

MIDDLE OB AREA LEARNERS' MENTAL CAPACITY AND CNS FUNCTIONAL STATUS FEATURES ACCORDING VARIATIONAL CHRONOREFLEXOMETRY METHOD

Yakovlev B.P., Litovchenko O.G.
Surgut State Pedagogical University
Surgut, Russia

The chronoreflexometrical performance characteristic of the Middle Ob Area residents aged from 7 to 20 years old was carried out on the ground of the simple visual-motor reaction latent period statistical analysis. The approximation of the CNS functional state estimation calculation criteria values and the performance level indexes allowed defining that the CNS functional status of Surgut school children and students had been at the reduced and insignificantly reduced performance level. A diminished attention, deterioration of temporary and precise activity parameters and significant performance lowering as a whole are indicative for such state.

The search for objective criteria of the nervous system development periods' estimation, the formation of its integrated systemic activity is one of important tasks of age-dependent physiological psychology. At that, it is important to know about the CNS age-dependent changes in comparison with other systems and functions of the body with due consideration of alterations in postnatal development sensitive periods (Soroko S.I. with other authors, 2006). A large body of research allows considering mental capacity as children's functional status integral index altering under the influence of endogenic and external cause factors (Grombakh S.M., 1988, Antropova M.V. and other authors, 2006).

Currently, as mostly often used in practice and objective method of the CNS functional state defining in physiological psychology of academic and professional activity the variational chronoreflexometry, at the heart of which a simple sensor-motor reaction latent period statistical analysis lies, is used. A relative simplicity of this method, usability in natural conditions, practical non-effect of training factor give an opportunity to use it as an express-method in applied research on human functional status estimation (Moroz M.P., Chubarov I.V., 2001).

In our research natives of the Middle Ob Area of both sexes aged from 7 to 20 took part, 1 and 2 health groups (1551 learn-

ers of municipal educational institutions of Surgut and the Pedagogical University students took part, among them 768 persons of male sex and 783 persons of female sex). All the examinees were referred to a Slavic nationality group and were born in Surgut by endemic population representatives, who had migrated to the places of new findings development from South-West and Southern areas of Russia and countries of the CIS.

For the purpose of getting information about the CNS functional state and the performance of the Middle Ob Area learners we used the computer program "Express-diagnostics of human functional state and performance" (Moroz M.P., 2003) by "IMATON" production, Saint Petersburg. The examination of school children and students was carried out in a separate sound-insulated laboratory in morning hours.

The Middle Ob Area learners' variational chronoreflexometry showed the following results (Fig. 1-6).

The comparison of average temporal values of a simple visual-motor reaction (SVMR) showed general improvement (reaction time reducing) from junior to senior age groups (Fig. 1). It appeared that the longest latent periods of the SVMR were in children of 7 and 8 years old, and the shortest and steadiest ones in the examined boys and girls aged 19 and 20.

