REVIEW ARTICLE

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Contents

- SUMMARY
- 1. INTRODUCTION
- 2. HISTORY
- 2.1 HOW NEUROPSYCHOLOGY CLASSIFIES HIGH SKILLS/GIFTED
- 2.2 ASSESSMENT OF THE INTELLIGENCE OF PEOPLE WITH HIGH SKILLS/GIFTED
- 2.3 NEUROPHYSIOLOGY FOR UNDERSTANDING HIGH SKILLS/ GIFTED
- 3. NEUROPSYCHOLOGICAL MECHANISMS OF PEOPLE DIAGNOSED WITH HIGH SKILLS/GIFTED
- 4. BRAZILIAN REALITY OF CHILDREN AND ADOLESCENTS WITH HIGH SKILLS/GIFTEDOVER IN THE SCHOOL PERSPECTIVE
- 4.1 MYTHS
- 4.2 SPECIAL EDUCATION – RIGHT OF STUDENTS WITH HIGH SKILLS / GIFTED
- 4.3 HISTORICAL RETROSPECTIVE OF BRAZILIAN PUBLIC POLICIES
- 4.4 SCHOOL LIFE – REPORTS
- FINAL CONSIDERATIONS
- REFERENCES
- APÊNDICE – REFERÊNCIAS DE NOTA DE RODAPÉ

SUMMARY

Neuropsychology is a field of psychology and neurosciences that studies the relationships between the central nervous system, cognitive functioning and behavior. Since the beginning, researchers in the field have sought understanding scans of the anatomy of the

brain and its correlation with cognitive abilities. Neuropsychology is constantly advancing and transforming, and thus, the findings of this science offer increasingly theoretical and methodological support for professionals and enable interventions and treatments more appropriate to patients. Despite advances in research on cognitive abilities, there are currently difficulties regarding the recognition of individuals with High Skills/Gifted. In addition, in many times, HS/G is confused with disorders. For this reason, this bibliographic study presents the main contributions of Neuropsychology to the identification and development of people with HS/G, denoting the historical aspects, the main advances and the current scenario. The analysis of the data collected in articles, theses, books, laws and public policies in force showed that there is still no precise classification for the understanding of HS/G. What is currently known is that intelligence is one of the factors for identification, but other skills are also considered as artistic, motivational aspects and leadership skills. There is also the association of the results of psychological tests with neuroimaging tests. In continuity of the investigation, the neuropsychological mechanisms of people identified with HS/G were investigated. The results of the researches examined indicate a relationship between the intellectual quotient and brain activity as well as indicative of differences in the functioning and anatomy of the brain of these people when compared with subjects of average intellectual quotient. The last topic addresses the Brazilian reality of children and adolescents with HS/G from the school perspective, the difficulties regarding the identification process and the adequate care for these individuals.

Keywords: Neuropsychology, high skills, gifted.

1. INTRODUCTION

High Skills/Gifted (HS/G) is still a little explored theme, with theoretical divergences, but expanding in Brazil. In this scenario, neuropsychology investigations indicate significant contributions, which is the science that studies the links between the central nervous system, cognitive functioning and behavior. It is observed as a problem that, currently, research in Neuropsychology has a great focus on global developmental disorders, and, moreover, there is still no consensus among authors regarding the process of Neuropsychological Evaluation and diagnosis of HS/G. Therefore, this study is justified because, in Brazil, there are difficulties and limitations in the early diagnosis of children with HS/G, a fact that generates

obstacles to adequate care and fundamental stimuli for the development of human potentials.

The theme is still seen as a rare phenomenon and has erroneous understandings. Due to these limitations, currently few schools offer specialized care to individuals diagnosed with HS/G. In this scenario, Souza (2013) points out that many students with high skills and gifted care may present academic performance lower than the level of study in which he is inserted, demonstrating demotivation and socialization difficulties. This reality evidences the importance of this research. Therefore, it is necessary to observe how Neuropsychology can contribute to the process of identification of HS/G, considering cognitive functions and behavior. The objective of the study is to investigate the contributions of Neuropsychology to the identification and development of people with High Skills/Gifted.

In view of this, it is intended to ascertain how Neuropsychology classifies HS/G; to address the neuropsychological mechanisms of people identified with HS/G to conduct a survey of the Brazilian reality of children and adolescents with HS/G from the school perspective. The methodological proposal of this study is to conduct a bibliographic research whose intention is to collect information about the contributions of Neuropsychology in the identification of subjects with HS/G and the relevant attributes for the development of their potentials. According to Severino (2007), bibliographic research is that carried out from an available record and is due to previous research. It is based on printed documents, books, articles and academic theses. It uses theoretical data that have already been worked by other researchers and records them.

The work, therefore, will be carried out analytically and, thus, will consider the existing theoretical and methodological contributions. The research data will be analyzed from the perspective of the qualitative method. According to Lüdke and André (1986), in the theoretical-qualitative approach, descriptive data and documentary statements are excellent for supporting information or clarifying questions. For this reason, data relevant to the proposed objective will be considered. The collection of information will be done through research available in articles, theses, books, laws and public policies in force, considering authors whose theoretical focus is Neuropsychology. It will also be ascertained why HS/G is still a little explored topic. This research also considers the main advances and collaborations of studies from Neuropsychology.

2. HISTORY

High Skills/Gifted (HS/G) is still a research theme that is little explored and is expanding in Brazil. Initially, it is necessary to present when this theme began to be studied and the main advances generated and present today. According to Merlo (2008), the first approaches related to the issue of High Skills/Gifted occurred in Brazil in 1929, initiated by psychologist and pedagogue Helena Antipoff, and later there was the development of research in the area. Although not a new theme, it is still a subject little explored by today's researchers. The first explicit manifestation of the theme in Brazilian Education policy took place in 1971, with Law No. 5,692 of August 11, 1971, Art. 9th, which established Guidelines and Bases for the teaching of 1st and 2nd grade.

