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| Восприятие традиционной / нетрадиционной музыки и его воздействие на ожидаемую продолжительность жизни: предварительное сообщение. Статья 2: Активность теломеразы / Perception of Traditional / Non-traditional Music and its Influence upon Life Expectancy: Preliminary Report. Article 2: Telomerase Activity |

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**ВОСПРИЯТИЕ ТРАДИЦИОННОЙ / НЕТРАДИЦИОННОЙ МУЗЫКИ И ЕГО ВОЗДЕЙСТВИЕ НА ОЖИДАЕМУЮ ПРОДОЛЖИТЕЛЬНОСТЬ ЖИЗНИ: ПРЕДВАРИТЕЛЬНОЕ СООБЩЕНИЕ.
 СТАТЬЯ 2: АКТИВНОСТЬ ТЕЛОМЕРАЗЫ**

В статье представлены предварительные результаты междисциплинарного научно-

исследовательского проекта, направленного на изучение фундаментальных механизмов восприя-



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тия традиционной / нетрадиционной музыки и их молекулярно-биологических коррелятов. 65 здоровых, молодых, русскоязычных респондентов наблюдались дважды, а именно, как до, так и после прохождения двухнедельного аудиокурса музыки определенного типа, по полтора часа в день. Они были разделены на три примерно равных по размеру подгруппы, одна из которых прошла курс легкой классической (традиционной) музыки, вторая – существенно отличающейся от нее по общей организации и тембру нетрадиционной (дизайнер-) музыки, третья – аудиокурс «звуков природы». С целью оценки динамики психологических процессов и состояний, было предложено применено 6 опросников, направленных на отслеживание изменений уровня настроения и общей невротизации, степени активации базовых психологических защит и стратегий совладания со стрессом, а также скрытых психологических резервов типа временной активации интринзивных религиозно-психологических установок и измененных состояний сознания. Молекулярно-биологические корреляты рассматривались на уровне длины теломер и активности теломеразы, которые, в свою очередь, используются в качестве маркеров стресса и предикторов ожидаемой продолжительности жизни. Для целей настоящего, пилотного исследования сырые оценки по обоим указанным индексам переводились в итоговые баллы, с использованием пороговых значений ± 30 пар оснований для длины теломер и $\pm 10\%$ условных единиц для активности теломеразы. При изменении данных показателей в пределах указанных границ, делался вывод об отсутствии статистически значимых изменений. При их изменении, переходившем указанные пределы, делался вывод о наличии статистически значимых изменений, в сторону роста либо падения. Таким образом, каждый из 3 типов изменения длины теломер мог сочетаться с любым из 3 типов изменения активности теломеразы, в случае каждой из 3

подгрупп респондентов. Как следствие, для каждой из этих подгрупп была определена вероятность использования каждой из 3х3 (в общей сложности 9) стратегий совместного изменения обоих молекулярно-биологических индексов. В итоге было установлено, что при восприятии музыки разных типов задействуется 2 ключевые стратегии. Первая из них, доминирующая при восприятии традиционной музыки, состоит в увеличении длины теломер, которое может быть поддержано усилением активности теломеразы, но может иметь место и в отсутствие такового. Вторая стратегия, доминирующая при восприятии нетрадиционной музыки, состоит в существенном увеличении активности теломеразы, которое не приводит к увеличению длины теломер. Приняв во внимание литературные данные, первая из указанных стратегий была нами связана со снижением уровня стресса и повышением ожидаемой продолжительности жизни. Вторая стратегия, состоящая в активации теломеразы с целью стабилизации длины теломер, задействуется в условиях, приближающихся к стрессогенным. С учетом полученных результатов, намечены пути пересмотра и коррекции такого дискуссионного феномена современной науки, как «Моцарт-эффект».

Ключевые слова: восприятие музыки, культурное наследие, активность теломеразы, длина теломер, уровень стресса, ожидаемая продолжительность жизни.

