NEURODEVELOPMENT DYSFUNCTIONS IN SCHOOL AGED CHILDREN

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INTRODUCTION

A neurodevelopment function is a basic brain process needed for learning and development. Neurodevelopmental variation refers to differences in neurodevelopmental functioning. Wide variations in these functions exist within and between individuals. These differences can change over time and need not represent pathology or abnormality. Neuro-developmental dysfunctions reflect disruptions of Neuroanatomic structure or psycho physiologic function and may be associated with academic under achievement, behavioral difficulties and problems with social adjustment. For the school-age child, an area of particular focus is academic skill development. Academic disorders have been diagnostically classified as Specific Learning Disorder (SLD) by the revised Diagnostic and Statistical Manual of Mental Disorder Fifth Edition (DSM-5).

Changes in DSM-5 (compared to DSM-IV) involve a broadening of the diagnostic criteria in an effort to recognize factors that may interrupt the effective acquisition of academic skills that include reading, written language, spelling and mathematics. The International Classification of Diseases (ICD) of the World Health Organization, 10th Edition (ICD-10) categorizes Specific Developmental Disorders of Scholastic Skills that include Reading Disorder, Spelling Disorder, Disorder of Arithmetical Skills, and Mixed Disorder of Scholastic Skills. Dyslexia (reading disorder) is included in ICD-10 in a separate category of symbolic dysfunction. The terms, Dyscalculia (mathematics disorder), and Dysgraphia (written language disorder) are also used by investigators and clinicians, but their inclusion in diagnostic classification systems has been inconsistent and a source of some disagreement among experts.

ETIOLOGY AND PATHOGENESIS

There are multiple factors underlying neurodevelopmental dysfunctions. These include genetic, medical, environmental and socio cultural influences. Genes that contribute to neurodevelopmental dysfunction have been identified. Reading disorders can be both familial and heritable, and studies have linked some reading disabilities to specific gene loci on chromosomes 6 and 15. Chromosomal abnormalities can lead to unique patterns of dysfunction, such as visual–spatial deficits in girls diagnosed with Turner syndrome or language deficits in children with fragile X syndrome.

Perinatal risk factors include VLBW, severe IUGR, perinatal HIE and prenatal exposure to alcohol or other drugs, environmental toxins including lead, infections such as meningitis and AIDS and brain injury as a result of intraventricular hemorrhage or head trauma. Chromosome 22q11.2 deletion syndrome (DiGeorge or velocardiofacial syndrome) is associated with predictable patterns of neurodevelopmental dysfunction, including a higher prevalence of intellectual disability, and deficits in visual–spatial processing, executive function, attention, working memory, verbal learning, arithmetic, and language with relative strengths in selected reading and spelling skills.

Early psychological trauma can result in both structural and neurochemical changes in the developing brain, which may contribute to neurodevelopmental dysfunction. Findings suggest that the effects of exposure to trauma and/or abuse in the developmental course can induce disruption of the brain’s regulatory system with connections in the orbitofrontal cortex, and may influence right-hemisphere function with associated risk for problems with information processing, memory, and frontal lobe related operations (e.g., focus and self-regulation). Environmental and socio-cultural deprivation can lead to, or potentiate, neurodevelopmental dysfunction, which most often results from a combination of contributing factors, rather than a single cause.

EPIDEMIOLOGY

The prevalence of learning disabilities range from 5%-10%. Attention deficits are reported in 3-5% of school aged children.
- Visual spatial organization
- Temporal sequential organization
- Receptive language
- Expressive language
- Memory
- Voluntary motor output
- Selective attention and activity
- Neurologic maturation

VISUAL–SPATIAL/VISUAL–PERCEPTUAL FUNCTION

The process of visual development begins well before birth, with continued development and refinement throughout childhood. Important structures involved in the development and function of the visual system, beyond the eyes themselves, include the retina, optic cells (e.g., rods and cones), the optic chiasm, the optic nerves, the brainstem (control of automatic responses like pupil dilation), the thalamus (e.g., lateral geniculate nucleus for form, motion, color), and the primary (visual space and orientation) and secondary (color perception) visual processing regions located in and around the occipital lobe. Other brain areas, considered to be outside of the primary visual system, are also important to visual function, helping to process what (temporal lobe) is seen and where it is located in space (parietal lobe).

The left and right cerebral hemispheres interact considerably in visual processes, with each hemisphere possessing more specialized functions, including left hemisphere mediated processing of details, patterns, and linear information, and right hemisphere processing of the gestalt and overall form.

Some of the more critical aspects of visual processing to develop in the school-age child include spatial relations—the ability to accurately perceive objects in space in relation to other objects; visual discrimination—the ability to differentiate and identify objects based on their individual attributes such as size, shape, color, form, and position; and, visual closure—the ability to recognize or identify an object even when the entire object cannot be seen. Children with subtle visual deficits are often misidentified and/or missed completely. Indications of visual processing deficits in the school-age child may include difficulty learning to draw and write, and problems with art activities. These children might also have trouble discriminating between left and right. They might encounter problems recognizing letters and words, resulting in delayed reading, spelling, and writing.

Visual–spatial processing dysfunctions are not a common cause of chronic reading disorders, but more recent investigations have established that deficits in orthographic coding (visual–spatial analysis of character-based systems) can contribute to reading disorders. Spelling and writing can emerge as a weakness because children with visual processing problems commonly have trouble with the precise visual configurations of words.

