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**FOREIGN CONCEPTS OF GIFTEDNESS: MEDICAL-BIOLOGICAL ASPECT**

For many years foreign and native researchers have been making the attempts to discover the nature of giftedness. There are constant discussions whether giftedness is inherited or talent can be developed. The lack of unanimity on this issue has led to the development of numerous concepts of giftedness, which support different positions of the authors. There are different dimensions of such concepts, most widespread of which are psychological-pedagogical, philosophical and medical-biological. It is emphasized, that medical-biological dimension has not gained much attention yet.

The aim of the article is to reveal the foreign medical-biological concepts of giftedness.

In the article the following research methods are used: general – analysis, synthesis, comparison, classification and generalization, which are necessary for studying the works of foreign researchers; terminological analysis which helped reveal the essence of investigated pedagogical phenomena by detection and clarification of fundamental concepts.

In the article a number of medical-biological concepts of giftedness have been characterized, in particular: “Model of the Dominant Hemisphere GBG”, “Concept of prenatal exposure and giftedness development”, “Prenatal exposures model of giftedness”. The highlighted models are aimed at explaining connection between the negative impacts during the processes of fetus development and emergence of either giftedness/different disorders or co-occurrence of giftedness and different disorders. Thus, medical-biological concepts of giftedness are based on the assumption that talent is conditioned by the unusual or unique development of the brain. These theoretical models not only provide understanding of emergence of giftedness from the neurophysiologic point of view, but also explain such phenomenon as “twice exceptionality”. It should also be stressed, that medical-biological concepts provide one of the ways of the solution of the problem on the nature of giftedness, while other aspects – psychological, philosophic, pedagogical etc. should also be considered in order to get versatile understanding of the studied phenomenon which will become the prospects for further research.

**Key words:** giftedness, concepts of giftedness, medical-biological concepts of giftedness, nature of giftedness.

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**Дарындылықтың шетелдік тұжырымдамалары: медико-биологиялық аспект**

Зерттеушілер көптеген жылдар бойы дарындылықтың табиғатын оқып зерделеп келеді. Мақаланың мақсаты – дарындылықтың шетелдік медико-биологиялық тұжырымдамаларын айқындау. Зерттеу әдістері: жалпы талдау, жинақтау, салыстыру және шетелдік зерттеушілердің еңбектерін саралау үшін қажетті жіктеу және жалпылау; зерттеліп отырған педагогикалық құбылыстардың мәнін ашып табуға және іргелі ұғымдарды түсіндіруге көмектесетін терминологиялық талдау. Мақалада дарындылық бас мидың бірегей ерекшеліктігі дамуының салдары деген болжамға негізделген дарындылықтың медико-биологиялық тұжырымдамалары сипатталады. Мақалада қарастырылған « ...бас миының жарты шарларының басымдылық моделі», «Туу алды жағдайлары және дарындылықтың дамуы тұжырымдамалары», «Туу алды жағдайларының дарындылықтың дамуына әсері моделі» сияқты теориялық тұжырымдамалар

дарындылықтың пайда болуын тек нейрофизиологиялық көзқараста түсіндіріп қана қоймайды, олар сонымен қатар мұндай феноменнің мәнін «екі өзгешелік», яғни психофизикалық дамуында өзгешеліктері бар балалардың да бар екендігін түсіндіре отырып ашады. Дарындылықтың медико-биологиялық тұжырымдамалары бойынша талант бас мидың бірегей ерекшеліктігі және өзгешелігімен дәйектеледі деген болжамға негізделеді. Көрсетілген модельдер дарындылықтың пайда болуына ұрықтың даму үдерісіндегі жағымсыз жағдайлар мен әртүрлі бұзылулардың байланысы әсер ететінін немесе әртүрлі бұзылулардың әсерінен дарындылықтың пайда болатынын түсіндіруге бағытталады.

**Түйін сөздер:** дарындылық, дарындылық тұжырымдамалары, медико-биологиялық тұжырымдамалар, дарындылық табиғаты.

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### **Зарубежные концепции одаренности: медико-биологический аспект**

На протяжении многих лет исследователи изучают природу одаренности. Цель статьи – выявить зарубежные медико-биологические концепции одаренности.

Методы исследования: общий анализ, синтез, сравнение, классификация и обобщение, которые необходимы для изучения работ зарубежных исследователей; терминологический анализ, который помог выявить сущность исследуемых педагогических явлений путем обнаружения и осмысления фундаментальных понятий.

