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Neurodiversity and Special Education

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Researcher's Perception is our Reality.

Summary

This research deals with types of neurodiversity and how they influence children's life and their ability to learn. It deals with the scientific approach to all sorts of neurodiversity, for instance, where innate learning difficulties (LDs) come from and how it is possible to discover them in babies and toddlers. In most cases, it makes it difficult for them to adapt to school life and to make progress. Therefore, they need a special curriculum and an individual approach. Schools for students with special education needs (SEN) provide them with all the possible accommodations and cooperate with their parents.

I am an English teacher at Beit Ekshtein School – it is a chain of SEN schools throughout Israel that have different specializations – from light LDs to severe mental retardation. Our school is situated in the central part of the country, and we teach high school students with LDs, mild cognitive deficiencies (CDs), and some psychological problems, such as high-functioning autism spectrum disorders (ASD), including the Asperger syndrome. Most of our students pass the final exams and do military service, and some get a higher education – in chapter 3, I will show the research of some of our alumni's studies and further life.

Usually, difficulties with reading, writing, doing elementary math tasks, and keeping attention are identified by kindergarten teachers when kids are four or five years old. However, these days, it is possible to find out about developmental dyslexia (DD) and other potential LDs much earlier. Thus, researchers at Tel Aviv University have started to discover it in toddlers and babies. That is helpful for their future development because, due to such data, parents, nursery, and kindergarten teachers get appropriate information about children's development and have a direction on how to work with them. Undoubtedly, it can help prevent or at least reduce LDs in the future when kids start school.

LDs, such as dyslexia, dysgraphia, dyscalculia, dyspraxia, and others, can be innate or gained later due to brain traumas or diseases. The research claims that neuroscience explores the mechanisms of the psyche at the level of cells and neural networks, and it claims that brain disorders are caused by molecular psychophysiology and genetic psychophysiology. In the field of research technologies, psychophysiology has approached the core of neuroscience. Thus, LDs are a neurodiversity that defines the different work of the brain in the light of neuroscience. This book researches the nature of the forenamed LDs and how to prevent or overcome them.

Dedications

My family, friends, colleagues, and co-workers.

Schools

Atlantic International University, USA
Shaanan College in Haifa, Israel.
Simferopol State University, Ukraine

Cheers

To all my colleagues throughout the world.
To all the staff of Beit Ekstein Rupin high school, Israel.
To the English Language Department of Kinneret Academic College, Israel.
To the Israeli Ministry of Education.
To the teachers' organizations: TESOL, IATEFL, and ETAI

Commonly used abbreviations

ADHD – Attention Deficit Hyperactivity Disorder
AS – Asperger Syndrome
ASD – Autism Spectrum Disorder
CBT – Cognitive Behavior Therapy
CDs – Cognitive Deficiencies
DCD - Developmental Coordination Disorder
DLD - Developmental Language Disorder
DS – Down Syndrome
LDs – Learning Disabilities
MR – Mental Retardation
PDD-NOS - Pervasive Developmental Disorder – not otherwise specified
SEN – Special Education Needs
SLT – Speech-Language Therapy
TS – Tourette Syndrome

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Introduction

Neuroscience is a multidisciplinary field that explores the nervous system's structure, function, and development. It encompasses various scientific disciplines, such as biology, chemistry, and physics. It relies on a symbiotic relationship between basic research and clinical medicine for the development of new diagnostic and therapeutic approaches for brain disorders. Neuroscientists specialize in diverse areas, ranging from neuroanatomy to neuropsychology, and investigate the nervous system's evolutionary, molecular, cellular, functional, and medical aspects. Their primary focus is on the brain and how it regulates behavior. Cognitive neuroscience is a subfield that applies the principles of cognitive psychology to study mental activity as an information-processing problem.

This research explores the neurophysiological mechanisms involved in the acquisition of both native and foreign languages. It delves into clinical studies on disorders related to speech, reading, writing, and calculation, as well as speech impairments linked with mental disorders. Additionally, the thesis analyzes behavioral and cognitive disorders as a form of neurodiversity. It hypothesizes that molecular and genetic changes in the nervous system result in various forms of neurodiversity and aims to identify methods to prevent and treat innate learning disabilities (LDs).

The study of mental, neuropsychic, and behavioral reactions has been a topic of interest for scientists since ancient times. Neuroscience research sheds light on the causes and patterns of deviations in behavior, which is crucial for helping individuals with mental disorders and opens up new possibilities for treating various other diseases and health disorders. Neuroscience is advancing from molecular and cellular levels to systemic and cognitive levels. The brain, the most complex organ in the human body, controls both physiological and psychological functions and transmits sensory reception from the peripheral nervous system. With the invention of the microscope, brain studies have become more sophisticated, sparking curiosity and optimism for a deeper understanding of the brain's intricate structure and operation.

Advancements in molecular biology, electrophysiology, and computational neuroscience have significantly contributed to modern neuroscience. These advancements have enabled us to gain a deeper understanding of neurodiversity, including neurological conditions such as autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD), which are now viewed as more than just disabilities. Through detailed neuroscience, we have gained insights into the nature of delays in learning, mental development, and other learning disorders. As my thesis focuses on these disorders, this article primarily discusses neuropsychology and neurodiversity.

Recent cognitive research has led to the development of various techniques aimed at enhancing memory, brain neuroplasticity, and cognitive abilities such as concentration and assimilation of new information. These studies serve as the foundation for many motivational training programs that target the human mind. The advancements made in neuroscience hold significant potential for improving the education system, particularly in adapting teaching methods to cater to the unique needs of neurodivergent students.

Neuroscience is a field of study that aims to understand the nervous system comprehensively. This includes investigating its structure, function, and development throughout an individual's lifespan and examining potential malfunctions. At the molecular level, neuroscience delves into the mechanisms of how neurons produce and respond to molecular signals and how axons form complex connectivity patterns. Furthermore, it explores the disorders that can arise when neurons fail to transmit signals properly. At a physiological level, neuroscience describes the structure of the nervous system and the diseases that can result from the reasons mentioned above. Lastly, at a cognitive level, neuroscience is concerned with studying human behavior, mental operations, cognitive tasks, and neurodiversity.

The central nervous system is susceptible to numerous diseases, and some of them have a genetic basis, including dyslexia, dysgraphia, and ADHD, among others. Trauma to the brain or spinal cord can lead to neurological disorders, while infections like meningitis can also cause such disorders. Inherited features of the nervous system that develop differently in one or both parents can be passed on to their children, resulting in certain learning disabilities running in families. Cognitive psychology examines the various mental operations involved in performing cognitive tasks and identifies potential limitations in executing such tasks.

Neurolinguistic research has established that language plays a crucial role in the socialization process and facilitates the development of neural connections that are critical for normal human growth. Neurodiversity is a term that lacks a precise definition, and it is subject to varying interpretations by medical professionals and individuals with neurodiverse characteristics. While some contend that conditions such as autism are debilitating, others assert that they represent a person's self-identity and may even indicate giftedness, enabling them to perform tasks that neurotypical individuals cannot.

Autism is a neurodevelopmental disorder that exhibits an atypical cognitive profile marked by a distinct variation in

the performance of various cognitive abilities. While some cognitive features may perform above age-appropriate levels, others may fall short of expected performance levels. This unevenness in cognitive abilities can create challenges in academic and everyday settings. However, it also highlights unique strengths in specific cognitive features. Moreover, individuals with dyslexia may demonstrate exceptional creative abilities, especially in artistic and musical domains.

Neurodiversity refers to the natural variations in cognitive functioning among individuals. Although people's brains work differently, there are certain limits beyond which these differences can result in a disability. In addition to innate and organic factors, environmental factors can also cause neurodiversity. Interestingly, as people with neurodiversity age, they are more likely to develop mental health issues. Some individuals with neurodiversity may choose to embrace their differences, but they still face numerous barriers in the workplace and school environments. Ultimately, individuals with neurodiversity are at a disadvantage, and more needs to be done to accommodate their unique needs.

Building a diagnostic hypothesis and finding ways of helping neurodivergent children will be effective only if the specialist understands the critical features of distorted development options. A correct psychological and pedagogical diagnosis is already half the success.

Method

The research participants are the students of one of Beit Ekshtein schools for SEN learners in the central region of Israel. They are 15-21 years old and struggle with learning due to different disorders, mainly LDs, ADHD, and ASD. Most of them are Hebrew speakers, some are Arabic speakers, and some are new immigrants from the former Soviet Union and France, whose native languages are Russian and French, respectively. Despite the abovementioned disorders, most are motivated and do well at school. Usually, our students finish school at 18 and do military service, which is compulsory for boys and girls in our country. Some of them continue studying with us until age 21 since they can complete the national matriculation program with all the appropriate accommodations for LDs. Those alumni who wish to continue their education at college or university can do it and receive similar accommodations, which will be researched below. I have also researched ten alumni's behavior, studies, and further lives.

Chapter 1

Nervous System and Theory of Neurodiversity

Nervous System

Neuroscience refers to medicine focusing on the nervous system, which controls and coordinates. It regulates the coordinated work of all organ systems, maintaining the constancy of its internal environment composition. Due to this, the human body functions. Due to the nervous system, the organism is connected to the external environment. It is divided into two parts: the central and the peripheral ones. The first is composed of the brain and spinal cord, and the second is composed of nerves connecting the spinal cord and all body parts.

The primary function of the central nervous system is the analysis of information coming from outside and the development of a response signal or reaction. Different brain regions exhibit different activities responsible for storing and using information later [1]. The cerebrum, divided into two hemispheres, is the largest portion of the human brain. The basic structures of each hemisphere of the brain include the cortex, basal ganglia, amygdala, and hippocampus, illustrated in Figure 1. Still, inside, they are very complex, and each hemisphere is responsible for one or another activity of the brain [2]. The research claims that the left hemisphere is called the digital brain, which means that if it is dominant, the person is good at logic, mathematics, and languages. If the right hemisphere is dominant, the person is creative and talented at music, art, etc. Both cerebral hemispheres also stand for the brain's cognitive capabilities. Connecting each of the hemispheres is the corpus callosum and several additional commissures [2].

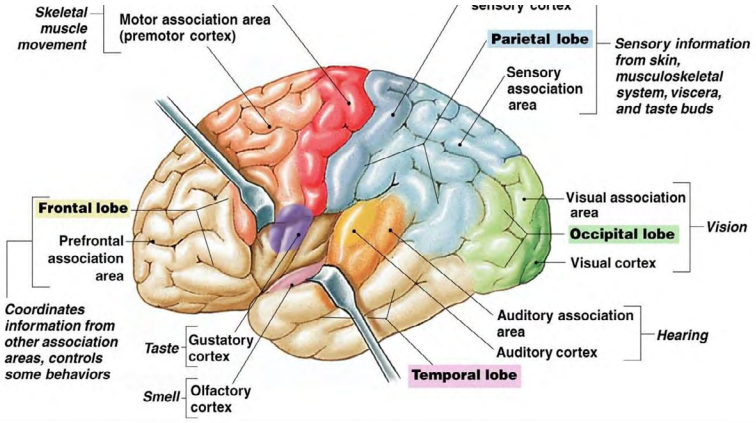

Figure 1: The primary functions of the human brain.

The peripheral nervous system is an intermediary between the central nervous system and human external and internal organs. It includes all the nerves in the human body branching off from the central nervous system - the brain and spinal cord. Those nerves that branch directly from the brain and spinal cord are called the cranial and spinal nerves, respectively [3]. The peripheral nervous system comprises specialized cells, known as neurons, responsible for transmitting electrical and chemical signals across the body.

Each neuron contains a cell body containing the nucleus and other cellular organelles. The neurons receive information through short, branching fibers called dendrites, which receive signals from other neurons. In the brain, signals are transmitted between brain cells through a complex network of neurons, allowing for the processing and integration of information [4]. The axon, a long and slender projection of a nerve cell, acts as a conduit for transmitting nerve impulses from the cell body to other nerve cells and target tissues [5].

"Molecular Neurobiology models brain activity in terms of interacting ions and molecules." Neurons, also known as nerve cells, are the fundamental units of the nervous system that transmit chemical and electrical signals. They are responsible for processing and storing information and play an essential role in forming and retrieving memories. Neurons are specialized cells that transmit information bidirectionally between the peripheral and central nervous systems. They are highly interconnected and capable of transmitting signals to and from the brain. Although neurons

share some similarities with other types of cells, they possess unique structural and functional features that allow them to carry out their specialized functions in the nervous system (Zimlich, 2022) [6]. Neurons serve as the fundamental building blocks of the nervous system, responsible for receiving, processing, and transmitting information to other cells. There are three main types of neurons: motor, sensory, and interneurons, with some neurons having dual motor and sensory functions. The malfunction of neurons can lead to nervous system disorders and neurodivergence, which is caused by disruptions in the brain's internal wiring [4].

What is Neurodiversity?

The term "neurodiversity" refers to genetic or gained variation in the human brain regarding sociability, learning, attention, mood, and other mental functions in a non-pathological sense. It was offered in 1998 by Australian sociologist Judy Singer, who considered the terms "neuro," which means "neuroscience," and "diversity" as "different." Her mother was a Holocaust survivor, and Judy researched her behavior. "It was like she came from a different planet or another dimension," Judy wrote about her mother. She thought it was a consequence of staying in Auschwitz-Birkenau concentration camp during World War II. Later, when her daughter was born, she never looked into her eyes and had problems communicating with other kids. Thus, Judy supposed that her daughter had an innate variation in the nervous system [7]. Judy Singer is herself on the autism spectrum [8]. Based on the available evidence, it is possible to hypothesize that certain individuals may have a genetic predisposition towards neurodiversity. The concept of neurodiversity was introduced by Harvey Blume, an American journalist, to emphasize the importance of acknowledging and accommodating different neurological conditions, such as autism, ADHD, and dyslexia. Blume argued that the concept above is as significant as biodiversity, which refers to the variety of species in an ecosystem, because it highlights the need for a specialized approach to supporting individuals with neurological differences. This approach recognizes that neurodivergent individuals have unique strengths and perspectives that can be valuable to society if properly harnessed and supported [9]. First, he claimed that neurodiversity included autism only, but modern science included such disorders as dyslexia, dysgraphia, dyscalculia, ADHD, and many more, as illustrated below in Figure 2. Furthermore, neurodiverse talents can also be included in this category [10]. Thus, giftedness is a sort of neurodiversity, and gifted kids are called twice exceptional [11].

The neurogenetic apparatus is the foundation of all learning processes in our brain. Long-term memory is formed through the modification of synaptic connections between many cells, which collectively form a neural network in the brain. This modification results in changes in the strength and efficacy of these connections, leading to the formation and consolidation of memories [12]. Despite the similarity in the functioning of human brains, there is a considerable amount of variation in their structure and activity patterns. This variation gives rise to the concept of neurodiversity, which refers to the diversity of brain functioning that deviate from the so-called "typical" or normative patterns. In other words, neurodiversity recognizes that there is a range of cognitive and behavioral differences that are not necessarily pathological but are rather a natural part of human diversity.

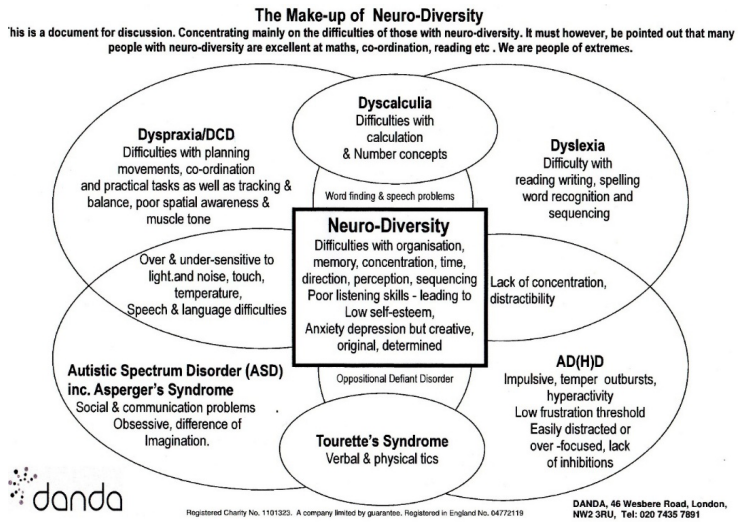

Figure 2: The make-up of neurodiversity.

Note: From Neurodiversity – Diagram showing how dyslexia, dysgraphia, AD(H)D, and Asperger's syndrome overlap, by Kerry. Neurodiversity, n.d., https://www.diverse-learners.co.uk/neurodiversity-diagram-showing-how-dyslexia-dyspraxia-adhd-and-aspergers-syndrome-overlap/

"Multimodal astrocyte-neuron communications govern brain circuitry assembly and function." [13]. Modern scientists describe mental processes using the methodological scheme "Human being - Neuron - Model." [14]. Therefore, the investigation of a specific mental phenomenon commences at the psychological level through the discipline of psychology. The inquiry then proceeds to neurophysiological experiments on animals or physiological experiments on humans, where the complete methodological toolbox of neuroscience is utilized.

In the final stage of the research cycle, a model is developed by combining data from the study's psychological and neurophysiological stages. However, this model has to meet specific requirements. It should be able to replicate the properties of the process being studied at the behavioral level. Additionally, the model's neuron-like elements must match the features of brain neurons that build the mechanism of the mental phenomenon.

"Advocates of neurodiversity assert that neurological variation is not only natural but is central to the success of the human species." [15]. Professor Edmund Sonuga-Barke, a renowned neurodevelopmental researcher from King's College London, is contemplating the possibility of establishing a new science of neurodevelopment based on the concept of neurodiversity. His research primarily focuses on investigating the distinctions in neurological development among individuals and exploring the potential implications of embracing neurodiversity as a foundational principle in this field. The professor and his colleagues shared the latest news from the RE-STAR project, "Regulating Emotions – Strengthening Adolescent Resilience." It deals with an inclusive research approach to neurodivergent young people [16].

Cognitive Neuroscience

Cognitive neuroscience is a multidisciplinary field that employs neuroimaging techniques to investigate the brain's organization of cognitive and communication processes. It aims to elucidate the neural underpinnings of various mental functions, such as memory, attention, perception, speech, thinking, emotions, motivation, and decision-making, as well as how they are influenced by different contexts.

Cognitive psychologists are interested in studying the brain's functions and describing human performance. "Brain areas are interconnected and form higher-level circuits involved in complex behaviors, such as motor control, visual perception, and cognitive processes. The development of the nervous system begins at an early stage in utero." [17]. For the successful interaction of neurons, cell A needs to participate in the excitation of cell B, so cell A must be activated immediately before and not simultaneously with cell B. This aspect of the cause-and-effect relationship proposed in Hebb's work anticipated what is now known as the "spike-timing-dependent plasticity phenomenon" [18].

Cognitive neuroscience is a multidisciplinary field that integrates neuroscience, psychology, cognitive psychology, psychobiology, and other related disciplines. This field aims to understand the mechanisms and systems underlying human cognitive functions by linking functional information with the physiological and biochemical properties of the nervous system. Cognitive neuroscience provides a comprehensive understanding of the complex interplay between the brain and behavior by studying the regulation of human cognition at the cellular, anatomical, and biochemical levels. "In contemporary cognitive science, there are two kinds of mechanistic explanations. In the form most common since the 1950s, the parts are mental representations such as concepts and rules, and the interactions are computational processes such as spreading activation and inference."

Cognition is a complex field of study in neuropsychology and neurology that begins with the development of perceptual abilities in young children. Cognitive neurology in children focuses on the most intricate cortical functions, such as information processing and assimilation, transmission of information, perception, and memory. In recent times, there has been a significant rise in the number of students with Cognitive function plays a crucial role in determining an individual's quality of life. However, the prevalence of neurocognitive disorders (NCDs) is on the rise with the increasing age of the global population. In fact, the number of individuals affected by dementia is projected to double every 20 years, and by 2050, it is expected to surpass 115 million worldwide.

Cognitive neuroscience investigates the neural circuitry underlying psychological functions to understand how these functions are produced at a cognitive level. Various studies led by scientists have demonstrated that distinct phases of visual perception are linked to varying patterns of neuron activity in the cerebral cortex. One type of neuron activity corresponds to the initial stages of visual processing, including the identification of stimulus features. The other type of neuron activity is associated with the later stages of perception, characterized by the focal attention, synthesis, and integration of multiple features [6]. "The Cognitive Neurosciences have provided us with good empirical demonstrations about the relation between brain activity and mentality, but we are still far from explaining how the brain generates the mind".

Causes of Neurological and Cognitive Dysfunction

Kovas, et al. claim that three factors cause neurological problems: genetic, organic, and socio-psychological, as I have composed in Figure 3.

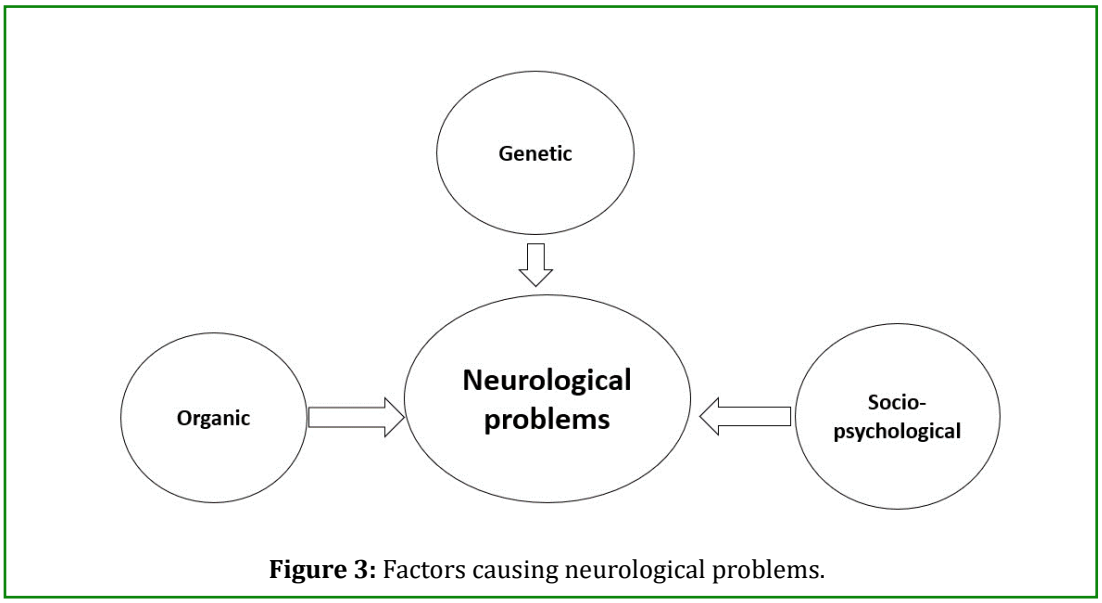

Figure 3: Factors causing neurological problems.

Neurological problems may arise from various factors such as genetic or congenital disorders, infections, physical health issues, malnutrition, brain and spinal cord injuries, or nerve damage. On the other hand, disorders like depression, anxiety, bipolar disorders, and others that lead to a lack of focus and motivation can be caused by adverse environmental factors such as poverty or war conflicts. "Children are especially vulnerable during times of conflict, and they are impacted in debilitating ways" [19].

The intricate and delicate nature of the nervous system makes it vulnerable to disruptions caused by injuries, diseases, and genetic anomalies. To comprehensively understand conditions like autism, it is imperative to gain insight into the unique human neural circuits responsible for language and empathy, as the manifestation of the disease is linked to dysfunction within these circuits. Furthermore, molecular neuroscience offers promising opportunities to psychiatrists for treating a variety of psychiatric and neurological disorders, including schizophrenia and Parkinson's disease. By leveraging advancements in neurobiological research, this field is helping to develop new therapeutic approaches that target the underlying molecular mechanisms of these conditions. This has the potential to improve the effectiveness and precision of treatments, and ultimately enhance patient outcomes.

Neurological disorders exhibit diverse forms and types, making identifying common symptoms quite challenging. However, some widespread signs can indicate the onset of a nervous system disorder. These signs primarily include:

- Sleep disorders – insomnia
- Increased anxiety and irritability
- Decreased performance
- Memory problems
- The occurrence of obsessive thoughts and phobias
- Nervous tics, involuntary muscle contractions
- Headaches, migraines, pain in limbs
- Frequent drops in blood pressure
- Smell disturbances, taste disturbances, vision problems
- Mental and cognitive disorders.