> Students who have physical or mental disabilities, those who are in considerable delay regarding the regular age of enrollment and the gifted should receive special treatment, according to the standards established by the competent Boards of Education (BRASIL, 1971).

Since then there have been advances, and thus Law 13,234 of December 29, 2015 provides for the identification, registration and care in basic education and higher education of students with HS/G.

> The public authorities should establish a national register of students with high skills or gifted care enrolled in basic education and higher education, in order to promote the implementation of public policies aimed at the full development of the potential of this student (BRASIL, 2015).

The objective of this Law is the development of public policies that address this public with HS/G, in order to provide the full development of potential. However, it is necessary to question how these students will be identified. Currently, the difficulty in recognizing these individuals significantly interferes in the learning process, and, in many cases, HS/G is confused with hyperactivity and lack of interest, a situation that culminates in repetition and school dropout. Considering the difficulties in recognizing individuals with HS/G, the importance of neuropsychology contributions in the identification process is noted.

2.1 HOW NEUROPSYCHOLOGY CLASSIFIES HIGH SKILLS/GIFTED

To understand how Neuropsychology classifies High Skills/Gifted it is necessary to elucidate the study of this science. According to Miotto, Lúcia and Scaff (2018), Neuropsychology is the area of psychology and neurosciences that studies the relationships between the central nervous system, cognitive functioning and behavior. In the clinical scope, it is objective with neuropsychological evaluation: to assist in the differential diagnosis of neurological and neuropsychiatric conditions; medical and surgical treatments and plan and monitor rehabilitation programs aimed at cognitive, behavioral and daily changes of the patient. According to Miotto, Lúcia and Scaff (2018), it is important to emphasize that neuropsychological evaluation cannot be limited to the application and correction of cognitive tests. Thus, it is necessary to trace the extent of cognitive alteration, verify the compromised and preserved functions, observe if there is the presence of mood changes and the impacts caused in the personal, social and occupational context of the individual.

According to Merlin (2012 *apud* SILVA; ROLIM; MAZOLI, 2016), Neuropsychology arose from the clinical observation of patients who had suffered brain injuries. Initially, we aimed to study the location of different brain cognitive functions, but with advances in technology, structural and functional neuroimaging techniques emerged, which allowed reliability in the localization of brain behaviors and abilities. This advance allowed a greater understanding of clinical cases, more appropriate treatment proposals, elucidation of prognosis and advances in research. It is observed through the research presented that since the beginning neuropsychology seeks to study cognitive abilities; based on the difficulties and facilities presented by the individual in his daily life. This science is constantly advancing and transforming, providing more and more support for professionals in the area and beneficiaries of this system: patients.

2.2 ASSESSMENT OF THE INTELLIGENCE OF PEOPLE WITH HIGH SKILLS/GIFTED

In this scenario of advances, it is important to highlight how the Intelligence Assessment of People with High Skills/Gifted emerged. Thus, Silva, Rolim and Mazoli (2016) point to Psychometrics as the area responsible for the elaboration of intelligence measurement instruments. Sousa (200*9 ap*ud SILVA; ROLIM; MAZOLI, 2016) explains that the understanding

of High Skills/Gifted in the 1950s was related to the high intellectual quotient score. These data indicate that the evaluation was limited to the application and correction of cognitive tests, a model criticized today. The measurement was performed in a psychometric way, disregarding attributes such as creativity and motivation. Currently, there are several scales validated by the Sistema de Avaliação de Testes Psicológicos – SATEPSI. When performing a search on the site, it was verified that in the period of this research fourteen instruments for the evaluation of intelligence are validated and favorable, according to table 1.

Table 1 – Instruments for intelligence assessment

Instrument	AUTHOR (ES)	Validity
Wechsler Intelligence Scale for Children – 4th Edition (WISC – IV)	Acácia Aparecida Angeli do Santos; Ana Paula Porto Noronha; Fabián Javier Marín Rueda; Fermino Fernades Sisto; Nelimar Ribeiro de Castro.	03/12/2031
Abbreviated Wechsler Intelligence Scale (WASI)	Clarissa Marceli Trentin; Denise Balem Yates; Vanessa Stumpf Heck.	18/11/2031
Wechsler Intelligence Scale for Adults (WAIS III)	David Wechsler; Elizabeth do Nascimento	15/10/2024
G-36 Nonverbal intelligence test	Efraim Rojas Boccalandro;	27/09/2023
G-38 Nonverbal intelligence test	Efraim Rojas Boccalandro;	31/08/2038
R-1 Form B – Nonverbal intelligence test	Acácia Aparecida Angeli dos Santos; Ana Paula Porto Noronha; Fermino Fernades Sisto	01/07/2025
R-1 Nonverbal intelligence test	Iraí Cristina Boccato Alves; Rynaldo de Oliveira	11/04/2023
R-2 Nonverbal intelligence test for children	Helena Rinaldi Rosa; Iraí Cristina Boccato	11/04/2023
Intelligence Test – IT	Fabian Javier Marín Rueda; Nelimar Ribeiro de Castro	18/11/2031
General Intelligence Test – Non-verbal (TIG-NV)	Silésia Maria Veneroso Delphino Tosi;	03/08/2027
Nonverbal intelligence test (TONI-3)	Acácia Santos; Ana Paula Noronha; Fermino Sisto	03/08/2027
Verbal Intelligence Test (TIV)	Fábio Camilo da Silva; Luciano Franzim Neto	22/03/2033
Beta-III general intelligence nonverbal test (matrix reasoning subtests and codes)	Gisele Aparecida da Silva Alves; Irene F. Almeida de Sá Leme; Ivan Santana Rabelo; Rodolfo Augusto Mateo Ambiel; Sílvia Verônica Pacanaro	01/07/2031
Nonverbal intelligence test – SON-R 2/5-7[a]	Camila A. Karino; Girlene R. de Jesus; Jacob A. Laros; Peter J.Tellegen	25/02/2032