В статье охарактеризованы медико-биологические концепции одаренности, которые основываются на предположении, что наличие таланта является следствием необычного или уникального развития головного мозга. Рассмотренные в статье теоретические концепции («Модель доминирующего полушария ГБГ», «Концепция пренатальных воздействий и развития одаренности», «Модель пренатальных воздействий на развитие одаренности») не только объясняют происхождение одаренности с нейрофизиологической точки зрения, но и раскрывают сущность такого феномена, как «дважды исключительность», то есть наличие одаренности у детей с нарушениями психофизического развития. Медико-биологические концепции одаренности основаны на предположении, что талант обусловлен необычным или уникальным развитием мозга. Выделенные модели направлены на объяснение связи между негативными воздействиями во время процессов развития плода и возникновением одаренности / различных расстройств или совместного возникновения одаренности и различных расстройств.

**Ключевые слова:** одаренность, концепции одаренности, медико-биологические концепции одаренности, природа одаренности.

### **Introduction**

For many years foreign and native researchers have been making the attempts to discover the nature of giftedness. There are constant discussions whether giftedness is inherited or talent can be developed. The lack of unanimity on this issue has led to the development of numerous concepts of giftedness, which support different positions of the authors. As has been noted in our previous studies (Boichenko, M. 2016) [1], there are different dimensions of such concepts, most widespread of which are psychological-pedagogical, philosophical and medical-biological. It should be also emphasized, that in Ukraine the most popular in the pedagogical discourse are psychological concepts of giftedness, both foreign and native, which can be explained by the traditions of development of gifted education in

our country. Instead, medical-biological dimension has not gained much attention yet.

### **Analysis of relevant research**

Different aspects of gifted education in Ukraine and foreign countries (in particular, history of gifted education, content-procedural foundations of gifted education at different levels of education system functioning, professional training of GT teachers, etc.) have become the issue of special interest of such native researchers as V. Alfimov, O. Antonova, I. Babenko, O. Bevz, O. Bocharova, A. Chichiuk, L. Chukhno, M. Drobotenko, M. Halchenko, Yu. Hotsuliak, M. Kabanets, I. Kholod, Ya. Kulchytska, M. Milenina, A. Sahalakova, A. Sbruieva, M. Sbruiev, V. Stryzhalkovska, P. Tadeiev, N. Telychko, V. Volyk and others.

Special attention in the frames of our study deserve the works of N. Lavrychenko (Lavrychenko, N. M. 2016, 2017) [2-3], where a number of foreign concepts of giftedness are revealed.

Considering the lack of attention to the issue under investigation in the native pedagogical discourse, the aim of the article is to reveal the foreign medical-biological concepts of giftedness.

### Materials and methods of research

In the article the following methods are used: general research methods – analysis, synthesis, comparison, classification and generalization, which are necessary for studying the works of foreign researchers; terminological analysis which helped reveal the essence of investigated pedagogical phenomena by detection and clarification of fundamental concepts.

### Results and discussion

Turning to the consideration of medical-biological concepts of giftedness, we'd like to note that their purpose is to consider the phenomenon under study from the standpoint of neuroanatomy, neurophysiology and neuropsychology. These concepts are based on the assumption that talent is conditioned by the unusual or unique development of the brain [4-10].

A significant contribution to the development of the neurobiological theory of intellectual giftedness was research of N. Geschwind and A. Galaburda (Geschwind, N., Galaburda, A. M. 1984) [11]. Although the main aim of the scientists was to study the asymmetry in the morphology and physiology of the brain, the obtained results allow better understanding of the nature of giftedness. In the monograph "Cerebral lateralization: biological mechanisms, associations and pathology" (Geschwind, N., Galaburda, A. M. 1987) [12], the authors emphasize that moderate violations of neuronal migration not only cause disorders in the functioning of the nervous system, but are often manifested in extraordinary abilities.

In the "Model of the Dominant Hemisphere GBG" (named after the first letters of its authors – N. Geschwind, P. Behan, A. Galaburda), scientists suggest that an increased level of testosterone in the pregnant woman prevents the development of the left hemisphere of the fetal brain, while enhancing the development of the right hemisphere. In support of this hypothesis, the authors of the model point out the link between frequent cases of autoimmune diseases,

bronchial asthma, allergies and myopia among the left-handed and ambidextrous (Geschwind, N., Behan, P. 1982) [10]. Other scientists, who studied mathematically gifted youth with extraordinary abilities (Butterworth, B. 1999) [5], also indicate a high frequency of manifestations of these disorders in the studied category.

