

Individual psychological determinants of stress resistance in rock climbers

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Abstract:

Athletes engaged in high-risk sports (skydiving, hang-gliding, paragliding, microlighting, and rock climbing) will confront significantly higher levels of stress. The purpose of our study is to define the individual psychological characteristics that determine stress resistance inherent in climbers - sportsmen facing high risks. 60 climbers from the Kyiv branch of the Federation of Mountaineering and Climbing and the climbing section of the National Aviation University (26 women and 34 men, aged 18 to 30 years old, $M_{age} = 24$, $SD = 1.57$) are involved in this study. The researchers have used the following tests: Cattell's Sixteen Personality Factor Questionnaire, Eysenck Personality Inventory, Diagnostics of Stress-Resistance Level ('Forecast'), the "Personality Differential" technique. High and average levels of stress resistance were detected in 42 rock climbers (70%) while most adults involved in non-extreme sports had the average levels of stress resistance. It is shown that climbers perceive a large number of situations as threatening and provoking the anxiety (the self-preservation instinct). High psychological variability and adaptability to external conditions are associated with low levels of neuroticism, high stability, and lability. Increasing the self-esteem of athletes boosts stress resistance. These research results allow us to conclude that the structure of stress resistance of athletes facing high risks is balanced and defined by one's systemic volitional capabilities (strength and stability), self-control behavior (self-esteem) and features of the nervous system which are characterized by susceptibility to external events (neuroticism).

Keywords: climbing; mountaineering; stress-resistance; individual psychological characteristics.

Introduction

Every person's life is filled with everyday stress, but the specificity and intensity of stressors depends on the activity in which the person is involved (Maslach, 2006; Vodopyanova & Starchenkova, 2008; Schaufeli, Leiter, & Maslach, 2009; Tukaiev, Vasheka, & Dolgova, 2013; Tukaiev, Vasheka, & Zyma, 2013; Imas E., Shynkaruk O., Denisova L., Usychenko V., Kostykevich V., 2018; Fedorchuk S., Lysenko E., Shynkaruk O., 2019). Active lifestyle and amateur sports have a beneficial effect on the day-to-day activities (Tukaiev et al, 2013; Jeckel & Sudeck, 2017; Tukaiev et al., 2017; Stamatakis et al., 2018). Some researchers consider professional sports to be a source of stress (Swinn, 1983; Milman, 1983; Wylleman & Lavallee, 2004; Scanlan, Babkes, & Scanlan, 2005; Goodger et al, 2010; Kostykevych V., Imas Y., Borisova O., Dutchak M., Shynkaruk O. et al., 2018).

Stress factors related to the involvement in sports include the assessment of one's capabilities, the expectation of future competitions, the excitement experienced by the athlete before an important competition, trauma, emotional and physical overload (Vyatkin, 1983; Khan, 1983; Miller, Vaughn, & Miller, 1990; Sarkar, & Fletcher, 2014), emotional disbalance, the apprehension of negative consequence (Scanlan, Babkes, & Scanlan, 2005). To achieve success, it is necessary to ensure the athlete's stress resistance. With this in mind, it would be

appropriate to add that the abilities to quickly restore the physical and mental states, adequately respond to failures, and overcome obstacles are contributing factors as well (Vyatkin, 1983; Galli & Gonzalez, 2015).

Research on stress in sports has a strong focus on the tension related to competition situations, but far less research has been conducted on the topic of stress caused by extreme sports. Nevertheless, since the 1970s, the number of people who are seriously addicted to extreme sports looking for a strong sense of risk has been growing rapidly in the world and covering almost all age groups (Breivik, 2010; Brymer, 2010; Alesicheva, 2016; Ivanov, 2016). The extremes of sports are determined by factors that go beyond the "normal" experience, to which the person has not yet adapted and is often not ready to act under the conditions characterized by a high level of risk to life and health (Giessen, Miroshnikov, & Mukhina 1980; Pedersen, 1997; Brymer, 2010). As the factors determining the degree of extremity, the following can be considered: various emotion-related influences due to the danger, difficulties, novelty, responsibility dependent on a situation, lack of necessary information or the availability of conflicting information; as well as excessive mental, physical, emotional overstrain, such as the influence of unfavorable climatic conditions (heat, cold, oxygen deficiency, etc.) or hunger and thirst. Based on the definition of extreme, as extreme actions related to the danger to life, extreme sports include mountaineering, skateboarding, snowboarding, parachuting, rock climbing, caving, rope jumping, B.A.S.E. jumping etc. (Pedersen, 1997; Thorpe, 2007; Langseth, 2012). One of driving motives of risk sport is achieving recognition (Langseth, 2012), another one is euphoria from the fear overcoming - the bungee jumping (jumping from a tall structure) leads to the twofold rise of concentration of beta-endorphin that results in a noticeable increase of euphoria ratings (Hennig, Laschefski & Opper, 1994). Despite that the risk factor regards as the plausible and objective reason for affordance, motivator for engaging in adventurous activities (Beames, Mackie & Atencio, 2019), experience, developed skills allow assessing the risk level, lead to a decrease in the initial fear and, as a result, the brain reaction on the extreme endeavours became comparable with non-risk practice (Nann et al, 2019).

