2-4}		0.01 _{1-5; 2-5; 3-4}	0.05 ₃₋₅	

various signs of personal growth following Antarctic deployment, at moderate to high levels (Table 1).

When the PTGI-X indicators obtained in our study were compared with the data of the Blight and Norris (2018), which involved 225 expeditioners from different countries, who, like the expeditioners in our sample, had quite different deployment experience ranging from one month to three years or more (Table 2), we found that on average Ukrainian expeditioners had higher overall PTGI-X ($M = 2.63$ vs. $M = 2.29$; $p < 0.05$). For comparison with other researchers' data, which were obtained using the same methodology, we, like Blight and Norris

Table 2.

Comparison of PTGI-X indicators from this study and from that of Blight and Norris (2018).

Scale/Subscale	Results				<i>t</i>	<i>p</i> <
	This study (<i>N</i> =62)		Blight and Norris 2018 (<i>N</i> =225)			
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Overall PTGI-X	2.63	1.08	2.29	1.18	2.51	0.05
Relations to others	2.35	1.27	2.00	1.27	2.20	0.05
New possibilities	2.92	0.95	2.75	1.27	1.42	–
Personal strengths	2.80	1.11	2.91	1.38	-0.75	–
Spiritual and existential change	2.50	1.28	1.63	1.37	5.09	0.001
Appreciation of life	2.63	1.08	2.70	1.41	-0.70	–

(2018), used single-sample *t*-tests that allowed us to examine whether the mean of a population was statistically different from known or hypothesized values. This was due to two out of the five overall PTGI-X indicators, namely, spiritual and existential change ($M = 2.50$ vs. $M = 1.63$; $p < 0.001$) and relations to others ($M = 2.35$ vs. $M = 2.00$; $p < 0.05$), being significantly higher in the current study. The other three indicators of overall PTGI-X (appreciation of life, new possibilities, and personal strengths) were quite similar for the two compared samples ($p > 0.05$).

Correlations between PTGI-X indicators of personality characteristics, age and time passed since returning from the last expedition are presented in Table 3. Different PTGI-X indicators were significantly correlated ($p < 0.05$ – 0.001) with indicators of three out of four measures used to assess expeditioners' personality characteristics, as well as with age and time passed since returning from the last expedition. There were no significant correlations for PTGI-X indicators with self-efficacy (GSE). Only one of the sixteen 16PF indicators (self-reliance) showed a significant correlation with overall PTGI-X ($p < 0.05$; $r = -0.27$). All six PTGI-X indicators correlated significantly with the EPQ-R indicator extraversion ($p < 0.05$ – 0.01 ; $r = 0.27$ – 0.38) and three PTGI-X indicators correlated with neuroticism ($p < 0.05$ – 0.01 ; $r = 0.26$ – 0.38). No significant correlations were found between PTGI-X indicators and psychoticism ($p > 0.05$).

Table 3.

Correlations between PTGI-X indicators, personality characteristics and age.

Personality characteristics and age	PTGI-X indicators					
	Overall PTGI-X	Relations to others	New possibilities	Personal strengths	Spiritual and existential change	Appreciation of life
Self-efficacy	0.02	0.12	0.02	-0.03	0.05	0.06
Extraversion	0.33**	0.27*	0.32*	0.38**	0.30*	0.28*
Neuroticism	0.30*	0.19	0.25	0.38**	0.26*	0.19
Psychoticism	0.14	0.04	0.12	0.21	0.18	0.04
Warmth	0.06	0.15	-0.02	0.01	0.06	0.04
Reasoning	-0.06	-0.20	-0.06	-0.03	-0.02	-0.02
Emotional stability	-0.22	-0.07	-0.21	-0.24	-0.24	-0.19
Dominance	0.03	0.04	0.07	0.05	0.10	-0.03
Liveliness	0.11	0.10	0.22	0.05	0.12	0.08
Rule-Consciousness	0.18	0.20	0.13	0.15	0.15	0.20
Social boldness	-0.22	-0.12	-0.20	-0.19	-0.18	-0.24

Table 3 – *continued*.