**PERCEPTION OF TRADITIONAL /
NON-TRADITIONAL MUSIC AND ITS
INFLUENCE UPON LIFE EXPECTANCY:
PRE-LIMINARY REPORT.
ARTICLE 2: TELOMERASE ACTIVITY**

The paper presents preliminary results of an interdisciplinary research project dedicated to psycho-



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logical aspects of perception of traditional / non-traditional music, and its molecular biological correlates. 65 normal, Russian-speaking, young subjects were observed prior to passing a two-week music course of a definite type, 1.5 hours a day, and right after it. They were divided into three subgroups, one of which passed a course of light classical music, which was quite traditional for them, another one listened to non-traditional, designer music, sharply different from the former one in key and timbre. The third subgroup, which listened to sounds of nature, served for the means of control. 6 psychological questionnaires were applied, providing assessment of levels of mood and neuroticization, degrees of activation of basic psychological defense mechanisms and strategies of coping with stress, and of such hidden human reserves as temporary activation of intrinsic religious attitudes, and short-term alteration of consciousness. Molecular biological correlates were regarded on the level of telomere length and telomerase activity, which served as stress markers and predictors of life expectancy. For the purpose of the present, pilot study, both molecular biological indices were scaled, using the thresholds of ± 30 basic pairs for telomere length, and of $\pm 10\%$ conventional units for telomerase activation. Shifting inside these intervals was regarded as statistically insignificant. Shifting outside these intervals, as a result of passing a music course of a given type, was regarded

as statistically significant, and as either an increase or, a decrease, depending on the direction of alteration. Thus any of the 3 ways of alteration of telomere length could be combined with any of the 3 ways of alteration of telomerase activity, in the case of any of the 3 subgroups of subjects. Thus 3x3 (that is, 9) strategies of alteration of telomere length and telomerase activity were regarded in the case of each subgroup of subjects. As a result, two dominating strategies of alteration of molecular biological indices, depending on the type of music course, were revealed. The first one, occurring in the case of the course of traditional music, consisted in increase of telomere length, which was often, but not necessarily, accompanied by increase in telomerase activity. The second strategy comprised sharp increase of telomerase activation, which was not accompanied by increase of telomere length. Basing on literary data, the former strategy was interpreted as related to stress reduction and rise of life expectancy. The latter one consisted in activation of telomerase, allowing to protect telomere length, as means of coping with stress. Basing on these results, revision of such controversial issues as Mozart effect, is proposed.

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Key words: Perception of music, cultural heritage, telomerase activity, telomere length, stress reduction, life expectancy.

The present report directly continues presentation of basic results of a systematic study of psychological aspects of the perception of traditional and non-traditional music and its molecular biological correlates, which was started in the preceding Article 1. The reasons that made us undertake our experiment, as well as its general design, were presented in the aforemen-

tioned paper. Its main results consisted in the fact that passing a course of traditional music, i.e. music belonging to the cultural heritage of our respondents, results in an increase in telomere length, which is statistically significant. Passing a course of sounds of nature tends to condition a general shift in the opposite direction, i.e. telomere length shortening. As to the subgroup which



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passed a course of non-traditional music, its results tended to be intermediate.

Basing on general theoretical assumptions, we further supposed that this increase was related to stress reduction, and to prolongation of life expectancy. The former of these assumptions was corroborated by data of a psychological survey, which included primarily questionnaires directed at the assessment of the level of neuroticization, and of the levels of activation of basic psychological defense mechanisms. As to the latter effect, it was most probably short-term and non-stable. Regarding basic results of our investigation, we finally expressed an opinion that it would be premature to formulate any serious conclusions basing upon a single predictor of stress adaptability and life expectancy, even being as important as the telomere length. Complementing them with a survey of shifts in the dynamics of telomere activity was defined as an urgent and constructive task.

The reason for choosing these two predictors of ageing for the initial analysis was conditioned by the fact that the dynamics of telomere length is normally rather slow and long-term, whereas the dynamics of telomerase activity tends to be much quicker and, as a result, it should be regarded as short-term¹. Thus both processes may be regarded as complementary in time (one should remind here that both processes are connected by the fact that activation of telomerase may serve as a factor triggering the process of increasing the telomere length, and supporting it).