Extreme sports require large amounts of physical and mental resources from a person (Breton, 2000; Breivik, 2010; Merritt & Tharp, 2013; Brymer & Schweitzer, 2013) especially when extreme sports engage stressful encounters, which might threaten life (Makarowski et al, 2016). There is a direct connection between the need for sensations and the high resistance to stress. In particular participation in extreme sports with high risk is associated with a high level of sensory needs (Zuckerman, 2007; Boldak & Guskowska, 2016). Also, individuals with these needs have a strongly expressed high level of stress resistance (Roberti, 2004).

Each person has a certain set of personal traits and mental characteristics that affect their mental state and behavior in extreme conditions. When determining mental characteristics, which are significant in this regard, it is necessary to take into account some specific requirements for athletes. More specific, the requirements for a person who participates in extreme sports are: initiative (the personal ability to assess and initiate actions independently, a willingness to take the risk for), resoluteness (the ability to make and consistently implement deliberate decisions), perseverance (the ability to pursue a goal continuously and for a long time), exposure (the ability to slow down the actions, feelings and thoughts that interfere with the implementation of the decision), courage (the ability to resist fear and face justified risk), self-control and self-criticism (Shagiev, 2009). Studying athletes with a high level of stress resistance, one can surmise that there is a set of the typical qualities in this respect. In line with this, the researchers propose to take the following characteristics into consideration into their research when trying to find links with stress resistance: systemic volitional qualities (self-control, initiative, responsibility, commitment, perseverance), features of self-regulation of behavior (evaluation of results, planning, overall level of self-regulation of behavior), motivation to achieve goals, psychodynamic properties (activity, rigidity, emotional excitability, rate of reactions) and State Anxiety (Smirnov & Dolgopolova, 2007; Shagiev, 2009; Kostiukevych V., Shchepotina N., Shynkaruk O., et al., 2019).

The motivations of high-risk athletes are many-sided and include attaining goals, taking risks, social motivation, getting rid of boredom, overcoming personal obstacles and overcoming fear, as well as feeling close to nature (Kerr & Mackenzie, 2012, Shynkaruk O., Lysenko E., Fedorchuk S., 2019). Overall athletes of different extreme sports can be considered to be largely heterogeneous in their mental characteristics (Monasterio et al, 2016) yet some overlap between sports might still exist. With this in mind, it is safe to say that various factors can influence the formation of stress resistance. Base jumpers and parachute jumpers using fixed objects (high-rise buildings, towers, bridges, rocks) are highly stable individuals with a high level of self-directedness, persistence and tendency to risk, but heterogeneous in their motives and reactivity to stress (Monasterio et al, 2016). Boldak and Guskowska (Boldak & Guskowska, 2013) established the heterogeneity of parachutists in temperament characteristics and motives, which are necessary for sensation and acceptance of risk. Considering the current state of the problem described above, the purpose of this study is to define individual psychological determinants associated with the stress-resistance of extreme sports athletes.

The study is aimed at defining the personal characteristics of athletes who are participating in extreme sports and to investigate how these characteristics ultimately influence the stress resistance of sportsmen and the features of the determinants. The overall hypothesis of this study is that; a positive attitude towards the self and other people is predictive of the stress-resistance of an adult participating in extreme sports.

Method

Participants

We have selected 2 groups of participants with an average of 2 to 7 years of experience in sports.

Group 1: adults involved in extreme sports – climbers of the Kiev branch of the Federation of Mountaineering and Climbing and the climbing section of the National Aviation University (60 people, 26 women and 34 men) aged 18 to 30 ($M_{age} = 24$, $SD = 1.57$).