Personality characteristics and age	PTGI-X indicators					
	Overall PTGI-X	Relations to others	New possibilities	Personal strengths	Spiritual and existential change	Appreciation of life
Sensitivity	0.18	0.17	0.18	0.21	0.12	0.14
Vigilance	0.24	0.15	0.11	0.25	0.23	0.24
Abstractedness	-0.07	-0.13	-0.17	-0.04	-0.03	-0.02
Privateness	0.06	0.03	0.09	0.06	0.12	-0.02
Apprehension	0.09	0.02	-0.07	0.13	0.11	0.12
Openness to change	0.00	0.02	0.08	0.04	-0.11	0.01
Self-Reliance	-0.27*	-0.24	-0.17	-0.21	-0.24	-0.24
Perfectionism	-0.09	0.03	-0.10	-0.10	-0.13	0.01
Tension	-0.21	-0.24	-0.24	-0.14	-0.18	-0.14
General level of professional hardiness	0.43***	0.47***	0.40***	0.37**	0.33**	0.42***
Professional commitment	0.31*	0.32*	0.26*	0.25*	0.31*	0.34**
Professional control	0.21	0.27*	0.19	0.18	0.13	0.23
Professional challenge acceptance	0.25*	0.27*	0.24	0.25*	0.15	0.24
Emotional aspect	0.16	0.23	0.26*	0.13	0.10	0.13
Motivational aspect	0.30*	0.31*	0.29*	0.27*	0.19	0.34**
Social aspect	0.22	0.22	0.18	0.15	0.13	0.28*
Professional aspect	0.42***	0.46***	0.33**	0.35**	0.35**	0.38**
Age	0.27*	0.32*	0.19	0.23	0.18	0.27*
Time passed since returning from the last expedition	0.27*	0.30*	0.22	0.30*	0.14	0.25

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The closest links were determined between PTGI-X indicators and professional hardiness indicators from the PHQ. All six PTGI-X indicators were most strongly correlated with the general level of professional hardiness ($p < 0.01$ – 0.001 ; $r = 0.33$ – 0.47), as well as the professional aspect of professional hardiness ($p < 0.01$ – 0.001 ; $r = 0.33$ – 0.46) and professional commitment ($p < 0.05$ – 0.01 ; $r = 0.25$ – 0.34). Five PTGI-X indicators correlated significantly with the motivational aspect of professional hardiness ($p < 0.05$ – 0.01 ; $r = 0.27$ – 0.34).

We should also note that PTGI-X indicators positively correlated with expeditioners' age and time passed since returning from the last expedition. In half of the cases, these correlations reached a statistically significant level ($p < 0.05$; $r = 0.27-0.33$).

To determine possible influence of participants' personality characteristics on their perceived growth following Antarctic deployment, we performed multiple regression analysis using the forward method. Because spiritual and existential change, new possibilities, relations to others, personal strengths, and appreciation of life made fairly independent contributions to the overall PTGI-X, we created prognostic models for overall PTGI-X and for each of its components separately (Table 4). All personality characteristics mentioned in Table 3 were entered as independent variables in each case. Age and time passed since returning from the last expedition were not used in the analysis, as they are not personality characteristics.

Table 4.

Multiple regression analysis of the influence of personality characteristics on indicators of perceived growth following Antarctic deployment. VIF – variance inflation factor.

Dependent Variables	Predictors	<i>R</i>	<i>R</i> ²	<i>B</i>	<i>Beta</i>	<i>t</i>	<i>p</i>	<i>VIF</i>
Overall PTGI-X	(Constant)	0.67	0.45	0.43		0.39	0.699	
	General level of professional hardiness			0.08	0.65	5.71	< 0.001	1.20
	Emotional stability			-0.19	-0.34	-3.22	0.002	1.10
	Tension			-0.19	-0.34	-3.30	0.002	1.07
	Openness to change			-0.15	-0.28	-2.49	0.016	1.19
Relations to others	(Constant)	0.62	0.38	0.45		0.39	0.701	
	General level of professional hardiness			0.08	0.59	5.15	< 0.001	1.20
	Tension			-0.20	-0.31	-2.90	0.005	1.07
	Emotional stability			-0.18	-0.27	-2.47	0.016	1.10
	Openness to change			-0.13	-0.24	-2.13	0.037	1.19
New possibilities	(Constant)	0.55	0.30	2.88		3.57	0.001	
	Professional aspect			0.09	0.32	2.86	0.006	1.03
	Emotional stability			-0.16	-0.32	-2.79	0.007	1.09
	Tension			-0.14	-0.29	-2.53	0.014	1.06
	Extraversion			0.05	0.24	2.14	0.036	1.03
Personal strengths	(Constant)	0.58	0.34	0.96		1.21	0.233	
	Extraversion			0.12	0.52	4.53	< 0.001	1.13
	Social boldness			-0.22	-0.40	-3.54	0.001	1.14
	Professional challenge acceptance			0.08	0.30	2.75	0.008	1.03

Table 4 – *continued*.