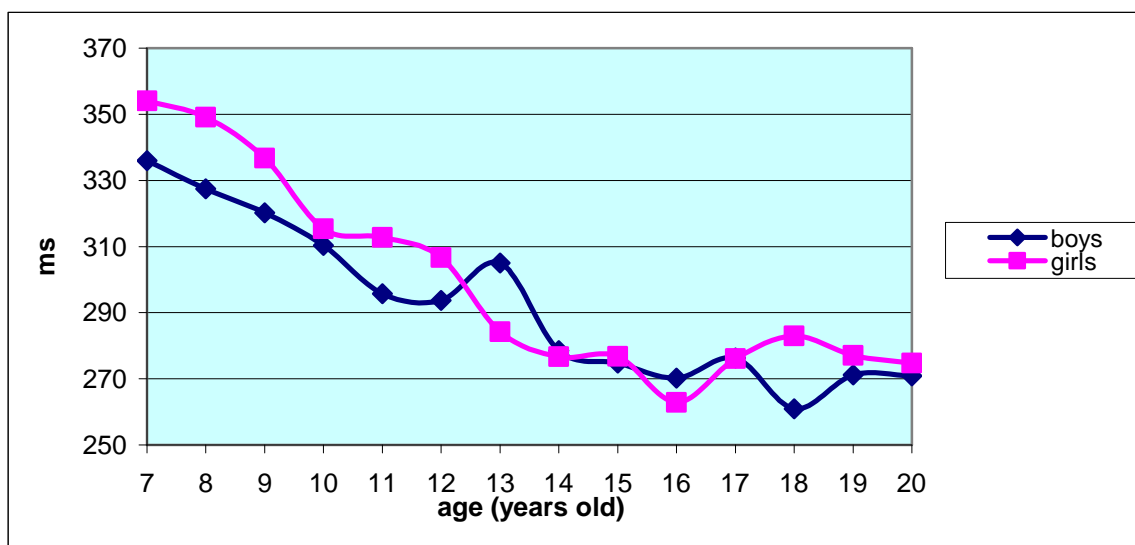


Fig. 1. Time of simple visual-motor reaction in Surgut natives (ms)

As the results of our research testify, an authentic shortening of the SVMR time occurred with the increase of years in Surgut natives of both sexes, that is probably associated with the CNS morphofunctional status and its highest departments' formation.

The reaction time reduction is most noticeable in the period from 7 to 11 years old both in boys and girls. The intensive changes of neurodynamic functions' properties in junior school learners are connected with the accelerated morphological brain maturity, regulation mechanisms improvement and specification of its separate departments, which are responsible for the reception and processing of information (D.A. Farber, N.V. Dubrovinskaya, 1991). At the age of 13 the SVMR speed is authentically higher in girls compared to the data of boys of the same age, that is probably can be associated with the beginning of active pubertal alterations in boys and changes of the functional status of the body as a whole.

During the puberty the pronounced SVMR variations were registered, and only in the ephebic period of ontogenesis the specified factor stabilized.

In 18-20-year-old boys the motor reaction speed is higher, than in girls, the SVMR in 18-year-old boys being authentically lower ($p < 0,05$) compared to 19-20-year-old boys.

The latent period duration of the sensorimotor reaction to a visual stimulus in non-adults is associated with not only morphofunctional formation of the visual analyzer's peripheral link, but, in a greater degree, of their central structures and, as a whole, the CNS functional state (A.I. Kiyenya, O.V. Kirichenko, 2001).

Boys were more responsive to visual stimulus compared to girls, statistically-valid differences are found out in age groups of 8, 9, 10, 18 years old.

The standard deviation analysis showed that from year to year the spread of VMR values reduced. The task performances improvement with the increase of years can be associated with the anterior cerebral cortex maturation, that manifests itself with the control function intensification, thereby a more selective brain structures' activation is achieved (T.V. Akhutina and other authors, 1999; V.M. Vodlozerov, S.G. Tarasov, 2002; N.Makarenko and other authors, 2005).

Our researches are based on bi-manual testing variant, which allowed investigating the interhemispheric functional asymmetry dynamics as well (Fig. 2, 3). It is known that the interhemispheric asymmetry phenomenon reflects the CNS adaptive activity based on bilateral regulation mechanisms.