Most diseases - chronic and severe differ in pathogenesis and etiology - occur in children with the forenamed severe nervous and physical disorders. As a result, they might have cognitive dysfunctions. The number of children with neurological disorders is constantly growing, and the signs of impaired neuro-cognitive diseases are as follows:

- Delay in the emergence of skills - they begin to sit, crawl, walk, or talk after a certain age.
- Impaired concentration.
- Learning difficulties.
- Lack of curiosity.
- Problems with logical thinking.
- Infantile behavior that persists through preschool and school age.
- Adhd.
- Chiam j [20].

In recent decades, there has been an increasing emphasis on studying brain differences, cognitive impairments, and learning disorders. Scientists have observed that different brains develop and function in unique ways, leading to the adoption of the term "neurodiversity" to refer to developmental disorders. Neurodiversity commonly refers to people with such disorders as:

- Dyslexia
- Dysorthography
- Dysgraphia
- Dyspraxia
- Dyscalculia
- Other LDs
- ADHD
- ASD
- Cognitive deficiencies.

Neurodiversity encompasses a range of other disorders, such as Tourette Syndrome, Down syndrome, and various chronic mental health disorders such as bipolar disorder, obsessive-compulsive disorder, borderline personality disorder, depression, and anxiety. These conditions are characterized by distinct cognitive and behavioral traits that are atypical when compared to the general population. Understanding neurodiversity is crucial for creating inclusive environments that cater to individuals with different cognitive abilities and needs [20].

Neurodiversity also means recognizing various kinds of atypical mental development, not as a pathology or disease but as one of the possible and even necessary ways of cerebral functioning for the evolution of humanity and treating them depending on their sources. Some of them are treatable successfully, such as depression and anxiety [21,22]. Unlike them, most types of neurodiversity are untreatable, especially innate ones, for instance, developmental dyslexia, dysgraphia, dyscalculia, and ASD [20].

There is controversy within the neurodiversity movement as to which features of neurological development are considered atypical and pathological. Social theorists have also contributed to the debunking of neurodiversity, pointing out the reductionist nature of this ideology, which reduces a person's existence to the uniqueness of his brain or genes, thereby removing responsibility for his life from a person. In addition, it has been observed that employees who are neurodivergent have the potential to demonstrate high levels of productivity and efficiency in the workplace due to their unique cognitive abilities and processing styles [23].

The Situation with Neurodiversity Worldwide

According to the WHO, about 20% of the world population have neurodiversity. Dyslexia are in first place, with a rate of about 10% of people worldwide [24]. Table 1 illustrates the rate of neurodiversity disorders all over the world. The research claims it grows yearly and hypothesizes that the COVID-19 pandemic has greatly influenced its growth. Nowadays, approximately one in two people have dyslexia, which ADHD, dyspraxia, or dyspraxia accompany. Otherwise, they have ADHD, which is accompanied by ASD or Tourette Syndrome.

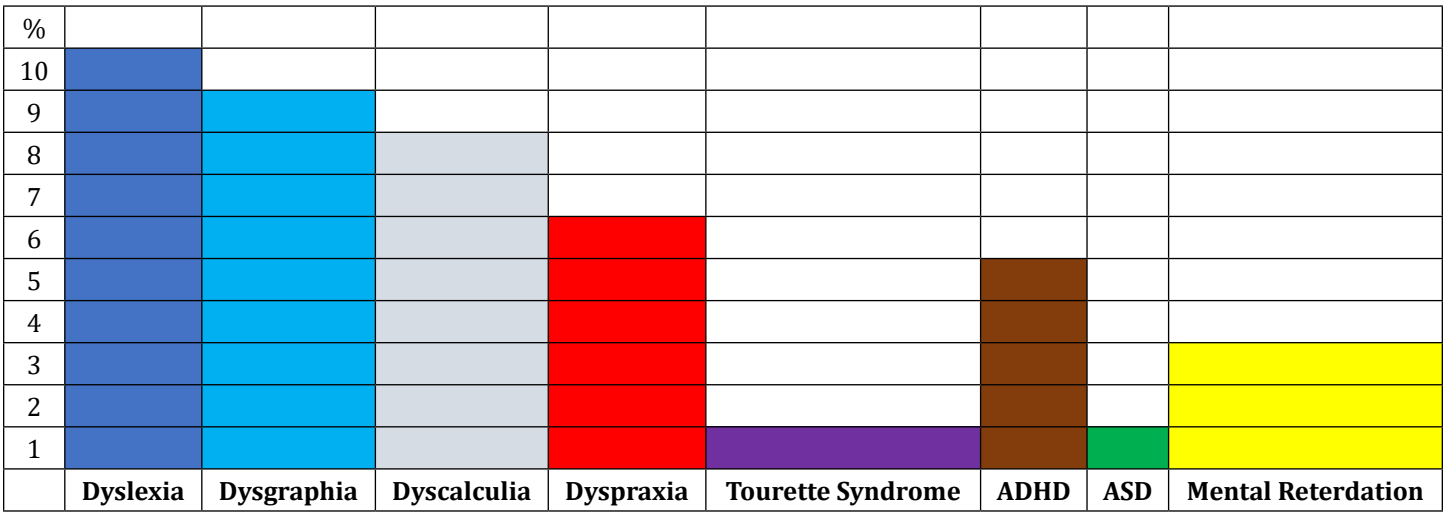

Table 1: The rate of neurodiversity worldwide in 2022.
Note: From Wikipedia, 2023 https://en.wikipedia.org/wiki/Neurodiversity and WHO, 2022 https://www.who.int/teams/mental-health-and-substance-use/world-mental-health-report

Multiple factors in the world influence children's psychic health, and among them, there are "genetic and environmental factors" [25]. Other factors can worsen it, for instance, a challenging ecological situation, the level of stress caused by wars, conflicts, natural disasters, or social situations, such as poverty or bad parenting, which cause post-traumatic stress disorder (PTSD), depression, and anxiety. As a result, children and adults may suffer from them for many years or even decades (National Institute of Mental Health) [26].

According to Professor Dubynin V [27], genetics play a crucial role in the development of neurodiversity. Specifically, 40-50% of the variation in figurative and critical thinking, different types of memory, and motor skills can be attributed to genetics. For dysfunctions like ADHD and dyslexia, genetic contributions are even more significant, accounting for 50-60% or even up to 70% of the variance. In the case of epilepsy and certain schizophrenia-like syndromes, genetic contributions can reach as high as 70%, 80%, or 90%.

Viral diseases in a woman during pregnancy, including influenza, flu, or rubella, can often cause mutations that delayed motor and mental development in the child [25]. For example, the studies of the generation born during the pandemic of the Spanish flu in 1918, had lower levels of education, which were then reflected in socioeconomic status among adults, and the 1964 rubella pandemic led to a 10- to 15-fold increase in the incidence of autism spectrum disorder or schizophrenia in offspring [28]. "Mutations demonstrate how a change in the genetic code can contribute to disease processes by altering the amino acid sequence of a protein, which may affect its structure and/or function as a consequence" [25].

The authors of the study from Columbia University Irving Medical Center cite figure that since the beginning of the COVID-19 pandemic, in spring 2020, millions of babies have been born worldwide [29]. And at the height of the pandemic, in spring 2020, 14% of women giving birth in the Columbia University Irving Medical Center hospital system tested positive for SARS-CoV-2. Furthermore, 2% of the world's population has been infected at some point during the pandemic [28,30]. Therefore, millions of infants worldwide were exposed to the SARS-CoV-2 infection.

It was discovered that babies born during the pandemic, no matter if their mothers were infected or not, had significantly lower scores on gross motor skills, fine motor skills, and personal-social domains than the kids that were born in 2015-2019. The researchers emphasize that many infants in the pandemic cohort met the criteria for gross motor delay [28]. Furthermore, Stress during the pandemic was caused by various life situations: job loss, food insecurity, loss of housing, fear of infection, and inability to communicate with others. A lot of scientific work has appeared around the world showing that the pandemic has led to a significant increase in symptoms of anxiety and depression. Scientists suggest that the stress experienced by expectant mothers is associated with an increased risk of adverse neurological development in children.

In the post-pandemic era, wars and conflicts have become a significant source of stress in regions like Ukraine, the Middle East, and some African countries. These stressors have led to economic crises, unemployment, poverty, and an increase in neurodiversity. As a result, there is a need to intensify research efforts to understand neurodiversity and develop effective coping mechanisms.

Chapter 2

Neurolinguistics and Learning Disabilities

The Theory of Neurolinguistics

Neurolinguistics is an interdisciplinary field investigating the relationship between language and the brain using neuroscience techniques. Its main aim is to explore the fundamental units and principles of the nervous system that underlie our ability to produce and comprehend language [31]. Additionally, neurolinguistics examines the reasons why some individuals experience difficulties in learning language, even when they do not have a diagnosed cognitive impairment.

Neurolinguistics is a contemporary field that emerged because of advancements in computer technology and the merging of the scientific interests of neurology and linguistics. It falls within the realm of cognitive sciences and has shifted the focus from studying language as a mere communication tool to investigating the neurological responses of the brain during communication. Neurolinguistics delves into the brain's functioning and properties during speech activity, thinking, emotional perception, and memory. It is an interdisciplinary science that is closely related to psycholinguistics and is sometimes considered as a single science [31].

Neuro-linguistic research is a more apparent subject of study since a laboratory experiment shows which part of the brain is involved during the experience. The direct interest of neurolinguistics is directed to the study of three zones of the left hemisphere responsible for the functioning of speech, illustrated in Figure 4:

* Broca's area (reactions to control oral speech occur in it)
* Wernicke's area (responsible for perception and understanding)
* Occipital part (logic-grammatical memorization takes place in it)

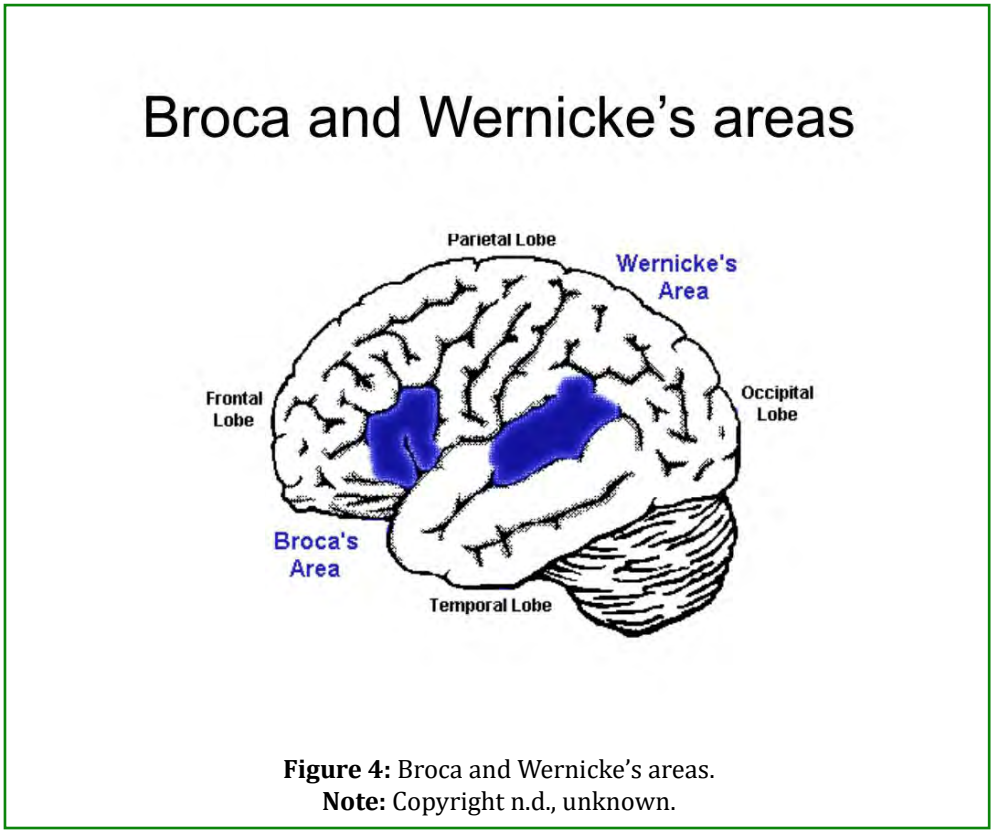

Figure 4: Broca and Wernicke's areas.
Note: Copyright n.d., unknown.

Neurology research is keenly interested in investigating the impact of language on the mechanisms involved in speech processing in the brain. Typically, these observations have three complementary stages:

- Linguistic stage.
- Neurophysiological stage.
- Psychological stage.

Human speech production in the brain involves several specialized zones, with some performing the primary functions and others acting as support. Neurolinguistic research utilizes various methods from related fields such as neurology, psychology, psycholinguistics, neurophysiology, neuropsychology, speech therapy, neurosurgery, biophysics, and biochemistry. The interdisciplinary nature of neurolinguistics is evident in the wide range of research methods employed, which has allowed the field to evolve into a distinct area of knowledge over time [31].

"Language and speech are rarely present in both hemispheres, either in one or the other. While it is true that the separated left hemisphere normally comprehends all aspects of language, the linguistic capabilities of the right hemisphere do exist, although they are uncommon" [17]. Although the zones responsible for our communication abilities are defined, their development varies among individuals. As a result, various types of small-scale imbalances between the hemispheres have been detected in regions associated with language.

An in-depth comprehension of the anatomy and physiology of the language-related cortices can provide significant insights into the cortical mechanisms that support linguistic analysis and production. This knowledge can further aid in understanding the underlying causes of disorders like dyslexia and autism. "MRI studies reveal that the area of the planum temporal is approximately symmetrical in children with dyslexia-a clue that their language difficulties may stem from the lack of a specialized left hemisphere. Interestingly, an MRI study on adults with dyslexia found that the typical medial temporal lobe asymmetries were reversed in dyslexic adults" [17]. According to recent research, there is no evidence to suggest that dyslexia or autism are directly inherited genetically. However, children can inherit specific brain and nervous system structural characteristics, which may predispose them to develop these conditions later on.

Neuropsychological research refers to the study of both speech perception disorders and the observation of neurolinguistic processes in people with obvious abnormalities, for instance:

- Speech pathologies.
- The influence of meditation on the character of a person and changes in his brain.
- Oncological diseases of the brain.
- Challenges with short- and long-term memory.
- Speech encoding in the cerebral hemispheres, which occurs differently in right-handers and left-handers
- How writing from left to right (in most world languages) and right to left (in Semitic languages) affects the perception of language and brain function, the formation of mental space.
- Difficulties in brain decoding of speech in children.
- Challenges with language acquisition, information processing in the brain.
- Phenomena of hallucinations.

The field of neurolinguistics aims to investigate the neurobiological underpinnings of language processing and acquisition. One intriguing phenomenon it examines is how the brain of a bilingual person, who has been exposed to and acquired two languages from birth, differs from that of a monolingual individual. Specifically, researchers are interested in understanding the mechanisms and neural correlates involved in bilinguals' ability to switch between languages and how this ability relates to differences in brain structure and function [31].

In cases of brain injury, can patients recover language abilities such as speaking and reading? What types of general and language therapies have been found to be effective? Researchers in Israel are exploring methods to help children with learning disabilities in Hebrew or Arabic to learn English, which is written from left to right, while Semitic languages are written from right to left. Moreover, "whereas in Hebrew morphological processing is independent of semantics, in English morphological activation is clearly modulated by semantic overlap" [32]. Additionally, what are the neurological differences between individuals with dyslexia, dysgraphia, and other innate learning disabilities compared to those without such conditions?

The Genetics of Developmental Disorders

"Developmental disorders are defined as diseases that arise in embryonic life or early fetal brain development and alter the developmental trajectory. Most developmental disorders have a genetic etiology." Genetic disorders can be hereditary. In non-hereditary genetic disorders, defects can be caused by new mutations or changes in DNA. They also may be caused by maternal infections during pregnancy (cytomegalovirus, chickenpox, rubella) and exposure to drugs and chemicals that pollute the air, water, or food. The causes of many congenital defects are still unknown. The research claims that, in many cases, genetic disorders disrupt normal brain development.

While susceptibility to mental illness typically has a familial link, it is essential to note that there are no specific genes

solely responsible for mental disorders, similar to the genes associated with traits like eye Color or single-gene disorders. Instead, there are numerous susceptibility genes with minor effects, each contributing to a person's risk of developing the illness by 5% or less. The prevalence of major mental disorders is comparable to other common medical disorders like diabetes and hypertension, and they also share similar complex genetic factors.

"Neurodevelopmental disorders (NDDs) such as ASD and ADHD can be caused by exposure to certain prenatal environments during pregnancy." Thus, Radford and Firth claim that "an important proportion is caused by exposure to environmental teratogens such as alcohol and sodium valproate." According to Karkavina genetic and ecological factors during pregnancy may contribute to potential psychiatric disorders in offspring.

Genetic disorders are not entirely curable, but early detection enables interventions such as training and therapy to facilitate adaptation and enhance the quality of life for affected children. Therefore, therapists should consider the familial medical history and inheritance patterns of genetic disorders to ensure effective treatment for the child. Understanding the genetic underpinnings of developmental disorders is also crucial for providing optimal care to pediatric patients with complex health needs. Recent advancements in genomic technologies have vastly improved the diagnosis of these conditions and have the potential to transform the management of previously refractory pediatric disorders.

To effectively harness these innovations and collaborate with clinical genetics specialists in interdisciplinary settings, pediatric practitioners must possess a comprehensive understanding of genomics and remain attuned to the technical and ethical complexities involved. "Understanding the mechanisms underlying the prenatal environment and fetal development can promote preventive medicine, early intervention, and treatment based on individual risks." In this in-depth review, scientists expound upon the genetic basis of developmental disorders, assess the various types of genetic tests currently in use, including their clinical utility and limitations, and deliberate upon the challenges and prospects in pediatric genomic medicine.

Learning Disabilities

It is not always possible to determine whether the atypical functioning of the brain is innate or acquired due to birth trauma. "Preterm birth was one of the most frequently reported risk factors for children's reading disabilities." Neurodevelopmental variations can result in challenges with sensory perception, information retention, recall, impulse control, and self-regulation. These foundational skills play a pivotal role in acquiring more advanced abilities, like writing or calculation, which are often impacted by such variations [33]. Consequently, individuals with such variations may have difficulty mastering academic and everyday skills and are at a higher risk of developing LDs.

Educators claim that the most common innate LDs are dyslexia, dyspraxia, dysgraphia, and dyscalculia [34]. Comorbidity among learning disabilities is common in children. It is not unusual for a child to exhibit symptoms of multiple LDs, such as dyslexia co-occurring with ADHD, or dysgraphia arising from dyspraxia. In fact, it is typical for a child to have two or more LDs simultaneously. Individuals with learning disabilities often struggle with written language and numerical concepts, leading to deficits in both writing and math skills. Furthermore, they may present difficulties with reading, indicating the presence of a reading disorder. This suggests the possibility of profound multiple learning disabilities [35].

Children who exhibit severe agrammatical writing disorders also tend to exhibit atypicality in reading and experience difficulties in performing mathematical tasks. These difficulties are not necessarily caused by problems with the sensory modalities such as vision, hearing, and speech, but rather are a result of altered neural processes involved in processing language. In the diagnostic analysis of children by speech therapists, a common conclusion is the presence of aphasia-related impairments in reading and writing. Aphasia is typically caused by damage or functional abnormalities in the left middle side of the brain [33].

During the early stages of researching reading, spelling, and handwriting disorders, it was initially thought that their root cause was a deficit in intellectual development. However, subsequent studies have demonstrated that such disorders are not correlated with intellectual underdevelopment. It is known that children can excel in math while having difficulties with reading and writing, and the opposite can also be true. In some cases, children with dyslexia and dysgraphia may show proficiency in mathematical skills, provided there is no co-occurring dyscalculia [36]. Contrary to popular belief, research has revealed that individuals with mental impairments possess robust logical abilities and excel in mathematical tasks. These findings challenge conventional notions and emphasize the significance of a nuanced comprehension and assessment of cognitive abilities in such individuals [35].

According to research, dysgraphia results from disruptions in higher mental activity due to the underdevelopment, damage, or absence of specific functions. The disorder is

characterized by consistent phonetic, grammatical, and syntactic mistakes while writing. It is entirely unrelated to the child's literacy level or proficiency in the rules of their native language. Notably, children with dysgraphia can exhibit a high IQ, exceptional abilities, or even giftedness Beckmann et al.

Hence, adopting a personalized approach and providing suitable accommodations to students with special needs in mainstream classrooms is imperative, particularly during assessments, including the final evaluations.

ADHD and other Accompanying Disorders

A student with an average or high IQ who exhibits disruptive behavior in class, such as talking to peers, causing distractions, and providing answers prematurely, may have classic ADHD. This student may also exhibit defiance by answering back to the teacher or peers who ask him to be quiet. However, the student may also appear to be daydreaming, listening to the teacher, and not causing trouble. Consequently, the student may perform poorly in school, complain that the material is too difficult or too easy, and lack the motivation or energy to study. As a remedial teacher, I can consider ADHD as a potential diagnosis for such students.

The latter is one of the main reasons why schoolchildren do not do well, although it is considered a health impairment rather than a LD (Learning Disabilities Association of America, 2023). Nevertheless, I am starting this chapter with the description of this disorder because it accompanies many LDs, as well as ASD and CDs, that will be researched in chapters 3 and 4, respectively. ADHD is a neurological behavioral disorder that begins in childhood and is characterized by difficulty concentrating and maintaining attention, poor working memory, excessive motor activity or hyperactivity, and incontinence or impulsivity [38,39]. Although it may be classified as a mental illness, it can also be considered as a neurotype.

According to the research, up to 15% of schoolchildren have ADHD. Nevertheless, only 5% of children suffer from ADHD caused by genetic factors. The risk factors include birth weight less than 1500g, head trauma, iron deficiency, as well as prenatal exposure to alcohol, tobacco, and cocaine, and certain medical conditions. ADHD can also be a consequence of abusive relationships with parents and peers and other challenging childhood experiences.

This disorder is usually detected in children under the age of 4 years old, and sometimes even earlier. While the peak age of diagnosis is between 8-10 years, individuals with the predominantly inattentive subtype of ADHD may not receive a diagnosis until they reach adolescence. Children with ADHD often daydream, stare at the same point, and get lost in their thoughts [39]. Unlike daydreamers, hyperactive kids cannot sit straight at the desk: they move their legs and arms, push their co-students, and get unfocused on the lessons. Moreover, they have peer relationship challenges due to their impulsivity. According to the National Institute of Mental Health [40], there are three main symptoms of ADHD, which are presented in Figure 5.

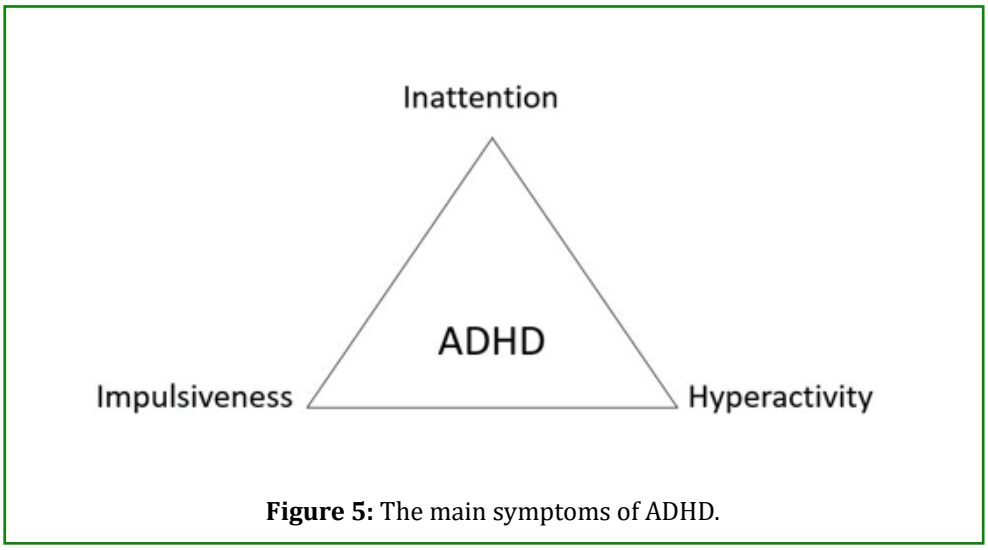

Figure 5: The main symptoms of ADHD.