Verbal intelligence test (V-47)	Efraim Rojas Boccalandro	25/10/2023

Source: Prepared by the author (2020)

Hanzin *et al* (2009) explain that the scientific community criticizes the construction of evaluative instruments for people based on the Intellectual Quotient – IQ, because they do not include other skills such as creativity and artistic and interpersonal skills. On the other hand, there are defenses that intelligence tests can corroborate the understanding of cognitive functions and clarify school difficulties and social behaviors. Continuing the analysis on the SATEPSI website, it was found, during the period of this research, that there are only two instruments commercially available for the evaluation of creativity in Brazil: the Test of Figural and Child Creativity, by the authors Nakano *et al* (2015), which appears to be approved on the page on the date of November 26, 2010, valid until November 26, 2030 , and the Styles of Thinking and Creating, by author Solange Muglia Wechsler, approved on December 1, 2006 and valid until December 1, 2026.

It is noted that although creative skills and artistic skills are fields implemented with regard to High Skills/Gifted, validated instruments for the measurement of these competencies in Brazil are still scarce. In addition to the use of psychological tests in the evaluation process, Almeida and Guenther (2010 *apud* SILVA; ROLIM; MAZOLI, 2016) propose quantitative electroencephalogram/brain mapping (EEGQ) as a confluence resource between intelligence tests (psychometric data), in order to ensure a careful evaluation. From the studies, it was found that adolescents with high IQ presented a predominant rhythm of alpha waves and that the psychophysiological signals emitted by the EEGQ allow relating the alpha waves and the role of the frontal lobe with IQ, which means that to identify people with HS/G psychometrics with Neurophysiology is important.

Considering this context, based on the information consulted, it was found that there are great advances in the area of Neuropsychology that corroborate the understanding of clinical cases, and also to the realization of treatment plans more appropriate for the neuropsychological conditions of the patient. However, there is still no precise classification in this field of study for High Skills/Gifted. It is known, therefore, that intelligence is one of the factors for the identification of a subject with HS/G, but there is no consensus among researchers regarding the evaluation process. The current data demonstrate advances in the search for evaluation of other skills: artistic, motivational and leadership aspects, and, in

addition, there is already the association of test results with neurophysiology, through neuroimaging tests.

2.3 NEUROPHYSIOLOGY FOR UNDERSTANDING HIGH SKILLS/ GIFTED

Considering the historical findings, data were raised that the brain was not always recognized as an important place related to the human mind, which is responsible for functions such as reasoning, perception, ability to feel and decision-making (PAULINO, 2014). According to Paulino (2014), archaeological evidence indicates that prehistoric man already suspected the link between the brain and mental functions. Thus, there is historical evidence of skulls from the Neolithic period (10,000 BC) that had signs of trepanation, a surgical technique that consisted of perforation of the skull and removal of a fragment. This practice was performed as a treatment for headache, epilepsy and head trauma. Research indicates that the oldest record in reference to the brain is found in an Egyptian medical papyrus published as “Edwin Smith’s Surgical Papyrus”, dated 1700 BC, but which was related to an earlier period (3000-2500 BC).

The exposure of cases of head injuries indicates that the ancient Egyptians also recognized that damage to the Central Nervous System could affect behaviors (FINGER, 1994). Other significant contributions emerged from the research of Hippocrates (460-377 BC) and collaborators who pointed to the brain as the location of the mind. About two centuries later, the doctor Galen (130-200 BC) also attributed mental functions to the brain (PAULINO, 2014). It is observable that several researchers cared about the theme and sought answers to the understanding of the human brain. Thus, several theories and hypotheses emerged, among these the idea that the cerebral cortex is composed of distinct areas of functioning. The two fundamental events for this understanding were the studies of phrenology, proposed by Franz Josef Gall (1758-1828) and Joahnnn Spurzheim (1776-1832) and the clinical atomian studies conducted by Paul Broca (1824-1880) (CASTRO; LANDEIRA-FERNANDES, 2012).

Another highlight in the search for understanding of the brain and its functioning occurred in 1891, from the works of Santiago Ramón y Cajal, physician and histologist (1852-1934) who presented the basic unit of the brain: the neuron. Since then, new information about its composition, functioning and action have begun to emerge in the scientific field. About 100

years after this milestone, in the 1990s, which was called the “brain decade”, it was possible to observe for the first time the living, conscious and functioning human brain through neuroimaging techniques (CASTRO; LANDEIRA-FERNANDES, 2012). Currently, as described by Paulino (2014), one of the great investigations of researchers is the understanding of the link between the brain and intelligence, considering individuals who have high capacities.

In a search of the CAPES Periodic database, considering only the articles of the 21st century (in any language), a result of 18,472 journals was obtained, which shows great interest of researchers in relation to intelligence. Intelligence is the field of research of several authors, but different theoretical definitions are observed. For Martin (2007 *apud* VILLAMIZAR; DONOSO, 2013) the word intelligence results from the union *logos y nous* which means to gather, join, elect, count, enumerate, compute, refer, speak; *nou*s refers to the ability to think, reflect, perceive and memorize. There is also the defense that intelligence can be classified into four currents: psychometrics in two strands: monolithic and multifactorial. In the first current intelligence is unique, innate and measurable and in the second there are multiple factors that can be evaluated with measurement instruments. There is also the Piaget Developmentalist, defined as a process of adaptation in the search for balance.