Group 2: adults involved in non-extreme sports (tennis and football) – students of the National Aviation University (52 people, 19 women and 33 men) aged 18 to 25 ($M_{age} = 18$, $SD = 1.13$) who regularly go participate in sports. Participants were eligible to enroll in this study if they had no clinical manifestations of mental or cognitive impairment. Exclusion criteria for participation were: the use of psychoactive medication, drug, or have an alcohol addiction, and suffering from psychiatric or neurological disorders.

Methods of research - The following questionnaires are used:

Personality factors

Cattell's Sixteen Personality Factor Questionnaire (187 items) was used to measure several different aspects of the participants' personality characteristics, inclinations, and interests (Kapustina, 2007). This questionnaire includes the following sub-scales: *communicative* (factors A (Warmth, Cronbach's alpha was 0,685), H (Social Boldness, Cronbach's alpha was 0,673), E (Dominance, Cronbach's alpha was 0,669), L (Vigilance, Cronbach's alpha was 0,681), N (Forthrightness, Cronbach's alpha was 0,654) and Q2 (Self-Reliance, Cronbach's alpha was 0,661)); *intellectual* (Factors B (Reasoning, Cronbach's alpha was 0,660), M (Abstractedness), N (Privateness, Cronbach's alpha was 0,651), Q1 (Openness to Change, Cronbach's alpha was 0,647)); *emotional* (factors C (Emotional Stability, Cronbach's alpha was 0,657), F (Liveliness, Cronbach's alpha was 0,698), H (Social Boldness, Cronbach's alpha was 0,705), I (Sensitivity, Cronbach's alpha was 0,653), O (Apprehension, Cronbach's alpha was 0,648), Q4 (Tension, Cronbach's alpha was 0,710)); and (factors Q3 (Perfectionism, Cronbach's alpha was 0,649) and G (Rule-Consciousness, Cronbach's alpha was 0,716)). The items were scored on a 1 (disagree) to 5 (agree) Likert scale.

Introversion/Extraversion Eysenck Personality Inventory (EPI) adapted by A. Shmelev (57 'Yes-No' items) for determining the type of temperament, taking into account the introversion-extraversion of the personality (E-dimension, 24 items, Cronbach's alpha 0,710), as well as the emotional stability/instability (neuroticism) (N-dimension, 24 items, Cronbach's alpha 0,753) (Raigorodsky, 2011).

Stress resistance The risk of maladaptation of a person under stress is caused by external and internal factors. The technique for determining one's neuropsychic resistance and the risk of maladaptation in stress (Diagnostics of Stress-Resistance Level "Forecast") was developed by Yu. Baranov (St. Petersburg Military Medical Academy named after S. Kirov) (84 'Yes-No' items) to identify the persons with signs of neuropsychic instability caused by both mental health and physical health. The survey allows to identify 4 groups of neuropsychic instability (NPI): *high neuropsychic stability* (5-6 and less points), *good neuropsychic stability* (7-13 points), *fair neuropsychic stability* (14-28 points) and *poor neuropsychic stability* (29-33 points) (Raigorodsky, 2011). We consider this questionnaire appropriate and suitable for our research because this test is widely used to assess the suitability for activities under extreme conditions (parachuting) (Pokrovskii & Mingalev, 2012). For this sample Cronbach's alpha was 0,667.

Personality structure

The "Personality Differential" technique (adapted at the Bekhterev Research Institute by E.F. Bazhin and A.M. Etkind) reflects the ideas (formed in the national culture) about the structure of the personality and is used to assess the subjective aspects of the person's attitude to himself/herself or to other people. "Personality Differential" is a partial modification of the C.E. Osgood's semantic differential and developed on the basis of the modern Russian language and includes 21 personality traits characterized by the three classical factors of the semantic differential, namely assessments (about the level of self-esteem and the level of attractiveness that one person can have when perceiving the others), strength (about the development of the volitional sides of the personality) and activity (evidence of the extroversion of a person) (Raigorodsky, 2011). The scales' Cronbach's alpha in the current sample was 0,811 for Assessments factor, 0,823 for Strength factor, and 0,795 for Activity factor.

Procedures

All participants were informed about the description of the study, the confidentiality of the information gathered and asked to complete a paper version of the battery of questionnaires during one 45-60 min session which was conducted from 2 p.m. to 6 p.m. at the sport sections during the period of training. The questionnaires included demographic data (gender, age), questions concerning the sport practicing (kind of sport, information about training time per week, sport experience per years), and questionnaires (Russian versions) to assess personality factors and personality structure, neuropsychic resistance, type of temperament.