Inattention refers to a student's inability to maintain alertness and focus during tasks that require quick reactions, visual perception, sustained concentration, and prolonged verbal information processing. This can lead to the student misunderstanding the teacher's instructions and incorrectly performing a different task or the right task [38].

Impulsivity is a behavioral tendency characterized by hasty actions that often result in negative outcomes. It can manifest in various ways, such as children engaging in physical aggression toward peers or displaying defiance toward authority figures like teachers. Similarly, teenagers and adults with impulsive tendencies may make impromptu decisions to drop out of school or leave their jobs without fully considering the potential consequences [41].

Hyperactivity is a condition characterized by an abnormal increase in physical activity. In elementary school-aged children, it can manifest as difficulty in maintaining calm and focused behavior in a classroom setting. These children may display restlessness, fidgeting, excessive talking, and irritability during breaks, leading to exhaustion in individuals communicating with them [42,43].

Williams P [44] claims that there are also combined types of ADHD, which are illustrated in Figure 6, and ADHD kids might have six or more symptoms of hyperactivity, inattention, and impulsivity.

	ADHD, Primarily Inattentive	ADHD, Hyperactive-Impulsive	ADHD, Combined Type
Inattentive/ Poor Attention Span	X		X
Impulsive and/or Hyperactive		X	X

Figure 6: Combined types of ADHD.

Several symptoms of ADHD become apparent during the early years of a child's life. These symptoms may also indicate issues related to communication that can arise due to other neurodevelopmental conditions, such as ASD, specific LD, anxiety, depression, or behavioral disorders, such as Conduct Disorder [39].

The Parent version of the Child and Adolescent Psychiatric Assessment (CAPA) is a valuable tool for mental health professionals, such as psychologists, therapists, and psychiatrists, to verify the diagnosis of ADHD in children and adolescents. The CAPA is a comprehensive assessment that aids in the identification of ADHD by evaluating the symptoms, severity, and functional impairment of the patient. It is a reliable and valid measure of ADHD that can assist clinicians in making informed decisions about treatment and care for their patients [45].

Children with untreated or undertreated ADHD often experience more severe symptoms in traditional classrooms and academic activities. Research suggests that specialized pharmacological and pedagogical interventions can have long-lasting effects. As individuals with ADHD age, poor peer acceptance and feelings of loneliness tend to increase, which can exacerbate symptoms. Moreover, if ADHD is not diagnosed and treated promptly, there is an increased risk of substance abuse and alcohol addiction among adolescents and adults with ADHD [42]

While the symptoms and signs of hyperactivity tend to ameliorate with age, some residual difficulties might persist into adolescence and adulthood. The predictors of unfavorable outcomes in adolescents and adults include:

- Low IQ
- Depression
- Anxiety
- Aggressiveness
- Interpersonal problems
- Parental psychopathology

Wolraich ML, et al. [46]

Individuals with ADHD who exhibit predominantly impulsive behaviors are at a higher risk of developing personality and social behavior disorders in adolescence and adulthood. This can lead to poor academic performance, low self-esteem, and difficulties in learning appropriate social behavior. Even in adulthood, many individuals with ADHD continue to struggle with impulsivity and poor social skills, which can have a significant impact on their daily lives. "As children with ADHD get older, the way the disorder impacts them and their family changes" [35]. It is shown in Figure 7.

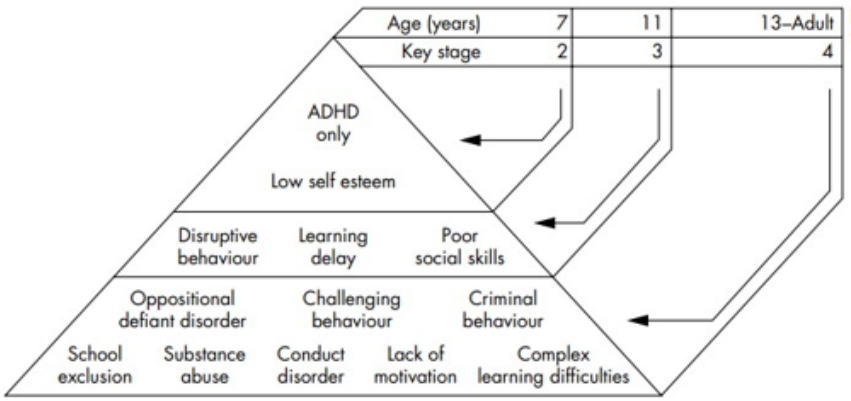

Figure 7: Stages of ADHD.

Some parents often believe ADHD to be a phase that children will eventually outgrow. However, in some cases, the disorder can persist and interfere with developing cognitive skills, including the ability to reason, learn, and effectively communicate. This is especially true when the disorder's organic basis impacts the central nervous system and hinders the normal functioning of the brain's executive functions [42]. As a result, individuals with predominantly inattentive ADHD exhibit symptoms of reduced motivation toward their academic pursuits and may find it difficult to adjust to social norms. They prefer interactive and experiential learning to passive learning, which requires sustained attention and task completion [39].

Furthermore, undiagnosed ADHD in adolescents and adults can present diverse symptoms and significantly affect various daily life aspects. Furthermore, it's noteworthy that ADHD symptoms can manifest differently among individuals, as per the research by Williams P [44] and Green R [47]. They claim that the prefrontal cortex, located in the anterior part of the brain, is a pivotal hub for higher-level cognitive processing, including executive functions, working memory, planning, decision-making, and personality traits. It also plays a vital role in regulating emotional responses, social behavior, and attentional control, making it a critical brain region for adaptive functioning in complex and dynamic environments. Here are some common signs and behaviors that may typify the disorder:

1. Difficulty Concentrating. Individuals with undiagnosed ADHD often experience difficulties sustaining attention on tasks that require prolonged focus [42]. They may exhibit heightened distractibility towards external stimuli, leading to challenges in completing projects or work. Such difficulties may even result in underperformance despite adequate preparation, as is commonly observed amongst high school and university students, including native speakers taking English tests. In adulthood, they may be more inclined towards work that involves less responsibility and sustained attention [48].
2. Procrastination. Persistent procrastination and difficulty initiating tasks are common symptoms of ADHD. People with ADHD often struggle with time management and tend to postpone important tasks until the last minute (ADDtude). This behavior is caused by a lack of motivation, difficulty concentrating, and feeling overwhelmed. As an educator, I have observed these behaviors in my students who find it challenging to initiate and complete tasks, such as writing projects and book reports, despite their desire to excel in their work.
3. Impulsivity and anxiety are the hallmarks of ADHD. It is a behavioral trait that can be characterized by hasty decision-making, interrupting others during conversations, or engaging in actions without considering the potential consequences [48]. In children, this trait can often manifest while performing tasks, where they prioritize speed and completion over accuracy. However, if they fail to achieve their goals, it can lead to frustration and emotional distress.
4. Forgetfulness and struggling with time management (ADDitude). School children with undiagnosed ADHD often exhibit forgetfulness regarding their school supplies and upcoming events. Adults with ADHD may experience difficulties in keeping track of appointments, deadlines, and commitments. They may also face challenges in accurately estimating the duration of tasks [42]. Children with ADHD struggle to complete their homework in a timely manner and may end up working on it late at night. This lack of sleep can result in fatigue during the following day, leading to classroom drowsiness.
5. Chronic Lateness. Chronic tardiness in individuals may

be a result of inadequate time management skills and a tendency to underestimate the time required to complete tasks. In the case of children, being late for school may stem from difficulties in gauging the time needed for daily routines, leading to a habitual pattern of tardiness that may persist into adulthood (ADDitude).

6. Disorganization is another consequence of poor time management skills, that can result in unfulfilled responsibilities and problems at school, university or work. Individuals of all ages, including school-aged children and adults, may struggle to organize their tasks and manage their time effectively. This may lead to cluttered personal spaces and untidy workspaces, making establishing and sticking to routines difficult [47].
7. Restlessness and Hyperactivity. Individuals with ADHD may exhibit hyperactivity, which is more conspicuous in children than adults. In adults, restlessness, fidgeting, or an inner sense of unease are some of the common symptoms of hyperactivity. They may also find it challenging to maintain a stationary position for an extended period of time [42].
8. Mood Swings. Kids, teens, and adults with ADHD may exhibit emotional dysregulation, characterized by abrupt mood shifts from excitement to anger, happiness to frustration, and irritability. This symptom can lead to difficulty managing stress and other emotional states, negatively impacting daily functioning [41].
9. Relationship Challenges. Adults with undiagnosed ADHD may exhibit challenges in maintaining relationships, both personally and professionally. These difficulties often stem from their characteristic symptoms of forgetfulness, impulsivity, and communication difficulties. As such, it is crucial to identify and diagnose this condition early on to provide targeted interventions that can help such individuals navigate their personal and professional relationships more effectively [48].

It is important to note that these symptoms can also be attributed to other conditions, and a thorough evaluation by a healthcare professional is necessary for an accurate diagnosis. Children with ADHD are characterized by poor social skills, relationships with peers, and low grades, which often leads to sleep disturbances, anxiety, dysphoria, depression, and mood swings [41]. Moreover, about 20–60% of children with ADHD have one or more LDs, such as dyslexia, dysgraphia, dyscalculia, and many more Health Direct. Moreover, it may be a part of more severe cases of neurodiversity, such as autism and mental retardation [49].

Dyslexia

As mentioned above, dyslexia affect people of all ages, with around 10% of the population experiencing symptoms, while in children, it is the most common learning disorder, affecting up to 17%-20% of school-aged ones in the USA in particular [24]. It is a LD that involves difficulty reading due to problems identifying speech sounds and learning how they relate to letters and words. Also called reading disability, dyslexia come from individual differences in the areas of the brain that process language [50]. Developmental dyslexia is a hereditary deficit that selectively affects the visual processing of words but leaves oral and non-verbal reasoning skills intact. It means that if one or both parents struggled at school, their children might have similar challenges. As a remedial teacher, I have noticed the following ones:

- They know letters, but they cannot read.
- They read syllables.
- They read slowly.
- They confuse letters.
- They guess the words.
- They have problems with reading comprehension.

In most cases, dyslexia develop because of intrauterine organic damage to the central nervous system after hypoxia, infectious diseases, or toxic exposure. Neurobiological factors, such as abnormal brain development and function often cause dyslexia. Genetic factors and heredity are also considered as contributing factors. Some neurological changes indicate a delay in the motor, mental, and intellectual development of dyslexic children, leading to reduced accuracy or differentiation of movements during conscious activities. Although children with dyslexia may show inconsistent motor skills compared to their peers, they do not differ in unconscious movements and games [51].

Hulbert G [52] claims that dyslexia is not a sign of problems with intelligence, hearing, or vision – the main reason for this disorder is the different structure of the brain. Therefore, it is one of the sorts of neurodiversity. Nevertheless, children with mental retardation, which will be researched in Chapter 4, show signs of dyslexia. “Do resilient dyslexics have distinct brain structures that allow for better resiliency, or is their success in reading a result of compensation strategies that altered the density of neurons in a specific region of the brain?” asks Dr. Patael from Tel Aviv University (The Science of Psychotherapy). After scanning babies’ brains for MRI, scientists tried to find the answer to this question and tested the same kids’ reading abilities three years later. They discovered that a higher density of neurons in three-year-old kids indicated their potential abilities to read at an older age.

Furthermore, dyslexic children exhibit slightly delayed brain maturation in electroencephalograms despite having normal hearing acuity. Recent studies have revealed that certain visual functions are also distinctive in children with dyslexia. Typically, both eyes’ perception zones are different, allowing

the brain to independently choose which group of receptors to direct the image to. However, in dyslexic individuals, the lack of differentiation in perception zones hinders the brain's ability to process visual information accurately [51].

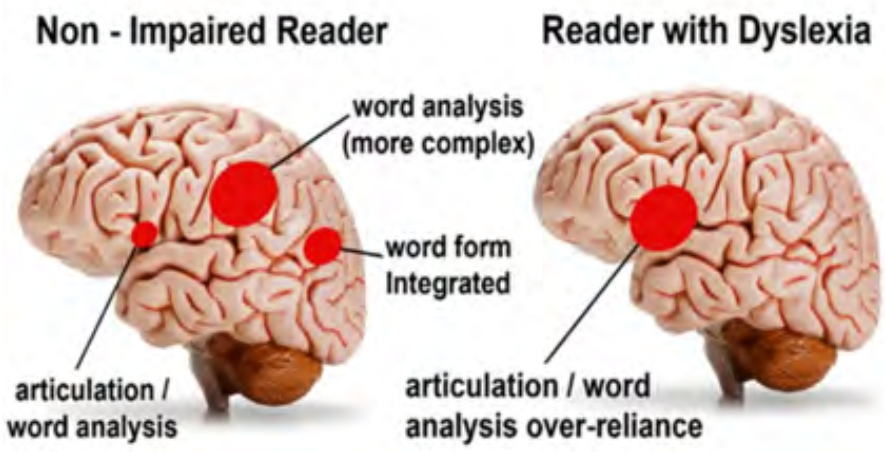

Figure 8: Brains of non-dyslexic and dyslexic children.
Note: From Understanding Dyslexia.
Cognitive, n.d., https://cognitive.com.sg/understanding-dyslexia

In Figure 8, the brains of non-dyslexic and dyslexic children are illustrated. In non-dyslexic ones, the parietal-temporal area responsible for word analysis is more complex than in dyslexic ones. Furthermore, language processing involves the activation of Broca's area, which is responsible for controlling speech production and linguistic analysis. Meanwhile, the occipital-temporal region serves as the word-form area, generating a neural representation of a word's spelling, pronunciation, and semantic meaning during reading [53]. In individuals with dyslexia, the parietal-temporal and occipital-temporal regions exhibit either low or no activation.

Most dyslexic children can succeed in school with the help of tutoring or the SEN program. Emotional support is crucial in teaching and treating them. Although there is no cure for dyslexia, early assessment and intervention lead to the best outcome. Sometimes, dyslexia stay undiagnosed for many years and is not recognized until adulthood, but it is never too late to seek help. The research claims that there are the following types of dyslexia:

1. Phonemic dyslexia mean a child cannot distinguish phonemes or similar sounds in auditory perception and articulation (g-k, z-s, d-t). Therefore, while reading, such children randomly replace phonemes similar in sound and pronunciation. Variants of phonemic dyslexia include violating phonemic analysis; children skip or insert extra letters while writing words. Sometimes, it is difficult for them to combine two syllables and then talk about "letter by letter" reading [51].
2. Semantic dyslexia, or "mechanical" reading - with this disorder, when reading, the child pronounces words correctly but does not understand their meaning. It is "caused by an acquired disease of the central nervous system such as stroke or traumatic brain injury. Acquired dyslexia results from damage to the mature reading system and manifests as an impairment in the comprehension of written language". This type of dyslexia is a condition where a person has difficulty forming words and phrases by combining different syllables. This can be caused by either an intellectual disability, which makes it hard for the person to establish grammatical connections between words in a sentence, or due to a specific impairment in semantic processing. Individuals with semantic dyslexia may read quickly, but their reading will lack comprehension, understanding, and memorization. They will not be able to answer content test questions as they cannot effectively decode and understand the meaning of the text [54].
3. Agrammatic dyslexia is a prevalent disorder characterized by a lack of vocabulary and underdeveloped speech. It is distinguished by incorrect case agreement and substitution of case endings. The underdevelopment of the grammatical structure of speech syntactic and morphological generalizations causes it. Agrammatic dyslexia can be either innate or acquired [55].

4. Optical dyslexia is a visual processing disorder in which a child is unable to accurately recognize and differentiate between graphic images, leading to confusion between letters and difficulty comprehending the meaning of words. This condition can make it challenging for children to learn to read and may require specialized interventions to improve their reading abilities. This type of dyslexia, known as visual dyslexia, presents itself in multiple forms, such as letter confusion, word reversal, and poor reading sequence caused by switching lines. The recognition of letters is particularly challenging due to their varying number and spatial arrangement of dots. Optical dyslexia is commonly observed among children with visual impairments [55].

Dyslexia may also be accompanied by delayed mental development when a child does not understand what sound a particular letter represents and cannot master the alphabet. Anyway, dyslexic children may have an average or even high IQ [56]. Individuals with dyslexia typically experience difficulty in accurately recognizing and decoding written words and letters. In contrast, those with intellectual disability exhibit a broader range of cognitive deficits that may affect various aspects of cognitive functioning beyond reading [57].

Nevertheless, sometimes, changes in the neurological status indicate a delay in the motor, mental, and intellectual development of children with dyslexia, especially if this disorder is recognized too late. Thus, they may experience insufficient accuracy or differentiation of movements during conscious activities [50]. The child's motor skills may be somewhat inconsistent with his age, although children are no different from their peers during games and unconscious movements. Electroencephalograms in dyslexic children also show slightly delayed brain maturation with normal hearing acuity [55].

However, visual functions studied recently have their characteristics in some children with dyslexia [50]. Usually, the receptors in the two eyes are different from each other and transmit different images to the brain. The brain independently decides which group of receptors in one eye or another to direct the image to Kaverina et al. In dyslexic kids, the perception zones of both eyes are the same, and if signals from them enter the perception zone simultaneously, then the brain cannot "decide" on the choice of the image, which is a mirror image. This explains the difficulty in quickly recognizing letters and syllables.

Dyspraxia

Dyspraxia, also known as Developmental Coordination Disorder (DCD), is a condition that results in difficulties related to planning and executing precise movements, fine motor skills, and sometimes cognitive function. It can be either acquired or innate, and in some cases, if motor awkwardness and clumsiness are a family trait, it may be a genetic disorder. People with dyspraxia often experience problems with coordination, which can negatively affect their daily activities [58].

According to research, Developmental Coordination Disorder (DCD) is caused by weak connections between specific nerve pathways in the brain. The disorder may also arise from premature birth or due to damage to the brain resulting from various factors such as infectious diseases, strokes in young children, or accidents. DCD is found in approximately 6% of school children (Cleveland Clinic). The prevalence of this condition is significantly higher among boys with a ratio of 2:1 to 5:1 compared to girls (CanChild). According to Tamplain's assertions, DCD and dyspraxia are distinct conditions. DCD primarily impacts movement and coordination, while dyspraxia is a more complex disorder that affects memory, speech, organization, and social and emotional skills. Additionally, dyspraxia can lead to difficulties with sensory processing.

Dyspraxia is a neurodevelopmental disorder that results in difficulties with fine and gross motor coordination. This condition affects children and can lead to physical and behavioral issues, as well as emotional distress. The clumsiness and coordination problems associated with dyspraxia are caused by motor LDs. It negatively affects the child's daily activity, self-care, school performance, behavior, and communication, requiring timely, targeted correction. Thus, DCD can be noticed in toddlers who start walking later. When they do, they are clumsy, and their body movements and positions are unusual. They also challenge eating with cutlery. Such children often start speaking later and mispronounce many sounds (NHS).

Dyspraxia in toddlers is characterized by difficulty and inaccuracy in performing purposeful motor acts and by various types of motor impairment:

- clumsiness
- poor coordination
- awkward hand movements
- difficulty with holding toys and other objects

Pietrangelo A [58]

Furthermore, parents and kindergarten teachers may notice the following signs of dyspraxia in kids of 3-5 years old:

- They struggle with doing up their buttons or tying shoelaces.
- They cannot button up.
- They have difficulties with holding pencils and cannot

draw.

- They cannot run and jump.
- They bump into other people or objects.
- They cannot keep their balance and often fall.
- They cannot hold spoons and forks and make a mess while eating.
- They need help while dressing.
- They have problems with fine motor skills.
- They get tired quickly and avoid sport games.
- They avoid many physical activities.

Dyspraxia in schoolchildren can manifest through impaired motor skills, resulting in difficulties with coordination, balance, and movement planning. Other common symptoms include poor handwriting, stuttering, and slurred, slow speech. These motor challenges often stem from issues with the brain's ability to plan and coordinate movements, and can impact a child's ability to perform everyday activities and succeed academically (Pietrangelo), (Johnson). They also might have dyslexia, dysgraphia, and ADHD simultaneously. Furthermore, they avoid communicating with peers because they fear being mocked and bullied. Being diagnosed as having dyspraxia or other LDs, they may get depressed and suffer from anxiety.

The pathogenetic core of dyspraxia is the delayed maturation of cortical and subcortical structures that provide various types of motor skills, which is illustrated in Figure 9. The process of executing a movement plan requires a complex interplay of different cerebral structures. Studies suggest that children with dyspraxia exhibit improper functioning of the left and right hemispheres of their brain, which leads to a lack of coordination. This deficiency in the designated structures results in an impairment of basic motor skills, including those related to speech, visuospatial abilities, and construction (Dyspraxiakids).

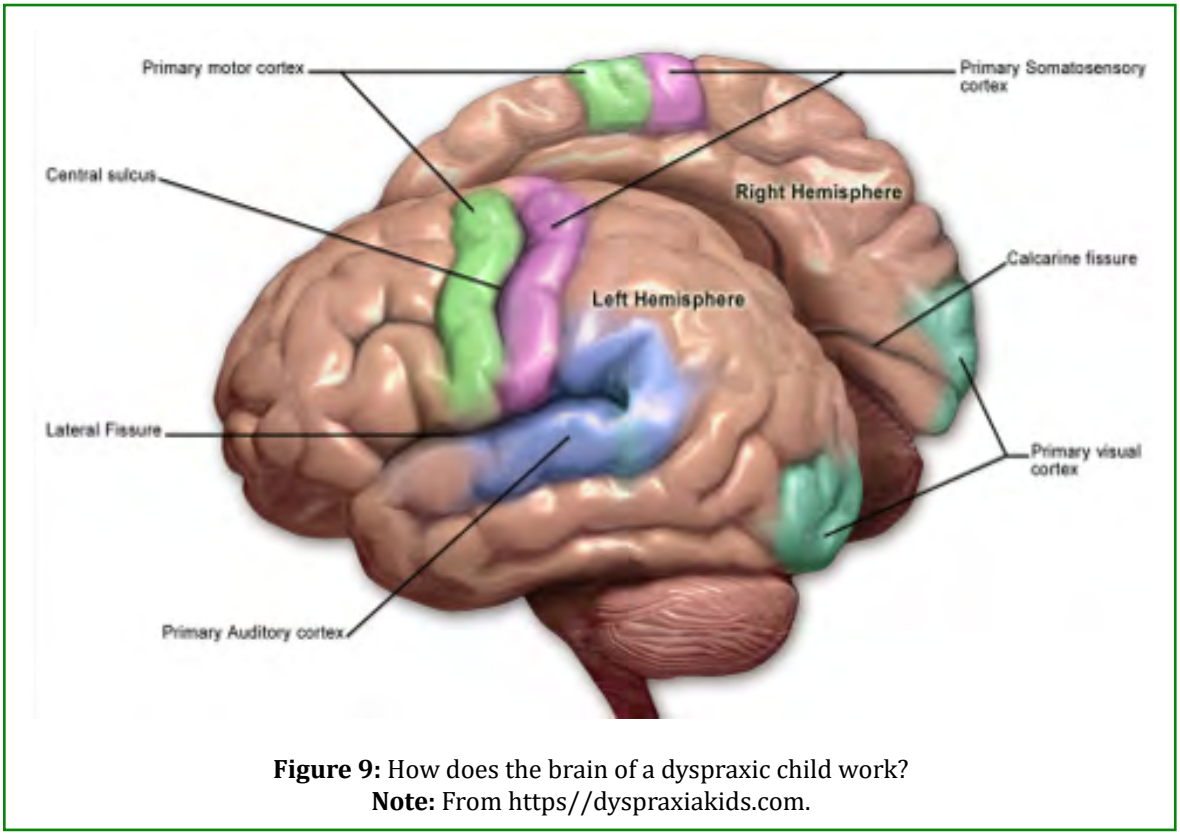

Figure 9: How does the brain of a dyspraxic child work?
Note: From https//dyspraxiakids.com.