It develops in four stages: heredity, physical experience, social transmission and balance. There is the Sociocultural proposed by Vigtsky. It concerns the formation and development of superior psychic processes and the concepts of the real and proximal development zone. And finally, there’s Cognitive, founded by Gardner. It is the theory of multiple intelligences (PAULINO, 2014). According to Almeida *et al* (2009), psychologist and neurologist Gardner proposes the existence of multiple intelligences that are divided into: musical, linguistic, spatial- visou, corporal-kinesthesia, logical-mathematics, intrapersonal, interpersonal, naturalistic, existential and spiritual. To this end, research in the field of neurophysiology investigates the relationship between brain activity and the intelligence of people identified with High Skills/Gifted and medium intelligence.

The objective of these studies is to know in detail the brain functioning and factors implicit to intelligence (PAULINO, 2014). Currently, it is understood that the brain is formed by distinct components that perform different functions. The cortical modules responsible for these functions are located in the right and left frontal lobes. From the point of view of Neuropsychology, executive function covers the phenomena of cognitive flexibility and

decision-making (MOURÃO JUNIOR; MELO, 2011). The set of information presented in this chapter covers the most relevant factors for the historical understanding of HS/G and its correlation with Neuropsychology nowadays. From this perspective, it is possible to understand why advances in the theme are correlated with the understanding of the brain and its respective functions.

3. NEUROPSYCHOLOGICAL MECHANISMS OF PEOPLE DIAGNOSED WITH HIGH SKILLS/GIFTED

This chapter will cover the theme High Skills/Gifted considering the anatomy and biology of the brain. Thus, it seeks to present research data to understand the neuropsychological mechanisms of people diagnosed with HS/G and the myths that permeate the theme. For Mrazik and Dombrowski (2010 *apud* BARTOSZECK, 2014), the human brain grows and develops from the postnatal period to the average of seven years of age. On the other hand, the sinatic connections continue to develop beyond the second decade. Thus, the right and lower prefrontal association cortex that involves anticipatory planning and the regulation of emotional behavior evolves up to 20 years of age in the population evaluated with HS/G. In studies, it was found that the brains of smarter boys and girls, submitted to intellectual quotient assessment tests, develop differently.

In this population, a delay in maturation and thickness of the prefrontal cortex layer (executive function) was observed, considering a normative sample of more than 300 children and adolescents aged 6 to 19 years. This slower growth becomes an advantage because it allows the formation of multiple and more complex sinatic connections (BLAKEMORE; FRITH a*pud* BARTOSZECK, 2014). According to Andrade (2016), man is born with only 30% of his brain connections ready. This information signals that the work of humanization, education and learning is responsible for the new sinatic links that will be fundamental to development. The researcher also clarifies about the correlation between gifting and stimulation after birth. To this end, it is explained that all communication effectiveness is established during the prenatal period and continues its development during the first four years of age.

Currently, it is known that the organization of the nervous system (cell growth, regulation of size, shape and neural density) is influenced by androgens during prenatal care and after

birth. Thus, approximately in the 8th week of gestation, male fetuses are exposed to a peak of exposure to testosterone, which, in part, is responsible for the phenotypic differentiation of female/male brains, that is, increased levels or sensitivities to androgens in the uterus may cause neuroanatomical changes (ANDRADE, 2016). This theory defends the existence of a relationship between prenatal exposure of androgens and gifted, but although it is considered a logical and satisfactory model, it is not accepted by all researchers. Researching giftedcare, Simonetti (2008) conducted a comparative study of cognitive processes based on psychological tests and neurophysiological indicators. The research of the contributions of neural sciences in the identification and description of giftedcare was given as an intention in this research.

Thus, it was investigated through the performance of verbal and spatial cognitive tasks, the adolescents evaluated as gifted after submission to IQ tests. The researcher used brain activity as a psychophysiological signal and quantitative electroencephalogram with brain mapping as a technique. Thus, we sought to verify whether the neurological representation differed in gifted and non-gifted adolescents. This study had the participation of 77 students who attended or attended care programs for talented students in Vitória (Espírito Santo, Brazil), aged between 11 and 14 years. These students were submitted to a psychometric evaluation – WISC III and considering the psychological criteria, 15 people were selected for the electroencephalographic examination, of which they were divided into two groups: experimental, with IQ equal to or greater than 130, and comparison, with IQ above 100 and not higher than 120.

It is noteworthy that the electroencephalographic recording occurred at the time when the subjects performed verbal and spatial cognitive tasks. The results of the research indicated that in the group of gifted patients, the predominance of alpha, percentile of frequency always higher and high amplitude in the performance of tasks was constant, given that it was not observed in the comparative group. The location of brain waves occurred predominantly in the occipital, prefrontal and frontal areas, with dominance of the left hemisphere in both groups. According to Simonetti (2008), these results reinforce the hypothesis that there is a relationship between the intellectual quotient, the frequency and amplitude of alpha waves during the performance of tasks and that the EEGQ of the gifted indicated high alpha power, that is, less mental activity, given not verified in the comparison group.

Analyzing these findings, we question the neurophysiological aspects of gifted. Also according to Simonetti (2018), studies and research indicate that some people are more prone to the development of intelligence than others, considering the interaction between genetic endowment and environmental stimulation. Thus, researchers hypothesize that these people's brains organize itself in an integrated, flexible and complex way, resulting in more accelerated and advanced functions. To understand the present question, it is necessary to study the anatomy of the brain and to investigate possible differences between subjects with high and medium abilities. Among the efforts to discover the correlation of superior capacities and the structure of the brain is the dissection (separation into fragments) of the brain of physicist Albert Einstein (1879-1955).