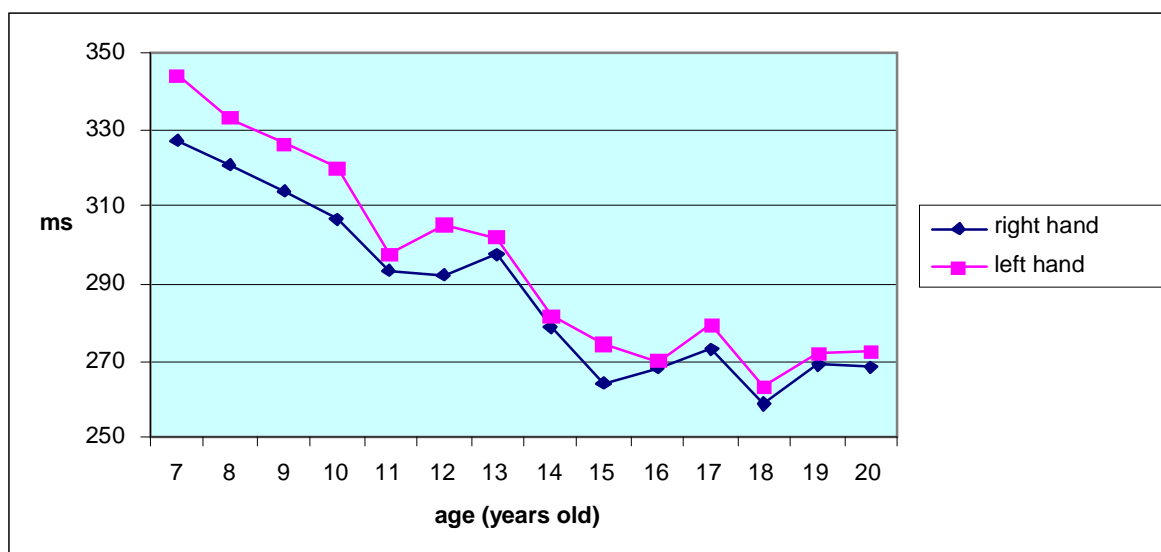


Fig. 2. Simple visual-motor reaction values (mc) in Surgut boys

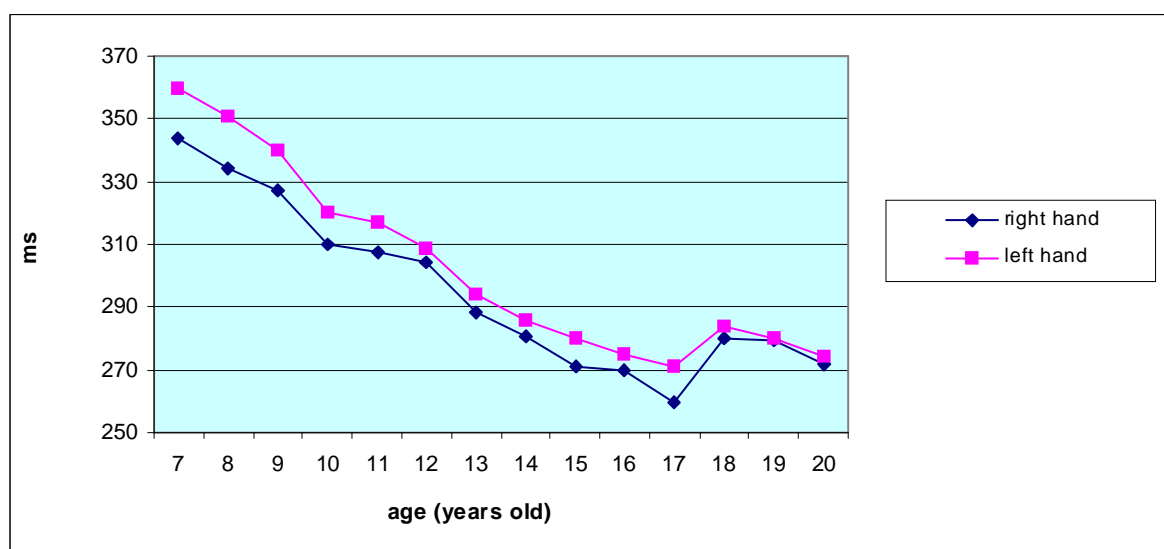


Fig. 3. Simple visual-motor reaction values (mc) in Surgut girls

The information processing by brain in each specific case is defined by the asymmetry of hemispheric activation levels and the dynamic character of interhemispheric relations. The response hand demonstrates a less sensomotor reaction time in the examinees (A.P. Bizyuk, 2005).

In the majority of the examined school children and students the SVMR speed was higher in the right hand.