Ethical Clearance

The study was approved by the Bioethics Commission of Educational and Scientific Centre "Institute of Biology and Medicine", Taras Shevchenko National University of Kyiv and written informed consent was

obtained from each subject in accordance with the World Medical Association (WMA) declaration of Helsinki – ethical principles for the medical research involving human subjects (Helsinki, Finland, June 1964).

Data analysis

The Statistical Package for the Social Sciences (SPSS 17.0) is used to analyze the data obtained during research. To determine the type of distribution, the Kolmogorov-Smirnov test is used. Based on the normality of the sample, the Pearson rank correlation coefficient is applied to establish the relationship between the stress-resistance indicators and the personal characteristics of an individual. Multiple linear regression analysis is used to identify the main determinants of stress resistance in rock climbers – athletes participating in extreme sports. The significance of the regression model is estimated by Fisher's F-criterion (Byshevets N., Denysova L., Shynkaruk O. et al., 2019; Fundamentals of research work for higher education graduates in the field of Physical Culture and Sports, 2019).

Research results

Analysis of the data (the "Forecast" technique; (Raigorodsky, 2011) indicated that, 42 of 60 rock climbers - athletes participating in extreme sports (70%) had a high and moderate level of neuropsychological stress resistance ($M= 7.9$, $SD = 1.7$). High adaptive and compensatory capabilities shown by this group are related to the adequate responding under conditions of emotional stress and low probability of emotional frustration. These indicators show that the participants are well equipped to cope with the stress caused by external and internal factors related to participating in extreme sports.

The results of the correlation analysis lead us to conclude that there is a significant connection between the level of stress resistance and the personal characteristics of athletes participating in extreme sports (see Table 1).

Table 1

Relationships of stress resistance and the personal characteristics of athletes

Stress-Resistance Level (the neuro-psychic instability) ("Forecast")		Cattell's Sixteen Personality Factor Questionnaire						EPI	Personality Differential
		Primary Factor C (Emotional Control)	Factor F3 (Emotional lability)	Primary Factor Q4 (Tension)	Global Factor 'LowAnxiety/High	Global Factor 'Lack of Restraint/Se	Factor MD (Self-rating)		
High-risk sportsmen	Pearson rank correlation coefficient, r	,682	,345	-,342	-,572	,424	,473	-,706	,780
	significance level, p <	,001	,007	,008	,001	,001	,001	,001	,001
Amateur sportsmen	Pearson rank correlation coefficient, r	,421	,435	-	-,623	,479	-	-,505	,603
	significance level, p <	,006	,006	-	,001	,001	-	,006	,001

The negative correlation between anxiety and stress resistance indicate that a certain level of anxiety may be a necessary feature of an active individual, which, in turn, can provide an instinct for self-preservation. It would be appropriate to add that the higher the indicator of personal anxiety, along with the tendency to perceive a large range of situations as threatening and react to these situations with anxiety, the lower the stress tolerance of such persons, and the more they are vulnerable to all stressors, especially to extreme stresses, which corresponds to their low stress resistance. To confirm the negative feedback of stress-resistance with the index of tension may take place, the researchers emphasize the fact that athletes with a high level of stress are unsure of themselves and more restless, which in turn leads to low stress resistance (Yakovlev, 2014).

The group of athletes involved in our study can be characterized by a high level of liberalization, independence, the ability to control the situation and responsibility for what is happening. The direct connection between stress resistance and self-control indicates that the interviewees are less prone to stress and external circumstances and, accordingly, they turn out to be less vulnerable. It is also shown that high self-rating is associated with an appropriate level of stress resistance. The reason is that the level of self-confidence, one's own strengths and capabilities can be increased as a result of sports training and achievements. This kind of increase can enhance one's mental stability to protect from stressors under extreme conditions. Equally, the existing connection shows that overcoming the difficulties mentioned above and the impact of stressors under extreme conditions significantly increases the level of self-esteem; in other words, this interpretation is more believable, considering that a very high and a very low level of self-confidence presumably affect the mental stability to protect from stressors. It should be noted that this influence is not positive, but negative, especially

under extreme conditions. The direct connection of stress resistance with stability and the reverse of the level of neuroticism means that respondents characterized by extreme stability, poise and good adaptation have a much higher level of stress resistance. The connection with lability indicates that high levels of stress tolerance of this sample are due to a certain degree to the high psychological variability and adaptability to changing conditions.

