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Трансформация пространства копинга в условиях пандемии на разных циклах обучения в вузе и оценка ее интегральных показателей

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Финансирование: Работа выполнена за счет средств федерального бюджета на проведение фундаментальных научных исследований (тема №АААА-А21-122042600140-6).

Аннотация. Изучение аспектов психического здоровья, связанных с условиями пандемии (и ее последствиями) входит в топики наиболее актуальных исследований в самых различных регионах мира. Особый интерес представляют методы, которые позволяют людям справляться с трудностями. Отметим, что студенты вузов были отнесены к подгруппам (в одном ряду с пожилыми людьми и медицинским персоналом), которые были выявлены в исследованиях как имеющие более высокий риск проявления психических симптомов среди других подгрупп населения. Можно предположить, что в вузе адаптация к учебному процессу будет иметь различную специфику для начальных и старших курсов (для специалистов), для бакалавров, для магистрантов и аспирантов. Целью данной работы стало выявление методов для оценки направления и степени трансформации пространства копинга при сочетанном влиянии условий жизнедеятельности при пандемии и участия в учебном процессе в вузе на разных циклах обучения, а также демонстрация эффективности оценки групповых показателей с помощью генерации генеральных совокупностей.

В псевдолонгитюдном исследовании приняли участие 416 (здоровых) добровольцев, из них 260 испытуемых, обследованных до начала пандемии, и 156 испытуемых, которые были обследованы в условиях пандемии; 291 обучающих в бакалавриате, 59 — в магистратуре и 66 — в аспирантуре. Была использована Методика для психологической диагностики способов совладания со стрессовыми и проблемными для личности ситуациями (Вассерман и др. 2009).

У всех испытуемых модель копинга была обусловлена одной латентной структурой, связанной с психофизиологическими особенностями. Показано, что в условиях пандемии в группах бакалавров пространство копинга «сжимается», а в группах магистров и аспирантов «расширяется».

Ключевые слова: пандемия, копинг WCQ, студенты, перестановочный критерий, генеральная совокупность, бикомпонентный PLS-анализ, критерий Мантеля

Coping space transformation at different levels of university training during the pandemic and the assessment of its integral indicators

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Abstract. The impact of the pandemic on mental health is top of the research agenda in various regions of the world. Of particular interest are the methods that allow people to cope with difficulties. University students are a subgroup (along with the elderly and medical staff) that was found to have a higher risk of psychiatric symptoms among other population subgroups. Presumably, university students of different levels of training—specialist degree students in junior and senior years of training, bachelor, master, and doctoral students—will show different adaptation patterns to learning in the new environment. The purpose of the study was to identify the methods of assessing the direction and degree of transformation of coping space in students of different levels of university training under the combined influence of living and studying during the pandemic. The study also aimed to demonstrate the effectiveness of assessing group indicators by generating statistic populations.
The pseudo-longitudinal study included 416 (healthy) volunteers. Among them 260 were examined before the pandemic and 156 during the pandemic. The sample comprised of 291 undergraduate students, 59 master and 66 doctoral students. The study is based on the Methodology for the Psychological Diagnosis of Ways to Cope with Stressful and Problematic Situations.
The coping model in all the subjects is underpinned by a latent structure associated with psychophysiological characteristics. It is shown that during the pandemic the coping space of bachelor students tends to shrink, while master and doctoral students show an expansion trend.

Keywords: pandemic, Ways of Coping Questionnaire, students, permutation test, statistical population, two-block partial least squares, Mantel test

The impact of the pandemic on mental health is top of the research agenda in various regions of the world (Bottaccioli, Lazzari, Bottaccioli 2021; Cao, Zuo, Li et al. 2020; Dagnino, Anguita, Escobar, Cifuentes 2020; dos Santos, Pico-Perez, Morgado 2020; Giallonardo, Sampogna, Del Vecchio et al. 2020; Majeed, Schwaiger, Nazim, Samue 2021; Schudy, Zurek, Wisniewska et al. 2020; Thomas, Barbato, Verlinden et al. 2020; Wang, Chudzicka-Czupala, Grabowski et al. 2020).