The contributions of the scientist helped in the understanding of space and time, from which guided several aspects of modern physics. According to dr. Silvia Helena Cardoso, from the State University of Campinas (2000), in her article "Why Was Einstein a Genius?", the author presents contributions of neurophysiology to this explanation. The author explains that the physicist died in 1955 at the age of 76, and that Dr. Thomas Harvey, the pathologist who performed the autopsy, removed Einstein's brain and gave some parts for use in scientific research. Scientist Marian Diamond was one of the scientists who received one of the brain fragments in the 1980s, and, along with her team, made great discoveries. In this investigation, they counted the number of neurons and glial cells in Einstein's brain: the nine and thirty-nine areas of the cerebral cortex in the right and left hemispheres.

Area nine is located in the frontal lobe (prefrontal cortex), considered important for the elaboration of behavior, attention and memory. The area thirty-nine is located in the parietal lobe and is part of the "associative cortex". It is believed that this area is responsible for language and other various functions. The researchers compared the percentage of neurons in relation to glial cells with brains of eleven other men who died at the age of approximately 64. The elements found indicated that Einstein seemed to have a higher percentage of glial cells. The group then concluded that the greater number of glial cells of the type "oligodendroglia" – auxiliary cells that increase the speed of neural communication could be indicative that neurons in Einstein's brain had greater "metabolic need" and, consequently, used more energy.

This is a relevant data for the thought skills demonstrated and for analyzing conceptual

dexterity. The research continued and in June 1999 a team from the Department of Psychiatry and Neurosciences at mcmaster university's School of Health Sciences made a comparison between Einstein's brain and 35 other individuals, 35 men and 50 women with so-called normal intelligence. It was found that the physical brain was about 15% wider in the parietal region, compared to the others. It is notepoint that visuospatial cognition, mathematical thinking and motion images are dependent on this area. According to scholars, this element may explain why Einstein solved scientific problems with such insight. In addition, the researchers observed the absence of a rift in the region known as *sulcus* Latino.

Thus, it was speculated that this non-existence may have allowed a larger number of neurons to make connections and work grouped together, possibly creating a large extension of integrated cortex within a functional network. According to the conclusions of this research, what differs some people from others in the resolution of questions that require the use of cognitive functions is due to the structural differences of the brain region that mediate these functions. In this scenario of research and advances, several neurophysiological studies (EEG) are emerging with the objective of understanding whether there is a relationship between brain activity and psychometric intelligence. It is important to clarify that eeg brain waves change frequency and are based on the electrical activity of neurons and these relate to changes in concentration state to adapt to a specific task (ANTUNES, 2008).

Another important neurophysiological aspect of High Skills/Gifted was presented in the Alexander, O'boyle and Benbow (1996) research, which was an electroencephalographic study (EEG) with male and female adolescents of high and medium abilities and had university students of both sexes. The research aimed to investigate the relative contributions of the right and left cerebral hemispheres during the performance of a task. Thus, 90 individuals had basic EEG registered in three groups with equal numbers of men and women, i.e., 30 gifted adolescents, 30 adolescents with medium capacity and 30 subjects of university age. The results show that gifted adolescents may have a state of improved brain activity for development, similar to that of adults of university age.

Another scientist who deserves to be highlighted and regarded as a genius by modern society was Stephen Hawking, a British theoretical physicist and cosmologist (1942-2018), who had a neurodegenerative disease: amyotrophic lateral sclerosis, which left him totally paralyzed, but despite this, the physicist followed the development of intellectual theories

that entered history. Research speculates on the interest of researchers in the study of the brain of the physicist, but more compelling data regarding the progress of these studies were not found (OCAMPO, 2018). Currently, several studies in neurophysiology seek to ascertain whether there is a relationship between brain activity and intelligence, among these the use of alpha waves to understand the neurophysiological aspects of giftedness. In this field, the researchers Gerlic and Jausovec (1999) conducted a research that investigated the cognitive processes involved in learning information that was presented in multimedia format and text using electroencephalographic measurements (EEG).

Thirty-eight students participated, 19 with high skills and 19 with medium skills. They learned from the material that was presented, that is, in the form of text, image and video, while their EEG was recorded. In this study, alpha power was analyzed and, in the cases of text presentation, alpha power measurements showed greater amplitudes, which means less mental activity on the occipital and temporal lobes and less alpha power, that is, greater mental activity on the frontal lobes. Gifted students presented lower mental activity during the three formats of presentations. These differences were mainly observed in the video format. No differences were observed regarding the gender of the participants in the EEG patterns related to the presentation format. Another study of great relevance was conducted by Jin *et al* (2007), whose main objective was the investigation of areas of the brain that are related to the memorization of a complex figure.

Thus, considering the context presented, it is worth noting that the EEG was recorded in 18 right-handed, healthy and gifted students before and after the memorization of the figure. The spatial-visionmemory skills, planning and also the executive functions were evaluated. The results showed that the gifted obtained high scores compared to the average population during memorization and it was also observed the dominance of the right hemisphere in subjects with HS/G compared to the average of the students. According to Simoneetti (2000), although neurophysiological studies of cognition provide explanations of some biopsychological phenomena such as intelligence and gifted, it is necessary to recognize the advantages and limiting factors.

For the author, considering the results pointed out in the studies in recent years, some neurophysiological data demonstrate the need for more refined research, such as the afforestation of cortical neurons, interneural and dendritic connections, neurotransmitters,

cerebral glucose metabolism and nerve conduction velocity. The elements covered in this chapter showed that the brain in its magnificent anatomy still has many fields that require further research. Considering the various advances and research related to individuals with HS/G, a promising field is observed with regard to the study and understanding of brain biology. The next chapter will cover the Brazilian reality of children and adolescents with High Skills/Gifted from the school perspective, the challenges for professionals and the most common myths.