The pathogenetic approach identifies two types of dyspraxia: primary and secondary. Primary dyspraxia is caused by the immaturity of the motor analyzer and pyramidal tracts, while secondary dyspraxia is associated with impaired sensory stimuli processing. The latter is more prevalent and severe. In adults, a breakdown of voluntary movements is referred to as apraxia.

DCD is identified during a neuropsychological and speech therapy examination of the child. There are the following types of such a disorder:

1. Motor dyspraxia is a condition that affects a person's ability to coordinate physical movements, such as walking, running, jumping, catching, and kicking balls. It can cause difficulties with writing, dressing, and skipping skills. Children with motor dyspraxia often struggle in sports lessons and may be subjected to bullying by their peers. As a result, they may avoid participating in sports altogether, missing out on opportunities to improve their coordination and physical condition. Fortunately, exercise therapy classes and occupation therapy sessions can be beneficial for individuals with motor dyspraxia and are available at local clinics.
2. Verbal dyspraxia manifests in omissions, distortions, and replacing complex sounds with simpler ones. It causes problems with active speech (Johnson). Children cannot coordinate their tongue muscles to produce appropriate speech sounds and pronounce words correctly. Their speech is unclear. They struggle to speak fluently and often stutter. Otherwise, they speak slowly and make long and frequent pauses. Verbal dyspraxia is a neurologically based speech disorder that falls on a spectrum ranging from mild to severe. Individuals with severe verbal dyspraxia often rely on non-verbal communication methods, such as gestures, due to their difficulties with coordinating the complex muscle movements required for speech production [59].
3. Oral dyspraxia is the impairment of mouth and tongue movements can lead to difficulties in producing different speech sounds. Each speech sound has a unique form of articulation, which necessitates the ability to quickly switch the position of the tongue between different locations in the oral cavity [60]. Oral dyspraxia means a limited ability to control the articulation organs voluntarily. The condition affects the child's orofacial musculature, leading to difficulties or abnormalities in performing precise tongue and lip movements required for speech [59]. Consequently, the child exhibits misarticulation of certain sounds.

Children with motor dyspraxia need complex correction of motor skills (Pietrangelo), (McPherson). They benefit from various types of physical activity, such as cycling, balance biking, roller skating, trampolining, and other outdoor games or swimming. Within this approach, sensory integration methods, such as tactile and visual stimulation, are widely used. In therapy classes, child psychologists also use finger gymnastics and bodyboards. Sensorimotor games are conducted with younger children, and sand therapy and art therapy sessions are held with older children. For dyspraxia, training on a balancing board is indicated - cerebellar stimulation.

In correctional work, adhering to a structured approach is crucial by completing one stage before moving on to the next [60]. Occupational therapy involves assisting children in developing legible handwriting and performing daily tasks with greater ease and efficiency. This therapy primarily focuses on enhancing their fine and gross motor skills while also striving to optimize the home or school environment for the children's benefit (Seladi-Schulman).

Verbal and oral dyspraxia are speech disorders that can be corrected by training articulatory motor skills through speech therapy. This therapy can also aid in the development of phonemic hearing and pronunciation of syllables (Santos-Longhurst), (McPherson). Working on general motor skills simultaneously with speech therapy is recommended to improve overall speech disorders. Focusing on sound pronunciation is unnecessary if a word's syllable structure is broken. Therapists can combine work on three types of dyspraxia, such as involving finger work and syllable pronunciation to enhance motor skills development [60].

Dysgraphia

Dysgraphia is a partial violation of the writing process, in which persistently repeated errors are observed: replacement of letters, distortion of the sound-syllabic structure of a word, violation of the fusion of writing individual words in a sentence, and agrammatism in writing. Sometimes, their handwriting is unreadable or not very neat: it may be too big or too little, and the letters "jump" due to dyspraxia and problems with fine motor (Pietrangelo).

Various factors such as intrauterine infections, birth trauma, heart disease, surgical interventions, somatic diseases, and traumatic brain injury can cause pathological effects on the developing brain at different stages from prenatal development through school age. These negative factors can impact specific centres in the speech zones and the entire speech complex, leading to general speech underdevelopment (Cleveland Clinic).

In situations where unfavorable conditions are experienced, the development and operation of brain regions that control language and written communication, particularly the parietal lobe, may be affected, resulting in deviations. (Psychology). It is seen below in Figure 10.

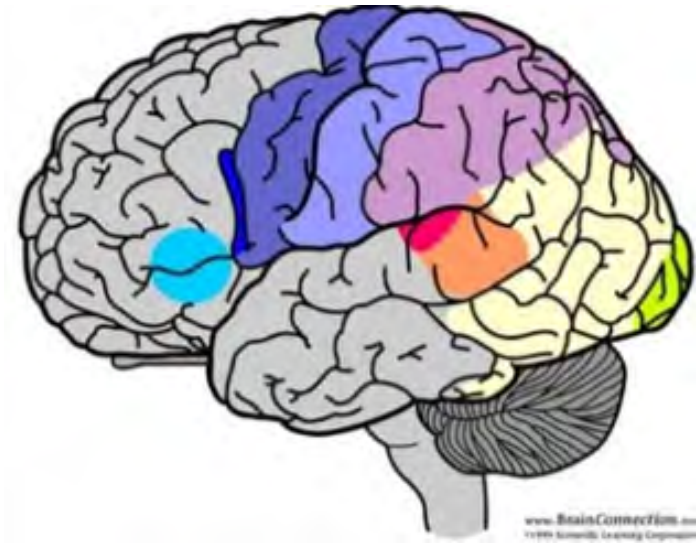

Figure 10: Brain structure and dysgraphia.
Note: From Dysgraphia, https//en.ppt-online.org

Relatively recently-only since the end of the 19th century-this state of children's written speech began to be deeply examined and made into a separate science (Leigh). Many researchers, when working with children, noticed and described similar deviations in speech and grammar.

"Before children write numerals and letters formally, they should practice drawing vertical, horizontal, and slanted lines, circles, half circles, angles, and making loops" [36]. It is common for preschool-aged children to experience difficulty writing neatly, often confusing or omitting letters and syllables. However, most children naturally improve their handwriting with experience, practice, and language acquisition. However, some children continue to struggle with handwriting well into the first or second grade despite receiving occupational therapy. This indicates a possible diagnosis of dysgraphia, as they consistently make the same errors when writing words, sentences, and texts.

I teach in junior high and high school. I often notice that some of my students may have unreadable handwriting, misspell words, misplace words, and struggle with grammar and organizing sentences. They write slowly, repeat or rearrange letters and syllables, write extra letters in words, or do not finish the end of words. There may be fluctuations in the height and slope of letters, slippage from the line, replacement of uppercase letters by lowercase letters, and vice versa. Ignoring capital letters is more than typical for Hebrew speakers because, in that language, they do not exist. Furthermore, the speakers of Hebrew, Arabic, and other Semitic languages often write in English from right to left.

Errors in writing are not necessarily indicative of inattention or lack of knowledge of the rules. The writing process is a complex, multi-level system that engages various components, including visual, auditory, speech, and motor systems. These systems operate simultaneously and interact with one another, playing a crucial role in the writing process. "Visual processing is a higher cortical function. Decoding and interpretation of retinal images occur in the brain after visual signals are transmitted from the eyes" [36].

In cases of disordered interaction, there is a lack of coordination between systems, leading to persistent disorders. These disorders are not limited to written speech but also affect oral speech. As a result, dysgraphia is often accompanied by non-speech symptoms such as neurological disorders, decreased performance, low neurodynamics, distractibility, hyperactivity, and poor memory.

Dysgraphia is a disorder that affects the ability to write and makes it very challenging for individuals to study and master new material. Children with this disorder often experience anxiety during language tests, leading to feelings of insecurity. They also tend to get easily fatigued during regular classes, resulting in a lack of writing motivation. Dysgraphia, which often occurs alongside other speech disorders such as alalia, dyslexia, and aphasia, can negatively impact self-esteem and overall mental health. Since it does not go away independently, it requires targeted correction and regular work with speech therapists, teachers, and psychologists.

Many kids with dysgraphia have messy or unreadable

handwriting, which is "commonly observed in children with a high intellectual quotient (HIQ) and generally associated with developmental coordination disorder (DCD)." Does handwriting influence studying? On the one hand, it is a marker of good development and learning of the child [37]. Furthermore, Vygotsky claimed that written language reflects the child's thinking. On the other hand, for the last two decades of working for a particular educational institution, I have noticed that not all students with good handwriting do well at school and vice versa. Sometimes, students with a high IQ have messy or unreadable handwriting. Nevertheless, even if a child has a high IQ, poor handwriting demotivates. " Problems with handwriting can affect self-esteem, perception of ability, and relationships with peers and teachers" [36].

The advice to read more and write more usually does not work. Problems with reading and writing always have specific neurological causes. These dysfunctions cause the brain to work in a constant overload mode, which is why the child is often tired or, on the contrary, overly active. The brain of many children cannot cope with the processing of information coming from the senses - sight, hearing, and tactility (Finn).

The neuropsychological approach to the analysis of dysgraphia suggests looking for the essence of the problem much deeper. It is essential to know the mechanism of errors for the correction to be effective, regardless of who performs it: a neuropsychologist or a speech therapist. That is why children are unlikely to outgrow dysgraphia McCloskey et al. A detailed program of neuropsychological correction makes it possible to achieve high results in increasing neurodynamic, correcting distractibility, lack of concentration, hyperactivity, and increasing memory capacity without medications and side effects.

From the point of view of neuropsychology, there are five types of dysgraphia [61].

1. Dyslexic Dysgraphia is a condition in which individuals have difficulty in spontaneously generating written compositions, while they can copy written works quite easily. During the process of writing dictations, they may make spelling errors and grammatical mistakes, despite having average motor skills. According to Gubbay and de Klerk, this type of dysgraphia may be acquired due to cerebellar injury, which also affects the coordination of writing.
2. Motor Dysgraphia occurs due to poor fine motor skills, deficient muscle tone, clumsiness, and slowness (Pietrangelo). It "does not affect the symbolization of writing, but the shape of letters and the quality of writing." Martins et al. Research suggests that while spelling can be a strong suit for some students, illegible and disorderly handwriting is a common issue, often resulting from hasty writing. In such cases, occupational therapy has proven to be an effective solution and is widely incorporated into Israeli special education programs.
3. Spatial Dysgraphia is characterized by a visual-spatial deficit [61]. This disorder causes illegibility in both spontaneous written assignments and copied works. Individuals with this disorder have average fine motor skills and do not frequently misspell words. However, they have trouble maintaining a consistent writing posture and holding the line while writing. Additionally, they are unable to recall the complete image of letters or words, resulting in significant variations in letter slope, width, and height in their writing. This dysgraphia "occurs in people with right hemisphere lesion."
4. Phonological Dysgraphia is a type of dysgraphia that manifests as difficulty in accurately spelling words due to an inability to remember and match phonemes with their corresponding letters. Individuals with Phonological Dysgraphia may struggle with regular and irregular spellings and mispronounce and misspell words. They often have trouble memorizing spelling patterns and may make errors even with words that they have encountered before [62].
5. Lexical dysgraphia is a cognitive impairment characterized by the inability to spell irregular words accurately despite having a good grasp of spelling rules. People with this condition rely on sound-to-letter patterns while writing, often leading to misspellings of irregular words. Although their spelling skills may seem proficient, they tend to follow standard sound-letter patterns to a greater extent, resulting in errors when spelling words that do not conform to them [61].

Dysgraphia is a condition that cannot be cured, but its symptoms can be mitigated with the aid of occupational therapy and other accommodations [62]. In the case of students struggling with dysgraphia, they often experience fatigue while writing, which is why teachers should assign fewer writing tasks or allow them to complete tasks orally or using electronic devices. Alternatively, students can answer questions or fill in the blanks on paper or online instead of being tasked with writing. Another option is for students to write as much as possible and then read their text aloud to the teacher for evaluation. Additionally, students with dysgraphia require more time to complete tasks, so teachers should allow extended deadlines Rosenblum et al.

Many students find it challenging to take notes while listening to the teacher or copying from the board so they can record the teacher's speech on their devices. They can also record themselves and send oral assignments to the teacher or do self-checking exercises online (Jones). In many special

education schools, including the Israeli chain of Beit Ekstein, students do not get any homework not to be overwhelmed. Nevertheless, school psychologists and occupational therapists offer them some activities to practice at home that enable them to train their working memory and fine motor skills [63].

Dysorthography

Dysorthography is another writing disorder often observed in children who experience difficulties in accurately spelling words and adhering to grammatical rules. This condition can manifest as challenges in phonological processing and written expression. It commonly co-occurs with other language disorders, particularly dyslexia. Children with dysorthography struggle to produce written language and may also experience difficulties with phonological awareness and decoding skills. This difficulty in writing is closely associated with existing language disorders and delays, such as dyslexia and dysgraphia [64].

While dysgraphia refers to persistent difficulty mastering the motor skills required for writing, dysorthography involves difficulty mastering the spelling rules of a language. These two conditions often co-occur in younger children and share similar underlying causes. Children who have been diagnosed with dyslexia often develop dysorthography, but it is possible to have dysorthography without an associated reading disability [64]. It is noticed in elementary school, and prompt intervention is crucial to prevent impacts on a child's development. Timely assessment by a specialist is imperative upon observing symptoms of this disorder to support the affected child. However, dysgraphia tends to improve with age, unlike dysorthography, which may persist into adulthood.

Dysorthography is a neurodevelopmental disorder associated with word spelling development. Children affected by this condition encounter challenges in visualizing words and establishing connections between sounds and letters or letter groups. This results in frequent spelling errors, such as the phonetic spelling of words without consideration for their correct form, for example, "teibl" instead of "table" or "fain" instead of "fine." Besides, the sentences the child writes are often incoherent due to wrong word order or poor grammar.

The etiology of dysorthography is complex and can be classified into several categories. Intellectual causes are related to challenges in understanding basic grammatical rules. Linguistic causes stem from difficulties in language acquisition and limited vocabulary knowledge. The individual's cognitive style influences educational causes and requires tailored teaching methods. Finally, perceptual causes are linked to issues with visual and auditory processing.

Effective prevention of the disorder is a pressing concern for parents and teachers. Collaborative work between parents and teachers is crucial for the early detection of the disorder and its successful management Lost Guidance. Parents should provide support at home, while teachers should offer assistance in the classroom. Another area of focus for parents and educators is treating the disorder. Identification of the original cause of the problem is imperative for effective intervention. The disorder often originates from visual or hearing impairments, pronunciation challenges, or an unsupportive study environment. Depending on the cause and severity of the impairment, a tailored treatment plan, recommended by a speech therapist or child psychologist, should address associated difficulties and improve accurate pronunciation and spelling skills.

Dyscalculia

"The term dyscalculia comes from Greek and Latin, which means "Counting badly" [65]. Dyscalculia is a specific learning disorder characterized by difficulties in understanding and processing numerical and arithmetic concepts, such as performing calculations and solving mathematical problems. It is akin to dyslexia in that it affects the ability to learn a fundamental skill, with dyscalculia specifically impacting math and number comprehension. (Markov). This particular syndrome is a well-defined neurological and neuropsychological disorder that requires early identification by a trained neuropsychologist during a child's preschool years. Failure to identify it during this critical period could result in a complex and protracted correction process [66].

Dyscalculia is a specific learning disability that is caused by an underdeveloped intraparietal sulcus in the parietal lobe of the brain. This area is responsible for processing visual information related to mathematics [67]. Specifically, the condition affects a child's ability to accurately visualize numbers and mathematical problems, making it difficult for them to learn math effectively. Therefore, strong visualization skills are crucial for children to succeed in mathematics [68].

Like dyslexia and dysgraphia, dyscalculia can be innate or acquired [66,69] "In neuroscience, hypotheses about the neural basis of disorders often fall into two categories: dysfunction in specific brain regions and cognitive representations versus disrupted connectivity and impaired access to these representations" [70]. People with dyscalculia struggle with math tasks due to the intraparietal sulcus, which is smaller in volume and not actively active enough in people with dyscalculia. It is illustrated in Figure 11. Studies have shown that the intraparietal sulcus exhibits increased

activity during mental operations related to quantities and arithmetic. This finding confirms the well-established central role of the intraparietal sulcus in mathematical thinking, as previously identified by psychologists.

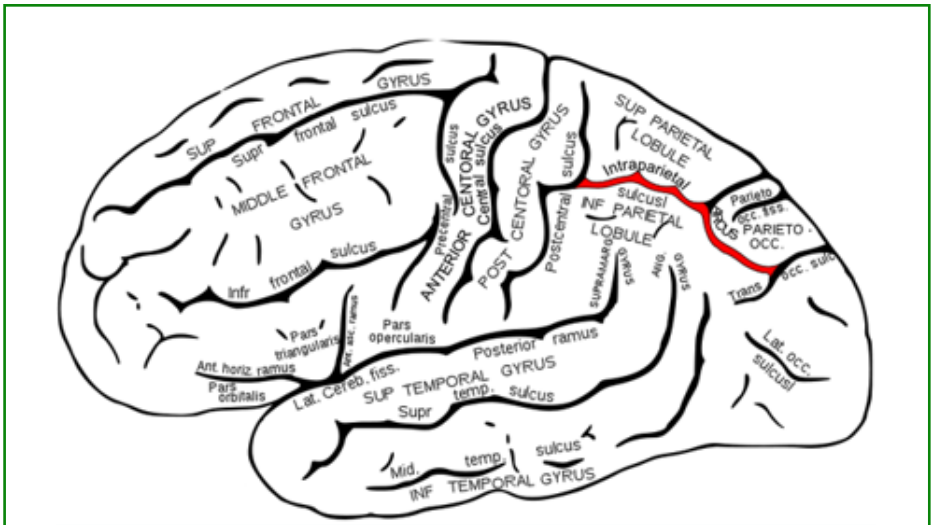

Figure 11: The outer surface of the left hemisphere and the intraparietal sulcus.

"Although the groups activated the same brain networks, the dyscalculic children's allocation for approximate assessment of number magnitude was weaker, more variable, and less widespread" [67]). So, dyscalculia is another neurological disorder that various factors, including prematurity, birth asphyxia, genetic diseases, brain injury at an early age, or neuroinfectious illnesses can cause.

General mental retardation and various psychotraumatic factors can also contribute to the development of dyscalculia. Children with dyscalculia have difficulties with counting, performing math tasks, and acquiring math concepts. This can result in a fear of mathematics, which can be exacerbated by growing up in a dysfunctional family due to the possibility of punishment for poor academic performance [71].

Developmental dyscalculia is a math disorder that affects between 3-6% of the population, as evidenced by studies conducted by Michels L, et al. [72] and Bulthe J, et al. [70]. This condition is characterized by deficits in the neural connections within the brain region responsible for numerical processing, and is often linked to neurological growth problems and psychomotor disorders, as noted by Iukulano T [68].

Neuropsychological diagnostics help identify the reasons for a child's lag or uneven development using test tasks that show the degree of maturity and the level of interaction of different parts of the brain (Rapin). To confirm and clarify the results of hardware-free diagnostics, our center uses instruments to assess the brain's ability to process vestibular, visual, and audio information, the quality of the blood supply to the brain, and the energy supply of the brain stem structures. "Structural and functional MRI studies revealed that developmental dyscalculia shows structural disparities from typical development, particularly in the parietal and frontal cortex" [72].

"Pure" dyscalculia in children is rare, and it often has "high comorbidity with other disorders and symptoms, such as dyslexia, ADHD, anxiety and depression". As in the case of dyslexia or dysgraphia, it is essential to understand dyscalculia, a selective disorder associated with difficulty in mastering arithmetic and mathematical sciences in general, always entails several other features. In most cases with "mathematical dysgraphia," other dysfunctions will also manifest themselves to varying degrees: dyslexia, dysgraphia, ADHD; a complex of features will be observed, expressed in difficulties in learning to read, write, and count. The symptoms by which you can determine whether a child has dyscalculia are simple. At preschool age, it is difficult for a child with dyscalculia to understand what numbers are. It is also difficult for him to correlate objects by shape and size.

Portnov A [71] claims that in elementary school, when the first arithmetic lessons begin, the symptoms are as follows:

- It is difficult for a child to connect the graphic designation of a number and its letter writing (for example, "4" - "four," "10" - "ten.");
- Errors when writing numbers that have similar elements (for example, "3" and "8" or "9" and "6");
- Incorrect writing of numbers during mathematical dictation or copying from the board (mirror writing, writing completely different numbers, etc.);
- Problems with ordinal counting.

- Sound errors of numbers and numbers that are similar in pronunciation.

Schoolchildren with dyscalculia struggle while recognizing arithmetic symbols (for example, using "-" instead of "+"). In elementary school, they refuse to play math games, struggle to connect numbers to symbols and amounts, or cannot read clocks [66]. As a result, they have to memorize the multiplication table and other math rules by heart. Furthermore, they experience difficulties with subtraction, addition, division of the most straightforward numbers, and mathematical operations in a column. In junior high and high school, they have problems with logic, mechanical memory, and date and time recognition and cannot understand or solve mathematical problems.

The research claims that there are the following types of dyscalculia:

1. Verbal dyscalculia is a specific subtype of developmental dyscalculia in which the child has trouble in perceiving numbers aurally. This difficulty is related to the oral comprehension of mathematical concepts and numbers while the child's ability to write numbers is unaffected. The condition is marked by deficiencies in number processing, phonological awareness, and working memory. Children with verbal dyscalculia may face challenges in completing mathematical calculations, learning mathematical concepts, and understanding word problems that involve mathematical operations [60].
2. Graphical dyscalculia is a subtype of dyscalculia characterized by difficulty in recalling the visual representation of mathematical symbols, numerals, and other mathematical notations. This can lead to difficulties in reading or writing mathematical expressions, equations, or problems [60,73].
3. Operational dyscalculia is a neurodevelopmental disorder that affects a child's ability to perform basic mathematical operations such as counting, addition, subtraction, and other verbal and written operations. Although children with this disorder can recognize numbers and mathematical symbols, they struggle with directly manipulating them to perform calculations and arrive at the correct result. This condition can negatively impact a child's academic performance, especially in math-related subjects, and may require specialized interventions to address the underlying difficulties [60].
4. Practognostic dyscalculia is a specific subtype of dyscalculia that affects a child's ability to comprehend abstract mathematical concepts and apply them in real world [73]. This condition makes it challenging for the child to perform basic mathematical operations, such as counting, comparing, and problem-solving. It arises due to a lack of spatial and temporal understanding of numbers and quantities. Children with this condition cannot connect mathematical symbols and concepts to real-world situations, making it difficult for them to understand the significance of numbers and mathematical operations [73].
5. Lexical dyscalculia is a subtype of dyscalculia characterized by difficulties in reading numbers, mathematical equations, and symbols. The affected individual demonstrates comprehension and retention of arithmetic concepts but struggles with the reading and interpretation of them Singh M, [74]. This condition is thought to result from an impairment in the brain's ability to process visual and symbolic information, leading to a deficit in the phonological and orthographic processing required for numerical reading. "People suffering from lexical dyscalculia may be able to read individual digits but unable to recall their places in a larger number" [65].
6. Ideognostical dyscalculia is a specific learning disability that affects a child's ability to perform mental operations related to mathematical concepts without the use of numbers. This type of dyscalculia specifically impacts a child's ability to recall and apply arithmetic terms [73,74]

Hornigold J [75] claims that some students suffer from pseudo-dyscalculia. It is a condition where some students experience math anxiety during tests, leading to poor performance despite not being diagnosed with any learning disability. This can be attributed to a lack of understanding of the material at the start of the course, which results in a lack of motivation. Correcting real dyscalculia is a multi-faceted process that demands the expertise of several highly specialized professionals, including a child psychologist, neuropsychologist, and speech therapist. On the other hand, pseudo-dyscalculia necessitates a comprehensive and professional approach to engage students in the lesson, pique their interest, and motivate them. Students whose dyscalculia is not medically confirmed often show improvement through repetition and multiple training. Ultimately, the teacher's rapport with the students and clear explanations are crucial components that can reduce mathematics anxiety [76].