¹ Ornish D., Lin J., Daubenmier J., Weidner G. et al. Increased Telomerase Activity and Comprehensive Lifestyle Changes: a Pilot Study // *The Lancet Oncology*, 2008, Vol.9, No.11, p.1048-1057.

Blood samples taken from every respondent both before passing a music course of a definite type and after it, allowed us to conduct systematic study of the telomerase activity. Trapeze RT Telomerase Detection Kit, produced by German biotechnological company Merc, was applied for this purpose. This part of our investigation was conducted by a research team working upon the facilities of the Institute of Cytology, Russian Academy of Sciences in St. Petersburg, Russia.

In measuring the level of the telomerase activity, protocols recommended by the aforementioned company, were applied by us. Having detected in this way levels of telomerase activity prior to passing the music course, and right after it, the difference between them was calculated for each subject. Finally these indices were aggregated into three big intervals: increase in telomerase activity (the level of telomerase activity rose by more than 10 percent), no statistically significant shifts (telomerase activity shifted by less than $\pm 10\%$), decline of telomerase activity (the corresponding level fell by more than 10% conventional units).

Passing on to the results of our experiment, we would like to remind that the group studied by us consisted of 65 young Russian urban dwellers, who were divided into three subgroups.

Subgroup 2 passed a two-week (90 minutes a day) course of light classical music, which was quite well-known and traditional for them, and so belonged to the realm of their cultural heritage.

Subgroup 3 passed a course of designer music, sharply different from the light classical



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one both in key and timbre, which was mostly unknown to the members of the subgroup, and definitely non-traditional for them. Musical treks applied in the former case, were recommended for relaxation and stress reduction by the Federal Ministry of Health of Russia. Treks used in the latter case, were recommended for purposes of stress reduction and healing by iAwake Technologies (USA), basing on the general approach elaborated by an outstanding expert in this field, E. Thompson².

Subgroup 1 passed a course of sounds of nature, which allowed it to serve as control subgroup in our experiment.

Regarding raw data on the dynamics of telomerase activity, as a result of passing a music/sound course altogether, no general regularities were detected. Then the group was divided into three subgroups, i.e. those who passed a music course of traditional music (2), the non-traditional one (3), and the control subgroup (1), which demonstrated statistically significant difference between them. The corresponding data are cited in Table 1, line 1. Their meaning seems to be quite clear: dynamics of the telomerase activity of the non-traditional group is qualitatively different from both the dynamics of the traditional one, as well as of the control subgroup.

Index / P-value	P-value by Dunn test (with Šidák correction for three comparisons by pairs)			P-value by Kruskal-Wallis test
	Comparison 'control subgroup – non-traditional subgroup'	Comparison 'control subgroup – traditional subgroup'	Comparison 'traditional subgroup – non-traditional subgroup'	
Shift in telomerase activity	0.0*	0.34	0.0*	0.0*

Table 1. Assessment of statistical significance of shifts in telomerase activity in subgroups, as a result of passing music course of different types

Abbreviations. Assessments of the statistical reliability of differences between the three subgroups (control (1), non-traditional music (3), traditional music (2) is presented, by means of the post hoc analysis by Dunn test with Šidák correction of p-values for multiple comparisons), and of the Kruskal-Wallis non-parametric criterion. Statistically significant results (at the level of 0.05) are marked by red color and by an asterisk ()*

² The authors are grateful to E.Thompson for having kindly provided recordings for this part of our research. For more detailed information on the activities of the iAwake Technologies, see their web site: <http://www.iawaketechnologies.com>



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To get deeper insight into the essence of these differences, we would have to take into account the results of our analysis of the dynamics of telomere length, which was conducted in Article 1 of the present report. To do so, members of each subgroup were divided into those whose telomere length increased; those whose telomere length diminished; and, finally, those whose telomere length remained on the same level, as a result of passing a music/sound course. Results of this analysis are presented at Figure 1 (traditional subgroup), and Figure 2 (the non-traditional one).