Despite the criticism of the opponents of GBG, the leading idea of the model has been developed in further research by US, British and Canadian scholars.

In particular, A. Fingelkurts and A. Fingelkurts put forward arguments to confirm the link between high mental abilities and high levels of testosterone in a pregnant woman by the example of male monozygotic twins (Fingelkurts, An. A., & Fingelkurts, Al. A. 2002) [9].

In turn, a group of foreign researchers led by M. O'Boyle invented unique examples of the brain activation using functional Magnetical Resonance Imaging (fMRI) to diagnose mathematically gifted youth while performing tasks for mental rotation.

In particular, gifted students demonstrated enhanced development of the anterior part of the right hemisphere and increased bilateral activation of the brain while performing the three-dimensional rotation task in comparison with the control group.

Thus, the study of M. O'Boyle et al. confirmed the position of GBG model, noting that the increase in testosterone levels during the second trimester of pregnancy can be explained by the prevalence of the number of male individuals among mathematically gifted. It should be noted that in modern conditions the number of studies devoted to physiological preconditions and various dimensions of cognitive functioning is increasing (O'Boyle, M. W., Cunnington, R., Silk, T. J., Vaughan, D., Jackson, G., Syngeniotis, A., et al. 2005) [16].

At his time, the leading theorist of gifted education of the beginning of the twentieth century L. Terman noted that the inequality of the psychophysiological characteristics of a gifted child is the same as that of ordinary children. However, more recent research has proved the mistake of the scientist's idea, in particular, by demonstrating the presence of mathematical and linguistic abilities in intellectually gifted students, which is, rather, a rule than an exception (Winner, E. 2000) [17].

Researchers D. Detterman and M. Daniel have found out that mathematical abilities of the students with high IQ scores were significantly higher than linguistic compared with students with lower IQ scores (Detterman, D., & Daniel, M. 1989) [6]. Consequently, in this contingency, giftedness is

explained, first of all, by the domination of the right hemisphere of the brain. In support of this thesis, E. Winner mentions a number of arguments, namely: 1) children with high abilities in the field of mathematics, arts and music demonstrate increased activity of the right hemisphere, compared with ordinary children, in the performance of tasks specific to this hemisphere; 2) gifted children are disproportionately not right-handed; 3) musically or mathematically gifted children have a more bilateral, symmetrical structure of the brain, and the right hemisphere often performs functions that usually belong to the left hemisphere; 4) giftedness in spatial activity is accompanied by a greater incidence of speech disorders, including dyslexia; 5) children with higher IQ scores are more likely to have autoimmune diseases and different disorders (Winner, E. 2000) [17].

The studies in the field of neurophysiology demonstrate presence of the neurological uniqueness of gifted individuals, primarily the increased activity of the right hemisphere of the brain. In particular, such scholars as S. Jin, S. Kim, K. Park, and K. Lee, having compared the encephalograms of 18 gifted students with encephalograms of ordinary students during neuropsychological tasks on visual spatial design, received results that showed the dominant activity of the right hemisphere in the gifted students along with the best results of neuropsychological tests. The authors confirmed the conclusions of their predecessors that the dominance of the right hemisphere is associated with higher coordination and distribution of resources of the cerebral cortex in gifted individuals (Jin, S. H., Kim, S. Y., Park, K. H., Lee, K. J. 2007) [13].

The authors of another study also hold a similar opinion, emphasizing that the frontal asymmetry in the right side of the cerebral cortex may act as a physiological marker of a gifted brain (Fingelkurts, An. A., & Fingelkurts, Al. A. 2002)

It should be noted that in addition to a group of scientists led by M. O'Boyle (O'Boyle, M. W., Cunnington, R., Silk, T. J., Vaughan, D., Jackson, G., Syngeniotis, A., et al. 2005), the method of functional Magnetical Resonance Imaging was used by other foreign researchers to detect a typical cases of activation of functional visualization. A number of studies have identified brain divisions, including prefrontal cortex (PFC), anterior cingulate, posterior parietal section, most involved in tasks with increased g-loading.