It is important for parents and educators to recognize that early diagnosis and correction of dyscalculia can lead to more effective and noticeable results. Additionally, incorporating educational games and exercises into a child's home routine can be a helpful and unobtrusive way to support their development [69]. To this end, a game designer, Hanna Rutzky [77], has created a series of engaging and age-appropriate games for preschool and elementary school children that can help prevent future math difficulties. She

claims that such games are supposed to help children stop being afraid of math. Such games emphasize counting and numbers and feature activities such as telling time, using a telephone, and calculating prices. It works well if parents and educators use "verbalization of mathematical process and developing metacognition, mathematical scenarios and encourage mathematical thinking" [75].

Tourette Syndrome

Tourette Syndrome (TS) is a developmental disorder characterized by involuntary and repetitive tics that can be vocal or movement (Neuroscience News). It is also manifested by hyperkinesis, shouting, echolalia, echopraxia, and hyperactivity, which periodically spontaneously arise and are not controllable by the patient. Such tics usually involve some muscle groups and are very short in duration. Moreover, they tend to be meaningless in their appearance or phonation [78].

The exact causes of the pathology are unknown, but it has been established that in most cases, a genetic factor plays a role in the development of TS, which affects mainly males [45]. Family cases of the disease have been described in siblings, including twins [78]. Parents and close relatives of sick children often have hyperkinesis. According to observations, an autosomal dominant type of inheritance with incomplete penetrance predominates, although an autosomal recessive transmission route and polygenic inheritance are possible [79].

Among other possible prenatal factors that increase the risk of developing TS in a child are toxicosis and stress of the pregnant woman; taking medications, such as anabolic steroids, alcohol during pregnancy; intrauterine hypoxia, prematurity, intracranial birth injuries. The severity of TS is influenced by infectious, environmental, and psychosocial factors [80]. In several cases, the occurrence and exacerbation of tics was noted in connection with a previous streptococcal infection, intoxication, hyperthermia, the prescription of psychostimulants to children with ADHD and emotional stress.

Neuroradiological and biochemical studies have proven that the hereditary defect that causes TS is associated with a violation of the structure and function of the basal ganglia, changes in the neurotransmitter and neurotransmitter systems [78]. Among the theories of the pathogenesis of TS, the most popular is the dopaminergic hypothesis, since in this disease there is either an increase in the secretion of dopamine or an increase in the sensitivity of receptors to it [81]. Clinical observations show that the administration of dopamine receptor antagonists leads to the suppression of motor and vocal tics. "Probably, the disturbance of the dopaminergic neurotransmission is the final stage of different pathogenetic pathways."

The research claims that "a complex processing stream used multiple convolutional neural networks to identify salient spatial features mapping to tics, and a different form of neural network to identify temporal signatures of tics." People with TS have higher levels of a neurochemical called gamma-aminobutyric acid (GABA) in a part of the brain known as the supplementary motor area (SMA) helps to dampen down hyperactivity in the cortical areas that produce movement [78].

Due to dysfunctions of the neurotransmitter systems of the brain, the exchange of dopamine and serotonin is disrupted. An increase in the functional activity of the dopaminergic system leads to insufficient control of movements, which is clinically manifested by tics. Also, the latter are caused by the changes in the subcortex and cortex, disorders of the frontotemporal region of the right hemisphere of the brain (Neuroscience News). In Figure 12, the SMA is a part of the areas of the secondary motor cortex.

The first signs of TS most often occur at the age of 5-6 years, when parents notice oddities in the child's behavior: winking, grimacing, sticking out the tongue, frequent blinking, clapping hands, or involuntary shrugging. In the future, as the disease progresses hyperkinesis spreads to the muscles of the trunk and lower extremities and becomes more complex, for instance, jumping or squats [82]. The phenomena of echopraxia or repetition of other people's movements and copropraxia or reproduction of strange gestures may occur. Sometimes tics are dangerous, for instance, head banging, or lip biting, which can cause patients with TS to cause serious injury to themselves [80].

While in most cases, the TS child's intellectual development does not suffer, "it is not only a movement disorder, but a psychiatric disorder". It often comes with one or more LDs and behavior disorders, mainly ADHD. Other behavioral disorders may include impulsivity, emotional lability, aggression, and obsessive-compulsive syndrome (Watson). Symptoms of TS usually peak during adolescence, then may decrease, or stop altogether as people get older. However, in some patients they persist throughout life, increasing social maladjustment.

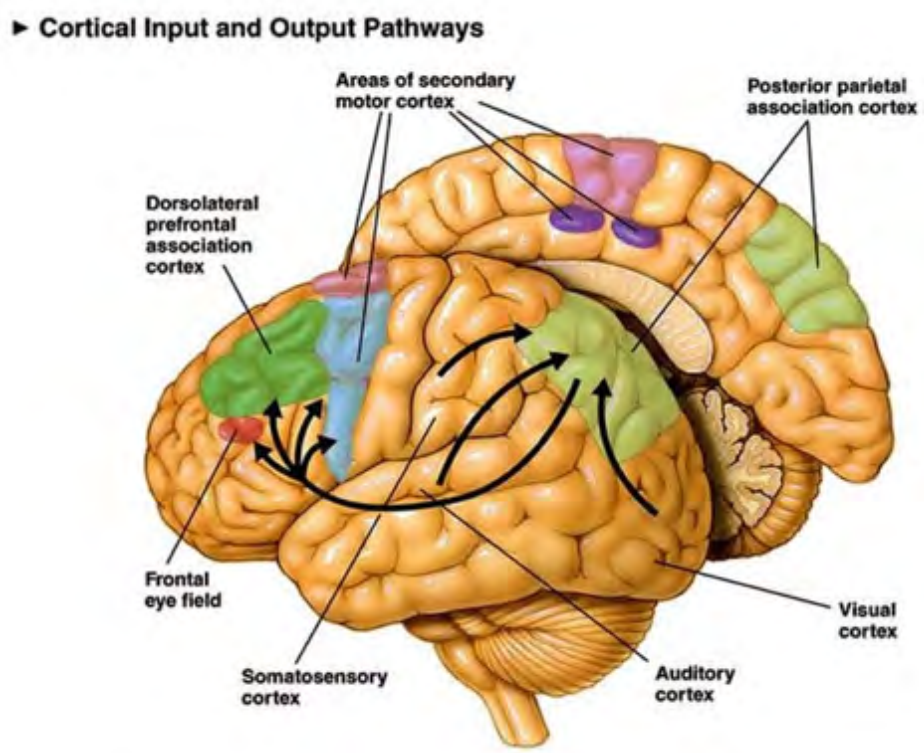

Figure 12: Broca and Wernicke's areas.
Note: From Brain Chemical Potential New Hope in Controlling Tourette Syndrome Tics. https://neurosciencenews.com/gaba-tourette-tics-neurology-1364/

Speech skills allow a child with TS to enter dialogue, respond to the interlocutor's remarks, ask questions, and maintain a conversation. The vocabulary of a Tourette child is distinguished by its qualitative originality [83]. His speech is quite intelligible and intelligible, but it is usually difficult for the interlocutor to understand it due to the presence of vocalisms, and other unnecessary extra sounds. They need support from their parents and teachers who should help them to find a hobby or to involve them into activities that will make them busy, so that they will reduce the stress that leads to tics [80].

The ability of a child with TS to study in a public school is determined not only by a sufficiently high level of his general and speech development, but also by his psychological readiness to communicate with others and to engage in joint activities with ordinary peers [83]. The development of this readiness can be greatly facilitated by the presence of a child with a tic in a mass kindergarten, at least a year before school. Of course, it is difficult to teach such a child together with other children, but it is even more difficult for a Tourette child to learn in a classroom [80].

The main role in his adaptation to life in a team is played by the kindergarten teacher and the class teacher at school. The teacher should help the child get comfortable in the team and try to make friends with his peers. It is important that children accept a child with TS as an equal, help him not out of pity, do not humiliate him, do not ask unnecessary questions about his disease, and protect him in necessary cases. Extracurricular activities can also provide more opportunities to build friendships and work on social skills, which can be difficult with Tourette syndrome [83].

Availability of professional help and various therapeutic techniques can effectively alleviate the clinical symptoms of the disease and increase the social adaptation of patients. In case of multiple LDs and emotional disorders, TS patients get behavioral and pharmacological therapies [78]. Some teenagers with TS can reduce the number of tics they experience using behavior modification techniques. These are strategies that are developed in collaboration with a doctor and a psychologist. This way the child will be able to identify his triggers and receive a plan to reduce attacks. And since tics often occur in school, a plan may need to be agreed upon with the class teacher.

Early Diagnostic of LDs and Preventing School Difficulties

In new research presented at the virtual meeting of the Cognitive Neuroscience Society, scientists report on these biological and environmental factors - including early technology use - as they discover biomarkers that may identify children susceptible to the risk of developing LDs. Nowadays, more and more children are born into a "neurodevelopmental lottery," so they should be examined for potential LDs and other sorts of neurodiversity, such as ASD, ADHD, depression, and bipolar disorder [84].

Prevention of LDs in preschoolers involves identifying the child's predisposition to its occurrence. First, we must discuss the genetic component of dyscalculia, dysgraphia, or dyslexia. In other words, if one of the parents had and still has severe difficulties with reading, spelling, writing, or arithmetic, then the likelihood is that the son or daughter will have similar LDs. This may be a genetic predisposition to severe infectious disease in infancy - you can read more about the reasons below; if necessary, expert testing followed by diagnosis and, finally, careful development of corrective work [85].

Usually, dyslexia and dyscalculia are found in kids in kindergarten, and their teachers notice that they are unfocused, misunderstand instructions, forget words, and cannot retell stories or calculate. Furthermore, dysgraphia is noticed in elementary school, mainly in the first or second grade, when kids cannot write: their handwriting is not very neat or unreadable [36]. Nevertheless, it is possible to discover developmental LDs at a very early age, even in babies. It is highly recommended to do this if their parents struggle at school.

The researchers from Tel Aviv University tried to understand the cognitive mechanisms that could help dyslexic children cope with reading and overcome their decoding weaknesses. They suggested new approaches to enhance working memory in early childhood to prevent potential LDs at school. They suggested that kids with potentially resilient dyslexia have a different brain structure, especially the left hemisphere responsible for reading skills. Some years later, many kids with such differences struggled with reading.

Researchers from the University of California and Harvard Medical School have developed ways of finding potential LDs in three-month-old babies. They researched their brains with the help of MRI. They discovered that the brain's left hemisphere, which is responsible for executive functions, differed from the regular kids' brains. Some years later, they had resilient dyslexia or other LDs. (The Science of Psychotherapy). Research has found that the brains of babies and toddlers who subsequently develop dyslexia are already atypical even before they go to kindergarten. "The functional brain differences exhibited by the children with developmental dyslexia are noteworthy in that the scanner task did not involve reading or the phonological processing of auditory language". Gaab claims that babies already have the basic brain structure at three months old that shows potential LDs. Therefore, such kids should receive exceptional medical and pedagogical help to prevent potential reading, writing, and calculating difficulties.

Thus, LDs may be diagnosed in babies and toddlers. They are caused by genetic factors, otherwise due to problems with pregnancy or birth injury. "The main finding from recent studies suggests that reading difficulties (inferior phonological skills) interact with other cognitive skills and environmental factors to produce a continuously increasing risk of dyslexia." Moreover, "abnormalities in cerebral structure and functioning" also causes other developmental delays. Babies with DD start sitting and walking later, or toddlers do not talk until they are two or older. Usually, they catch up with their peers until they have more severe disorders, such as TS, ADHD, ASD, or mental retardation [86].

It is possible to help them with the correct diagnosis, medical treatment, and individual treatment, such as speech therapy. By the age of six, they can start school. Nevertheless, most of them need special education classes. Gaab (2007) claims that her team is also working on research into the co-occurrence of disorders such as ADHD, dysgraphia, and dyscalculia. They also want to understand how children successfully compensate for dyslexia.

Traditional and Modern Methods for Overcoming LDs

Since the 1990s, educators and researchers have applied neuroscience to education and believed that the latter improves their ways of teaching and enhances students' learning. Nevertheless, the attempts to merge neuroscience and education do not always work in the regular classroom, especially if kids have innate disorders (Tan et al., 2019). As it was said above, LDs do not come along. Many students with dyslexia also have dysgraphia, dyspraxia, and dyscalculia. Otherwise, TS is accompanied by one or more of the latter LDs. Moreover, one or more LDs are often accompanied by ADHD, which means they have problems with reading, calculating, and general misunderstanding and get tired and distracted too often.

In case of severe TS, ADHD, or dyspraxia, which influence not only on the studies, but also on the daily life, children need to get special treatment depending on their needs [81].

Thus, the question of treatment methods for TS, dyspraxia and other motor dysfunctions, children need occupational therapy, music therapy, psychological support and the creation of a favourable emotional atmosphere surrounding the child [82]. Anyway, it works well with other LDs to motivate students to do well at school.

Most teachers still use traditional methods, such as a "rule-based treatment and whole-word treatment" The first one supposes children to learn graphemic forms and their phonological output, and the second one activates the visual memory with the form of flashcards so that children will memorize how the word is spelled. Later, they compose the word with the help of separate letters offered by the teacher. Others practice multiple rewriting of the same words until kids spell it correctly. I think such methods have a temporary effect because the following day, children forget the rules, the words, and the spelling. Instead of forcing a child to rewrite works, educators must understand the neuropsychological reason for unreadable handwriting. Therefore, according to Garguilo and Bouck, kids with multiple disorders need special equipment, which can be no-tech, low-tech, mid-tech, and hi-tech.

- No-tech equipment includes table games, flashcards, pictures, specially lined paper, and graphic organizers. Pencil grips can also serve as a low-tech writing-based assistive technology to support students with dysgraphia. They help those with unreadable handwriting, and with the help of such grips, they write more clearly.
- Low-tech devices are binder clips to turn pages for kids with poor fine motor skills, work pages in larger fonts for those who suffer from spatial dysgraphia, adapted pencils, and highlighters.
- Mid-tech tools enable students to press buttons for special operations. For instance, an electronic dictionary or smartpens can be used during the tests. Such devices can train fine motor skills as well.
- High-tech devices are the most sophisticated. They are commonly associated with computer-based technology, for instance, "text-to-speech" and "e-readers or supported e-text" for reading, "speech-to-text" and "word prediction" for writing.

"Many schools offer accommodations in testing and teaching to students with dysgraphia, but these students also need ongoing, explicit instruction in handwriting, spelling, and composition." (International Dyslexia Association). Thus, the forenamed Beit Ekstein schools for special education allow them to take computerized or oral exams. Nevertheless, such an approach only enables students to avoid failing tests – in fact, dysgraphia and other LDs require more thorough treatment.

So, neuropsychologists practice a holistic approach and consider other factors, such as how a child learns math and other subjects. Thus, some kids may be good at math, while others may struggle because "dysgraphia is an invisible disability that often goes hand in hand with dyslexia and dyscalculia" [36].

Therefore, educational computer programs developed based on neurobiological data should help correct dyscalculia, which, in turn, will not only improve people's lives, but also have a beneficial effect on the economy [87].

Leigh T [88] claims that a clinically proven therapy works directly with the student's brain. It is enjoyable and effective since it is drug-free and non-invasive. Moreover, it works well if directed to training working memory and fine motor skills. In special education, kids can get this help during the day. They are also provided with CBT, especially for those who suffer from anxiety, depression, and low self-esteem, which often accompany poor progress in school.

Success-oriented teaching is crucial for LD students. "Recognition of the need for structured teaching programs with a particular emphasis on visually based cues; these provide the child with predictable and readily understandable environment, which helps to limit confusion and distress". Thus, many students in SEN schools are allowed to take computerized tests, especially those whose handwriting is unreadable due to dysgraphia. Those, who have severe dyslexia and dyspraxia, are allowed to be tested orally.

Chapter 3

Autism Spectrum Disorder

General Characteristics of ASD

Autism spectrum disorders (ASD) are complex mental development disorders caused by differences in the brain (Center for Disease Control) [89]. They are characterized by social maladaptation, inability to communicate and social interaction, as well as stereotypical behavior, for instance, multiple repetition of monotonous actions. They are innate, begin in childhood and persist throughout adult life [79]. ASD in children is considered a developmental disorder that affects all areas of the psyche - intelligence, emotions, sensitivity, movement, thinking, memory, speech.

ASD can cause a wide range of symptoms, grouped into three broad categories:

- Problems and difficulties with social interaction, such as lack of understanding and recognition of other people's emotions and feelings [90].
- Impaired language and communication skills, such as delayed language development and inability to initiate or participate in conversations properly Kasari et al.
- Unusual patterns of thinking and physical behavior. This involves repetitive physical movements such as tapping with the hands. The child develops certain behavioral habits that can upset him if these habits are disrupted Patterson et al.

Each case of ASD is individual: a child may exhibit all the listed signs in a severe form, or there may be a milder version of the course, in which the child's unusual. Furthermore, like other cases of neurodiversity, which were researched in the previous chapters, autism rarely is pure: in most cases it is accompanied by other disorders. The level of intelligence in ASD people is highly polarized, so those whose IQ is over 140, are gifted [91] claims that among high functioning autistic people there are a lot of mathematicians. Thus, ASD includes different sorts of neurodiversity, for instance, autism, ADHD and giftedness, which will be researched below. Moreover, gifted children often have ADHD and autistic features, which is presented in Figure 13.

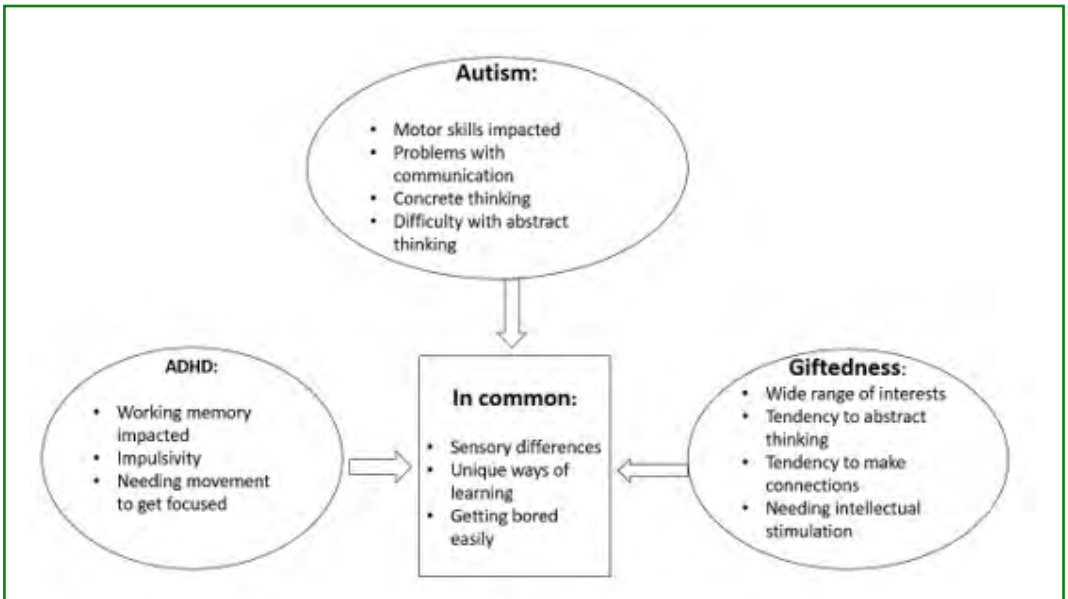

Figure 13: General characteristics of ASD.

For the last decades, according to statistics, the incidence of ASD has increased significantly - from 4-5 people per 10 thousand children to 50-116 cases per 10 thousand children. This disease occurs more often in boys than in girls (4:1) Scientists around the world are studying the problems of autism, and they have not reached a consensus on the reasons for such a sharp increase in the incidence of ASD (Center for Disease Control) [89]. Nevertheless, they believe that autism is caused by environmental, genetic, neurological and psychological factors [92].

Types of Autism

"The autism umbrella is vast. Within its boundaries it is a wide range of abilities and disabilities, a wide range of differences" [93]. Autism is a genetically determined pathology that is manifested by a reluctance to contact others and various developmental delays. Children with autism perceive society differently, it is difficult for them to interact with other people and adapt, they prefer loneliness. According to the observations of specialists, ASD is detected 2 times more often in boys (Center for Disease Control).

Autism in a child manifest itself with signs of different nature and severity. Such children often lack speech and have motor impairments, they do not focus on the eyes of their interlocutor, do not respond to their name, develop more slowly, and all these manifestations cause disturbances in social interaction. Thus, one of autism signs is echolalia, or the repetition of standard phrases. It often appears as soon as children hear them. Perhaps after some time. They are remembered entirely. Often, with a child's good memory, the illusion of a developed ability to speak arises. From the outside it seems that they are passionate about some kind of activity or reflection, while in fact, it is not because the child often does not answer the questions, repeats other people's phrases (McFayden et al., 2022) [97]. Figure 14 demonstrates the brain regions that have been implicated in echolalia.

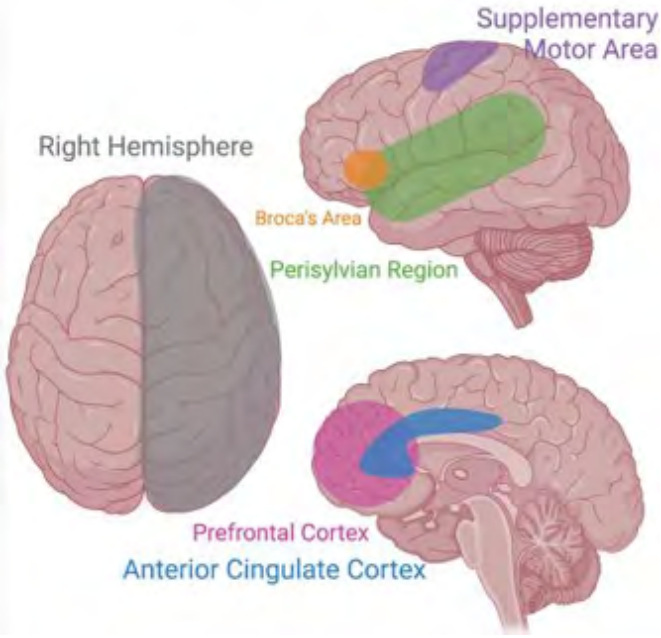

Figure 14: The mechanism of echolalia.

Harris N [94] claims that the diagnosis of ASD is not given to young children, but often before the age of 1 year, specialists and parents can see alarming symptoms in a child, who…

- has various and persistent sleep and/or nutrition disorders in infancy.
- shows intolerance to some foods and suffers from intestinal or skin problems.
- has sensory distortions.
- struggles to speak and prefers non-verbal communication.
- shows uneven metal or cognitive development or non-age skills, abilities and interests.
- does not listen to them or is involved in any activity too much.

Harris N [94].

While children grow up, they reach milestones in their development, which can be seen in the way of their speaking, communicating with other people, playing, acting and learning. A delay in one or more such aspects areas can justify a developmental problem, for instance, cognitive deficiencies or autism [89]. Mandel A [95] claims that there some types of autism, such as:

1. Classic autism: Children with classic autistic disorder usually have severe problems with spoken language, social interaction, and behavior. One of the earliest and most sensitive markers of autism is the inability of a one-year-old child to point to a distant object to attract attention. It is assumed that the child cannot imagine that another person can understand what has been stated; instead, the child shows desires only by physically touching the desired object or using the adult's hands as an instrument [94].

Differences in the brain structure might cause autism, which is often accompanied by ADHD [79]. Due to differences in brain function, children may process information or react to their environment differently than their neurotypical peers. In most cases, they have LDs and problems with communication [86]. Nevertheless, sometimes disorders might be accompanied by mental retardation, and along with the forenamed challenges, kids struggle with CD [96]. Recent research also suggests that differences in sensory processing underlie social interaction and communication differences in young children with autism spectrum disorder Patterson et al.

Such children prefer non-verbal communication, with the help of jesters, body movements and specific sounds instead of words. "Evaluating speech abilities includes assessing the oral mechanism and abilities to produce different speech sounds." Many kids at the age of 3-4 years old call themselves "you" or "he/she". They repeat words and phrases just heard or learned from a movie or television program they watched or speak in pre-rehearsed phrases. Moreover, their speech has an unusual rhythm [97].

In many cases, classic autistic children start speaking later than their neurotypical peers, or do not speak at all Kasari et al. Nevertheless, I have noticed that some of them talk only to people they love or trust, but they keep silence with others. Thus, some years ago I had such a student, who talked to very few co-students and teachers. Most of the time he was calm and quiet and used mainly mimics and jesters while communicating with the most school workers.