4. BRAZILIAN REALITY OF CHILDREN AND ADOLESCENTS WITH HIGH SKILLS/GIFTEDOVER IN THE SCHOOL PERSPECTIVE

In the Brazilian reality there are several myths and erroneous understandings that result in the stigmatization of people with HS/G and reverberate during the life of these subjects, especially in their school trajectories when their potentials are not properly explored, generating dissatisfaction and evasion of the educational institution. This panorama can also be understood in Alencar's interpretation (2007) which states:

> In Brazil, giftedism is still seen as a rare phenomenon and proof of this is the astonishment and curiosity towards a child or adolescent who has been diagnosed as gifted. It is observed that there are many erroneous ideas about them present in popular thought (ALENCAR, 2007, p. 15).

As a consequence of these beliefs, the neuropsychologist, in his professional practice, is associated with parents and teachers apprehensive about the identification and care of people with high HS/G. They feel insecure in indicating characteristics that denote above-average skills (ARANTES-BRERO, 2018). The ignorance of guardians and teachers generates fear and their involvement is paramount, since individuals with HS/G need adequate support from those around them, because they often feel misadjusted, different and not belonging to a group. Both families and the school need clarification and support on how to deal with this subject, so that they understand him and assist him in the process of social, educational and emotional adaptation (ARANTES-BRERO, 2018).

It is for this reason that it is so important to qualify education professionals in the process of

identifying students with HS/G, in order to refer them so that other professionals also evaluate the case, and, in a multidisciplinary way, establish or not the diagnosis of HS/G. It is emphasized that trained professionals contribute to demystification and provide better subsidies for the recurrent doubts of the subject and his/her family members. According to Joseph and Renzulli (2018), society needs to invest in special resources for the development of gifted, because the educational proposal of teaching must provide the subjects with the maximum opportunities for self-realization through the development and expression of a set of performance areas, so that the higher potential is exploited.

Thus, according to the aforementioned doctrinators, it will be possible to increase the reservoir of people in society who can help solve the problems of contemporary civilization, these being the producers of knowledge and art rather than mere consumers of pre-existing information. According to Negrini and Freitas (2008), it is important to highlight that the identification of people with HS/G is not intended to "label" these individuals, to form an elite group, among other placements that are made regarding this proposal. The objective with the identification is the provision of specialized care that contemplates the true needs and interests of this subject so that he can be stimulated and, thus, develop his skills satisfactorily and with quality. The need for greater understanding of the cognitive processes of subjects with HS/G in a situation of development and academic learning is justified according to the data found on the website of the Ministry of Education.

International studies show that the percentage of gifted children or children with HS/G ranges from 10 to 15%. In Brazil, statistics indicate a smaller number, due to the identification difficulties that occur in schools. Currently, Arantes-Brero (2018) explains that one of the criticisms in relation to school and teaching provided is mainly due to the fact that it is based predominantly on logical thinking, thus discouraging, rambling, not knowing, free associations and significant experiences that lead the student to access the unfamiliar through the family member. In continuity the theme, the next sub-topic lists the main myths that hinder the understanding and implementation of more effective interventions that provide the full development of people with HS/G.

4.1 MYTHS

The article Gifted and its Myths, by Antipoff and Campos (2010) presents the mistaken understandings about high skills / Gifted. The respective themes addressed contribute to the demystification, clarification and improvement of programs aimed at subjects with HS/G and the social environment in which they are inserted.

2. People with High Skills stand out in all areas of the school. According to Antipoff and Campos (2010), gifting in a certain area, such as mathematics, does not necessarily imply an overdom in other areas, such as Portuguese and sciences;
4. Every gifted individual has a high IQ. According to the authors, this idea should be discarded, because according to Winner's definition (1998), there are "often autistic individuals, with IQs in the extension of delay and exceptional skills in specific domains". It is also important to highlight that there are children who are gifted in the artistic field, but who do not have high IQ in other areas of knowledge;
6. Gifting is innate or a product of the social environment. The biological and cultural influence each other, there is no more important factor than the other (HALPERN, 2006 *apud* ANTIPOFF; CAMPOS, 2010);
8. The gifted individual is also psychologically well adjusted. The literature points out that these subjects may be instible due to attempts to match the average population (which can cause anguish and loss of identity). And as punctuated by (NOVAES *apud* ANTIPOFF; CAMPOS, 2010) another reason is due to probable peer ridicule and lack of maturity to deal with issues they can already rationally understand;
10. Gifted children become eminent adults. This is another mistaken idea, because the authors point to winner's quote (1998) "many gifted children, especially prodigies, malogram, while others end up dedicating themselves to other areas of interest". According to Guenther and Freeman (*apud* ANTIPOFF; CAMPOS, 2010) giftedism is something that the individual brings in potential from birth, but it is necessary to work this development, considering the psychological and the social;
12. People with High Abilities come from high economic class. For Antipoff and Campos (2010) this is another mistaken belief that only those children from families from more affluent classes will be able to be stimulated and develop their respective talents. The authors mention the document prepared by mec, the *Fundamental Human Resources Training Program: Giftedand Talent, (BRASIL,* 1999) that addresses the subject.
14. You shouldn't identify people with high abilities. It is essential that teachers know how to identify their talented students, so that they can refer them to a specialized service, aiming at improving skills, because it is necessary to identify them in order for special needs to be met (RECH; FREITAS, 2005 *apud* ANTIPOFF; CAMPOS, 2010).
16. People with High Skills do not need special educational care. The researchers in the area state that it is very important to identify these individuals as soon as possible and that a differentiated care is essential so that talents are not wasted and for the strengthening of emotional and psychological development (ANTIPOFF; CAMPOS, 2010).

The questions raised by Antipoff and Campos (2010) demonstrate the relevance of the subject and how important the dissemination of scientific studies and research that support

demystification with regard to HS/G is important.