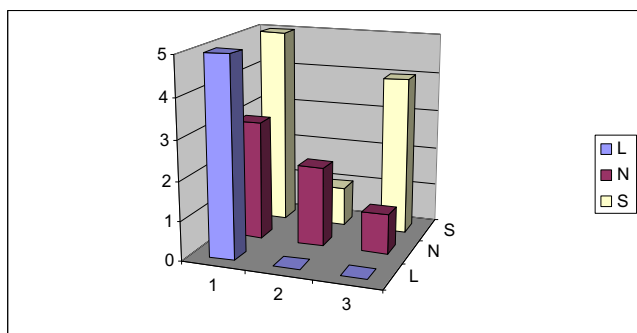


Figure 1. Alteration of telomerase activity as a result of passing a course of traditional music

Abbreviations. Abscissa axis – members of subgroup 2, whose telomere length: 1 – increased, 2 – remained the same, 3 – diminished. Ordinata axis – number of respondents. Colours and codes of histograms – blue: increase in telomerase activity (L), red: no significant difference (N), yellow: decline of telomerase activity (S). Measurement error did not exceed 0.05 in all cases.

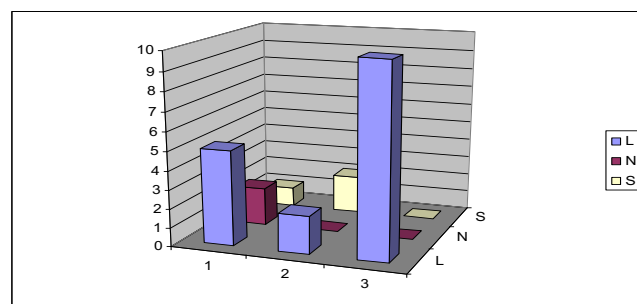


Figure 2. Alteration of telomerase activity as a result of passing a course of non-traditional music

Abbreviations. Abscissa axis – members of subgroup 3, whose telomere length: 1 – increased, 2 – remained the same, 3 – diminished. Ordinata axis – number of respondents. Colours and codes of histograms – blue: increase in telomerase activity (L), red: no significant difference (N), yellow: decline of telomerase activity (S). Measurement error did not exceed 0.05 in all cases.

Comparing data of Tables 1 and 2, we may trace back two sharply different strategies, induced at the level of the predictors of ageing, as a result of passing a music course of a definite type. For members of the traditional subgroup, the main strategy consisted in a considerable increase of telomere length, which could be supported by the activation of telomerase, but could occur even without such activation (cf. the left part (i.e. row 1) at Figure 1). For members of the non-traditional subgroup, the main strategy consisted in activation of telomerase, which did not result in increasing the telomere length (cf. the right part (row 3) at Figure 2). Data of the control subgroup would not be cited here, as its patterns of alteration of the



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telomerase activity did not differ in a statistically significant way from data of the traditional subgroup (as shown by Table 1).

Prior to passing to the interpretation of these strategies, we would briefly review results of the psychological testing, which was conducted simultaneously. The levels of psychological tension, and of concentration / attention could serve as constructive examples of data acquired by us (cf. respectively Tables 2 and 3).

Subgroup / Index	M1	Sd1	M2	Sd2	n	p.FC
1	11.85	1.45	13.25	2.05	20	0.01
2	12.30	2.13	12.65	2.64	20	0.62
3	11.95	2.24	12.05	3.20	22	0.81
p.KWC	0.82		0.18			

Table 2. Alteration of psychological tension level, as a result of passing a music course of different kinds

Abbreviations: M1 – mean value of the index of psychological tension for the given group before passing the audiocourse, M2 – mean value of the index of psychological tension for the given group after passing the audiocourse, Sd1 – standard deviation before the course, Sd2 – standard deviation after the course, n – sample size, p.FC – probability confidence level by the Friedman criterion, p.KWC – probability confidence level by the Kruskal-Wallis criterion. Statistically significant shift is marked by red colour; and an asterisk ().*