Nevertheless, I realized that his cognitive abilities were good enough, since he did tasks quite well, while many of such kids have LDs and cognitive impairments since their IQ is below the average intelligence. Classic autism is also known as severe autism, since some kids are aggressive and hit others – they even hit themselves and practice self-harm [92]. In our school I have seen a lot of students with scars on their left hands, and the school psychologists say, they have tried to commit suicides.

Children with mild autism symptoms often manage to moderate them as they get older (Mandel, 2023) [95]. Sometimes going to school gives them the opportunity to learn social and communication skills that come naturally to non-autistic children, and other people do not notice any ASD features in them.

This case is described by L.H. Willey in her book "Pretending to be normal". The main character learned to understand other people, their ideas and behavior patterns, although she "was experiencing sensory overload" [93]. Children with more severe autism may find school increasingly stressful. This can cause episodes of disruptive and challenging behavior. It can even be accompanied by mental retardation, if the level of IQ is less than 70 Kar et al.

To help identify treatable or inherited diseases, such as inherited metabolic disorders and fragile X syndrome, metabolic and genetic testing is recommended in addition to standardized tests. "Assessments of children with minimal verbal skills should include a combination of standardized and experimental measures, depending on their impairments and the level of development". Children with autism spectrum disorder are difficult to test, often perform better on performance tasks than verbal items on IQ tests and may exhibit age-appropriate performance despite cognitive limitations in most areas. However, reliable diagnosis of autism spectrum disorders is increasingly becoming possible at an earlier age, for instance, tests of visual and auditory abnormalities, and basic sensory functions. An IQ test administered by a trained examiner can often be a useful predictor of outcome Kar et al.

2. Asperger syndrome: Children with AS have milder symptoms than those with the classic autistic disorder. Their social interaction and behavior are better developed, their language development is usually not affected, and their IQ is above the average. They have difficulties in verbal and non-verbal communication, and their behavior is strange. They do not have problems with speech quite the contrary, some of them have a good memory and logical thinking. They are often creative and have good abilities at mathematics, computer science, art, music, and many more. Their cognitive development is not characterized by a general delay, but by specific impairments in certain areas [98].

Hosseini et al. claim that genetic and environmental factors influence on the birth of a child with AS, and among them there is a genetic mutation, a premature birth, low birth weight, hypoxia, neonatal encephalopathy, and many more. Furthermore, other factors, such as maternal obesity and diabetes, multiple pregnancies, rubella, and cytomegalovirus also might cause AS.

Hereditary factors, history of parental medical disorders, preterm birth, and exposure to psychotropic drugs or insecticides on fetal disease are associated with an increased risk of developing AS [36]. According to the research, people with AS have changes in the gene GABRB3. "A key component of the GABA system is encoded by the GABRB3 gene, which has been previously implicated both in autism spectrum conditions and in individual differences in empathy." Furthermore, Figure 15 illustrates abnormalities in various parts of the brain, such as the frontal cortex, hippocampus, cerebellum, and amygdala.

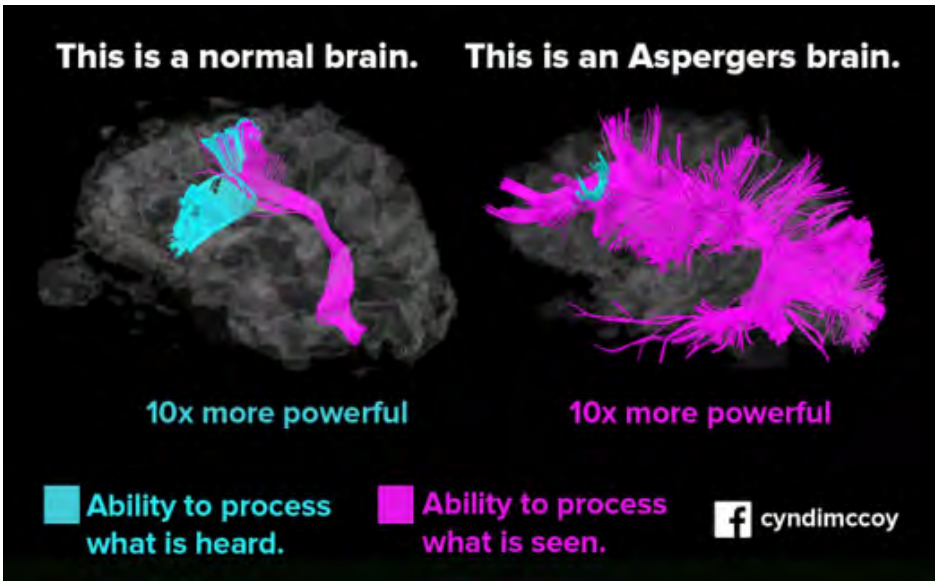

Figure 15: Neurotypical and Asperger brains.
Note: Retrieved from https://hotcore.info/act/kareff-121579.html

The appearance of people with SA is no different from that of ordinary people. People with AS choose comfortable and practical clothes and do not spend much time taking care of themselves and their hair. They usually adhere to their own rules and discipline. Nevertheless, they can be recognized due to poor coordination of movements, or unusual gestures are common in AS children [99]. Furthermore, they have little interest in sports and have difficulty performing specific activities such as buttoning a shirt or tying shoes. Also, children with AS experience severe hypersensitivity. It may involve being selective about food or overreacting to noisy environments, certain types of contact, or body odor. It is often accompanied by anxiety and ADHD [100].

Sometimes parents think that their children are just "strange" and the diagnosis of AS may be made too often, even in adulthood. The syndrome in teenagers and adults is characterized by a lack of eye contact and facial expressions. Sometimes neurotypical children may be a bit "strange", and unconfirmed as having AS. "The diagnosis of AS required at least two symptoms of social interaction impairment and one symptom of behavioral and interest restriction, a normal cognitive functioning and the absence of significant general delay in language." Thus, people with AS have average to superior intelligence, which allows them to mask deficits in social interaction and communication skills to a certain extent. However, the difficulty lies in the lack of flexibility in behavior. This leads to a risk of anxiety and depression [36].

AS children are characterized by social isolation at school. They have difficulty making friends. Research shows that children with AS are interested in relationships, question the cause of their loneliness, and identify feelings of loneliness early on. Children with AS have difficulty interpreting details of nonverbal language, gestures, and facial expressions, do not fully understand humor and metaphors, and may speak with unnatural intonation. All of these problems and lack of social skills put them at higher risk of interpersonal difficulties and being the target of ridicule from their peers. About 63% of children with AS have been victims of bullying at school [100].

Some children with AS are often interested in the technical details of trains, mechanics, space, history, music, or meteorology, and they are good at memorizing. Thus, some years ago I taught some students with AS. One liked talking about aliens, another was excellent at languages, and someone talked about potential inventions. Another student invented a smart tag with built-in GPS, which is now used by the Israeli Defense Force (IDF) and helps find lost soldiers [101]. Furthermore, it can help families find elderly relatives who might leave home and get lost. They all had high cognitive abilities and did well at school.

Nevertheless, other students complained that talking to them was a bit tiring and boring. Furthermore, I have noticed signs of dyspraxia, dyslexia, and dysgraphia despite their good cognitive abilities. For instance, some of them were very good at art, math, or writing stories, even in English, while their native languages were Hebrew, Arabic, or Russian.

3. Pervasive developmental disorder – not otherwise specified (PDD-NOS): It is also called atypical autism

(Sissons). It is a group of pathologies that are united by behavioral disorders of psychoneurological origin. The latter are expressed in social maladjustment, speech dysfunction, monotony of movements. Diseases are often diagnosed in childhood when parents notice their first signs. Usually before the age of 5 the diagnosis has already been made. Regarding mental retardation, the decline in cognitive function can be expressed in varying degrees.

PDD-NOS occurs due to damage to the central nervous system during fetal development or childbirth. "The etiology of this complex disease is highly heritable, but likely involves environmental factors" [102]. ASD can be noticed in babies if they do not smile or do not display any reactions to their parents. PDD-NOS is characterized by delayed development of speech and fine motor skills in toddlers. Kids of three years old and older, avoid eye contact, prefer isolation, lack emotions, and display inadequate reactions. Moreover, they are often busy with monotonous, meaningless actions [103].

The trigger that starts pathological processes can be bullying in the family or the kindergarten. It does not cause the disorder, but it can make it worse. Therefore, such kids try to avoid people and activities that might cause fear or anxiety. Difficulties in social interaction, speech impairments, lack of emotion, and a tendency to monotonous, repetitive actions characterize it. Pervasive disorder is usually diagnosed in children before the age of five [104].

This diagnosis is given to children who have some characteristics of classic autism or AS. They have problems with communication, social behavior and changes in routine or environment [98]. They play unusual games with dolls and other toys – for instance, break them to see how they are made. They often practice repetitive body movements and behavior patterns. Furthermore, they have unusual tastes and preferences in closing.

Since no two children have the same signs of PDD-NOS, the same strengths, and the same weaknesses, each needs an individual learning program and treatment, including CBT. Choosing an appropriate treatment should be based on the current symptoms, communication patterns, social competence, neuropsychological history, and behavioral history [103].

4. Giftedness: Talented and gifted children are a dream for many parents, who want them to win Math Olympiads, play musical instruments or paint beautiful pictures before they start school, invent an important device, or go to university while their peers are still in junior-high school. Some children really do, and their parents are happy. At the same time, they face a lot of challenges when their young prodigies sleep very little, make a mess at home by drawing on the walls, make a lot of noise with the musical instruments or end up in tantrums if something goes wrong. Furthermore, they are often lonely because they think their peers are boring and refuse doing class tasks that are "too easy and boring". Nery few parents are aware that giftedness is a sort of neurodiversity and requires a special approach.

Scientists of the University of Edinburg hypothesize that there is a link between autism and high level of intelligence and even giftedness. They suppose that the same genetic variation causes the risk of autism and a higher cognitive ability comparing to non-autistic individuals [105]. Gifted people, who also have ASD and LD, are called twice-exceptional [91].

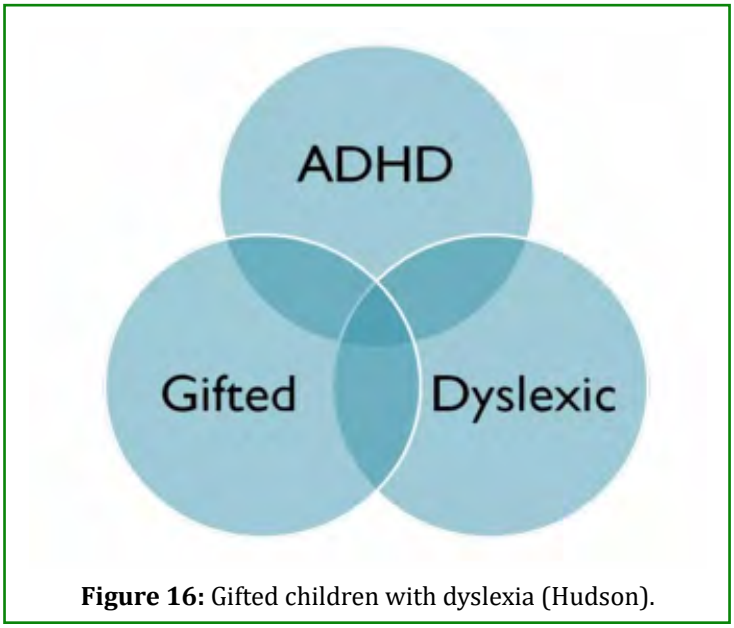

Figure 16: Gifted children with dyslexia (Hudson).

According to Szalavitz, the majority of child prodigies had attained fame and professional recognition in their respective domains by the age of 10. The majority of them exhibit musical talent, with a single artist and a mathematical prodigy who pioneered a new discipline and, by the age of 13, had authored a paper accepted for publication in a mathematical journal. On the one hand, they had remarkable abilities; on the other hand, they were diagnosed with ASD, mainly high-functioning autism, or Asperger Syndrome, as illustrated in Figure 17.

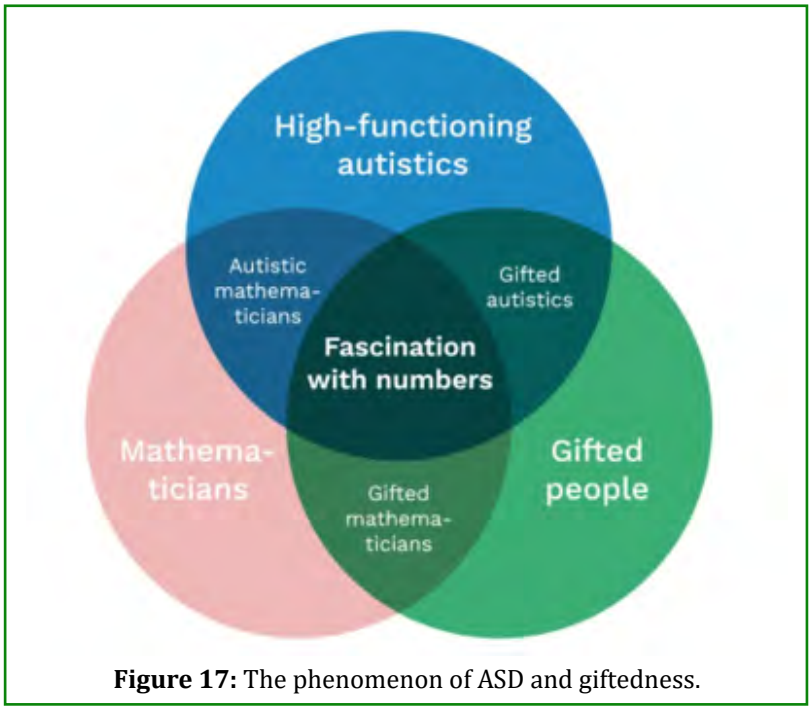

Figure 17: The phenomenon of ASD and giftedness.

Although gifted kids have exclusive working memory capabilities, they are characterized by extreme attention to small details, like classic autistic ones. Moreover, they had challenges with communication and often found themselves lonely and not accepted by peers.

How to Treat ASD Children

Although it is impossible to cure ASD, it is possible to lessen its symptoms and help children adapt to society better (Mayo Clinic). Treatment for ASD should begin as early as possible. The most common treatments for autism are biological therapies. Many studies have found that autism and Asperger's syndrome are not just mental disorders but also involve metabolic disorders. It is believed that in children with autism, the proteins gluten and casein, which are found in dairy and flour products, are not fully broken down.

A proper diet for autism should exclude milk, wheat, rye, oats, and barley as these cereals are gluten-rich. In healthy people, these proteins are absorbed without problems. However, in people with autism, they enter the bloodstream like endorphins, which can have negative effects on their behavior and reactions to their environment. Many people with autism may crave flour and dairy products due to their dependence on endorphins. Therefore, people with autism should follow a gluten-free and casein-free diet [106]. Most parents of autistic children who follow this diet have reported positive results after some time.

Medications can boost brain function, memory, and the nervous system's ability to handle stress. They can also have a calming or stimulating effect and act as an antidepressant. The primary objective of pharmacotherapy for childhood autism is to alleviate specific unwanted symptoms that hinder the efficacy of educational and psychological interventions. These symptoms include aggression, self-harm, stereotypies, negativism, and motor disinhibition. Additionally, certain medications can enhance the integrative function of the brain and stimulate memory and cognitive processes.

Pharmacotherapy may help relieve symptoms. Atypical antipsychotics have been shown to help improve behavioral problems such as ritualistic, self-injurious, and aggressive behavior [98]. Other drugs are sometimes used to control certain symptoms, including selective serotonin reuptake inhibitors for ritualistic behavior, mood stabilizers for self-harm and aggressive behavior, and stimulants and other drugs to treat ADHD for inattention, impulsivity, and

hyperactivity [79]. Pharmacotherapy also plays a crucial role in the treatment and rehabilitation of children with autism and is only used in combination with pedagogical and psychological correction methods.

Teaching and Training Students with ASD

ASD describes a range of developmental disorders that affect social and communication skills and motor and language skills to a greater or lesser extent. This diagnosis is so broad that it includes people with high IQs and those with intellectual disabilities. In an inclusive educational setting, a student with ASD receives education on par with neurotypical peers, typically suited for those with average intelligence and speech abilities. On the other hand, an integrated classroom accommodates students with various disabilities, including ASD, each of whom follows an individualized education program tailored to their specific needs.

People with autism can be talkative or silent, affectionate or cold, pedantic or disorganized. Other complementary and experimental therapies, such as facilitated communication, music therapy, pet therapy, and classroom integration training, are also effective [79]. One of the most helpful ways is speech therapy as a variety of communication tools, including sign language, picture communication, and communication devices that generate speech based on symbols selected by children on a tablet or other handheld device in the same way as when speaking. Physical and occupational therapists plan and implement strategies to help affected children compensate for deficits in specific motor function, motor planning, and sensory processing Hosseini et al.

In our school, I have noticed that many children with ASD develop a strict routine, such as walking around the tree in the schoolyard an exact quantity of times, for instance, five. Others prefer watching the same cartoon on YouTube from start to finish before the lessons, and they are never fed up with it – quite the contrary, they believe, it helps them focus in the classroom or brings luck. If these rituals are disrupted, the child may have a severe tantrum or harm himself by hitting his head or biting his skin. Nevertheless, as they grow older, they stop such rituals, mainly when they communicate with peers without ASD.

Therefore, the chain of Beit Ekshtein schools helps such kids to achieve such results. SEN students need special education methods and treatment to adapt to life and work in society. Thus, in Beit Ekshtein school, they get psychological help, cognitive behavioral therapy (CBT), speech therapy, art therapy, music therapy, and animal therapy. For instance, students can attend a mini-zoo or a farm, where they can feed animals, pet them, or ride horses. Moreover, they get individual lessons in Math, English, Hebrew, and other subjects. In case they are not ready to learn English, Math, or other subjects, they do not have to. In such cases, they can get other classes or treatment. Some of our alumni with ASD go to universities and colleges, and some do not. Thus, since they stay at school from 8 am to 4 pm, they can participate in extra classes, such as music, art, cooking, or gardening, which enhance their motivation to study and use such knowledge and skills in their future life.

Chapter 4

Educating Children with Cognitive Deficiencies

Cognitive Functions and the Psychic Development

Cognition is the mental process of learning. It supposes getting knowledge through general information, senses, and experience [107]. In psychology, this concept refers to the individual's mental processes, especially the study and understanding of their mental states, including personal beliefs, desires, and intentions. This term can be interpreted in a cultural-social sense as denoting the knowledge and the concepts associated with that knowledge, expressing themselves in both thought and action.

Plessis S [73] claims that the key cognitive skills are:

- Perception
- Attention
- Memory
- Speech
- Intelligence
- Sensation

The cognitive domain encompasses all human mental activities, including perception, comprehension, memory, attention, and problem-solving. These skills are crucial in interpreting sensory input, processing language, performing mathematical calculations, planning activities, and analyzing complex situations. Since cognitive development begins in early childhood and continues throughout life, it is paramount to identify any cognitive deficits or impairments as early as possible, particularly in children [108]. Cognitive thinking is a complex process encompassing various cognitive functions such as perception, memory, decision-making, reasoning, and imagination. It also involves understanding and applying contextual knowledge, which involves both abstraction and concretization. Additionally, cognitive thinking includes general learning skills and the ability to function effectively in society [109].

Most behavioral reactions are based on the work human brain and nervous system - it determines every human feeling, emotion, thought, decision, and action behind any episode generation of knowledge, its transmission in civilization and accumulation in culture, for collective and historical memory, public consciousness, the functioning of social groups, networks, and society – and two spheres of psychology deal with all the forenamed aspects: cognitive psychology and neuropsychology.

Cognitive psychology is a branch of psychology that studies perception, imagination, thinking, speech, memory, and other cognitive processes. Vygotsky believed that it worked only due to the child's social interactions with peers and adults and due to his own discoveries. Social and cultural environment allows kids to use these elementary skills to develop and finally gain higher mental functions, such as attention, sensation, perception, and memory [110].

Neuropsychology aims to find out the sources of cognitive deficiencies (CDs). It researches the integrated levels of the brain and its higher functions, from genes and proteins to the whole brain and its cognitive systems, to the diagnosis and therapy of their disorders in medicine, to their research in the humanities and social sciences, to mathematical modeling and reproduction of cognitive brain capabilities in new artificial technical systems. It conducts clinical research, investigates brain-behavior relationships and ways of teaching children with CDs, which range from mild developmental delays to severe mental retardation [109].

Human cognitive functions develop throughout their lifespan, and thus, any discussion about cognitive impairment in children must consider the various stages of their cognitive abilities. Cognitive disorders (CDs) can result in the complete or partial loss of cognitive functions, which can range from mild conditions to severe forms of dementia that lead to a complete breakdown of personality [111].

Cognitive psychology is highly focused on exploring the brain's covert processes that impact an individual's behavior and cognition, even when they are not consciously aware of it. According to Vygotsky's theory, the Zone of Proximal Development is where a child can acquire new skills that further enhance their cognitive abilities. This process occurs through the guidance of a more knowledgeable individual who provides support and scaffolding to facilitate learning [110]. On this basis, cognitive Behavioral Therapy (CBT) was developed to address cognitive impairments resulting from communication problems, anxiety, prolonged stress, eating disorders, and LDs. CBT techniques are grounded in evidence-based practices and have been shown to be effective in treating a wide range of mental health conditions. By tackling negative thought patterns and behaviors, CBT helps individuals to develop more positive and adaptive coping mechanisms, leading to improved mental health outcomes [107].

How to Recognize Cognitive Deficiencies in Young Kids

Children with CDs may experience difficulties in various areas of cognitive activity. Symptoms of CDs typically manifest in the process of perceiving information, specifically through the sensory knowledge of the world acquired through hearing, vision, taste, etc. Different types of CDs may arise during the analysis and retention of information, and they affect speech, learning, and practical activities, which are common [109].

Although LDs and CDs often happen for similar reasons, such as genetic abnormalities, hypoxia, birth injury, brain trauma or disease, child abuse, and many more - children with LDs have an average or high IQ. In contrast, those with CDs have severe developmental delays, and their IQ is lower than 70 [107,112]. Nevertheless, LDs accompany CDs since kids have poor memory, get distracted and unfocused, and struggle a lot [109].

CDs may be noticed in young kids when they show significant limitations in learning and function. Such a childhood diagnosis is one of the most common brain diseases [16]. Neuroscientists claim that along with research on the nervous system of each CD child, it is not less important to create an appropriate environment at home and in kindergarten so that it will positively influence their physical, mental, and cognitive development [17]. It is hard to underestimate the importance of the educational process in correcting developmental delays in young kids. Its effectiveness can be achieved by forming internal motivation for learning from elementary school [57].

Through extensive research, I have gained insight into the development of a 13-year-old boy named Eli, who faces challenges with mental retardation, ASD, and hypotonia. Eli was born to a 39-year-old mother and a 40-year-old father and has two brothers, one older and one younger, who are neurotypical and excel in a traditional school setting. Eli requires a permanent caregiver and has yet to develop verbal communication skills.

Eli was born with a weight of more than 4 kg, and due to his mature size, his mother had a cesarean section. Although he appeared healthy, the pediatrician noticed weak muscles, lack of eye contact, and excessive crying. At 4 months old, Eli was taken to a neurologist, who predicted that he would outgrow these symptoms. However, at 6 months old, Eli was suspected to have hearing problems, despite his normal senses. An MRI examination found that Eli had a deficiency of white matter in his brain, which was the reason behind his developmental delay as compared to his peers. The etiology of this white matter deficiency remains unknown.

Eli, a child with physical and mental delays, was enrolled in a day-care center for toddlers, where he received treatment from a team of medical professionals, including pediatricians, neurologists, speech and language therapists, and physiotherapists. Despite undergoing multiple massage sessions, he faced significant delays in achieving motor milestones and did not start walking until the age of three. Eli also suffers from weak mouth muscles, which have resulted in him being unable to speak and consume solid food. He is solely reliant on a liquid diet and has difficulty drinking water. Additionally, when dental treatment is required, he is administered general anesthesia to avoid any discomfort or anxiety.