4.2 SPECIAL EDUCATION – RIGHT OF STUDENTS WITH HIGH SKILLS / GIFTED

In this context, it is important to understand about inclusion for students with HS/G:

> The National Policy of Special Education in the Perspective of Inclusive Education aims to ensure the school inclusion of students with disabilities, global development disorders and high skills/gifted, guiding education systems to ensure: access to regular education, with participation, learning and continuity at the highest levels of education; transversality of the modality of special education from early childhood education to higher education; offer of specialized educational care; teacher training for specialized educational care and other education professionals for inclusion; participation of the family and the community; architectural accessibility, in transport, furniture, communications and information; and intersectoral articulation in the implementation of public policies (BRASIL, 2008).

The document explains that for a long time the organization of special education, in parallel to common education, was more appropriate for the learning of students who had disabilities, health problems or any inadequacy to the structure organized by the education system. However, the development of studies in the field of education and the defense of human rights have been modifying these concepts as well as the laws and pedagogical and management practices have carried out a restructuring of regular and special education (BRASIL, 2008).

With the Salamanca Declaration of 1994, it is established, as a principle, that regular schools should educate all students, facing the situation of exclusion of children with disabilities and the gifted (BRASIL, 2008). It is observed that this inclusion proposal aims to benefit any student who does not adjust to the regular education system, opportunistic alternatives for their learning and consolidation of their training. Thus, for the provision of inclusive education to subjects with HS/G, the National Policy of Special Education in the Perspective of Inclusive Education defines:

> Students with high skills/gifted demonstrate high potential in any of the following areas, isolated or combined: intellectual, academic, leadership, psychomotricity, and arts. They also have high creativity, great involvement in learning and performing tasks in areas of interest. Specific functional disorders include dyslexia, dysorthography, dysgraphia, dyscalculia, attention disorder and hyperactivity disorder, among others (BRASIL, 2008).

For Matos and Maciel (2016), the definition of students with HS/G is explicit in this official document of the federation that deals with Special Education, and, thus, demonstrates that these people can manifest this condition in various areas of knowledge, in uniqueness or concomitantly, which results in above average performance when compared with other subjects of the same age group and schooling. For this reason, the need for public policies that regulate specialized and targeted care for this population is denoted.

4.3 HISTORICAL RETROSPECTIVE OF BRAZILIAN PUBLIC POLICIES

Conducting a historical retrospective of public policies in Brazil, Matos and Maciel (2016) point out that the first normative prescriptions regarding teacher education to work with special educational needs occurred in the 1960s, with the Campanha Nacional de Educação e Reabilitação de Deficientes Mentais (CADAME). This campaign corroborated the approval of Decree No. 48,961, of September 22, 1960, the document of which showed, in Art. 3, the way in which education, training and rehabilitation of children with special needs should be developed. However, this document made no mention of special education for HS/G (MAZZOTA, 2003; JANUZZI, 1992 *apud* MATOS; MACIEL, 2016). Therefore, the first mention of Education for “exceptional students” in Brazilian public policies, ensured in the Lei de Diretrizes e Bases da Educação Nacional (LDB), approved in 1961 (BRASIL, 1961).

However, only 10 years later, in 1971, with the enactment of Law 5,692/71, the guidelines for teaching “gifted” in Art were included. 9, which states that: the gifted must receive special treatment, according to the standards set by the competent Boards of Education (BRASIL, 1971). Later, in 1973, the National Center for Special Education (CENESP) was created, linked to the MEC, aiming to promote educational actions and finance care actions for people with special needs, including disabilities and HS/G (BRASIL, 2008). Thus, Ministerial Decree No.

550, on CENESP, established its internal rules, which defines, in the ca*put a*nd sole paragraph of Art. 2nd, that CENESP aims and planning the promotion and development of Special Education in the pre-school period, in the teachings of 1st and 2nd grade, higher and supplementary for people with visual, hearing, mental, physical, multiple disabilities and for the gifted (MAZZOTTA, 2003 a*pud* MATOS; MACIEL, 2016).

After 13 years, another important milestone occurred: CENESP was then replaced in 1986 by the Secretária de Educação Especial (SESP), responsible for publishing manuals for the guidance of teaching students with HS/G. A few years later, the National Education Plan (Federal Law No. 10,172/01) and the National Guidelines for Special Education in Basic Education were elaborated in September 2001, with the determination of the implementation of specialized care (MATOS; MACIEL, 2016). A new advance happened with the study by Prieto (2004) who carried out a work called “Policies of school inclusion in Brazil”. This study portrays the difficulties in identifying students with HS/G and the lack of appropriate services for these subjects, and in some cases, the scarcity of public policies for these individuals was observed. As described by Matos and Maciel (2016), the Fundo Nacional de Desenvolvimento da Educação (FNDE) and the Departments of Education in partnership with the Organização das Nações Unidas para Educação, Ciência e Cultura (UNESCO) institute the Núcleos de Atividades de Altas Habilidades/Superdotação (NAAH/S).

It is also interesting to highlight, considering the scope of public policies, that NAAH has existed since 2005, with implementation in all states and in the Federal District, and, thus, reference centers were formed for specialized educational care for students with HS/G. The centers also offer guidance to families and continuing training to teachers to serve this public (BRASIL, 2008). These nuclei represent a response to social needs and subjects with HS/G so often disregarded by public policies. Therefore, they began to have adequate rights and services that promote full development. After this historical survey, the impressions of the education system and the school environment will be demonstrated by people diagnosed with High Skills/Gifted.

4.4 SCHOOL LIFE – REPORTS

The researchers Arantes-Brero (2018) present in the book “Altas Habilidades/Superdotação”

the creative, affective processes and the development of potentials in a study that shows the life histories of young people and adults diagnosed with HS/G. They gave statements about how the diagnosis was discovered, school life and the relationship with knowledge, family and social environment. With emphasis on the school life of these subjects, three statements of the study participants are presented[1]: Paulo[2]: "*it was a place where there were easy classes and a lot of free time. Sometimes they were monotonous, not out of lack of interest, but because they were very repetitive*."

