

DEGREE OF EXTROVERSION INFLUENCE ON VARIABILITY
OF CARDIAC RHYTHM PARAMETERS

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The subject of the study is the variability of cardiac rhythm parameters, when carrying out a creative assignment, in patients differing in degrees of extroversion. Decreases in the stress index, indicating an increase in the influence of the parasympathetic part of the autonomic nervous system, were identified in introvert subjects. In contrast with introverts, a parasympathetic effect was not observed in extroverted subjects.

Keywords: degree of extraversion, variability in cardiac rhythm, stress index, index of autonomic equilibrium.

Introduction. It is known that intellectual processes, including those associated with creativity, are characterized by a certain level of tension in regulatory mechanisms, and are illustrated by shifts in various autonomic indicators [1–2], amongst which the relatively well documented are indicators of cardiovascular system, which reflect the energy aspects of carrying out any mental act. There are a number of works that document changes in cardiac rhythm indicators during both physical and mental activities [3–5]. The influence of intense intellectual, and especially creative, activity on regulatory systems and cardiac function is also illustrated [6]. It is worth noting that the nature of changes in autonomic reactions relies upon individuals' psychological perception of the situation, as well as their temperament and features that have an impact on physiological functioning and psycho-emotional sphere [7]. Indicators of temperament such as introversion-extroversion are particularly closely linked. The issue is that the nature of variability in cardiac rhythm indicators as a result of creative activity in individuals with varying degrees of extroversion is poorly studied. This is why we set out to study the effect executing a creative assignment on changes in variability of cardiac rhythm, in individuals with varying degrees of extroversion. We assumed that temperament (degree of extraversion) is the key factor influencing changes in the stress index, mainly reflecting the activeness of the sympathetic section of the autonomic nervous system. The proposed hypothesis led to the task of determining changes in indicators of cardiac rhythm variability before and after the completion of a verbal creative assignment taking into account individual characteristics.

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Materials and Methods. One of the most popular methods for the analysis of variability in cardiac rhythm, which is one of the most mobile and easily registered physiological indicators of a human's systemic functionality, is the method of variational pulsometry developed by R.M. Bayevski.

Research is conducted on 42 practically healthy subjects in the range of 18 to 22 age. The subjects are tested with Cattell's multifactorial personality questionnaire for factor F_2 (introversion-extroversion). The task assigned to subjects was to compose a story within 1h using a predetermined set of words from various semantic fields. The diversity of semantic fields provided the main challenge. In order to reveal the functional state of the cardiovascular system, the subjects were monitored with the electrocardiogram (ECG) before and after completing the creative task (T_0 and T_1 respectively). The ECG was conducted using an 8-channel encephalograph ("Medikor", Hungary), via the standard configuration of limbs: left hand–right hand–left leg. The subjects were in the half-upright position.

R.M. Bayevski's variational pulsometry method was used to process the ECG [2]. The sample size for each subject was 100 cardio-intervals. A specially developed computer program was used to process the experimental data (7200 cardio cycles), which took into account the following statistical parameters for cardiac rhythm: stress index (SI) of regulatory systems, which reflects the centralization degree of regulation of cardiac rhythm ($SI = AMo / 2\Delta X Mo$); index of autonomic equilibrium, $AEI = AMo / \Delta X$; autonomic rhythm indicator, $ARI = 1 / \Delta X Mo$; indicator of adequacy for regulatory processes, $IARP = AMo / Mo$, where Mo is mode; ΔX is the magnitude of variation and AMo is the mode amplitude. Data concerning cardiac rhythm indicators were subjected to statistical analysis by T-tests (among the package of statistical programs).

Results and Discussion. Subjects were separated into two groups by degree of extroversion: the I group was comprised of subjects with pronounced extroversion (22 individuals), and the II group was comprised of subjects with pronounced introversion (20 individuals). The data obtained as a result of statistical analysis of changes in cardiac rhythm parameters are presented in the Table.

Main statistical parameters of variability in cardiac rhythm (c.u.) of subjects in the I and the II groups

	I group				II group			
	SI	AEI^*	ARI	$IARP$	SI^*	AEI^*	ARI^*	$IARP$
T_0	175.61± 124.06	227.43± 148.8	9.92± 5.26	45.56± 16.25	221.09± 13.85	315.35 ± 204.7	12.09± 7.12	48.62± 15.68
T_1	216.35± 141.8	299.72± 194.12	11.13 ± 6.45	151.72± 50.9	152.83± 16.46	234± 157.4	8.92± 5.55	84.58± 13.6

* $p < 0.05$.

According to the results of the study, trends of increase in the values of SI by 41 c.u. and $IARP$ by 106 c.u. relative to base values as well as a reliable ($p < 0.05$) decrease in the value of AEI by 72 c.u. relative to base values of the respective variables were observed in the I group subjects.