Now Eli can walk independently, but his caregivers restrict his outdoor activities to a wheelchair. He likes art and computer gaming, and he often gets engaged in these activities during his leisure time at home and in the care facility. The patient has receptive language skills, but expressive language abilities are yet to be developed. Due to his susceptibility to accidents, he requires constant supervision and care, which necessitates his long-term residence in a psychoneurological care center.

The success of teaching and adopting CD kids to life in society depends on different factors: the severity of disorders, the approaches and methods, and medical and physical treatments. Teachers working with children with CDs and severe mental disabilities must learn to design the pedagogical process using educational technologies. The specificity of teaching and educating children with such disabilities implies increased requirements for the professional competence of a special education teacher to make kids interested and motivated. Successful learning requires motivation to interact with teachers, peers, and others, provided and maintained through encouragement [86]. The earlier children are diagnosed and the treatments are started, the better their chance to progress and catch up with their peers.

Developmental Delays

According to statistics, "17% of children in the U.S. have some form of cognitive developmental delay" [113]. They suffer from cognitive problems of various natures and severity from birth or caused later by other factors, such as neurological disorders, mental disease, or brain concussion [114]. In most cases, developmental delays (DDs) can be corrected well, so parents need to know the main types of DDs and prevent potential ones in their kids. DDs manifest themselves at the motor level [113].

A child with a psychomotor developmental delay will likely have speech delay problems and LDs later. Such a

child needs the support of special educators, doctors, and parents. Theories on cognitive development, for instance, cognitive neuroscience, are previously focused on brain work, which is enabled by neurons that "receive, evaluate, and transmit information. This process is referred to as neuronal signaling" [19]. Distortions and interferences in the ability of neurons to process data are likely associated with various neurodegenerative disorders and diseases of the nervous system [115]. In light of the Israeli scientists' discovery, it can be assumed that such distortions affect the ability of a neuron to perform parallel calculations. In autism, the excitability of dendritic branches can be altered, leading to numerous effects associated with this condition. The new understanding of how neurons work opens up new avenues for research into these and other disorders with the hope of treating them in the future.

The researchers in Hassenfeld Children's Hospital at NYU Langone [86] highlight findings from research on developmental delays that may affect children's intellectual functioning and cause LD when kids begin school. As a result, they might have low self-esteem, which often makes communicating and playing with others challenging. Furthermore, such delays often affect their physical, social, communication, behavioral, or emotional skills. All the factors mentioned above might lead to CD because "emotionally disturbed children are not only deficient in the measured cognitive skills, but even the rate of development of these cognitive skills was inferior to that of the normal population" [116].

Parents can recognize children with delays when they start sitting, walking, gaining self-care skills, and talking later than their peers. " The study strengthens the reports that confirm the presence of autistic features in a significant proportion of mentally retarded children." Some have problems with communication and use gestures or other signs of non-verbal communication, and some have problems with coordination. They can also have rather often tantrums, and it takes them more time to calm down. This behavior identifies developmental delays [86]. Children with LD, attention deficits, communication disabilities, or general developmental disabilities are sometimes thought to have intellectual disabilities [107].

All kids with delayed or abnormal development or learning patterns should undergo comprehensive psychoeducational testing to make a correct diagnosis. To assess cognitive impairment in children, specialists use tests that identify deviations from the age norm in sensory, motor, emotional, volitional, etc. Typically, cognitive impairment is diagnosed by observing the child, interviewing parents, and comparing indicators with accepted standards for a given age group [117]. Therefore, they need more support to cope with social and emotional challenges and prevent or reduce LD in kindergarten and elementary school.

Sorts of Developmental Delays

The researchers at Hassenfeld Children's Hospital claim that the following developmental delays affect cognition functions:

1. Mental retardation may be genetics, such as DS, or consequences of brain traumas or infections, such as meningitis. Such delays cause LD, communication problems, and cognitive impairment in the most severe cases.
2. Motor delays also may result from genetic conditions. One of them is dyspraxia, which is characterized by various types of motor impairment: clumsiness, poor coordination, clumsiness of hand movements, articulation inaccuracy, and writing difficulties.
3. Speech delays may be caused by brain damage, hearing loss, or genetic problems, for instance, weak muscles of the mouth and tongue. Lack of stimulation speech development can also be one of the reasons why a child prefers non-verbal communication.
4. Social, emotional, and behavioral delays. Children have social and emotional skills challenges and struggle to build relationships with their relatives, peers, and teachers. As a rule, they are caused by neurobehavioral disorders like ASD and ADHD.

Hassenfeld Children's Hospital [86].

The research claims that problems with health also cause developmental delays. For instance, sickle cell disease, brain tumors, leukemia, and congenital heart disease might be fatal or cause developmental delays that reduce cognitive function and lead to CDs [118]. Moreover, neural plasticity varies significantly with development, and disease-related processes may cause significant damage to the brain and disrupt brain organization and development [119]. Thus, children and teenagers with several chronic health conditions often suffer from neurocognitive problems that follow them.

Neurocognitive deficiencies' effects on children and adolescents span childhood, adolescence, and adulthood [120]. Cognition is the mental process that enables humans to acquire knowledge and understand different things through experiences, thinking skills, and senses. It encompasses various intellectual functions and processes, such as attention, memory, decision-making, planning, reasoning, judgment, perception, comprehension, etc. "Cognitive deficit" is an inclusive term that describes the impairment of one or more of the forenamed functions [107].

Degrees of Mental Retardation

Prenatal disorders, parental alcohol abuse, complications

during childbirth, and diseases of the nervous system in early childhood can lead to CDs in the future, which appear in different periods of childhood, depending on the severity of the disorders (Health Jade). As it was mentioned in chapters 2 and 3, LDs and ASD are not signs of mental retardation (MR), but they often accompany it, depending on its severity [121]. The researchers of CDs describe three degrees of MR: mild, moderate, and severe [111]. Categories are based on scores obtained using age-standardized cognitive ability tests [117].

1. Mild MR is defined when an individual's IQ is below 70 [121]. The symptoms of mild conditions usually appear at the age of 5-7 when parents and teachers notice the following disorders:

- ADHD
- Speech delay
- Poor memory
- Unreadable handwriting
- Dyslexia
- Problems with reading and doing math tasks
- Anxiety and other behavior problems
- General difficulties with school performance
- Byrd F [122]

Mild MR is often challenging to diagnose because its symptoms are mistakenly attributed to defects in upbringing, such as lack of willpower, impudence, or tantrums, as the typical characteristics of spoiled or ill-bred kids. In most cases, children and teenagers with mild CDs can successfully adapt to society. Moreover, adults "can be independent or need some supervision, and 80% of them do unskilled or semi-skilled jobs" [111]. Therefore, if there is any suspicion of CD in a child, parents must consult with a neuropsychiatrist and start a course of treatment, if necessary.

2. Moderate MR is recognized when a person's IQ is about 35-40 [123]. The causes of moderate CD in children are often prenatal; otherwise, they might occur during childbirth. Hypoxia, premature, and other pathologies often damage the central nervous system. Also, moderate MR can be associated with neurological diseases - cerebral palsy, epilepsy, and more. In all these cases, the severity of CD strongly depends on the degree of damage to the brain and other parts of the child's nervous system [107].

In addition to the forenamed disorders, children with moderate MR suffer from more CDs. Their memory and vocabulary are poor, so they experience severe difficulties with learning and socialization [17]. Most often, cognitive impairments in them manifest not by one symptom but by a complex one. For example, a delay in speech development can be combined with psychomotor problems or ADHD. The success of correcting this condition often depends on timely diagnosis and initiation of treatment. Most individuals with moderate MR "can manage unskilled work in sheltered conditions with supervision and guidance" [111].

3. Severe MR is diagnosed when an individual has an IQ score up to 34 [111]). Among all types of CDs, such forms of mental disease are the consequences of serious damage to the brain, and they are the most difficult to correct. As a rule, severe CDs are associated with genetic diseases of the brain, including chromosomal abnormalities such as DS [117]. Another common cause is congenital malformations of the brain [107]. Kids with such a degree of retardation do not talk or have a minimal vocabulary; some are aggressive and have self-harming behavior. As a rule, "they have severe organic diseases that cause further mental retardation" [111]. Furthermore, "9.6% of children as having autistic disorder are in severe mental retardation group." Such children are often identified in the first year of life and incapable of independent living without care during their lifetime [17]. However, when favorable conditions are created in special hostels, including a comfortable psychological atmosphere, many of them can successfully socialize and lead a full life.

How to Distinguish Autism and Mental Retardation

At first glance, it may be difficult to distinguish children with classic autism and with MR. There are often cases where autistic traits are combined with CDs. In such patients, the complex of symptoms includes signs of both diseases. For instance, kids with ASD and MR have problems with speech and motor skills. Nevertheless, there are quite a lot of differences that allow parents, kindergarten teachers and therapist to identify the child's diagnosis.

- Speech development. As it was researched in Chapter 2, speech development goes on according to the milestones in neurotypical children. Usually, in ASD kids' speech is developed according to age, but has its own characteristics. They can simultaneously manipulate complex phrases and the very first words they learn. Furthermore, ASD kids insert into speech many phrases picked up from the background environment, while in mentally retarded children, and then adults, speech is grammatically incorrect, greatly simplified, speech development is delayed in all respects [27]. Such people are not able to comprehend and formulate complex sentences, have difficulty understanding other people's statements, cannot construct long phrases, and do not remember phrases constantly used next to them. Nevertheless, autistic people are not talkative; they do not make contact first and prefer to use gestures. In certain forms of autism spectrum disorder, by the age of 2 years, regression of speech skills and even complete disappearance of speech may occur. But this is rather an exception. Children understand other people's speech [124].

- Interaction with the society. Unsociability is a hallmark of autistic people. They feel uncomfortable when it comes to interacting with people. Moreover, both their own and others are perceived equally negatively. Such people practically do not maintain eye contact. They do not initiate communication first. Children with mental retardation differ little from their peers in their desire to communicate with others. Due to their abilities, they establish contacts with adults and children, strive to constantly communicate, make friends, maintain dialogues, permanent relationships, easily make eye contact, and do not turn away [27].

- Intellectual development. Autistic people often have intact intelligence with development potential, but they do not express it openly due to their specific perception of the world around them [73]. They are not interested in cognitive activity, although they can carry it out at a level with normal peers. They often demonstrate impressive abilities in areas within their area of interest, while ignoring others. Such patients often show different results in a familiar environment and in a new one, which is stressful for them [125]. Autistic people with a mild form of the disorder receive higher education, becoming excellent specialists in a narrow field of interest to them, Herman E [126].

"Children with mental and developmental retardation have a reduced attention span, poor eye-hand coordination, restricted memory, and weak concentration" [127]. Their cognitive activities are limited and they have a simple inner world; the main goal in life rarely goes beyond the fulfilment of natural needs. In any situation, they demonstrate approximately the same level of knowledge and skills. People with educational qualifications often master simple blue-collar jobs [128].

- Household skills. Unlike MR people, autistic ones are not particularly independent. They have difficulty mastering daily rituals. Sometimes they remain disabled for the rest of their lives, while showing high intelligence [125]. They do not like to move independently, even around a familiar city, perceiving it as a frightening, sometimes completely impossible experience. While ones with MR learn to dress, eat, take a bath, and take care of themselves more slowly than normal ones. When they are teenagers, they can do a lot: they can buy groceries in a store or move around the city independently [124].

- Skills of playing games. While mentally retarded child is significantly retarded in development, and often refuses role-playing games, an autistic one prefers to ritualize games, constantly playing out the same scenario [127].

Sometimes a child has both ASD and DD at the same time. In this case, the child exhibits feature of both mental syndromes simultaneously. This makes it difficult and sometimes unpromising to corrective work aimed at adapting the patient to society. Children should receive early diagnosis and appropriate treatment, otherwise, socialization with combined pathology sometimes does not occur [126]. A person remains disabled, unable to fully communicate with others for the rest of his life.

How Cognitive Neuroscience Explains CD

Cognitive neuroscience is the biology of the mind, which "has been formed by the principles of cognitive psychology, the study of mental activity as an information-processing problem" [17]. It connects the principles of psychology and neuroscience. It researches mental processing, and it aims to explore different sorts of neurodiversity and propose the most effective methods to prevent possible disorders in young kids, teach neurodivergent ones, and adapt them to live in society. The science of human cognition is multidisciplinary and involves clinical psychology, speech-language pathology, neurology, psychiatry, linguistics, mathematics, and more disciplines [57].

Rhoshel L, et al. [119] claim that human brain develop goes on with the help of complex interactions of genetic and environmental influences. CDs might follow neurodiversity, like ASD, ADHD, and many more. Genetic disorders, such as DS, also lead to mental impairments of various levels. Brain traumas, especially in babied and toddlers, and infections, such as meningitis, might cause "cognitive slowness, learning difficulties, short-term memory deficits, and poor academic performance" [129]. Sometimes, neurocognitive problems and other developmental delays may be consequences of chronic diseases, such as leukemia or brain tumors [118].

"Scientists have understood for many decades that neurons in the brain are functional units and that how they are interconnected yields specific circuits to support particular behaviors" [17]. Neural connections are formed due to environmental changes, characterized as actions of the human senses that send electrical impulses to the brain. Thus, the nervous system always creates new neural connections in which information about the situation that influenced its creation is stored. Neurons transmit information both to the central nervous system and from it. They are tightly connected and send and receive signals from your brain. Dysfunction of neurons leads to nervous diseases [6].

Among the numerous causes of CD, it is possible, for example, heterotopia of neurons in certain areas of the cortex and violations of the proportions of neurons (Armstrong). Such disorders are rare congenital malformations of the brain that

occur due to a breach of the processes of neuronal pathology. Neuronal heterotopia is a type of brain abnormality that arises from the improper migration of neurons during fetal development. This condition may lead to various neurological deficits. Kazuhiro I, et al. [130], Holland N, et al. [120] claim that neuron loss also causes cognitive deficiencies. Often, patients with subcortical laminar heterotopia have a developmental delay, as well as a decrease in the level of intelligence and behavioral disorders. Mental disorders occurring in these patients are poorly understood. Behavioral disorders characterized by impulsiveness, aggressiveness, and emotional instability are described. These patients may also present with varying CDs [131].

Chromosomal disorders like Down Syndrome (DS) also affect intellectual development and may increase cognitive delay risk. Children with DS are known to have developmentally altered brain structures caused by trisomy of chromosome 21. They are characterized by delayed central nervous system maturation, linked to neurogenesis and synaptogenesis prenatal abnormalities [132]. Children with this syndrome look similarly – they have flattened faces, almond-shaped eyes, and small feet and hands. They usually are shorter than their neurotypical peers. Although they have different levels of IQ, on average, it is lower, and their development is delayed.

The development of the brain depends not only on neurons' connections and genetic influence. Dhakal A, et al. [107] claim that CD may be innate or caused by environmental factors such as brain injury, mental illness, and neurological disorders, that developmental delays might follow. So, another mechanism of increased combination of mental disorders is also possible. Thus, asphyxia at birth, traumas, meningitis and other life-threatening diseases at a very young age may influence brain function and cause mental delays [129]. Moreover, the distorted formation of organs and tissues causes a sharp violation of body functions, which can also affect brain development. According to Rhoshel L, et al. [119] disturbed body functions or environmental changes might slow down brain functions. Compas BE, et al. [118] claim that chronic diseases also delay brain development in young kids and cause CD.

How to Teach Children with CD

Parents must pay attention to how their children play with toys, communicate with their peers, and get self-caring skills. Various tools can be used to help the child overcome developmental delays and catch up with their peers. However, it works better when diagnosed as toddlers, so therapy and teaching will help them more. They can catch up with their peers, but it takes them longer [17]. Thus, as a remedial teacher, I can confirm that kids with mild CD can learn in a regular school but still need an individual approach – therefore, they may be put into inclusive classes. As a rule, teaching in such classes is differential, and teachers create individual education programs for each student [133].

The classroom environment should be organized to help students with intellectual disabilities maintain focus and stay on task [134]. The main question for a teacher working with CD children is what should be taught first and how to teach a child with moderate or severe mental impairment. The category of children with moderate and severe mental retardation is very heterogeneous. The content of each lesson depends on the correct definition of each of these components and their rational combination [135]. Each class should include the most effective methods of work, mainly games, to make them interested and motivated. Cognitive motives are essential for various reasons. Firstly, they expand the boundaries of the mental potential of a growing personality. Secondly, they enrich children's theoretical knowledge with practical experiences. Thirdly, they contribute to their ability to be independent, do tasks, and predict possible results [136].

The nature of the developmental disorders of children with special educational needs determines each lesson. Its objectives should determine forms of work, for example, teaching them adaptive skills to increase their level of independence, reading, writing, and basic math. Otherwise, lessons may be devoted to developing social and self-caring skills [111]. The latter are crucial for kids with severe CDs.

The classroom environment also needs to be friendly and welcoming. Teachers need to make their students trust them because it is the only way to catch the kids' attention. Individuals with moderate mental impairment should be taught in small groups or individually, and the material must be chunked and repetitive to enhance their skills and knowledge [134]. Remedial educators also must be clear and specific: they should give short and clear instructions and visualize the materials. In this case, eye-catching materials are helpful, for instance, highlighted texts, picture games, computerized video games, and self-checking exercises. Such activities "develop students' listening skills and enlarge their vocabulary" [137]. Kids with CDs find it challenging to study online, so they should study in computerized classes or use their tablets and other devices.

As mentioned above, DS and other genetic disorders are innate and lifelong. Special education schools offer speech, physical, and occupational therapy to help DS children to develop their physical and intellectual abilities and full potential. If they have mild mental retardation, they may be included in a regular class, although they may need extra help or attention in school. Hughes J [135] claims that "for

most children with DS, language comprehension is better than language production." Therefore, flashcards help them learn cognates, letters, words, and basic math and develop working memory skills. The same can be done with the help of educational technology, for instance, on classroom computers or personal tablets.

Some children prefer gestures to oral communication, mainly those with speech delay and ASD [79]. Many ASD children respond very well while communicating with horses and benefit from hippotherapy [138]. Others are delighted with swimming and communicating with dolphins – so dolphin therapy helps them [139]. Music, dancing, aromatherapy, and sports activities can serve children with mild and moderate retardation well because they need therapy focused on teaching cognitive skills and relaxation strategies". Moreover, it helps them get to know each other and communicate through playing and doing the forenamed activities together. Music helps children with severe CD respond and develop their emotional skills. It is also beneficial for their coordination, especially if they challenge walking [111].

Teachers, pediatricians, psychologists, and psychiatrists should cooperate with kids' parents to support them, give good advice, and learn more about their progress. In many countries, including Israel, associations of parents of inclusive children have been established to exchange their experiences, support each other, and look after children in turn. Parents are invited to special conferences and parties with kids where they can communicate with each other and learn socialization skills. Such communities are in the chain of Beit Ekstein schools for children with mild, moderate, and severe CD. Some children live in their families, some in boarding schools, and parents collect them on weekends [140].

Young CD children who suffer from developmental delays may have motor, language, and social skills challenges [113]. They find it more difficult to study at school and learn new skills. They also lack resilience and fail to manage their emotions and behavior. Some children improve their forenamed skills and catch up with their peers before they start school (Hassenfeld Children's Hospital) [86]. Still, their progress depends on the severity of their CDs and other sorts of neurodiversity accompanying them, as well as appropriate treatment and teaching. When younger kids get proper therapy, they can catch up with their peers more.

Kids with DS and other severe cognitive impairments must be taught self-caring skills to stay independent and safe. Step-by-step, they can learn letters, numbers, and other cognates to enlarge their vocabulary, read, and calculate at least on a basic level. It is helpful to teach them with the help of flashcards and other eye-catching materials [135]. Teachers also can use textbooks with pictures, computers, or realia. Music and sports activities also benefit them by reducing anxiety, developing speech and coordination, and helping them interact with other people. For those who struggle to speak and prefer non-verbal communication, hippotherapy and dolphin therapy are also helpful [139].

Cognitive health is becoming one of the greatest challenges and achievements of quality human life in the 21st century. Romanchuk claims that identifying genetic and epigenetic factors will help to prevent CDs or find out their first signs in babies. It is crucial to use effective pedagogic, psych didactic and medical to slow down CDs and neurodegenerative diseases in school children to help them to do well at school and to get adapted in the society.

Chapter 5

Social Problems and Neurodiversity

Stress and Mental Disorders

Stress is the body's natural response to internal or external events that are perceived as threatening or uncertain. It can be caused by physical danger, emotional distress, conflict, environmental changes, and other factors. It can affect health throughout life, but there are no the same opinions about which types and aspects of stress are most important for health and human diseases. This is partly since "stress" is not a monolithic concept, but rather an emergent process that involves interactions between individual factors and environmental factors, historical and current events, allostatic conditions, and psychological and physiological reactivity [141].

Stress is a natural response of the body to environmental challenges and demands. It can have both positive and negative effects. When stress is positive, it is known as eustress, and it can motivate us to cope with tasks and achieve our goals. However, if stress is too intense or lasts too long, it can have negative effects on our mental and physical health [142].

Stress factors occur within the context of a person's life. These contextual factors include individual characteristics such as a personality and an environment in which a person lives, current and past exposure to stressors and protective factors. All this together determines the basic allostatic state of physiological regulation and neural network paradigm and prism, through which stressors are perceived and given meaning. Contextual factors and habitual processes together influence psychological and physiological responses to acute and everyday stressors. It has been studied that these reactions, if not regulated, lead to allostatic load and ultimately to depression, physical and psychic diseases.

Measuring stress is a complex task as it can manifest itself in social, psychological, and physiological forms. There are no universally accepted measures for stress because the measurements are often contradictory, superficial, and have mixed designs. To improve the measurement of stress, we need to develop a common language of stress and more precise stress models that take into account the multi-level nature of stress. A multi-paradigm taxonomy can be used as a step toward providing a common language for measurement, including measurements of impacts, reactions, and time frames [141,142].

There are two well-known hypotheses regarding the lateralization of emotions in hemispheres. Right Hemisphere Hypothesis (RHH) postulates that emotions and associated behaviors are dominant and lateralized function of the right hemisphere. Valence Hypothesis (VH) states that the right hemisphere modulates negative emotions and associated behaviors, and the left hemisphere modulates positive emotions and associated behavioral manifestations. Although both RHH and VH supported by extensive research data, they are mutually exclusive, suggesting that the game may be missing a factor that can provide more a precise description of how emotions are lateralized in the brain [143].

Evidence presented which give a much broader perspective of emotions, taking the concept that emotions can be classified into primary and social types, and that lateralization hemispheres is better explained by the Emotion-type Hypothesis (ETH). ETH states that primary emotions and associated behaviors are modulated by the right hemisphere, and social emotions and related manifestations behaviors are modulated by the left hemisphere [143,144].

From a behavioral neuroscience perspective, the role of the right hemisphere in emotions also by addressing the often overlooked but equally important role of the left hemisphere in emotion. Numerous studies suggest that the left hemisphere modulates social emotions and related behavior, while the right hemisphere modulates the primary emotions and related behavior. Although there are several theoretical models defining what emotion is, the theory of perceptual-motor skills (PMT) has proven to be the most helpful and neurologically significant for understanding emotional disorders [145,146].

The Central Neural Theory defines emotions by identifying different brain regions involved in emotional expression and the generation of internal states of feeling. On the other hand, the Cognitive Arousal Theory states that emotions occur when perceptual and cognitive processes cause arousal in the individual. Neurophysiology suggests that VH does not fully explain the differential lateralization of emotions in hemispheres and associated display behavior. New data suggests that ETH may be a more effective means of solving the problem of emotional lateralization [144].

However, only future deductive types of research will be able to finally confirm ETH, provided that the appropriate incentives and responses. For example, a study found that

patients with damage to the right hemisphere significantly reduced autonomic reactions to emotional stimuli compared to patients with left hemisphere damage, and this discovery was used to support RHH. However, if the incentives used to induce vegetative reactions, were primary emotional in quality, which did not specifically include social emotional stimuli, then the results would be significantly shifted to reveal autonomic hypo reactivity of the right, but not the left hemisphere [143,144].

Social feelings cover important mental experiences that mean optimal functioning, dissonance, and the dynamics of social synchronization. Interpersonal contexts evoke different feelings to influence mentalizing and involuntary, for example, mirror neurons, which are part of the social cognitive processes. MRI meta-analysis confirms that social brain structures and limbic structures mediate feelings towards "hot" and "cool" social functions, including the front medial cortex, the anterior cingulate cortex, and the orbitofrontal cortex.