In the age groups of 11, 14, 16, 19 years old in boys and 12, 19, 20 years old in girls the SVMR values of the right and left

hand were closest to each other or practically coincided. In the age groups of 7, 8, 9, 10, 12 years old in boys and 7, 9, 10 years old in girls maximal differences of the SVMR values of the right and left hand are registered (the differences are authentic, $p < 0, 05$).

A special attention was paid by us to the three quantitative criteria reflecting various sides of the CNS functional state, and also the performance levels: the nervous system functional level; the functionality level of the formed functional system; the nervous

reaction stability (T.D. Loskutova, 1975; M.P. Moroz, 2003).

The first chronoreflexometry criterion, which we analyzed, is the functional level of the system (FLS). Its value is determined mainly by the SVMR absolute indexes, i.e.

by the variation curve position against the absciss.

The given criterion was smoothly growing from 2, 1 to 2, 7 relative units (Fig. 4) over the period of the studied ontogenesis in the examined learners.

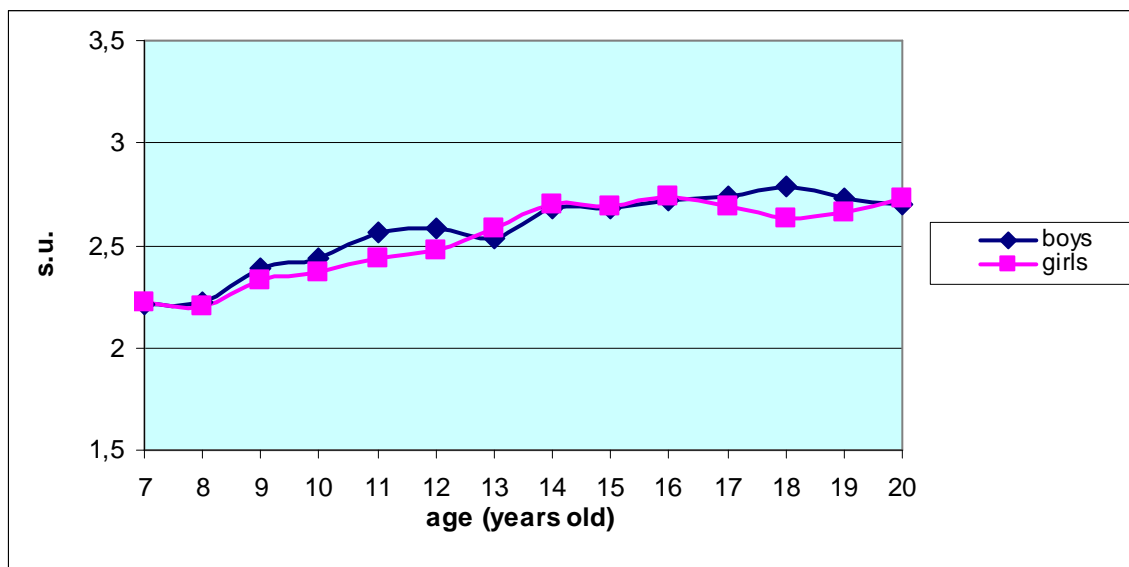


Fig. 4. Values of chronoreflexometry criterion “functional level of nervous system” in Surgut natives (relative units)

In the same age groups in boys and in girls no authentic differences were registered.

However, the fact that the given factor was within the limits of the functional status, which is characterized as “reduced performance”, comes under notice. Thus, according to M.P. Moroz (2003), the chronoreflexometry criterion “functional level of the nervous system” must be from 4, 9 to 5, 9 relative units.

The second criterion – the functionality level of the formed functional system (FL), is the fullest characteristic of the CNS state and allows judging about its ability to form and keep the corresponding functional system long enough.

In school children and students aged from 7 to 20 the FL was within the limits, which corresponded to the state of the char-

acterized as “insignificantly reduced performance” anywhere from 2, 0 to 3, 7 relative units (Fig. 5).

The FL criterion fluctuations were observed in puberty boys. In Surgut natives the FL criterion stabilized only with the beginning of ephebic period of ontogenesis.