Analysis of histogram and scatter-plot of this group showed that variability in cardiac rhythm in extroverts was within normal bounds. Following the completion of the creative task, a decrease in “accuracy” of cardio-intervals was observed in the I group subjects, reflecting the presence of a sympathetic effect. The most characteristic changes of this group are presented via individual “portrait” of subject M.N. in Fig. 1.

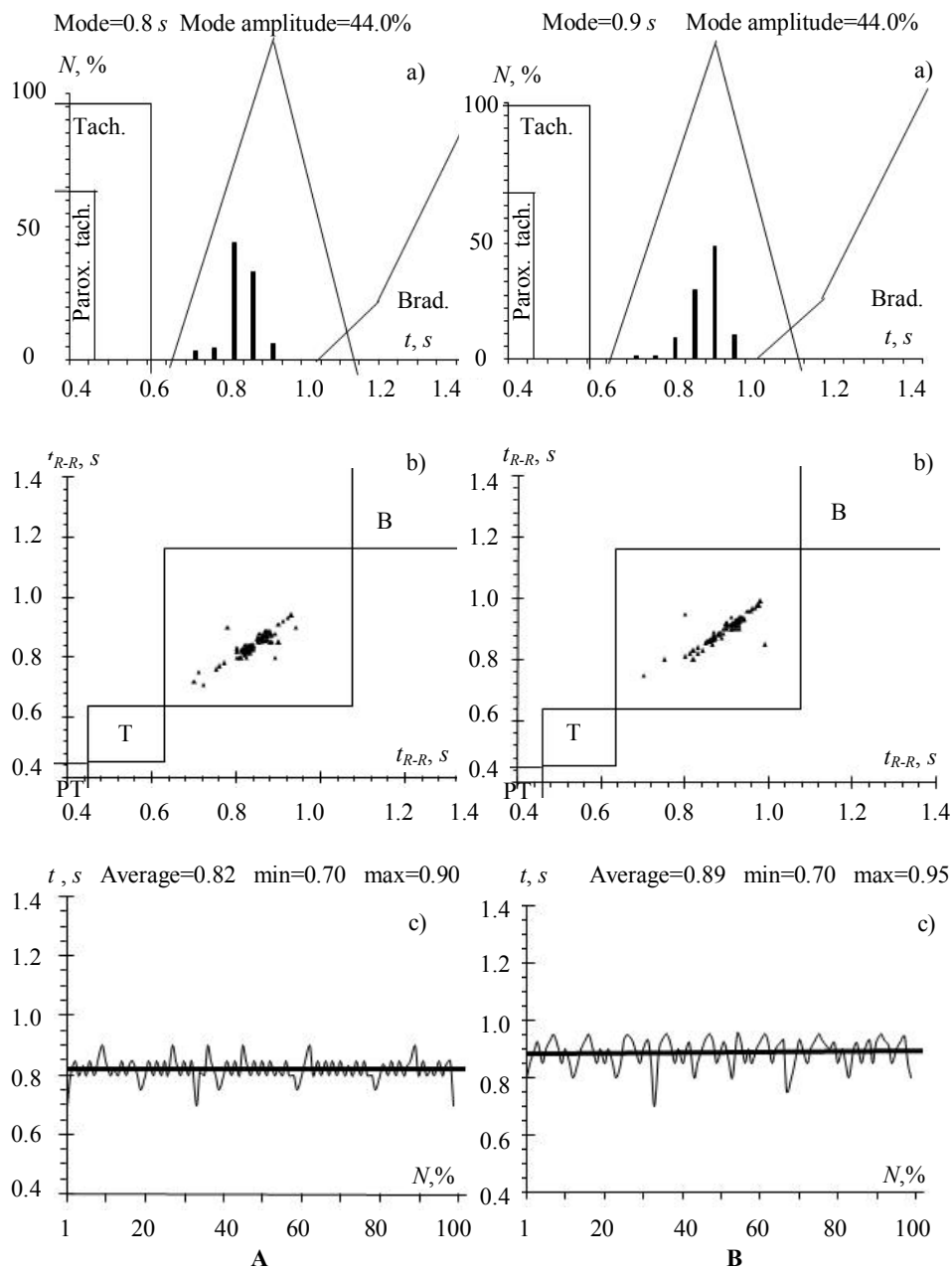


Fig. 1. Changes of parameters of cardiac rhythm variability of subject M.N. (group I) before (A) and after (B) performing creative task.

Analysis of changes in cardiac rhythm parameters in subjects of the II group showed that following the completion of the creative assignment, values of *SI* decreased by 69 c.u. ($p < 0.05$) and values of *IARP* increased by 36 c.u., while values of *AEI* and *ARI* significantly ($p < 0.05$) decreased by 81 and 4 c.u. in comparison with base values (see Table). Analysis of histogram and scatter-plot of the II group subjects showed that cardiac rhythm was maintained within a normal range, without any changes in “accuracy” of cardio-intervals, as was the case for the I group. The most characteristic changes of this group are presented in Fig. 2 via individual “portrait” of subject R.G.