Of special interest are the studies exploring the combined effect of various factors. The most well-known and numerous among them are a range of works on the mental health of medical personnel (Zhang, Wang, Pan et al. 2020; Zhang, Xie, Wang et al. 2020).

No less important research avenue (considering that the consequences may affect the future capacity of the younger generation) is the study of the combined impact of adaptation to the changes in educational and living conditions during the pandemic (Akdeniz, Kavakci, Gozugok 2020; Van Der Feltz-Cornelis, Varley, Allgar, de Beurs 2020; Giusti, Salza, Mammarella et al. 2020; Steinmetz, Leyes, Florio et al. 2021).

It should be noted that university students are a subgroup (along with the elderly and medical staff) that was found to have a higher risk of psychiatric symptoms among other population subgroups. (Luo, Chua, Xiong et al. 2020).

University training has several levels: undergraduate, master and doctoral. Therefore, it can be assumed that adaptation to the pandemic-induced changes in university training will have different impact for students of different levels (Koroleva, Nikolaeva, Petrova, Katcheva 2010; Solovyova, Bobrovskaya, Bobrova, Krivoshchekov 2019; Viktorova 2003). At the same time, the pandemic has an additional impact on people's behavior in numerous other contexts (Lopez-Bueno, Calatayud,

Ezzatvar 2020; Mccombie, Austin, Dalton et al. 2020; Pranata, Lim, Yonas et al. 2020).

Well-known ideas about coping (Worthington, Scherer 2004) allow us to consider effective coping as an indicator of qualitative regulation of cognitive, behavioral and emotional processes to adjust them to living during the pandemic (Nachimuthu, Vijayalakshmi, Sudha, Viswanathan 2020; Parlapani, Holeva, Voitsidis et al. 2020; Rossi, Socci, Talevi. et al. 2020; Silva, Seguro, de Oliveira et al. 2020; Torales, Ríos-González, Barrios 2020; Zhang, Wang, Pan et al. 2020; Zhang, Xie, Wang et al. 2020), including adaptation to changes in teaching and learning modes (Akdeniz, Kavakci M., Gozugok 2020; Steinmetz, Leyes, Florio et al. 2021), and isolation (vacation, working remotely, etc.) (Giusti, Salza, Mammarella et al. 2020; Van Der Feltz-Cornelis, Varley, Allgar, de Beurs 2020).

Hence, the purpose of the study was to identify the methods of assessing the direction and degree of coping space transformation in students of different levels of university training under the combined influence of living and studying during the pandemic. The study also aimed to demonstrate the effectiveness of assessing group indicators by generating statistic populations.

Sample characteristics

The pseudo-longitudinal study involved 416 (healthy) volunteers from different levels of university training who had no record of pandemic-related medical conditions. The sample included:

- 260 subjects examined before the outbreak of the pandemic, and 156 subjects examined during the pandemic;
- 254 female subjects and 162 male subjects;
- 291 undergraduate students (hereinafter referred to as bachelor students), 59 students on the master programme (hereinafter referred to as master students) and 66 on doctoral programmes (hereinafter referred to as doctoral students).

The total sample was broken down into 12 subgroups based on the three factors: gender, level of training, pre or during the pandemic examination.

According to the Methodology for the Psychological Diagnosis of Ways to Cope with Stressful and Problematic Situations (Vasserman, Iovlev, Isaeva et al. 2009):

- bachelor students are entirely included in the first age cohort (younger than 21; in our sample: from 18 to 20 years old inclusive);
- master students are entirely included in the second age cohort (aged from 21 to 30; in our sample: from 21 to 22 years old inclusive);
- doctoral students are included in the second and third age cohorts (aged from 21 to 30 years and from 31 to 45 inclusive; in our sample: from 23 to 45 years old inclusive).

The deviation of average values from 50 T-scores on all scales of coping strategies in subgroups is less than 7 T-scores (0.7 SD), which indicates an acceptable level of adaptation to university training both before and during the pandemic.