The third criterion – the reaction stability (RS), was considered as the CNS states stability criterion. The less the SVMR values variability is, the more this factor value is (T.D. Loskutova, 1975; L.P. Pavlova, 1988).

In our researches the RS criterion in boys was smoothly growing from 7 to 11 years old. In girls the given criterion started growing from 12 only. The reaction stability approached the regulatory values (M.P. Moroz, 2003) only by 19, 20 years old both in boys and in girls (Fig. 6).

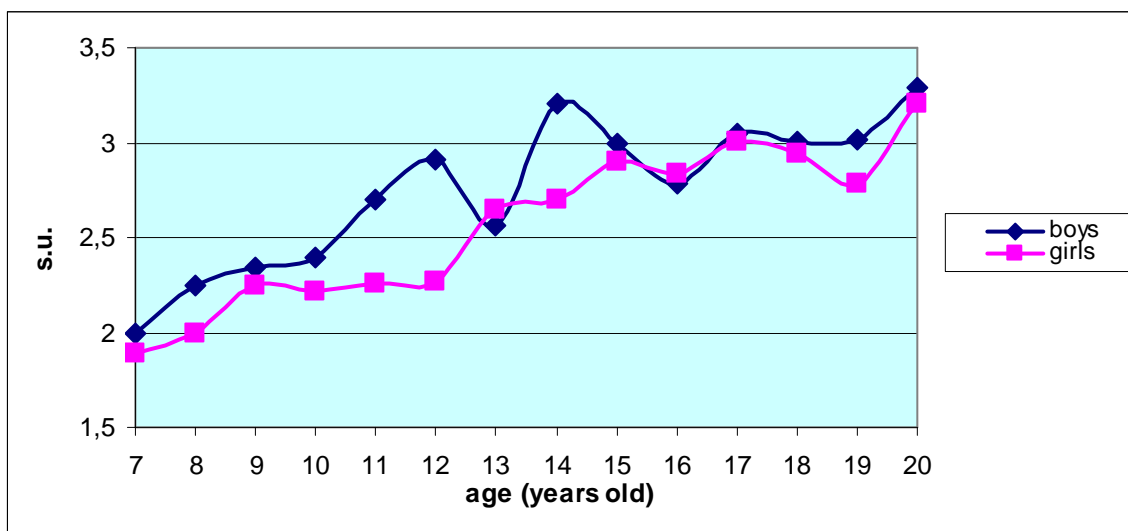


Fig. 5. Values of chronoreflexometry criterion “functionality level of the formed functional system” in Surgut natives (relative units)