In turn, J. Lykken defines such a unique characteristic of gifted individuals as the ability to creative thinking, emphasizing that intellectually-

creative individuals are typically highly motivated to accomplish tasks and can solve a problem from different angles (Lykken, D. T. 1998) [14]. Sometimes these people are called outside-the-box thinkers because they can look at the prospects that most ordinary people do not take into account. Other researchers point to a link between intellectual creativity and reduced latent inhibition. According to the scientists, individuals with a high level of mental development can simultaneously handle a large number of different tasks. For this, the working memory of the person should be extraordinary, and this fact is evidenced by research using the method of Magnetical Resonance Imaging, in particular with regard to increased activation of the brain parts responsible for the memory of the work.

Researchers M. Mrazik and S. Dombrowski suggest that the uniqueness of the brain functioning in gifted persons is due to their ability to perform tasks persistently and constantly develop and improve abilities far more than ordinary people do (Mrazik, M., Dombrowski, S. C. 2010) [15]. Consequently, we can state that current research in the field of neurophysiology confirms the presence of significant differences in the structure and functions of the brain of gifted children and youth compared with their ordinary counterparts.

Within the framework of medical-biological concepts, deserve attention the concepts of prenatal origin of giftedness, in particular the "Concept of prenatal exposure and giftedness development" of S. Dombrowski.

In the basis of this concept is laid the hypothesis of the existence of a connection between the influence of adverse factors in the prenatal period and the subsequent psychological, behavioral disorders and difficulties in learning. In this context, the authors of the concept do not focus on the influence of such well-known negative agents as rubella, alcohol or narcotic substances that cause severe developmental maladies. The subjects of scientific interest are such influences that cause minor changes in the central nervous system (CNS) of the fetus. Such CNS abnormalities do not cause visible physical anomalies and do not have clinical manifestations until the child faces certain life difficulties. The result is a lack of attention, difficulties in learning, speech and behavioral disorders, reduced cognitive abilities. As scientists point out (Dombrowski, S. C., & Martin, R. P. 2009) [8], the above mentioned problems are the result of adverse impacts on the fetus in the second and third trimesters of gestation.

Researchers emphasize the importance of the second and third trimesters of gestation precisely

because during the first trimester only the rudiments of the central nervous system are formed, while its improvement occurs during subsequent periods. During the second and third trimesters of gestation, the brain develops more rapidly than in any other period of human life. During this period of accelerated development the brain is the most vulnerable.

In this context, it should be noted that position of the authors of this concept coincides with the views of J. Dobbing and J. Sands, who confirmed their hypothesis by numerous medical studies in the 80's of the twentieth century. Scientists also stress the importance of taking into account the frequency, strength and duration of prenatal effects that may lead to changes in the growth of the central nervous system. In particular, processes of neuronal proliferation, migration, differentiation, myelination and apoptosis (cell death) in specifically defined periods of gestational

risk are the cause of serious changes or disorders (Dobbing, J., & Sands, J. 1979) [7].

A significant amount of research is devoted to the study of the relationship between influenza in the second and third trimesters and the development of schizophrenia in a child. Other investigations are devoted to the study of the effects of such negative factors as infectious diseases, malnutrition, concussion in a pregnant woman on the occurrence in the child of such violations as autism, schizophrenia, learning difficulties, etc. (Mrazik, M., Dombrowski, S. C. 2010)

It should be noted that the above-mentioned connections also explain the emergence of giftedness, because, according to the scientists, the outlined problems and talent have the same nature. Neuronal changes (proliferation, migration, differentiation, myelination and apoptosis) cause not only mental / behavioral disorders, but also the emergence of giftedness.