Methodological foundations of the work

A theoretical WCQ model of ways to cope with stressful situations (Lazarus, Cohen, McCleary 1998) and the Methodology for the Psychological Diagnosis of Ways to Cope with Stressful and Problematic Situations (Vasserman, Iovlev, Isaeva et al. 2009);

- theoretical concepts about the relationship between stress and coping as well as stress and processes that regulate recovery (Compas, Connor-Smith, Saltzman et al. 2001, Cole, Martin, Dennis 2004, Campos, Frankel, Camras 2004);
- research on the impact of life during the pandemic on people's mental health (dos Santos, Pico-Perez, Morgado 2020; Bottaccioli, Lazzari, Bottaccioli 2021);
- research on population subgroups with a higher risk of mental symptoms against other population subgroups concerning life during the pandemic (Luo, Chua, Xiong et al. 2020);
- research on coping strategies during the pandemic and their correlation with emotional (professional) burnout Zhang, Wang, Pan et al. 2020; Zhang, Xie, Wang et al. 2020); cognitive and emotional regulation (Schult et al. 2020); resistance to the effects of psychological stressors associated with the pandemic by educational stakeholders (Van Der Feltz-Cornelis, Varley, Allgar, de Beurs 2020).

Multidimensional analysis

To analyze the results obtained from the examination of the sample, multivariate analysis tools were used: Two-Block PLS and Mantel test. Cross-correlation of variables or data distribution patterns (for example, the scales of one questionnaire) pose no limitations to using the outlined methodology.

The Mantel test evaluates a multidimensional correlation (parametric or rank) between matrices of distances between features (Mantel, Valand 1970; Shiryaev, Ravkin, Efimov et al. 2016) for groups with different composition of participants (data can be presented as group averages). In our case, such

matrices contain distances between the studied scales of the questionnaire for subgroups of subjects before and during the pandemic. The result of the Mantel test is Rm, a coefficient varying from 0 to +1 (it has a physical meaning of the correlation coefficient taken modulo its value), and the level of statistical significance p.

PLS stands for Projection to Latent Structure (or Partial Least Squares as an outdated, but still frequently used option). Two-Block PLS identifies deep joint mechanisms that simultaneously describe both sets of multidimensional data (Kovaleva, Pozdnyakov, Litvinov, Efimov 2019). In the Two-Block PLS process, centering, scaling and reversal of two data blocks is carried out so as to maximize the covariance between the matrices of their scores (such operations preserve all structural relationships between objects, which is the key difference from the OLS tools, Ordinary Least Squares). Any kind of PLS analysis effectively accumulates the maximum information from the entire data set in the first few components. Unlike OLS tools, it is true not only about the average values, but also about the nature of data distribution even in cases when the analysis covers many hundreds of indicators (Ränner, Lindgren, Geladi, Wold 1994).

If the distance matrices for the Mantel test are prepared taking into account centering, scaling and rotation by an angle that maximises covariance (for example, after Two-Block PLS), then Rm reflects not only the level of correlation, but also the level of congruence of the matrices (Polunin, Shtajger, Efimov 2019).

Multivariate analysis was performed using JACOBI 4.3.20 software (Polunin, Shtajger, Efimov 2014; Efimov, Efimov, Kovaleva 2019).

Threshold values of the ratios for the level $p < 0.05$ correspond to the conditions $\alpha \leq 0.05$ (α is a statistical error of the first kind) and Power = $(1 - \beta) \geq 0.80$ (β is a statistical error of the second kind). G * Power 3 software was used to analyse the values of α and Power (Faul, Erdfelder, Lang, Buchner 2007).

Indicator of coping space transformation during the pandemic

Two-Block PLS analysis of distance matrices between scales of coping strategies for subgroups showed that one coordinate axis (Latent Structure) is sufficient to preserve all statistically significant information. Thus, coping space in our case will have a single dimension, which is conditioned by a single Latent Structure (mechanism). It can be assumed that this Latent Structure is associated with the psychophysiological mechanisms of coping. However, answering this question requires further studies.