Dependent Variables	Predictors	<i>R</i>	<i>R</i> ²	<i>B</i>	<i>Beta</i>	<i>t</i>	<i>p</i>	<i>VIF</i>
Spiritual and existential change	(Constant)	0.64	0.41	3.36		2.95	0.005	
	Professional aspect			0.16	0.37	3.56	0.001	1.03
	Emotional stability			-0.27	-0.39	-3.56	0.001	1.10
	Tension			-0.22	-0.32	-3.02	0.004	1.07
	Extraversion			0.08	0.28	2.63	0.011	1.04
	Openness to change			-0.13	-0.23	-2.20	0.032	1.04
Appreciation of life	(Constant)	0.61	0.37	-0.45		-0.43	0.663	
	General level of professional hardiness			0.06	0.40	3.74	< 0.001	1.07
	Social boldness			-0.24	-0.39	-3.51	0.001	1.11
	Extraversion			0.08	0.32	2.79	0.007	1.18

All models were quite informative ($R = 0.55\text{--}0.67$; $R^2 = 0.30\text{--}0.45$), explaining 30–45% of the variation for various PTGI-X indicators. Each prognostic model included three to five personality characteristics. The most informative was the model with the overall PTGI-X as the dependent variable ($R = 0.67$; $R^2 = 0.45$). The highest impact in this model had the general level of professional hardiness ($t = 5.71$; $p < 0.001$). The model also included emotional stability, openness to change and tension with significances in the range of $p = 0.016\text{--}0.002$.

The general level of professional hardiness proved to be the most important predictor for two of the five indicators that make up the overall PTGI-X, specifically relations to others and appreciation of life as dependent variables ($p < 0.001$). For two different indicators of the overall PTGI-X (new possibilities and spiritual and existential change as dependent variables), the most important predictor was the professional aspect of professional hardiness ($p < 0.001$). In only one case out of six—the prognostic model with personal strengths as a dependent variable—the most important predictor was not professional hardiness from the PHQ, but rather extraversion from EPQ-R ($p < 0.001$). In addition to this, extraversion was included as an important predictor in two other prognostic models ($p = 0.011\text{--}0.007$).

As other important predictors, emotional stability and tension were included in four models ($p = 0.014\text{--}0.001$), openness to change was included in three models ($p = 0.037\text{--}0.016$), social boldness was included in two models ($p = 0.001$) and professional challenge acceptance was included in one model ($p = 0.008$). With the exception of professional challenge acceptance, all of the above were indicators of 16PF and were included in prognostic models with negative values.

To detect possible multicollinearity of the predictors, we used the variance inflation factor (VIF), which measures the correlation and strength of correlation

between the variables in a regression model. VIF values for all identified predictors were very close to 1, which indicated that multicollinearity was not a problem in these regression models.

Discussion

To answer the first research question – how pronounced are possible salutogenic outcomes in expeditioners who participated in year-long expeditions to the Ukrainian Antarctic *Akademik Vernadsky* station organized over a 25-year period (1996–2021) – the expressiveness of such outcomes was verified through the analysis of the obtained quantitative values of their perceived growth following Antarctic deployments and comparing these values with data on expeditioners' growth obtained by other researchers. To answer the second research question if the described salutogenic outcomes depend on expeditioners' personality characteristics – we performed multiple regression analysis, in which personality characteristics acted as independent variables and indicators of perceived growth as dependent.

