DESCRIPTION OF ATTENTION FUNCTION FEATURES IN ARCTIC POPULATION

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Abstract. The states of the Cold area similarly unfavorably influence the condition of higher types of willful consideration among all inhabitants, leveling the factor of individual contrasts. An individual's stay in the Ice locale is joined by change of the utilitarian asymmetry of the cerebrum and a lessening in the ordinary capacity of the overwhelming side of the equator. The got discoveries recommend a particular right asymmetry of consideration among agents of indigenous populace of the Cold district. The agents of the non-indigenous populace with age and an expansion in the term of their stay in the Ice locale altogether increment the extent of individuals with a fractional kind of consideration asymmetry, which additionally mirrors the difference in hemispheric collaboration, because of the expanded impact of the correct half of the globe. The got information are reliable with the suppositions about the insecurity of practical asymmetry and the likelihood of its change affected by distressing occasions, which incorporate the general population's stay in the Ice locale.

Keywords: attention function, the Arctic Region, encephalic asymmetry, aborigines of the North.

1.Introduction

Despite the significant role of functional asymmetry in ensuring the adaptive activity of the CNS (Vizel, 1996; Rotenberg, 2009; Khomskaya & Batova, 1992; Corbetta, Kincade & Shulman, 2002; Corbetta, Patel & Shulman, 2008; Corbetta & Shulman, 2002; Corbetta & Shulman, 1998; Downar et al. 2001, 2003; Weintraub & Mesulam, 1998), experimental studies of the interaction between the right and left hemispheres of the human brain during adaptation under extreme conditions are few. The published research results mainly relate to the asymmetry of "sidedness" in the motor sphere. Thus, when adapting to unusual environmental conditions, an increase in the asymmetry coefficients was found, which indicate an increase in motor effects depending on the dominant hemisphere of the brain (Agadzhanyan, Baevsky & Barseneva, 2000; 1999; Filippova, 1999; Leutin & Nikolaeva, 1998; Arshavsky, 1988; Gil, Eduardo González. 2018). It is the non-right-handed who, for example, have an increased tolerance for adaptation disorders in expeditionary fly-in/fly-out working conditions traditionally prevalent in the Arctic regions (Khasnulin, Khasnulina & Chechetkina, 2009; Neustroev, N. D., Nikolaeva, A. D., Neustroeva, A. N., & Ivanova, A. V. 2016). In the study of long-term adaptation, a sufficiently large number of people surveyed with right-sided laterality were revealed, but as the duration of residence in the North increased, the combination of the left eye and left hand became dominant (Agadzhanyan, Baevsky & Barseneva, 2000). Research results have shown that non-right-handed at high latitudes is associated with adaptive changes in the human body. Natural selection only reinforced the predominance of these features in the population of indigenous people living under the constant influence of extreme environmental factors. The fundamental research conducted in the North-East of Russia (Arshavsky, 1988; Arshavsky, 2011) also indicates differences in the dominant methods of processing information from the indigenous and non-indigenous populations. There is evidence that resistance to the stressing effect of Arctic factors is formed in people with high functional activity of the right hemisphere of the brain, with normal function of the left hemisphere (Filippova, 1999, Khasnulin, Khasnulina & Chechetkina, 2009). The role of genetically and culturally deterministic types of hemispheric response in human adaptation based on the physiological concept of search activity (Arshavsky, 1988) is substantiated. In the works of Russian scientists there are also assumptions about the instability (lability) of

functional asymmetry and the possibility of its change not only under the influence of psychoactive substances or stress effects, but also for no apparent reason (Abramov & Abramova, 1996; Bragin & Dobrokhotova, 1988; Deglin, 1996).