The interviewee was always well treated by the teachers and recognizes that he was not a bad *student: "Some teachers, in particular, directed their questions to me or some specific students, because it was very likely that we knew the answer, turning the explanation into a dialogue (...)*. Rafael, for his part, points out that[3]: he did not like school and felt that his interests were not taken into consideration, *"a left-wing teen head was a little weird in a very grimacey school ... from the 6th grade, more or less, my interests were different, it had nothing to do with that institution, it was something kind of out of place."* Regarding the proposed activities: *"I did exactly what they wanted so they wouldn't off my balls and my questions, my interests I took apart, off the curriculum."*

On the other hand, Hollingworth apud Alencar (2002) points out that exceptionally intelligent students (IQ equal to or above 130), when they have the opportunity to interact with their peers, present significant changes in behavior, so that involvement and contributions in group activities become more significant. This data can be observed in John's statement[4]:*"I remember several times people who called me to go to study.*" At this time of school had already published his first book, resulting from an activity proposed by the teacher: *"I think more this than the issue of the gifted influences a little in my personality, this thing of appearing."* He was a celebrity among his friends because of the interviews he gave. *"I was there giving a TV interview and as soon as it was over, my friends saw it, took some pieces of paper and wanted me to sign (...) it was a lot of fun."*

Considering these discourses, it is possible to understand how people with HS/G understand the education system. The reports show that all had ease with academic tasks, a triggering factor for the demotivation of some of them. On the other hand, it is noted, in one of the statements, that the reception and support of classmates contributed to a greater engagement in the activities. There is the great relevance of social support, especially during

the academic period. The subject who obtains resources and companions capable of understanding it will more easily access its potentialities. It is for this reason that the importance of public policies aimed at these subjects is observed: spaces for the exploration and construction of knowledge that is significant for this population, qualification of professionals and orientations for families. This chapter has demonstrated significant advances in this field, however, it is necessary to expand and improve.

FINAL CONSIDERATIONS

The reflection of the present work allows us to understand the significant contributions and advances of Neuropsychology to the understanding of High Skills/Gifted. Considering the bibliographic survey, it was found agreement among scholars in the area that the theme is an ancient demand of society, however, the most refined studies are recent, with limitations and divergences in the theoretical field. The investigation of historical landmarks in chapter 1 indicates that the first approaches related to the subject occurred in 1960 and the first manifestation of the subject in the Brazilian Education Policy only happened eleven years later, with Law 5,692, of August 1971. Since then, changes and reformulations have occurred. In addition, the objective was, in the first chapter, to present how Neuropsychology classifies High Skills/ Gifted.

Thus, it was verified that since the beginning of the area it is sought to study cognitive abilities, considering the difficulties and abilities manifested daily. Despite the concern of these scholars, it has been demonstrated that there is no precise classification for HS/G in this field of study. However, it was noted that researchers are concerned with the processes of intelligence classification, and, among these, neuropsychological evaluation through tests and instruments private to the psychologist. It is noteworthy that many authors argue that this evaluation should not be limited to the application and correction of cognitive tests. In this chapter it was also demonstrated that theorists point out the need to understand the anatomy and biology of the brain in the investigative studies of neurophysiology that aim to establish a relationship between brain activities and intelligence.

Therefore, it was addressed about the neuropsychological mechanisms of people diagnosed with High Abilities/ Gifted. The data showed research that correlates brain activities with

intelligence and quantitative analyses of brain activity (EEGq). These studies showed that the neuropsychological mechanisms of people with HS/G differ from the normative sample of other subjects with average abilities, considering the same age group and schooling. This demonstrates great advances in the area, however, there are still limiting factors that indicate the need for investigation, such as the afforestation of cortical neurons, interneural and dendritic connections, neurotransmitters, cerebral glucose metabolism and nerve conduction velocity. The last chapter of this study portrayed the Brazilian reality of children and adolescents with High Skills/Gifted from the school perspective.

It is exposed that the lack of knowledge and understandings inadequate to the theme can result in the stigmatization of individuals with HS/G and cause damage, especially in academic life. Another theme of great relevance explained in this chapter were the myths that permeate the subjects with High Abilities/ Gifted. Thus, a list of the most common erroneous understandings regarding HS/G was presented, so that this corroborates for elucidation and clarification. Given the above, this study demonstrated that there are still obstacles in the processes of recognition of subjects with HS/G in the school environment, because there is a lack of professionals trained for identification and proper referral. It was also observed that the diagnosis should serve as an opportunity to promote opportunities, development and self-realization.

Considering this context, it was relevant to portray special education and to carry out a historical retrospective of the needs of this population and the recognitions acquired in the form of law. In this survey, it was possible to observe that it has been 58 years since the first mention in the Lei de Diretrizes e Bases da Educação – LDB. Gradually, significant advances have been observed, among these the existence, since 2005, of the Núcleos de Altas Habilidades/ Superdotação (NAAH/S) in all states of the Brazilian federation and in the Federal District. It aims to provide specialized educational care for these students, in addition to continuous training for professionals and guidance to family members. Finally, the last topic list the testimonies of people diagnosed with HS/G who reported their perceptions of the teaching system and experiences in the school environment.

It was evidenced, from the reports, that everyone was very easy with school tasks and that the proposed activities did not contemplate their true needs, which generated demotivation. On the other hand, the social support of colleagues contributed significantly to the

engagement in the studies. In analysis of the elements addressed, this work complies with the proposal presented in the specific objectives, because through the aforementioned data the contributions of Neuropsychology to the identification and development of people with High Skills / Gifted. It aims, therefore, to foster the interest of professionals and students in the area and generate reflections for new research.

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