This study showed that of five indicators comprising overall perceived growth following Antarctic deployment, the best indicators for Ukrainian expeditioners were new possibilities ($M = 2.92$) and personal strengths ($M = 2.80$), both of which significantly exceeded ($p < 0.05$ – 0.001) the importance of the other three PTGI-X indicators. Appreciation of life ($M = 2.59$) and spiritual and existential change ($M = 2.50$) were of similar importance to each other as indicators, and the least pronounced indicator was relations to others ($M = 2.35$). Most importantly, however, the majority of expeditioners (55–71%, on various grounds) experienced personal growth at a moderate to high level following Antarctic deployment. Thus, we have reason to believe that the answer to the first research question – how pronounced are possible salutogenic outcomes in expeditioners who participated in year-long expeditions to the Ukrainian Antarctic *Akademik Vernadsky* station organized over a 25-year period (1996 – 2021) – was provided in sufficient amount.

Comparing our PTGI-X data with the data Blight and Norris (2018) obtained from a sample of 225 expeditioners from different countries also supported the above conclusion. Indeed, on average, Ukrainian expeditioners had higher overall PTGI-X ($M = 2.63$ vs. $M = 2.29$; $p < 0.05$), which was due to the significantly higher values of two indicators, spiritual and existential change and relations to others. Values were comparable for the other three indicators. We assume that one explanation for this may be that part of the sample in the Blight and Norris (2018) study consisted of expeditioners with Antarctic deployment experience of one to six months, whereas our study involved expeditioners with at least one year of Antarctic deployment experience. That is, it is possible that a relatively short Antarctic deployment (one to six months) is insufficient to obtain

sufficiently pronounced salutogenic outcomes. In this context, we should note that we found significantly positive correlations between expeditioner age and three PTGI-X indicators (the overall PTGI-X, relations to others and appreciation of life; $p < 0.05$; $r = 0.27$). This is perhaps due to the possibility that over time/with age, expeditioners begin to feel and become more aware of the salutogenic outcomes that have enabled them to participate in Antarctic expeditions.

The results obtained in our study are also fully consistent with those of Suedfeld (2018) concerning the possible emergence in expeditioners of such salutogenic outcomes as improved relationships and personal growth; Zimmer *et al.* (2013) regarding personal growth, and improved emotion and mood; Leon *et al.* (2011) in relation to personal growth and transformations of expeditioners' personal values; and Mehta and Chugh (2011) concerning expeditioners' adaptability, need for achievement and optimistic future orientation. In contrast, however, our study, like that of Blight and Norris (2018), specifies the above, rather generalised, trends both quantitatively and qualitatively. Our data are generally consistent with recent data from Feingold *et al.* (2022), which recorded signs of personal growth among frontline health care workers during the COVID-19 pandemic, more than half of whom (67.0%) appreciated higher their life, and near half of them improved relationships and personal strength. Although, at the same time, we should note that this research took place almost simultaneously to the pandemic. While in our study, the period from the moment of return from the last expedition in different participants ranged from 7–8 months to 24 years.

Given the rather intense impact of stressors caused by life and working conditions at Antarctic stations, we also consider it quite natural that a significant number of expeditioners (29–45%, on various grounds) did not show signs of personal growth following Antarctic deployment. After all, not all expeditioners have capabilities to overcome successfully the challenges of long-term work at Antarctic stations (Collet *et al.* 2015; Chen *et al.* 2016; Khandelwal *et al.* 2017; Bhargava *et al.* 2000). Moreover, *ca.* 5% of polar expedition participants even met criteria for psychiatric disorders (Palinkas and Suedfeld 2008).

We also found a significant set of factors that influence expeditioners' post-expedition growth by examining a relatively limited number of personality characteristics, obtained with four instruments. Of the indicators of personality characteristics that we examined, ten correlated significantly with various indicators of growth following Antarctic deployment ($p < 0.05$ – 0.001) and all prognostic models built using those indicators were quite informative, explaining 30–45% of the variation in various PTGI-X indicators. We should also note that there were no multicollinearity of the predictors in all prognostic models, which additionally confirmed the rather successful choice of measures used in the study. Thus, in our view, there is every reason to believe that we have received an answer to the second research question – do such salutogenic outcomes depend on expeditioners' personality characteristics?

The most important predictors of post-expedition growth were the indicators of professional hardiness from the PHQ. The most important predictor for the overall PTGI-X was the general level of professional hardiness, as well as for two of the PTGI-X's five indicators (relations to others and appreciation of life; $p < 0.001$). For two other indicators of the overall PTGI-X (spiritual and existential change and new possibilities), the most important predictor was the professional aspect of professional hardiness ($p < 0.001$). In contrast, the model for personal strengths included professional challenge acceptance as a predictor ($p = 0.008$). In a single case, namely that of personal strengths, the most important predictor was extraversion from EPQ-R ($p < 0.001$), which was also included in two other prognostic models ($p = 0.011$ – 0.007).