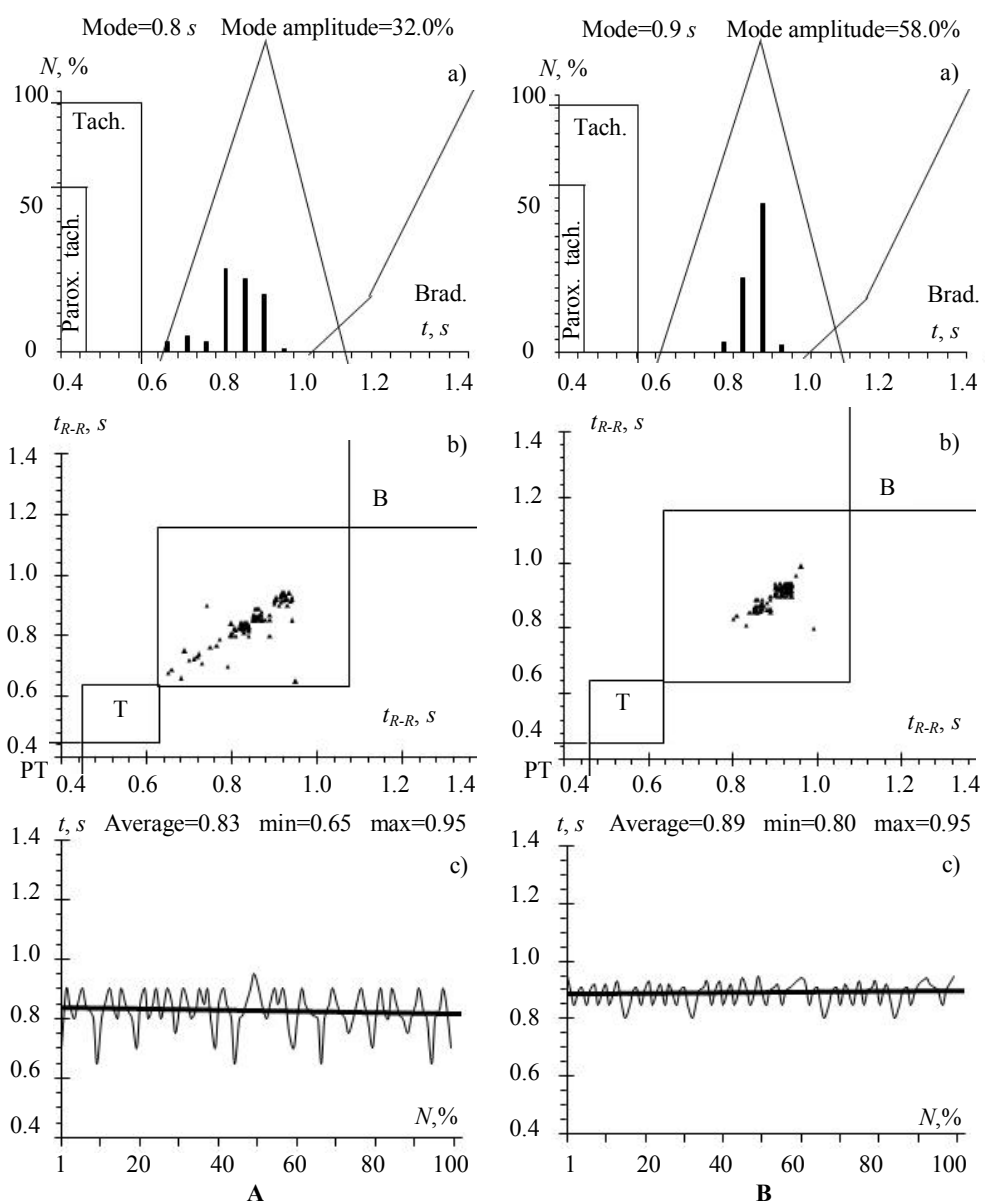


Fig. 2. Changes of parameters of cardiac rhythm variability of subject R.G. (group II) Before (A) and after (B) performing creative task.

The results of the study indicate that for individuals with varying temperaments, cardiac functionality reacts differently to the creative process. Thus, significant changes in cardiac rhythm are not observed for subjects of the I group with pronounced extroversion. At the same time, subjects of the II group experience decreases in *SI* as a result of carrying out the creative assignment, indicating an increase in parasympathetic influence. Intense mental activity is accompanied by a sympathetic effect. However, conscious creative thought such as orientational research activity is characterized by a fall in heart rate and a decline in *SI*, as well as a release in cholinergic agents linked with strengthening of the parasympathetic effect. In accordance with several authors [8], decrease in heart rate during mental activity is noted to individuals with low indicators of mobility of neural processes, which is characteristic to individuals with pronounced introversion. Thus, it is possible to assume that the creative process positively influences cardiac activity in individuals with pronounced introversion, while a parasympathetic effect is not observed for individuals with pronounced extroversion.

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