It is shown that the functional activity of the brain hemispheres in people adapted to the factors of the Arctic zone is higher than the average of the similar activity of people of the tropics and mid-latitudes (Leutin & Nikolaeva, 1988). Standards of efficiency and the timing of fatigue are different in individuals with right and left asymmetry profiles, as also evidenced by data obtained in the conditions of the Arctic expedition. The increase in the inhibitory processes in the central nervous system in the group of left-brained people, as compared with right-brained people, is indicated. Different are adaptive capacities, mobility of nervous processes, efficiency, time perception, timing of fatigue (Leutin & Nikolaeva, 1988). With a change in climatic and geographical conditions, changes in the functional asymmetry of memory processes were detected (Filippova, 1999). However, the role of functional attention asymmetry for human adaptation in the conditions of the Arctic region has not been studied enough. At the same time, its importance for the formation of occurring disorders of adaptation, both in the mental and somatic areas, dictates the need for its study in adapting to the conditions of the Arctic. Objective of the study: to identify the features of the attention function in people of working age of the indigenous (aborigines of the North, AN) and non-indigenous (migrants of the North, MN) population of the Arctic.

1.1. Participants

The studies were conducted on the basis of the Federal and Municipal Medical Institutions of the Yamal-Nenets Autonomous Area (YNAA) and Federal State Budgetary Educational Institution of Higher Education (FSBEI HE) "Yugra State University". Residents of the indigenous and non-indigenous population of both sexes, aged 16 to 69 years attended this study. A total of 378 people, including 106 (28.0%) male and 272 (72.0%) female were examined. The sample of the examined individuals from among the AN (Nenets) was 223 people, among the MN (the Slavs) was 155 people. The duration of stay in the Arctic region among representatives from among the MN exceeded on average 20 years.

2.Methods.

In this paper, a version of a digital Dot cancellation test was used, which allows to evaluate the level of active attention, productivity and regulation at an individual (Amatuni, 1969; Wasserman, Dorofeeva, Meerson, 1997). This technique allows to use it to study the functional asymmetry of attention (AA). For this purpose, the number of mistakenly crossed out or missing figures in the right and left half of the table was counted. The calculation of the AA coefficient (AAC) was carried out according to the formula: AAC = $\frac{M_2}{M_1}$, where M_1 is the number of errors in the right half of the table, M_2 is the number of errors in the left one.

3.Results and Discussions

Studies have shown that the change in the average level of AA at representatives from the AN is manifested by a distinct dominance of the right hemisphere of the cerebral cortex. When analysing the localization of errors caused by AA, differences in M_1 and M_2 are found in the group of AN at the level of high statistical significance ($p < .001$). When analysing separately the male and female subgroups, the statistical differences in M_1 and M_2 are also significant (respectively at $p < .05 – .01$). Female AN gave a particularly clear increase in M_1, compared with male (Table 1).

Table 1. Comparative indicators of the implementation of the Dot cancellation test in the groups of indigenous and non-indigenous population of the Arctic region (M ± m)

Age groups	Sex	Number of errors			
		Aborigines of the North (AN. Nenets)		Migrants of the North (MN. the Slavs)	
		Right side of cancellation test (M_1)	Left side of cancellation test (M_2)	Right side of cancellation test (M_1)	Left side of cancellation test (M_2)
16-19 years	male	6.00±1.02*	4.21±0.71	4.00±0.99	5.30±1.49
	female	7.88±1.24*	6.40±1.40	4.78±0.91	4.78±1.15
	both sexes	7.47±1.00**	5.92±1.11	4.37±0.66	5.05±0.93*
20-29 years	male	4.25±0.86	2.75±0.86	2.67±0.74	4.00±1.32*
	female	5.90±0.88	5.81±1.11	3.17±0.47	2.59±0.35
	both sexes	5.56±0.72	5.18±0.91	3.02±0.40	3.00±0.46
30-39 years	male	7.60±3.66	8.60±3.56*	4.42±1.26	4.67±1.36
	female	8.02±1.38	7.52±1.58	5.00±1.96	5.11±1.99
	both sexes	7.94±1.29	7.72±1.43	4.77±1.26	4.93±1.30
40-49 years	male	6.93±1.84*	5.79±1.49	4.24±0.82	3.71±0.85
	female	4.86±0.83	4.46±0.74	5.67±1.19	4.58±0.88
	both sexes	5.55±0.83	4.90±0.69	5.07±0.78	4.22±0.62
50-59 years	male	7.50±1.50	4.00±2.00	4.86±1.08*	3.21±0.76