Subgroup / Index	M1	Sd1	M2	Sd2	n	p.FC
1	8.90	2.92	9.90	3.77	20	1.00
2	9.55	2.95	9.85	3.36	20	0.23
3	8.86	4.76	10.09	4.02	22	0.04
p.KWC	0.72		0.95			

Table 3. Alteration of concentration / attention level, as a result of passing a music course of different kinds

Abbreviations: M1 – mean value of the index of interest for the given group before passing the audiocourse, M2 – mean value of the index of interest for the given group after passing the audiocourse, for the other abbreviations, see note to Table 1.

As stated by the authors of the popular psychological questionnaire, applied by us in this case, normal values belong to an interval, limited by 9 and 15, in both cases³. Regarding columns M1 and M2, we may state that all of the data acquired by us, belonged to the same, normal interval. Regarding the last (p.KWC) row of both ta-

³ Kurgansky N.A., Nemchin T.A. Assessment of Psychological Activation, Interest, Emotional State, Tension, and Comfort // Practical Manual in General, Experimental, and Applied Psychology. St. Petersburg, Piter, 2006, p.310-311. (in Russian). As pointed out by the authors of this methodology, it was based upon the well-known idea of semantic differential, elaborated by the American psychologist Ch.Osgood.



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bles, we also see that there was no statistically significant shift between the states prior to passing the music course, and after it. As a result, we may state that the psychological state of our Ss was not deeply affected by passing the music course, most possibly because it was not as intensive as it should have been for present-day young urban dwellers, who are accustomed to loud pop music, almost 24 hours a day.

Another factor, which is not so obvious, consists in the fact that the main indices applied in our research, were based upon psychological mechanisms, which comprised considerable conscious processing of experiences and emotions. However, in listening to music, the role of conscious processing conducted by our Ss tended to be minimal (especially because there were no professional musicians in our subgroups)⁴. Thus it could be quite possible that perception of the music course by our subjects was mostly sub- or, unconscious. As a result, dynamics of lower levels of the organism, including the molecular biological one, could be much more agile, than that of the upper levels, primarily human consciousness.

To corroborate this assumption, we feel authorized to cite the results of the study of the electrical activity of the brain of our subjects, which had been conducted by us earlier. Both in the short wave (EEG) frequency band, and in the ultraslow bandpass, basic patterns of brainwaves discovered by us, demonstrated dynamics, which

⁴ Professional musicians tend to conduct most active cognitive processing of music, implying application of specific brain mechanisms, cf. Gaser C., Schlaug G. Brain structures differ between musicians and non-musicians // *The Journal of Neuroscience*, 2003, Vol.23, No.27, p. 9240–9245.

was highly agile and statistically significant⁵. Presence of two basic strategies in the dynamics of brain activity were found, one being proper for the traditional subgroup, another for the non-traditional one. Systematic comparison of these patterns with the dynamics of the molecular biological level forms topic of a special paper. It would be sufficient to point out here that both the levels of brainwaves, and of ageing predictors, however different, are primarily linked to sub- or, unconscious processing of stimuli, unlike psychological processes, assessed by applying our questionnaires.

Having regarded this general trend, we would like to point out that in the case of quite a few psychological processes, statistically significant dynamics was still present. Returning to Table 2, we may state that the level of psychological tension has grown considerably by members of the control subgroup 1, which was not the case of the other two groups. The data of Table 3 show that the level of concentration / attention has sharply fallen by members of subgroup 3, who passed a course of designer music, which was not the case of the two other subgroups. Both the increase in psychological tension, and the diminished ability to concentrate one's mind, are definitely linked to an increase in psychological stress. The former shift could be tentatively linked to a reduction of telomere lengths by members of the

⁵ Spivak D.L., Shemyakina N.V., Nagornova Z.V., Pustoshkin E.A., Zakharchuk A.G., Spivak I.M. Psychological Effects of Perception of Traditional / Non-traditional Music and their Brain Correlates. Article 2: Brain Correlates // *International Journal of Cultural Research*, 2016, No.2 (23), p. 159-169.