It can be seen from Figs. 1–3 that the ratio of the variance along the X axis of a set of coping strategies (coping space) during and before the pandemic can be regarded as an indicator of coping space transformation during the pandemic. For a one-dimensional space (as in this case with coping), the variance can be visually correlated on the graph with a range of values along the X axis: the range from the minimum to the maximum value.

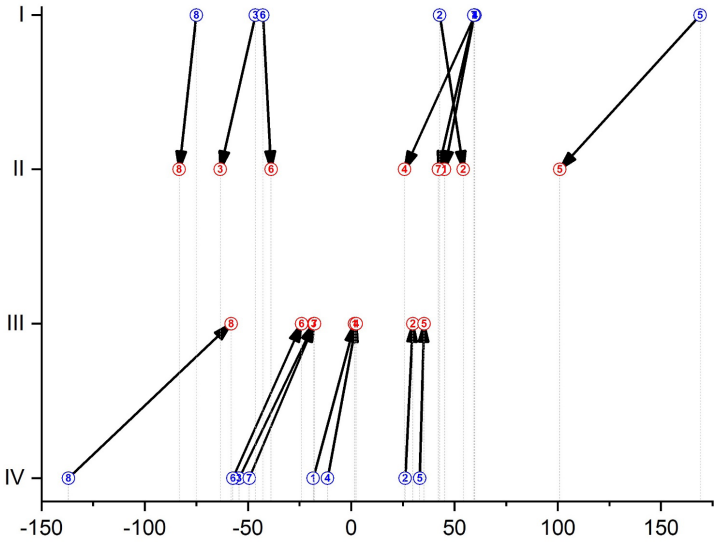

Fig. 1. 2B-PLS analysis of distance matrices of WCQ scales for bachelor students.
The X-axis is the load matrix (covariance coefficients) for latent structure No. 1;
I—before the pandemic (female subjects), II—during the pandemic (male subjects), III—before the pandemic (female subjects), IV—during the pandemic (male subjects);
1—Confrontation; 2—Distancing; 3—Self-control; 4—Acceptance of responsibility; 5—Escape/avoidance; 6—Positive reassessment; 7—Search for social support; 8—Problem solving planning.

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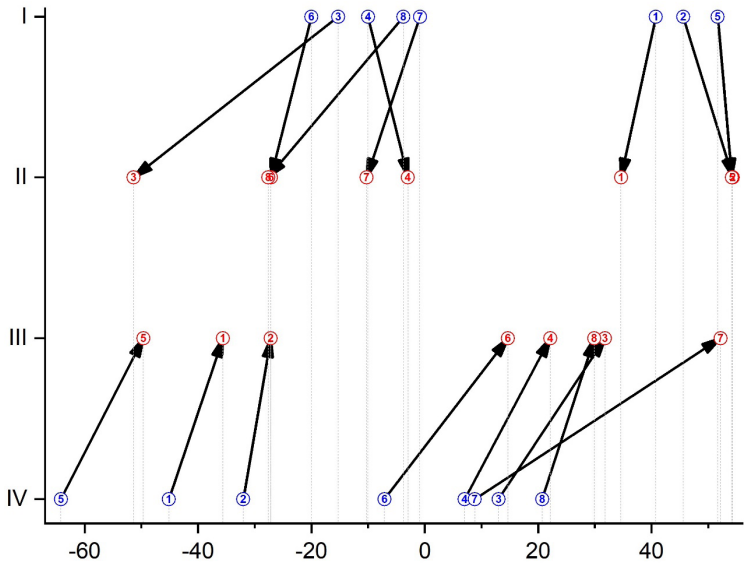

Fig. 2. 2B-PLS analysis of distance matrices of WCQ scales for master students. See Fig. 1 for legend.