	female	6.19±2.00	5.44±1.87	4.63±0.76	3.68±0.71
	both sexes	6.33±1.78*	5.28±1.67	4.73±0.62*	3.48±0.52
60-69 years	male	4.00±3.00	2.50±2.50	-	-
	female	-	-	3.86±1.50	3.57±0.90
	both sexes	-	-	4.60±1.33	3.80±0.87
16-69 years	male	6.28±0.94*	5.22±0.88	4.18±0.45	4.14±0.49
	female	6.89±0.59**	6.17±0.65	4.49±0.48*	3.92±0.44
	both sexes	6.75±0.50***	5.95±0.54	4.37±0.34	4.00±0.33

Note. The differences between the errors made in the right and left side of the cancellation test are significant when * - $p < .05$; ** - $p < .01$;*** - $p < .001$

As can be seen from the table, the difference between M_1 and M_2 is insignificant in the general group of 20-year-old persons from among the AN. The differences can be seen in the female group. However, a subgroup of 20-year-old male AN showed other result. Among male AN, 1.5 times more errors were made in the right field of cancellation test than in the left, the difference is statistically significant ($p < 0.05$). For 30-year-old AN, the M_1 indicator is slightly higher than M_2, the difference is not accurate. The same proportion is true for female AN. But, in contrast to female AN, for male AN of this age group the indicator M_2 clearly increases ($p < .05$).

For 40-year-old male AN, when performing the cancellation test, the M_1 indicator again exceeds the M_2 indicator ($p < .05$). The same trend exists both for female AN and for the general subgroup of AN of this age, but without statistically significant differences. The older age group of the AN (50-59 years) is characterized by a significant increase in M_1 ($p < .05$). No statistically significant differences of M_1 and M_2 were found for male AN and female AN of this age group.

Thus, by age decades, a significant increase in errors in the right side (M_1) of the cancellation test table was obtained in the general youth group ($p < .01$) and in the older group (50-year-old persons from the surveyed AN) ($p < .05$). A significant increase in M_1, compared with M_2, for male AN at the age of 20 and at the age of 40 is revealed ($p < .05$). A significant increase in M_2, compared with M_1, for 30-year-old male AN is revealed ($p < .05$). In general, as we see, for male AN AA profile by age decades is more labile than for female AN.

A correlation analysis of age with the value of asymmetry error (M_1 and M_2) confirmed that the profile of attention is little dynamic, and is mainly characterized by a right-sided strategy for processing non-verbal incentives at the representatives of AN (especially female AN). Thus, in a separate analysis, a reliable association of age with M_1 was found for female AN ($r = .3$, $p < .05$).

A reliable correlation between age and asymmetry errors (M_1) was found in the youth group of AN ($r = .3$, $p < .05$). A 20-year-old male AN revealed a significant association of age with M_2 ($r = .75$; $p < .05$), which confirms the state that AA profile is not fixed rigidly at the male AN. By the average period there is an asymmetry vector shift when the left type clearly dominates. Meanwhile, in the older age groups of the AN, from the age of 40, the prevalence of the right AA type is again found.

The study of AA indicators obtained in the group of non-indigenous population (MN) also suggests that with long-term residence in the conditions of the Arctic region, residents show a large functional activity of the right hemisphere. In our sample, an increase in the indicators of the right AA type, compared to the left AA type, was determined, first of all, for persons with many years Arctic experience (age group of 50-59 years old) ($p = .032$).