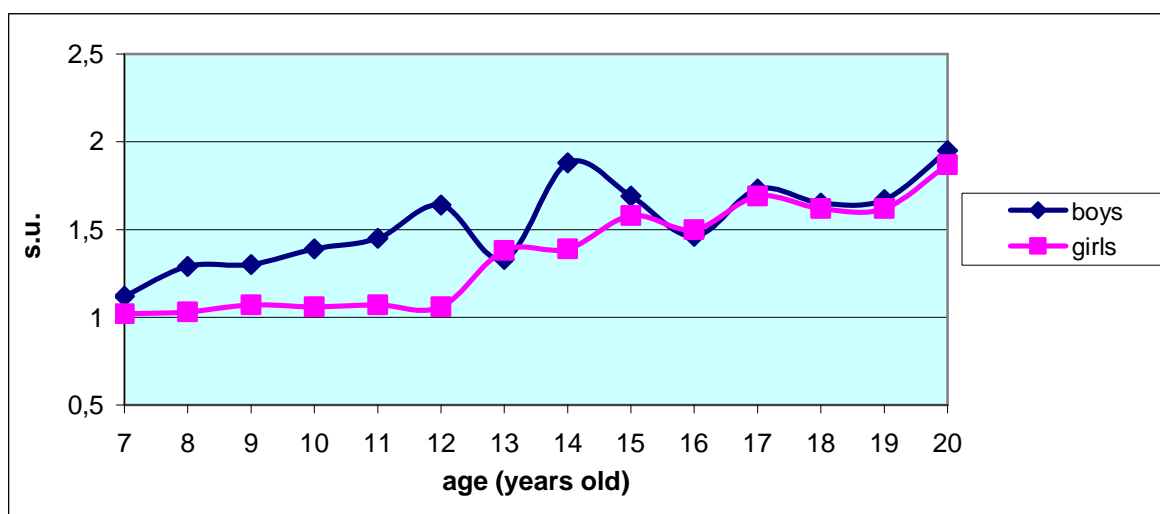


Fig. 6. Value of variational chronoreflexometry criterion “nervous reaction stability” in Surgut natives (relative units)

Thus, the approximation of the CNS functional state estimation calculation criteria values and the performance level indexes allowed defining that the CNS functional state of school children and students had been at the reduced and insignificantly reduced performance level (M.P. Moroz, 2003). For insignificantly reduced performance level the state of diminished attention is indicative, mistakes are assumed, the task performance time increases. The functional state at the level of reduced performance is characterized

by the deterioration of temporary and precise activity parameters and significant performance lowering as a whole.

The findings got by us can be used to control the psychophysiological state of the learners living in specific climate-geographical conditions of the Middle Ob Area. The CNS functional state express diagnostics can be used as an additional method of learners’ functional status differential estimation and performance control in various

periods of academic activity with the help of variational chronoreflexometry.

References:

1. Antropova M.V., Kuznetsova L.M., Paranicheva T.M. Mental capacity and its features in connection with sexual maturation in school children aged from 11 to 13 // *Human physiology*. 2006. V. 32, N 1, pp. 37-44.
2. Akhutina T.V., Melikyan Z.A., Niznaiko N.N. Attention features in junior school children according computer research data // *Moscow University Reporter. Psychology*. 1999. N 4, pp. 36-48.
3. Bizyuk A.P. Neuropsychological research methods compendium. Teacher edition. - SPb.: Speech, 2005, p. 400.
4. Vodlozerov V.M., Tarasov S.G. Human visual-motor activity in tracking conditions. - Kharkov: Humanitarian Center, 2002, p. 242.
5. Grombakh S.M. Performance and health of school children. – M.: 1988, pp. 142-150.
6. Karpenko A.V. Fluctuational structure of psychophysiological factors as source of information about mental capacity productivity // *Human physiology*. – 1988. – V. 14, N 5, pp. 730-738.
7. Kiyenya A.I., Kirichenko O.V. Sensomotor reactivity of children living in radiation unfavourable zone // *Human physiology*. – 2001. – V. 1, N 2, pp. 98-103.
8. Loskutova T.D. Central nervous system functional state estimation on simple motor reaction parameters // *Physiological Magazine of USSR*. – 1975, V. 61, N 1, pp. 3-12.
9. Makarenko N., Lizogub V., Bezkopylny A. Formation of neurodynamic functions properties in sportsmen // *Science in Olympic sport*. 2005. N 2, pp. 80-85.
10. Moroz M.P. Express-diagnostics of human functional state and performance. – SPb.: IMATON, 2003, p. 38.
11. Moroz M.P., Chubarov I.V. Methodology of human operator performance estimation and forecasting. – SPB.: “Petrocenter”, 2001, p. 80.
12. Pavlova L.P. Dominant performance mechanisms // *Nervous system*. – L.: Publishing House of LSU. – 1988, N 26, pp. 203-218.
13. Soroko S.I., Burykh E.A., Bekshayev S.S., Sidorenko G.V., Sergeyeva Ye.G. and others. Features of systemic brain activity and vegetative functions formation in children in conditions of European North // *Russian physiological magazine named after Sechenov I.M.*, N 8, 2006, pp. 905-929.
14. Farber D.A., Dubrovinskaya N.V. Functional organization of developing brain (age peculiarities and some principles) // *Human physiology*. – 1991, V. 17, №5, pp. 17-21.