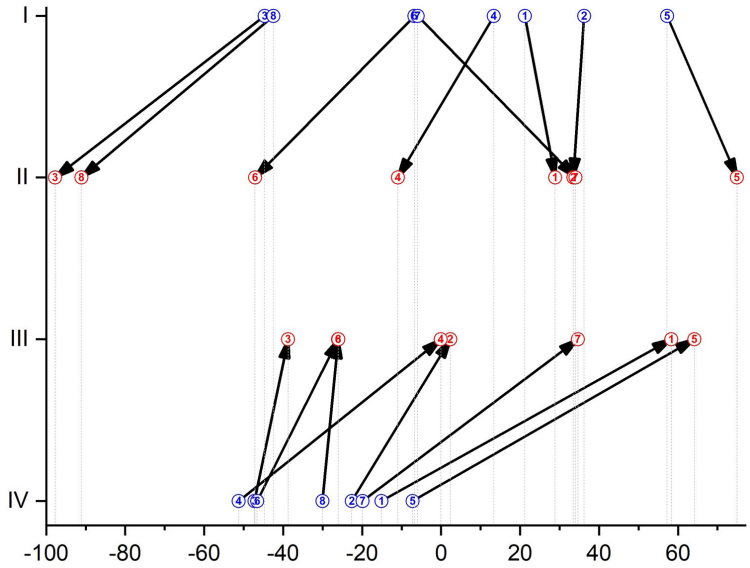

Fig. 3. 2B-PLS analysis of distance matrices of WCQ scales for doctoral students. See Fig. 1 for legend.

The indicator will be less than 1 (during the pandemic the space "shrinks") for bachelor students (Table 1), while for master and doctoral students the indicator is >1 (during the pandemic the space "expands"). Note that the pre-pandemic coping space is "wider" for the subgroup of bachelor students than for the other subgroups.

Table 1. Indicator of coping space transformation during the pandemic

Subgroups	Before the pandemic	During the pandemic	Indicator
	SD1	SD2	SD2 / SD1
Bachelor students, m	2586	806	0.31*
Bachelor students, f	5535	3656	0.66*
Master students, m	842	1202	1.43*
Master students, f	774	1408	1.82*
Doctoral students, m	240	1375	5.73*
Doctoral students, f	1125	3525	3.13*

Notes: SD—variance along the X axis; *—the difference between the variances of coping space before and during the pandemic at $p < 0.05$

The initially "wide" coping space in the subgroup of bachelor students is probably due to their adaptation to university-level training ("learning to learn"), during which, among other things, individual features of coping become most manifest.

Then, an additional stressor (the pandemic) can act on them as an eustress in the conditions of chronic stress. Thus, the pandemic produces a mobilizing effect (according to the results of coping scales, bachelor students have a regulatory capacity for such mobilization), which is accompanied by the "compression" of coping space.

Unlike bachelor students, the subgroups of master and doctoral students are initially more adapted to university training. Hence, the pandemic as a new stressor encourages adaptation which is shown as an "expansion" of coping space. Undoubtedly, further experiments are necessary to test the hypotheses about the expansion and contraction of coping space.

Thus, the proposed indicator shows not only the degree of change in coping space, but also the direction of transformation.

Correlation between coping spaces before and during the pandemic

After Two-Block PLS processing, the matrix of distances between coping scales for target subgroups showed almost a close correlation (Table 2) between coping space before and during the pandemic. This indicates a good level of congruence of matrices in pairs. According to (Cohen, Manion, Morrison 2007, 536), correlation in the range of coefficient values from 0.35 to 0.65 (modulo) is a good predictor of group dynamics, however, serious errors are possible when predicting individual dynamics.

Correlations in the range from 0.65 to 0.85 in the long term allow us to make qualitative individual forecasts, and even more so with values > 0.85 (Cohen, Manion, Morrison 2007, 536). Note that the distance matrices between the indicators can be compiled for a group of subjects, group averages and each subject individually.

Thus, the Mantel test (identifies the correlation for distance matrices between indicators of groups with different composition of participants) acts as a group integral indicator of coping space transformation during the transition to pandemic-induced changes in university training. The Mantel test for distance matrices that have undergone preliminary Two-Block PLS processing can be used both as a group and, in some cases, as an individual integral indicator of coping space transformation.