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control subgroup 1, regarded by us in the previous article 1. As to the latter one, it could be linked to the activation of telomerase by members of the non-traditional subgroup 3, presented above, cf. Figure 2, and Table 1. Systematic study of these tendencies forms an important task of the next stage of our research, comprising the application of much more aggressive sound technologies.

Having regarded basic results of our psychological survey, we may now return to the two basic strategies, discovered by us at the molecular biological level. One of them consisted in a considerable increase of telomere length, which could be supported by the activation of telomerase, but could occur even without such activation. Another one comprised rather sharp activation of telomerase, which did not result in increasing the telomere length, but, most possibly, contributed to its preservation.

As to the former strategy, a large number of papers may be cited, starting from the pioneer work published in 2004 by E. Epel and her co-authors, where the increase and aggravation of stress, both psychological and psychosocial, was proved to result more or less regularly in the telomere shortening⁶. On the contrary, overall positive

lifestyle changes, ranging from healthier diet to regular meditation, tend to result in a definite increase in telomere length⁷. There is no doubt that telomerase activity serves as a much better marker in these cases⁸. However, dynamics of telomere length tends to be also quite instrumental and constructive.

As to the latter strategy, the situation here tends to be somewhat more complicated. Originally life stress and ageing were regarded as being related to reduced telomerase activity. However in the course of the latest years a different regularity was traced back. It consisted in sharp activation of telomerase, which occurred at the background of

Cellular Senescence // Aging, 2016, Vol.8, No.1, p.3-11.

⁷ Jacobs T., Epel E., Lin J. et al. Intensive Meditation Training, Immune Cell Telomerase Activity, and Psychological Mediators // Psychoneuroendocrinology, 2011, Vol.36, p.664-681.

⁸ For details, see: Lavretsky H., Epel E., Siddarth P. et al. A Pilot Study of Yogic Meditation for Family Dementia Caregivers with Depressive Symptoms: Effects on Mental Health, Cognition, and Telomerase Activity // International Journal of Geriatric Psychiatry, 2013, Vol.28, No.1, p. 57-65; Schutte N., Malouff J. A Meta-analytic Review of the Effects of Mindfulness Meditation on Telomerase Activity // Psychoneuroendocrinology, 2014, Vol.42, p. 45-48; Daubenmier J., Lin J., Blackburn E. et al. Changes in Stress, Eating, and Metabolic Factors are related to Changes in Telomerase Activity in a Randomized Mindfulness Intervention: a Pilot Study // Psychoneuroendocrinology, 2012, Vol.37, No.7, p. 917-928; Epel E., Lin J., Dhabhar F. et al. Dynamics of Telomerase Activity in Response to Acute Psychological Stress // Brain, Behaviour and Immunity, 2010, Vol.24, No.4, p. 531-539; Ornish D., Lin J., Daubenmier J. et al. Increased Telomerase Activity and Comprehensive Lifestyle Changes: a Pilot Study. The Lancet Oncology, 2008, Vol.9, No.11, p. 1048-1057.

⁶ Epel E., Blackburn E., Lin J. et al. Accelerated Telomere Shortening in Response to Life Stress // Proceedings of the National Academy of Sciences of the USA, 2004, Vol.101, p. 17312-17315. For reviews, cf. Lansdorp, P. Stress, Social Rank and Leukocyte Telomere Length // Aging Cell, 2006, Vol.5, p. 583-584; Spivak I.M., Mikhelson V.M., Spivak D.L. Telomere Length, Telomerase Activity, Stress and Aging // Advances in Gerontology, 2016, Vol.6, No.1, p. 29-35; cf. Bernadotte A., Mikhelson V.M., Spivak I.M. Markers of Senescence. Telomere Shortening as a Marker of



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short telomeres⁹. Regarding these data, researchers assumed that if an organism had a sufficient potential to counteract stress, it might recur to a special strategy, consisting in sharp activation of telomerase, which in its turn counteracted tendency towards telomere shortening. As a result, telomere length was stabilized or even increased¹⁰.