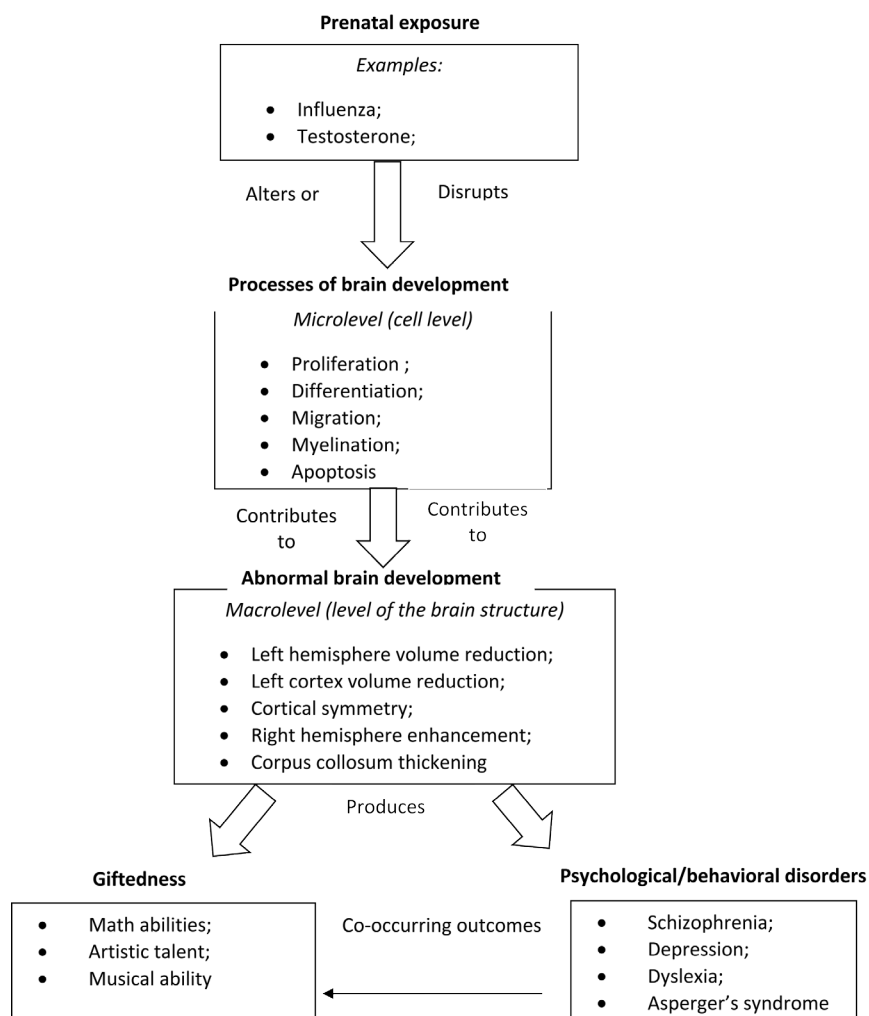


Figure 1 – Prenatal exposures model of giftedness (Mrazik, M., Dombrowski, S. C. 2010)

For the first time, the connection between prenatal effects and emergence of giftedness in a child was documented by American scientists N. Geschwind and A. Galaburda who presented the “Prenatal testosterone model”, according to which the increased level of testosterone affects processes of neuronal migration, which causes intense development of the right hemisphere (Geschwind, N., Galaburda, A. M. 1987). In addition, researchers have associated high levels of testosterone with improved coordination between hemispheres. The above mentioned makes it possible to understand better the essence of the “Prenatal exposures model of giftedness” (see Figure 1).

The above mentioned neuronal changes can have a number of manifestations, in particular:

- increased neuronal proliferation in one part of the cerebral cortex, which leads to a significant increase in its density;
- absence of neuronal apoptosis in certain parts of the cerebral cortex;
- moving the neurons responsible for the development of speech, which must be located in a certain part of the cerebral cortex, into another part.

Such changes, for example, can cause significant transformations in the structure of the brain, in particular excessive development of the lower parietal region of the cerebral cortex – the part responsible for visual, spatial, musical and mathematical thinking. This statement expands the thesis put forward by R. Brain back in the 60's of the twentieth century that the brain of a gifted person can form much more complex networks, creating

conditions for the development of high abilities (Brain, R. 1960).

Accordingly, redirection of the flow of neuronal migration from those departments responsible for the development of speech also leads to certain violations, such as dyslexia.

Besides, the fact that neurotransmitter systems are responsible for perception and behavior can explain the presence, on the one hand, of eccentric or psychopathic manifestations on the person, and on the other hand – extraordinary creativity or high perceptual abilities.

It should be noted that this model not only explains the nature of giftedness, but also such a phenomenon as “twice exceptionality”, that is, the combination of giftedness with certain disorders of psycho-physical development.

### Conclusion

Thus, medical-biological concepts of giftedness are based on the assumption that talent is conditioned by the unusual or unique development of the brain. These theoretical models not only provide understanding of emergence of giftedness from the neurophysiologic point of view, but also explain such phenomenon as “twice exceptionality”. It should also be stressed, that medical-biological concepts provide one of the ways of the solution of the problem on the nature of giftedness, while other aspects – psychological, philosophic, pedagogical etc. should also be considered in order to get versatile understanding of the studied phenomenon which will become the prospects for further research.

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