The direct connection between stress resistance and the "strengthscale" indicator developed by the "Personal Differential" technique confirms the availability of volitional qualities when providing resistance to stressors. Therefore, more stressful interviewees demonstrate self-confidence, independence, and a tendency to rely on themselves in difficult situations. The interviewees with low values of "strength" (the force factor in self-assessments) have insufficient self-control, inability to keep to the accepted norms of behavior, dependence on external circumstances and assessments. Upon contemplating this fact, it is possible to presume that these interviewees can demonstrate low levels of stress resistance. As for athletes of non-extreme sports, the connections between the level of stress-resistance and personal characteristics turn out to be similar, excluding connections between self-rating and tension (see Table 1).

Regression analysis allows one to identify the main determinants of the dependent variable (stress resistance) in high-risk athletes, which are self-rating, emotional stability, neuroticism and strength (the force factor in self-assessments). This regression model is suitable for interpretation because the value of Fisher's F-criterion is calculated as $P = 0.001\%$.

Table 2
Regression analysis for the "stress-resistance" variable of high-risk sportsmen (n = 60)

Indices	BETA	The standard error of BETA	B	The standard error of B	Student's t(60)-test	p-level
Factor C (Emotional Stability)	0,41	0,18	0,14	0,12	3,74	0,01
Factor MD (Self-rating)	0,36	0,20	0,10	0,28	1,17	0,02
Neuroticism	-0,39	0,17	-0,12	0,20	2,29	0,02
The force factor in self-assessments	0,62	0,21	0,17	0,09	2,62	0,001

Regression beta coefficients allow one to compare the relative contribution of each independent variable to the prediction of the dependent variable of stress resistance. The most important parameters are: self-rating, emotional stability, neuroticism and strength (the force factor in self-assessments) (see Tables 2, 3). The force factor in self-assessments is deemed to be the development of the volitional sides of the person and the volitional awareness displayed by the interviewees themselves.

This strength is manifested in the fact that athletes participating in extreme sports are able to both quickly and effectively act in stressful situations, and be better prepared for such situations in advance. A high level of emotional stability and a low level of neuroticism cause the interviewees to acquire such characteristics as calmness, balance, constancy in interests and preferences, orientation to reality, consistency, discretion, which leads to a high level of stress resistance.

Various stressors related to extreme sports slightly influence such integral and enduring individuals. Endurance and fortitude (integrity) allow the individuals to better cope with the influence of stressors. Adequate self-rating allows athletes to objectively evaluate their capabilities and correlate them with the situation, as well as periodically admit an acceptable level of risk, being aware of their own strengths and understanding that any strength has its limit. In addition, the level of self-rating does not generate high anxiety and lack of self-confidence which in turn could significantly decrease the effectiveness of one's activities in extreme conditions. In extreme conditions, caution and adequate response to alarm signals save lives or significantly reduce injuries, i.e. these factors also affect the effectiveness of one's activities.

Table 3
The relative contribution of independent variables to the prediction of the dependent variable (stress-resistance), %

Stress-resistance according to the «Forecast» technique	Factor C (Emotional Stability)	Global Factor 'Lack of Restraint/Self-control'	Factor MD (Self-rating)	Neuroticism	The force factor in self-assessments
High-risk sportsmen (n = 60)	22	-	16	19	43
Amateur athletes participating in non-extreme sports (n = 52)	12	32	-	8	48

The corresponding model is constructed to select athletes participating in non-extreme sports. The analysis conducted on this model allows us to assert that strength (the force factor in self-assessments), self-control, emotional stability and neuroticism have a determining influence on the stress-resistance of such athletes. It is clear that the determinants of stress resistance for athletes of non-extreme sports are a little bit different; in particular, one should take into account self-control, because it plays an important role for athletes of extreme sports. With all due respect, it should be noted that the expected significant impact on stress-resistance has not been revealed pertaining to self-control, in contrast to self-esteem, which in turn has not become a determining factor in the development of stress resistance in athletes of extreme sports.

Conclusion

The results of the research show that the structure of stress-resistance of athletes participating in extreme sports is balanced and there are systemic volitional qualities (strength, stability), specifics of self-control of behavior (self-esteem), and features of the nervous system that characterize susceptibility to external events (neuroticism).

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Contributions

All authors contributed equally to this work, read and approved the final manuscript. Author contributions: S.T., O.D. and O.L. conceptualized the overall project; S.T., O.D., A.R. and S.F. designed research; A.R., O.D., D.I. and S.T. conducted studies, collected the data, performed data analysis; S.T., O.D., A.T., E.L., S.F., N.B., O.Y., K.S., V.V., L.D. and O.S. wrote and edited the manuscript.

Competing interests - The authors declare that they have no competing interests.

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