There is compelling evidence that brain areas and psychological processes typically associated with cognition, such as dorsolateral. The prefrontal cortex and working memory play a central role in emotion. Besides, putative emotional and cognitive domains influence each other through complex neural network of connections in such a way that they jointly contribute to adaptive and maladaptive behavior. Emotion and cognition are deeply intertwined in the tissue of the brain, assuming that widely held beliefs about the key components "emotional brain" and "cognitive brain" are contradictory. A deeper understanding of the emotional-cognitive brain is important not only for understanding the mind, but also to find out the root causes of its disorders, such as depression and bipolar disorders.

Depression

As a remedial teacher, I have researched and found four main reasons for poor school progress, which lead to depression, as represented in Figure 18.

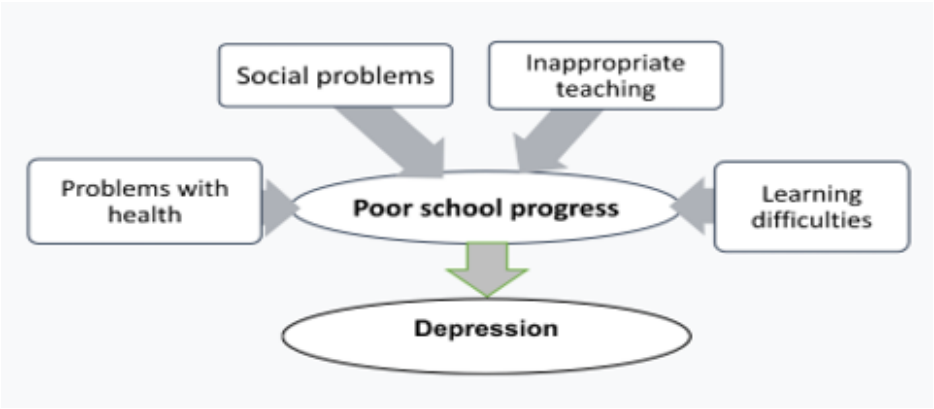

Figure 18: Sources of depression.

Thus, despite good cognitive abilities, students often struggle due to social problems. Challenging socio-economic living conditions and poverty, growing up in a poor neighbourhood or "blue-collar family", which might be dysfunctional, often lead to bullying at school, which causes a lack of motivation. Moreover, an inappropriate environment in the family, lack of support, and permanent negative reinforcement to children only contribute to isolation and anxiety, which reduce their interest in learning and slow down their mental activity. In the worst case, they display "hostility and resentment toward their parents and others".

Children from families with low income or dysfunctional ones need tutoring and psychological support at school, but many countries, including Israel, lack highly qualified educators. As a result, school principals must hire students from pedagogical colleges and others who know particular subjects well but cannot teach appropriately. So, insufficient teachers' qualifications, poor educational process organization, overcrowded classes, and lack of an individual approach to students overwhelm them. Thus, "difficulty in accomplishing classwork, and learning activities are not stimulating to hold their attention generally moderately demotivate them in their learning" [147].

Depending on the severity of the disease, staying at home or in the hospital for a long time causes a struggle when the student returns to school. Lack of focus due to the disease or misunderstanding the material because of missing previous lessons demotivates and depresses the student, especially during cold and rainy winter days, which might identify SAD. Moreover, they are afraid of making mistakes and being criticized by their teachers or bullied by their peers and might want to stay away from school again and ask their parents to

transfer them to homeschooling. The same happens in the case of LD when students do not miss the lessons and try to study, but they still struggle and become overwhelmed and anxious.

All the forenamed factors often lead students to psychological problems and refusal to attend school. If this problem is not solved, they get severe depression and end up misbehaving, disrupting the classroom, often dropping out of school, and joining the ranks of so-called troubled teenagers. Otherwise, they find any opportunity to stay at home and ask their parents to transfer them to homeschooling. Berney TP, et al. [148] claim that children with depressive disorders are likelier to skip school than non-depressed psychiatric children.

The Link Between Neurodiversity and Depression

The research states that neurodevelopmental disorders rarely come alone. Dyslexia, dysgraphia, dyscalculia, and other LD cause a lack of assertiveness, discourage students from studying and lead to low grades [149]. ADHD and depression often accompany LD and share some common symptoms. Both conditions include difficulty concentrating and loss of motivation. Students with ADHD may lose motivation because they have trouble finishing tasks and often believe their efforts will not be noticed. Stressed and depressed students cannot complete their assignments because of deep sadness and a lack of purpose [90].

Weinstock states that ASD students are four times more likely to experience depression than their neurotypical peers. Studies show that a possible 65% of people with AS tend to be more susceptible to depression and anxiety. However, the inability of teens with autism to communicate their negative experiences, anxiety, or severe stress also makes it often difficult to diagnose depressive or anxiety conditions and teach them at school appropriately. The disease is often recognized only as it progresses strongly, with symptoms such as total withdrawal from social contact, increased compulsive behavior, and refusal to get out of home or go to school.

ADHD, ASD, bipolar disorder, depression and other behavioral problems cause tantrums and aggression (National Institute of Mental Health). Children with such speech disorders refuse to read aloud or answer the teacher's questions, which makes their school performance more and more challenging and causes more severe depression or aggressive behavior. As a result, they block learning abilities and cause fear of being taken to the principal's office or punished by parents. Such fear might cause stuttering. Karpova claims it "leads to stable negative personality changes, which creates a severe medical, psychological, and social problem."

Panicker et al. find that 75% of LD students show a deficient level of resilience and 16% of kids have severe stress, 14% have depression, and 23% have severe anxiety. They worry about taking tests, feel ashamed about looking stupid in front of classmates, and get nervous that their parents will punish them. All these worries are overwhelming. The same feelings can last into adulthood, and people may get anxious at work or during a job interview. This anxiousness can hold them back from reaching their potential and achieving what they want. LD can cause mental health struggles and what is the worst, people with LDs, depression, and low self-esteem might try to commit suicides or they really do [149].

If teachers notice signs of depression, they must contact the school psychologist and gently share their observations with parents. They should talk to their children and get other relatives to listen to their kids. Still, they need to show that they are ready to support him in everything and provide the necessary assistance without criticism or pressure. Thus, the teenagers will not close in on themselves but will understand that teachers and parents are ready to listen and support them. If teens trust their families and educators, they will have more chances to get rid of depression.

Mental health influences on people's emotional, psychological, and social well-being. It plays a vital role in every stage of life, from childhood through adulthood and effects thinking, feeling and everyday activities. The importance of mental health can't be overstated as it impacts daily living, relationships, and physical health. Only healthy mental state allows individuals to do well at school, realize their full potential, work productively, and contribute positively to their communities.

Discussion: Chapter 6

Neurodiversity and the Future of Special Education

The Principles of Special Education

Special education programs are designed to educate children with neurodiversity. The latter includes behavioral problems, retarded mental development, and health problems. Its subject is the process of raising and teaching children with physical or mental disabilities, delayed intellectual development, and emotional disorders, as well as the search and creation of the best methods for working with such deviations and preventing their occurrence.

Correctional work begins by establishing emotional contact with the child and identifying their interests, overvalued interests, motivation level, self-esteem, tolerance to mental stress, and the time they can actively participate in learning. This initial stage allows for a personalized approach to correctional and developmental examining and training that matches the child's cognitive general activity and personality. Individual programs should be created for each student through detailed neuropsychological diagnostics, focusing on identifying weaknesses and determining the child's zone of proximal development.

For decades, scientists have discovered new ways of thinking and research about brain neuroplasticity, growth mindsets, and other innovations. Thus, special education is supposed to find diagnostic categories, objectives, and remedial methods [150]. Neuroplasticity of the brain enables neurons and neural networks to change under the influence of new experiences, including restoring or forming new connections lost due to damage.

Special education includes various forms such as remedial lessons, individual consultations in academic subjects, different types of therapy, educational assistance for schoolchildren needing special attention, and health classes. It can be done successfully according to the following principles:

1. The principle of systematicity. According to Vygotsky, any education must be from simple material to more complicated. It, from simple to complex, is carried out according to three parameters: joint–independent action, mediated by external supports – internalized action, and expanded element-by-element action – condensed action [151]. Thus, the correction program aims to harmonize the child's overall mental functioning and personality, which can help the educator find a contact with the student or a group of students. Afterward, it enables the educator to teach and the students to learn. This principle acknowledges the need to prioritize the direction of work at each stage of correcting the child's psyche based on complex neuropsychological examination data.

2. An individual approach to each child. As it is known, the disorders researched above rarely come alone. Usually, each student has at least two or three disorders, for instance, dyslexia and ADHD, ASD, ADHD, and one or two LDs. Therefore, each disorder requires undergoing correctional and developmental training and an individualized education plan. Despite the similarity of symptoms revealed during neuropsychological examination, each child has features of ontogenetic development, living conditions, and upbringing, and, consequently, with his own personality and mental functioning features.

3. The principle of comprehensive evaluation. It includes a combination of methods of motor, cognitive and emotional-personal correction in each lesson. The specific mental function is simultaneously formed with the help of both cognitive and motor correction, therefore a combination of cognitive and motor methods in each lesson is mandatory. Comprehensive evaluation is also necessary to increase the overall brain activity of the child, improve cerebral circulation, normalize activation processes, relieve tonic disorders, and increase performance, the lack of which is one of the main reasons for the difficulties in the formation and successful functioning of all mental functions and failure in school education.

Correctional education is practiced in small groups, pairs, or individually. The lessons are usually conducted as a game, enabling kids to feel welcome and accepted. Thus, the Montessori pedagogy focuses on it. Respecting children, mutual respect, effective communication, and finding a solution instead of punishment provide a friendly classroom atmosphere. While learning new material or practicing new skills, kids should be encouraged to try instead to succeed immediately. Furthermore, they should accept failure because they are part of success [152]. The principle of Montessori pedagogy is to teach manners in a social-emotional environment.

Due to the Montessori method, children can evaluate their

progress in learning and behavior and discuss it with their educators and therapists. To track it, homeroom teachers and other educators must interact with their students' parents, psychologists, psychiatrists, therapists, and physicians. This enables them to provide each child with a comprehensive medical-psychological-pedagogical approach.

Prerequisites of the Progress of Special Education

Lev Vygotsky, the founder of correctional pedagogy, social psychology, and psycholinguistics, set himself the goal of involving all children in the educational process. This reflected the idea that every member of society should work to their best. Vygotsky set up psychological and pedagogical commissions to differentiate a child's difficulties and determine the best learning program for them.

As it was mentioned above, the quantity of neurodivergent kids has been increasing. When parents choose a school for their child with SEN or LD, they choose between a general education and a SEN school. "After a child experiences difficulty in school, is tested by a licensed school psychologist, and deemed eligible for special education services, he or she is referred to a local Placement Committee, which formally decides eligibility and placement." With the development of inclusion, many things change in regular schools.

However, this is sometimes not enough. Due to the lack of an environment and special equipment, children with SEN who could study in a regular school go to a correctional school with the necessary equipment and specialists [140]. Therefore, a modernized approach to inclusive and special education is required. Inclusive classes in regular schools can sometimes solve this problem, and even an individual approach to a neurodivergent student in a regular class. Otherwise, special education schools, like Beit Ekstein, accept such kids and provide them with different classes depending on their needs.

The Ministry of Education in Israel (2024) statistics claim that in recent years, more and more high school students have failed the final exams or passed them with low grades. Therefore, Israeli educators claim that sometimes even regular students need a special approach, which is usually practiced in special education schools. So, regular schools should provide inclusive education in regular classes or practice differential teaching.

Furthermore, many parents claim that regular school should have psychologists and therapists, that can help SEN students complete the school program successfully and choose the right profession in their future – perhaps even get a higher education.

The results of the scientific works of cognitive science are used in the work of neuroscientists and other medical areas where they face brain problems. Experts indicate the hereditary factor as a common cause of the development of dysgraphia in preschoolers and primary school students, as well as various diseases associated with damage to the central nervous, visual, and auditory systems. Since boys are more prone to neurodevelopmental disorders, including ASD, TS, and ADHD, among them, the hemizygous nature of chromosome X (Chr X) is known as a vulnerability factor, although it still remains unexplained despite multiple hypothesis [45]. "While the hemizygous nature of chromosome X (Chr X) in males has long been postulated as a key point of "male vulnerability", rare genetic variation on this chromosome has not been systematically characterized in largescale whole exome sequencing studies of "idiopathic" ASD, TS, and ADHD."

Experts suggest that developmental LDs, including dysgraphia, can be diagnosed in children who are at least eight years old. By this age, the fundamental skills of written language are typically formed [88]. The presence of a problem is evidenced if a student makes the same mistakes, his handwriting is messy and unreadable, he writes slowly, and he gets overwhelmed in the classroom. Thus, children prone to developing writing disorders also include children with problems with the fine motor skills of their hands Martins et al. Kids with dysgraphia often struggle with vocabulary, speech, phoneme correlation, and writing. Dysgraphia is a lifelong condition that requires intervention.

In addition to dysgraphia, children often have such LDs as ADHD, dyslexia, and dyscalculia [36]. Dyscalculia in many cases is an independent disease, and not a side effect of some other defects. It can be highly selective, that is, a person with a pathological inability to do arithmetic can be completely normal in all other respects. Nevertheless, some adults with dyscalculia understand geometry very well and even program at a professional level [87]. Thus, computerized education helps people succeed in spite of LDs.

Cognitive science develops remedial programs for children and people with LDs. Since no two kids have the same disorders, each gets an individual treatment. Nevertheless, identical twins, who have the same genetic set, often have very similar LDs. Thus, twin analysis shows that reading, writing, and arithmetic ability is largely (at least 30%) dependent on genes, and not on developmental conditions [87]. In addition, it turned out that learning abilities are inherited have their own neurological basis: perhaps there is some specialized part of the brain responsible specifically for perception, some for arithmetic, some for reading and some for writing [27].

The sooner the child is diagnosed and attends the occupational therapist and other specialists, the better the result will be. Although it is impossible to cure innate dysgraphia and other LDs, children can do better in school due to classroom accommodations and appropriate therapy. Such programs help psychologists and therapists correct the work of thought processes and give them a chance to achieve high results in learning. At the same time, it enables remedial teachers to create appropriate accommodations in the classroom for kids with dysgraphia, motivate them to study, and avoid low self-esteem and unrealistic demands of themselves [153]. The neuropsychological approach requires that it is essential to understand the mechanism of errors for the correct choice of a corrective route. To correctly build a correction route, teachers need to understand the mechanism of the students' errors, work with each of them pointwise, and get faster and more pronounced results.

Results

Our Alumni

In this section of the book, I will showcase a selection of our alumni from diverse backgrounds. During their time with us, they were diagnosed with ASD and multiple LDs. Having maintained contact with them, I have conducted research into their learning strategies and subsequent life paths. Presently in their late twenties, some have pursued higher education while others have started families.

1. Student K. (male) had a classic autism. He was good at English and math but preferred doing tasks alone and almost never spoke to other people. It was impossible to make him work in a group, so he sat alone for most of the lesson and did the tasks silently. He never asked for help, even if he did not understand the tasks and preferred to do them wrong rather than with the teacher. His handwriting was very messy, which led to dysgraphia, but for some reason, he refused to type the answers on a tablet and send them to the teacher.

K. wanted to get tasks suitable for his level and tried to understand them himself. Furthermore, he had very few friends at school whom he spoke with, but he never quarrelled with anyone; he just ignored people who were not very close to him. He got a CBT and a SIT, and he was advised to attend the zoo corner so that rabbits, hamsters, parrots, and other animals would help him to develop communication with other people. He did not finish school, and neither one did the military service, but he helped his parents in the family business – they ran a bakery.

2. Student S. (female) also had classic autism, which was accompanied by cognitive deficiencies. ASD, dyspraxia, and mental retardation caused her severe problems even at the school for special education. She often wore messy clothes, and in most of the lessons, she was silent and ignored the teacher's instructions. Sometimes, she was aggressive and could hit her co-students or even teachers. During the break, she preferred being alone. She had a caregiver who sometimes had to calm her. Most of the time, she sat at the desk and looked at the board but seldom took notes.

S. had only two favorite subjects - art and music- but she did not do any tasks during English lessons. Therefore, I had to leave her alone so that she would not curse or hit me. Nevertheless, when I read a story to the group, I asked her to draw the characters, and when she was in a good mood, she did it quite well. Later, perhaps due to sensory integration therapy, her behavior improved, and she stopped tantrums, although she did not make progress at school. When she was in the 9th grade, she ended up in a boarding house for the youth with mental retardation.

3. Student V. (male) was quite good at English language and literature, but he had dyscalculia and ADHD. He was a new immigrant from Russia, and he spoke three languages, Russian, Hebrew, and English, rather well. Nevertheless, his math teachers complained that he could not do elementary tasks and often ended up in tantrums. Perhaps he was afraid of Math. Furthermore, his parents divorced, and he came to Israel with his mother and grandparents. Later, his mother died, and he lived with his grandparents. Probably, a great deal of his difficulties in school were the result of his social circumstances. He was depressed for a long time; he had very few friends at school, and it was challenging to communicate with him.

During the CBT, SIT, and other treatments, most of his symptoms were attributed to ADHD, like hyperfocus on some topics that interested him, emotional crisis, and dyscalculia since he showed an inability to complete "boring" or "overwhelming" Math due to poor memory with calculations and formulas. Probably, he had severe psychological problems that made his school progress very challenging. As a result, he stopped learning Math and did not get a school diploma. Nevertheless, V. joined the Israeli Defense Force (IDF) at 18, and when he finished his military service, he started working as an electrician.

4. Student G. (male) had an Asperger syndrome, that ADHD and dysgraphia accompanied. He attended only the lessons he liked, mainly English, Math, and Science, while most of the time, he struggled in the schoolyard during

the lessons. Since it is permitted to continue studying at Beit Ekshtein school till the age of 21, many students do until they complete a full matriculation. Although his parents wanted him to do so, he refused to study after he had passed English and Math well and got minimal passing grades in other subjects. He refused to improve his low grades and finished looking at the age of nineteen.

During the occupation therapy and other treatment, several of his symptoms were attributed to giftedness since he was very good at computer science. Still, most of the symptoms were attributed to Asperger syndrome, such as problems with communication and ADHD. As far as I know, G. did not do the military service. Nevertheless, he went to college and got a BA degree in computer sciences. Now, he works for a high-tech and does it well since his job does not require too much communication with other people and does not need to write a lot.

5. Student L. (female) did very well in elementary school; she got only excellent marks. Nevertheless, when she started junior high school, she ended up at Beit Ekshtein School. Probably, she was denied an ADHD diagnosis because of her high intelligence. Otherwise, her parents thought that an ADHD person could not perform academically well. Generally, she did well at school aside from subjects that required a great deal of effort – for instance, writing projects that required reading incredible amounts of books or online materials. She was pretty good at English, but she often refused to write compositions or to do grammar exercises - perhaps she got used to being an excellent student, and now she was afraid of making mistakes. She was stubborn and argued with teachers, and she never did her homework because she was sure it was a waste of time.

At our school, L. was diagnosed with ADHD and Asperger syndrome, while she did not have any LDs. Perhaps some of her symptoms were attributed to giftedness since she memorized the material quite well, but she did not want to make any efforts to make the knowledge stronger. She was a twice-exceptional girl. At the age of 18, she joined the IDF, and she liked it. Nevertheless, despite good grades, she never went to university and preferred to work at a horse farm.

6. Student B. (female) She was an excellent student at school, and later, she got an MA degree in Business Administration. She ended up in Beit Ekshtein only in the 10th grade and studied with us for the last three school years. As far as I know, B. did not get on well with her previous classmates and felt very lonely in a regular school. She was advised to move to a SEN school, although she did not have any LDs. Quite the contrary, she did very well in math, English, Hebrew studies, and other subjects.

I noticed that B. had few friends at school and stayed alone during the breaks. Furthermore, for some reason, she often was depressed. Moreover, she wanted to get only excellent marks, and if she got 90 instead of 100, she cried. She was an absolute perfectionist. Perhaps she was gifted, and nobody noticed her giftedness, which could cause her depression. Nevertheless, she got some treatment at school that helped her overcome the psychological challenges. Finally, B. finished school with excellence and joined the IDF. Later, she went to Tel Aviv University and succeeded in completing her BA and MA degrees.

7. Student H. (male) was a good and motivated student despite ASD, ADHD, dyspraxia, and dysgraphia. He was clumsy, and his handwriting was messy. Therefore, he was often bullied, and sometimes, he bullied other kids. Therefore, he needed a behavioral therapy and some other ones. Furthermore, he needed some extra time to complete classes work and exams. Due to individual lessons in English, Math, Literature and some others, H. passed the final exams well.

After graduating from high school, H. did an alternative military service: he did some community work instead of serving in IDF. Later he went to university and studied computer science. Now he is a programmer and works mainly from home because he finds it difficult to work with other people. Nevertheless, he is a successful programmer.

8. Student A. (male) was diagnosed with ADHD and some LDs. Despite the latter, he was a good student. In my opinion, he was gifted because he invented a GPS for IDF, and nowadays, it is used by Israeli officers and enables them to find lost soldiers (Algemeiner). A. studied at our school for a year or two, and then moved to a regular school. After finishing military service, he enrolled at Tel Aviv University and became one of the best students. He completed the MA program and won a scholarship for research.

Conclusion

The central nervous system often suffers from different disorders. Some of them are caused by genetics, such as dyslexia, dyscalculia, dysgraphia, dyspraxia, and others. Many of them are accompanied by ASD or ADHD. Otherwise, kids are diagnosed just as ASD but do not have other LDs. Brain traumas, and some by infections cause some neurological disorders. Although neurodivergence is not a disability and stands for variations in brain activities, it's an invisible

challenge for those with neurodiverse characteristics [23]. Since each SEN child is different, they all need special education with the necessary treatment methods, teaching, and correction.

The fundamental goal of neuroscience is the research of all aspects of the nervous system. Neurologists, biologists, and other specialists study its structure, functions, development throughout the lifetime, and changes. Neuroscience also researches all the possible dysfunctions that cause disorders and diseases. Thus, at the molecular level, it explains the work of neurons, for instance, how they produce and respond to molecular signals. At the physiological level, neuroscience describes the nervous system's structure and possible diseases that might occur for many reasons [154]. At the cognitive level, neuroscientists investigate human behavior, mental activities and operations, cognitive tasks, and the sources of neurodiversity [155].

The neurodiversity movement has shifted the way we think about and construe autistic experiences, communication, interaction, and be with far-reaching implications for not just how autism research is conceptualized, conducted, and analyzed but also the changes it brings to the lives of autistic people. However, like most autism research, discussions of neurodiversity are primarily led by and centred on Western perspectives. Its implications for global autism research and relevance to the lives of autistic people from non-Western cultures and regions are less known and seldom discussed, particularly in countries or regimes where autistic people remain primarily out of the picture, where autism remains poorly understood and highly stigmatized. This research aims to compare the lived experiences of autistic people from socio-demographically diverse backgrounds to examine how discrimination affects their identity, mental health, and well-being [155].

Building on the premise that a stressful social environment leads to poorer health outcomes, do autistic people from cultures with high autism stigma report higher emotional distress? What is the role of the social environment in this regard? This study addresses these questions using a mixed-method design involving an online survey and semi-structured interviews with autistic adults. The findings are expected to shed light on the commonalities and differences influencing mental health and well-being in autism [156-160]. In addition, the implications of the findings for the neurodiversity movement will be considered [27].

Correctional and developmental support of the child is implemented in his route. On the one hand, training and education must be well-structured and practiced following the curriculum. On the other hand, corrective work and lessons must be planned and conducted. Kids are interested in participating in exciting activities corresponding to their general needs and vocabulary level [135]. Remedial teachers search for different forms and methods of special education and upbringing [161-170]. Teaching CD children makes it necessary to adopt the education content for each child depending on his diagnosis and level of cognitive impairment. CD schoolchildren should receive the general educational and labor knowledge, skills, and abilities necessary for social adaptation. Special education schools must consider their students' characteristics and capabilities to acquire elementary knowledge and skills adequate for their abilities [140] [171-183].

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