Analysis of the results of the average error in the right (M_1) and left (M_2) side of the Dot cancellation test indicates an increase in AA during long-term residence in the Arctic region. At the same time, it should be noted that representatives of the MN have large differences in results in determining the right or left AA strategies used in the performance of the task. Comparison of data showed that in the youth group of MN, errors were more often made in the left field of the cancellation test table (M_2), which was determined at a statistically significant level ($p = .048$). However, in a separate analysis of girls, errors in the right (M_1) and left (M_2) fields of the correction table were evenly distributed. Boys have unequal distribution with an increase in M_2.

In the general group of 20-year-old MN, the distribution of errors in the right (M_1) and left field (M_2) was equal. At the same time, at the separate analysis mixed results are received. For female MN, M_1 exceeded M_2, with no statistically significant differences. For male MN of a similar age group, there was a significant increase in M_2 compared with M_1 ($p < .05$).

In the group of 30-year-old representatives of MN, there was also a slight increase in M_2 compared with M_1. Meanwhile, for 40-year-old MN, both male and female, M_1 exceeds M_2, which indicates a change in the AA profile. By older age in the general group of 50-year-old MN, M_1 significantly exceeds M_2 ($p < .05$). The same picture was obtained by separate analysis, with a significant increase in M_1 at women ($p < .05$).

For male MN before the age of 40, there is a left AA profile. At the age of 40, the asymmetry vector is shifted, and for 50-year-old men from the MN group, the right AA profile is observed, which is fixed at a statistically significant level. For female MN in almost all age groups, the right AA profile is observed. Statistically significant differences between M_1 and M_2 were obtained in the total sample of female MN ($p < .05$).

Correlation analysis confirms that long-term residence in the Arctic region leads to a change in inter-hemispheric interaction with a predominant activation of the right hemisphere. For the 30-year-old MN, a direct connection of the Arctic experience with M_1 and M_2 was obtained, which is closer in the first case ($r = 0.35$ and $r = 0.31$, respectively). For 50-year-old MN, the correlation is also stronger with M_1, which is determined at a statistically significant level ($r = .44$, $p < .01$). For 30-year-old and especially for 50-year-old women among the MN, the direct connection of the Arctic experience with the right AA type index (M_1) is highly reliable ($r = .5$; $p < .05$ and $r = .7$; $p < .001$). In general, the analysis of the correlation between the value of the asymmetry index, on the one hand, and the duration of residence in the Arctic region, on the other hand, revealed that the interaction of these factors was uneven, but systemic (the closeness of connection in different age groups: from .21 to .77).

In connection with the above, it is important to study the frequency of distribution of this trait in different ethnic populations living in the Arctic zone. It should be noted that during the study we considered not only the ethnic and gender aspects of this problem, but also carried out the age breakdown, in order to more accurately determine the dynamics and nature of the functional resources of both hemispheres in the process of adaptation to extreme conditions of the Arctic environment.

The analysis showed that the distribution of AA types in different ethnic populations is characterized by an increase in the influence of the hemispheric type (Table 2).

Table 2. Occurrence of left-right asymmetry and attention symmetry among the indigenous and non-indigenous population of the Arctic region (%)