Taking into account the data cited above, we may assume that both strategies discovered by us are in fact quite well corroborated by the results of earlier research. One of them, which consists in general increase of telomere length, should be regarded as instrumental in stress reduction and finally in extension of life expectancy. Another one consists in sharp activation of telomerase, serving as instrumental in protecting the telomere length against shortening, imposed by stress. As we remember, the former strategy occurred as a result of passing a course of traditional music, while the latter one appeared in the case of the non-traditional one.

Thus having interpreted the two strategies which were traced back in our research in both molecular biological and psychological terms, we

⁹ Zalli A., Carvalho L., Lin J., et al. Shorter Telomeres with High Telomerase Activity are Associated with Raised Allostatic Load and Impoverished Psychosocial Resources // Proceedings of the National Academy of Sciences of the USA, 2014, Vol.111, No.12, p.4519–4524.

¹⁰ Beery A., Lin J., Biddle J. et al. Chronic Stress Elevates Telomerase Activity in Rats // Biology Letters, 2012, Vol. 8, No.6, p.1063-1066, ср. Материалы обзора: Deng W., Cheung S., Tsao S. et al. Telomerase Activity and its Association with Psychological Stress, Mental Disorders, Lifestyle Factors and Interventions: A Systematic Review // Psychoneuroendocrinology, 2016, Vol.64, p.150-163.

would like to discuss finally a couple of methodological problems having to do with duration of our music course, and with its general purport. To start with the first problem, one may state that the dynamics of our molecular biological indices was quite impressing – statistically significant, in any case. The question is, was our music course really long enough to condition the appearance of such major shifts.

There are no literary sources that would provide us with a direct answer to this question, as there have been conducted up till now no systematic studies of influence of music of different types upon ageing predictors. As to indirect answers, we might primarily cite here a relatively recent study of a serious research team, dedicated to influence of Buddhist meditation upon age predictors, primarily telomerase activity. A group of 30 young and middle-aged Americans were observed, living and training at a Buddhist retreat centre for 3 months. Their daily schedule included short guided meditation every morning and evening, and free solitary meditation for the rest of the day, for not less than 6 hours a day, all in all. As a result, statistically significant increase in telomerase activity was detected¹¹.

On the one hand, duration of the meditation course was longer than that of our music course. On the other hand, the input of systematic work was quite moderate in the case of the retreat, as its inmates mostly practiced free meditation, devoid of systematic control or guidance. As usual

¹¹ Jacobs T., Epel E., Lin J. et al. Intensive Meditation Training, Immune Cell Telomerase Activity, and Psychological Mediators // Psychoneuroendocrinology, 2011, Vol.36, p.664-681.



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for a retreat, they were both distracted by the general 'spirit of the place', and motivated by it. The effect on the level of ageing predictors turned out to be quite strong, however.

In another experiment, conducted by a team of experts under the guidance of D. Ornish, a group of men with prostate cancer was observed for 5 years. They were encouraged to practice comprehensive lifestyle changes including healthier diet, active lifestyle, stress management, and social support. As a result, considerable increase in telomerase activity was demonstrated to occur as early as in 2 to 3 months, as well as an increase in telomere length, which tended to take place much later¹². In this case we see another example of considerable alterations that occurred at the level of ageing predictors 2 to 3 months after having changed the overall lifestyle.

Another research team, guided by E. Epel, has recently demonstrated that the time span of 6 days of practicing overall relaxation proved to be quite sufficient to induce positive effect at the level of ageing predictors, which could be traced back up to 10 months later in some cases, especially by persons who practiced systematic meditation¹³.

Taking into account the bulk of results briefly reviewed above, we may come to conclu-

¹² Ornish D., Lin J., Chan J. et al. Effect of Comprehensive Lifestyle Changes on Telomerase Activity and Telomere Length in Men with Biopsy-proven Low-risk Prostate Cancer: 5-year Follow-up of a Descriptive Pilot Study // *The Lancet Oncology*, 2013, Vol.14, No.11, p.1112-1120.