If we take the Mantel test as an integral indicator of coping space transformation, then (Table 2) each level of university training is found to have its specific features. Moreover, the difference between men and women in this respect (at the level of $p < 0.05$) is only seen in master students.

As a proof of effectiveness of the integral indicator proposed in this article, let us compare the coping space for 1st and 6th year students (Katyushina 2020) and the coping space for the corresponding groups of our sample. This is done to assess which of the groups (pre or during the pandemic) show a more pronounced correlation. Previously, we highlighted that according to the publication date the examination of students took place no later than the end of winter 2019/2020, i.e., before the pandemic. The author of the article, however, does not provide any information in this regard. Now, let us test this hypothesis with the help of the integral indicator.

As follows from Table 3, the correlation coefficients between the data (Katyushina 2020) and our groups differ at the level of $p < 0.05$ for the periods before and during the pandemic. Moreover, $0.936 > 0.637$ and $0.861 > 0.805$, which allows us to conclude that the coping space of sixth-year psychology students and master students from our sample before the pandemic is closer compared to the period during the pandemic. At the level of $p < 0.05$, there is no difference between the values of the correlation coefficient for our conditions: 0.931 (Table 3) with 0.976 and 0.904 (Table 2), as well as 0.861 (Table 3) with 0.887 and 0.862 (Table 2). This allows us to conclude that the difference between the subgroups

Table 2. Mantel's test for coping groups before and during the pandemic

Subgroups	Male subjects			Female subjects		
	Rm	p	R^2	Rm	p	R^2
Bachelor students	**0.976***	< 0.001	0.912	**0.904***	< 0.001	0.817
Master students	**0.887***	< 0.001	0.808	**0.862***	< 0.001	0.743
Doctoral students	**0.548***	< 0.001	0.300	**0.759***	< 0.001	0.576

Notes: Rm—the Mantel correlation coefficient (from 0 to +1), p is the significance level, R^2 is the proportion of variance that is due to the Rm correlation; *—statistical significance of the correlation coefficient $p \leq 0.05$.

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Table 3. Integral indicator of coping space transformation for comparing sample groups (bachelor and master students) and data from other sources (Katyushina 2020) (1st and 6th year students)

Groups	Before the pandemic			During the pandemic		
	Rm	p	R^2	Rm	p	R^2
Bachelor students	**0.931***	< 0.001	0.867	**0.637***	< 0.001	0.406
Master students	**0.861***	< 0.001	0.741	**0.805***	< 0.001	0.648

See Table 2 for legend.

is not so much based on the level of training, but, rather, on its duration.

Thus, our assumption that the survey of psychology students was not conducted during the pandemic was confirmed statistically (based on the results of our sample) using the proposed indicator.

Conclusions

It was shown that coping of bachelor, master and doctoral students in the WCQ model is underpinned by a latent structure most likely associated with the psychophysiological mechanisms of coping.

An indicator was proposed to assess coping space transformation during the pandemic. It describes the degree and direction of coping space transformation. At the same time, it is shown that during the pandemic, coping space tends to "shrink" in the subgroup of bachelor students and "expands" in the subgroups of master (girls) and doctoral students.

The article proposes an integral indicator of coping space transformation during the transition to pandemic-induced changes in university training. It can be used as a group (for all levels of university training) or as an individual (only for bachelor and master students) integral indicator of coping space transformation. At the same time, it is shown that each level of university training has its specific features. Moreover, the difference between men and women in this respect is only seen in master students.

To provide evidence on the effectiveness of the proposed integral indicator we used it to find out which time period was taken to examine the subjects from one published study: during the pandemic (no) or before the pandemic (yes). The analysis of integral indicator values allowed us to conclude that the difference between the subgroups is not so much based on the level of training, but, rather, on its duration.

Conflict of Interest

The authors declare that there is no conflict of interest, either existing or potential.

Ethics Approval

All studies were conducted in accordance with the principles of biomedical ethics formulated in the Declaration of Helsinki 1964 and its subsequent updates. Each participant of the study submitted a signed written voluntary informed consent after they were provided with the information on the potential risks, benefits and nature of the upcoming study.

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