Age group	**Sex**	**Aborigines of the North (AN)**			**Migrants of the North (MN)**		
		Asymmetry, %		**Symmetry %**	**Asymmetry, %**		**Symmetry %**
		left	right		left	right	
16-69 years	male	35.7	57.2	7.1	70.0**	20.0	10.0
	female	32.0	62.0***	6.0	44.5	55.5	-
	both sexes	32.8	61.0***	6.2	57.9	36.8	5.3
20-29 years	male	12.5	75.0	12.5	66.6**	16.7	16.7
	female	32.2	54.9	12.9	31.0	48.3	20.7
	both sexes	28.2	59.0**	12.8	41.5	39.0	19.5
30-39 years	male	60.0	30.0	10.0	50.0	41.7	8.3
	female	31.8	52.3*	15.9	27.8	33.3	38.9
	both sexes	37.0	48.1	14.9	36.7	36.7	26.6
40-49 years	male	35.7	57.2	7.1	23.5	47.1	29.4
	female	35.7	50.0	14.3	29.2	58.3*	12.5
	both sexes	35.7	52.4	11.9	26.8	53.7**	19.5
50-59 years	male	-	100.0	-	21.4	57.2*	21.4
	female	31.2	56.3	12.5	21.0	63.2**	15.8
	both sexes	27.8	61.0*	11.2	21.2	60.6***	18.2
60-69 years	male	-	100.0	-	-	-	-
	female	-	-	-	28.6	42.8	28.6
	both sexes	-	-	-	25.0	50.0	25.0
16-69 years	male	34.0	58.0**	8.0	42.4	39.4	18.2
	female	32.6	55.6***	11.8	29.2	51,0***	19.8
	both sexes	32.9	56.2***	10.9	34.3	46.5*	19.2

Note. Differences between the occurrence of the right and left AA types are significant at * - $p < .05$; ** - $p < .01$;*** - $p < .001$

As can be seen from the table, the above trend is particularly pronounced among the indigenous people of the Arctic region. In the general group of AN representatives surveyed by us, the distribution of persons with the right AA type was 56.2%, with the left – 32.9% ($p < .001$). When analysing the results by age decade, the right AA type among representatives from the AN was revealed more often than the left AA type for young and middle age, and for 50-year-old residents.

The ratio of persons with right and left AA type was 61.0% and 32.8% ($p < .001$) in the youth group (16–19 years old), 59.0% and 28.2% in 20 years old ($p < .01$) and in the age group of 50–59 years – 61.0% and 27.8% of persons, respectively ($p < .05$). For middle age, the differences are not so sharp and statistically insignificant. Among the 30-year-old representatives from the AN, the distribution of the right and left AA types was 48.1% and 37.0%, respectively, and the group of people with attention symmetry (AS) was increased (14.9%). For 40-year-old AN, the ratio of right and left AA types was 52.4% and 35.7%, while the increase in the right type was due to a decrease in persons of the mixed group.

The distribution of left – right AA type for male AN and female AN was slightly different in age groups. In particular, female AN in all age groups showed predominance of the right, compared with the left AA type, significantly for young female AN ($p < .001$) and for female AN of middle age (30–39 and 40–49 years) ($p < .05$). In turn, the right AA type for male AN was significantly more frequent than the left type in the total sample (58.0 and 34.0%) ($p < .01$). Statistically significant differences were also obtained in the group of young AN (20–29 years old), where there were 6 times more men with the right AA type than male AN with the left AA type ($p < .001$). Male AN in middle age were more likely to have left AA type than right one (60.0% and 30.0%, respectively). This fact confirms that experimentally proven AA in healthy people is dynamic.

The attention symmetry (AS) among representatives of the AN did not exceed 15% and was found in all age groups about the same, with the exception of adolescence. For female AN, AS was noted, however, somewhat more often than for the male AN. The obtained data are consistent with the notion that the lateral human phenotype is caused by differences not only in the motor, sensory, but also in the mental sphere, determining by the functional asymmetry of the brain hemispheres and manifesting in two opposite forms - right and left, with only a small part of people is characterized by symmetry (Vizel, 1996; Rotenberg, 2009; Khomskaya & Batova, 1992).

In general, the total sample of the indigenous population is characterized by the fact that in all age groups the prevalence of the right AA type is noted, and the wider functional capacity of the right hemisphere of the brain is most clearly manifested at a young age. At the same time, it is noteworthy that the predominance of the right AA type is noted among 50-year-old AN, which also confirms that ageing is accompanied by a decrease in the function of the left hemisphere in each adaptive individual separately (Fokin & Ponomareva, 2003; Andrews-Hanna, 2007; Cabeza, 2002). This fact confirms the assumption about the advantages of opportunities for people with higher functional activity of the right hemisphere.