¹³ Epel E., Puterman E., Lin J. et al. Meditation and Vacation Effects have an Impact on Disease-associated Molecular Phenotypes // *Translational Psychiatry*, 2016, Vol. 6, No.8, e880.

sion that the time span of two weeks was sufficient for a pilot study to trace back influence of music perception upon the dynamics of ageing predictors, at least at the level of trends.

The problem that we finally wish to discuss consists in the question whether the notion of cultural heritage and, correspondingly, of the traditional / non-traditional [musical] text should really be essential for our research. A number of works may be cited where direct psychophysiological effects of music perception were found, without taking into account cultural constructs of any kind. The so-called Mozart effect could serve as a plausible example in this respect. The essence of this effect or, rather, hypothesis, which has been vividly discussed in the course of the recent quarter of a century, consists in the fact that listening to classical European music, especially that by Mozart, tends to reduce stress and enhance cognitive performance, which is not the case of music of other times and types.

The publication which gave impetus to this line of research treated a rather limited range of tasks which were studied with the help of specialized research tools (primarily Stanford-Binet Intelligence Scale)¹⁴. However the regularities tentatively regarded there, were soon generalized. In five years after the publication of the initial paper, the authors came to assumption that Mozart's music tends to directly affect some keynote psychophysiological mechanisms, which may be not necessarily human¹⁵. In this way, cultural psychology

¹⁴ Rauscher F., Shaw G., Ky C. *Nature*, 1993, Vol.365, p.611.

¹⁵ Rauscher F., Robinson R., Jens J. Improved Maze Learning through Early Music Exposure in Rats //



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and/or cultural studies became absolutely irrelevant in the studies of the Mozart effect.

After a number of independent checking experiments had been conducted, it was proved that the Mozart effect did not exist – at least in the form postulated by F. Rauscher and her colleagues. No general psychophysiological mechanism was found that would have been tuned *a priori* to the classical Austrian music. Influence of music perception upon the state of mind of humans turned out to be quite moderate.

However in the cases where effect of this kind arose, it tended to be mediated by positive arousal and aesthetic pleasure¹⁶. The former of these notions belongs to the realm of personality psychology; as to the latter one, it comprises an essential topic of cultural psychology, not to mention aesthetics and the philosophy of culture. Thus having briefly regarded the course of studies of the so-called Mozart effect, we feel authorized to assume that taking into account basic musical attitudes of our subjects was correct and constructive.

Basing on the results of our research, following conclusions may be done:

1. Perception of music of different types tends to affect such structures of the molecular biological level as telomere length and telomerase

Neurological Research, 1998, Vol.20, No. 5, p.427-432.

¹⁶ Steele K. Arousal and mood factors in the "Mozart effect" // *Perceptual and Motor Skills*, 2000, Vol. 91, No.1, p.188–190; Jones M., West S., Estell D. The Mozart effect: Arousal, preference, and spatial performance // *Psychology of Aesthetics, Creativity, and the Arts*, 2006, Vol.5, No.1, p.26–32; cf. Pietschnig J., Voracek M., Formann A. Mozart Effect – Shmozart Effect: A Meta-analysis // *Intelligence*, 2010, Vol.38, No. 3, p.314–323.

activity, which serve in their turn as stress markers and predictors of life expectancy;

2. Perception of music, regarded by our respondents as traditional, tends to increase the average telomere length, which process is often supported by the telomerase activation. The corresponding strategy implies stress reduction and general increase in life expectancy;

3. Perception of music, regarded by our subjects as non-traditional, conditions primarily considerable increase in telomerase activity, which is not accompanied by an increase in telomere length. In terms of molecular biology, this strategy implies counteracting stress by means of the telomerase activation, in order to protect the telomeres. The corresponding psychological shift might imply either a simple strategy (stress induced by unusual sound stimuli) or, a more complicated one (creative stress, which accompanies breakage of stereotypes and a shift towards creative thinking).

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