We believe that such results are quite natural because, as we pointed out in the introduction, the concept of general resistant resources occupies an important place in the salutogenic approach and describe one's capability to successfully cope inherent stress factors of human existence (Johansson *et al.* 2021). In our opinion, this concept is quite closely related to the concept of 'hardiness', which reveals the psychological mechanisms of a person's capability to maintain their health regardless of highly stressful life events (Kobasa 1979; Kobasa *et al.* 1982), which is especially important in the stressful conditions of life at the Antarctic station. In this concept, this capability is based on a certain set of attitudes and beliefs that provide an opportunity to turn difficult life situations into personal growth (Kobasa 1979; Kobasa *et al.* 1982; Bartone 2012; Azarian *et al.* 2016). Accordingly, high professional hardiness shown by expeditioners becomes not only a prerequisite for greater efficiency of their work, but also a prerequisite for their further post-expedition personal growth.

Extraversion as a salutogenic factor has previously been mentioned by Rascle *et al.* (2005), Unterrainer *et al.* (2014) and Grevenstein *et al.* (2016). For the studied Ukrainian expeditioners, the importance of this trait is also determined by a long stay in a closed group with 12–13 people during a year-long expedition. And extroversion, as evidenced by the results of Opt and Loffredo (2003) and Lee *et al.* (2008), is closely related to communication skills, which are absolutely necessary for interaction in such conditions.

We should note that various prognostic models included the 16PF indicators tension and emotional stability (four models; $p = 0.014$ – 0.001), openness to change (three models; $p = 0.037$ – 0.016) and social boldness (two models; $p = 0.001$) as important predictors, but in a negative manner. Based on meaningful interpretation of these indicators (Cattell 1989; Cattell *et al.* 1993), we suggest that expeditioners' perceived growth following Antarctic deployment is related to, to some extent, personality characteristics such as being relaxed, placid, tranquil, torpid and patient (descriptors of low tension); being emotionally changeable and affected by feelings (descriptors of low emotional stability); being traditional, attached to the familiar and respectful of traditional ideas (descriptors of low openness to change); and being shy, threat-sensitive and

hesitant (descriptors of low social boldness). The content of the above personality characteristics quite clearly proves, in contrast to the previously discussed content of professional hardiness, their negative significance not only for the expeditioners' effective work at the Antarctic station, but also for their possible post-expedition personal growth.

Conclusion

Firstly, the majority of expeditioners (55–71%, on various grounds) recorded moderate to high levels of personal growth following Antarctic deployment. Secondly, we were able to build informative prognostic models based on personality characteristics, explaining 30 to 45% of the variation in a number of indicators of expeditioners' post-expedition growth.

Although we used a limited number of these characteristics in our study, we found that a significant group of them influenced expeditioners' personal growth, leading us to assume that we will be better able to fully clarify the personality preconditions of expeditioners' post-expedition growth by expanding the list of such characteristics in further studies. This unlocks additional opportunities for the psychological evaluation and training of expeditioners. For example, our results suggest the need for testing and developing hardiness in expeditioners. The prospects for future research may also consist in determining the characteristics of salutogenic outcomes in representatives of various professions who periodically appears in extreme environments (military, firefighters, rescuers, police, *etc.*), determining the influence of salutogenic outcomes on their social relationships, professional efficiency and personal development.

Our study has limitations due to the specifics of the sample, *i.e.*, Ukrainians who participated in different year-long expeditions to the Antarctic *Akademik Vernadsky* station between 1996 and 2021, with little female representation. Also, participants took part in different number of expeditions (from one to eight), and there was a different period of time since returning from their last expeditions (from 7–8 months to 24 years). Another limitation can be considered the specificity and diagnostic capabilities of the used instruments to measure participants' salutogenic outcomes and personality characteristics. Despite its limitations, the present findings expand both understanding of salutogenic outcomes in expeditioners and how and to what degree personality characteristics can determine expeditioners' post-expedition growth.

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