In the group of non-indigenous population (MN), the picture of the distribution of various attention profiles was more mosaic. In the general sample of the MN, the right AA type was also significantly more frequent ($p < .05$). However, when comparing the data of the right and left types of AA by age decades in the sample of the MN, the following results were obtained. In the youth group of MN, the left AA type was more often noted. In the next two age decades (20–29 years old and 30–39 years old), the MN equally often showed both left and right types. In the older period (40–49 and 50–59 years), the MN already clearly showed a significant advantage of the right AA type with the progression of the right-brained strategy over the age decades ($p < .01 – .001$). Thus, the MN with age and an increase in the duration of residence in the Arctic environment, show changes in the functioning of the AA, during which a shift in the balance of intracortical interactions toward the right hemisphere occurs.

Similar results were obtained in other researches in the study of changes in the functional asymmetry of memory processes during an emergency change of climatic and geographical conditions (in the region of lake Baikal). It was established that the change of the functional stereotype, caused by a sharp change in climatic and geographical conditions, leads to a change in interhemispheric interactions with preferential activation of the right hemisphere, as evidenced by changes in the alpha index of the brain hemispheres (Filippova, 1999).

In the course of our study, differences in the distribution of the left and right AA types by age decades among male MN and female MN were also revealed. So, in the youth group and for 20-year-old male MN, the left AA type was significantly more often detected ($p < .01$). By the older age, the right AA type begins to dominate. At the age of 40, a change in the right and left attention strategies was accompanied by an increase in the number of male MN with AS. For 50-year-old male MN, the right AA type was already 2.7 times more frequent than the left one ($p < .05$). In turn, for female MN, the effectiveness of cognitive functioning is mediated to the same extent by the left and right hemispheric mechanisms of AA. However, the 40-year-old age of female MN is also characterized by an increase in the functional activity of the right hemisphere, at which the proportion of persons with the right AA type increases sharply ($p < .01$).

The indicator of AS at MN in some age periods approached the mark of 30% of cases. Very few MN with AS were only in the youth group (5.3%). In other age groups of MN, the AS indicator averaged 20% of cases. A significant increase in the AS index compared with the youth group of MN (16–19 years) was observed among 30-year-old MN ($p < .05$).

In a separate analysis, the distribution of the AS index for male MN and female MN also turned out to be different. Thus, for male MN, the AS index increased in the group of 40-year-old. It should be noted that the group of 40-year-old male MN was characterized by unstable (by the activity of voluntary attention) domination of the hemispheres, and was characterized by both a change in the dominant hemisphere and an increase among individuals without pronounced signs of AA. AS index increased for female MN at age of 30 years.

Significant changes in the balance of activation of the hemispheres and disruptions of normal interhemispheric interactions found among women of this period, which are manifested by a significant shift of the AA vector, indicate a highly unstable adaptation in the Arctic environment. Earlier in other works, results were obtained, according to which a significant attention asymmetry and an increase in the reaction time in the left visual field due to an emotional factor were found for women (Liotti & Tucker, 1992).

4. Conclusion. In the conditions of the Arctic environment, the interaction of symmetrical and dissymmetrical factors of attention function is disturbed. The obtained findings suggest a distinct right asymmetry of attention among representatives of indigenous population (Nenets). In people of non-indigenous population (the Slavs) who arrived in the Arctic region more than twenty years ago, a significant and distinct change in the average level of asymmetry and a shift in the balance of intracortical interactions toward the right hemisphere were revealed. Depression of the left hemisphere with a corresponding increase in the influence of the right one, determined by the process of long-time living in the Arctic region, is manifested by a significant decrease in the proportion of migrants with the left hemispheric functional attention activity. Dominance of the right type of attention asymmetry, stipulated by the prolonged living in the Arctic region, is confirmed by a correlation at the level of high statistical significance.

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