In mathematics, these children often have difficulty with visual–spatial orientation, with resultant difficulty aligning digits in columns when performing calculations and/or difficulty managing geometric material. In the social realm, intact visual processing allows a child to make use of visual or physical cues when communicating and interpreting the paralinguistic aspects of language. Secure visual functions are also necessary to process proprioceptive and kinesthetic feedback and to coordinate movements during physical activities. Children with visual processing deficits are thus susceptible to problems such as social isolation and withdrawal and consequent behavioral and/or emotional difficulties.

Assessment- Most commonly, children are asked to copy specific forms standardized for age. Confirmatory evidence of a visual perceptual motor problem may be derived from some of the subtests on the Wechsler Intelligence scale for children. The WISC-V takes 45–65 minutes to administer and generates a Full Scale IQ (formerly known as an intelligence quotient or IQ score) which represents a child's general intellectual ability. It also provides five primary index scores (i.e., Verbal Comprehension Index, Visual Spatial Index, Fluid Reasoning Index, Working Memory Index, and Processing Speed Index) that represent a child's abilities in more discrete cognitive domains. Five ancillary composite scores can be derived from various combinations of primary or primary and secondary subtests.

Five complementary subtests yield three complementary composite scores to measure related cognitive abilities relevant to assessment and identification of specific learning disabilities, particularly dyslexia and dyscalculia. Variation in testing procedures and goals can reduce time of assessment to 15–20 minutes for the assessment of a
single primary index, or increase testing time to three or more hours for a complete assessment, including all primary, ancillary, and complementary indices.

TEMPORAL-SEQUENTIAL ORGANIZATION

Spatial ordering and temporal-sequential ordering are two ordering systems in which data or information may be arranged to facilitate the processing of incoming information, the long and short term storage of needed facts and procedures, and the output of various "products" or intellectual activities. Working together, these two systems greatly facilitate the learning, academic productivity, and student's overall efficiency. When impaired, significant obstacles to learning and working, may result. Temporal-sequential ordering arranges data in a sequence or "linear chunk". Spatial and temporal-sequential ordering systems operate a five distinct level. Processing (perception), memory, production, organization, higher-order cognition are also facilitated. Disordered sequential organization can interfere with spelling and arithmetic. An inability to grasp the concept of number or a predictable order of letters within a word may result. Some children have sequencing difficulties primarily in the auditory channel, others have more problems with visual or motor sequences, and some have difficulties in all the areas.

Assessment- The digit span, which tests the immediate recall of a sequence of numbers, is sometimes interpreted as a test of auditory sequential memory. Object span assessment in which the child is asked to tap or point to a series of objects in a particular order (e.g. key, chalk, pencil, spoon) as demonstrated by the examiner. This gives some indication of the child's appreciation of a visual sequence. Pure motor sequencing involves imitation of a sequence of motor activities (e.g. simultaneously opening and closing of both the hands, arms extended.)

Note- Receptive Language and Expressive Language

It is important to distinguish between receptive language dysfunctions (those affecting understanding) and expressive language dysfunctions (those impeding production or communication). Children with primarily receptive language problems may have difficulty following instructions in the classroom, understanding verbal explanations and interpreting what they have read. Expressive weakness can result from problems with speech as well as language.

MEMORY

Active working memory during reading enables children to remember the beginning of a paragraph when they arrive at the end of it. It lets them remember what they intend to express in writing while they are attempting to remember where to place a comma or how to spell a particular word. It also enables the linkage between new incoming information that is held in short term memory with prior knowledge or skills held in long term memory (conversion in the amygdala).

Assessment- Visual memory may be assessed by having a child draw forms from memory. Children's inability to retain classroom instructions may also be seen.

VOLUNTARY MOTOR OUTPUT

Inefficiencies of fine motor performance may directly affect the ability to write, to copy from a blackboard, and to draw. Grasping of a pencil may be ineffective. Some children perform fine motor activities effectively at rates below classroom expectations.

Assessment- A child who is functioning poorly during the school years requires multidisciplinary evaluation, including a pediatrician, a psychologist or psychiatrist and a psycho educational specialist (Educational Diagnostician).

CLASSIFICATION OF NEURODEVELOPMENT DYSFUNCTION

1. ADHD - Most Common
2. Learning Disorder- Dyslexia (reading disorder) Dyscalculia (mathematical disorder) Dysgraphia (written expression disorder)
4. Early Onset Schizophrenia

ATTENTION DEFICIT HYPERACTIVITY DISORDER

It is the most common neurobehavioral disorder of childhood. Affects 3-5% of school age children and it is more common in boys than girls.
According to DSM-IV, ADHD is characterized by:

1) Inattention, including increased distractibility and difficulty sustaining attention

2) Poor impulse control and decreased self-inhibitory capacity

3) Motor over activity and motor restlessness

Affected children commonly experience academic underachievement, problems with interpersonal relationships with family members and peers and low self-esteem. ADHD frequently co-occurs with other emotional, behavioral, language and learning disorders. ADHD is not only a disorder of impaired focus, but also includes a host of symptoms related to problems with vigilance, distractibility, impulsivity in thought and behavior, hyperactivity, and flexibility. Disordered attention can occur owing to faulty mechanisms in and/or across subdomains of attention. These subdomains include selective attention (the ability to focus attention to a particular stimulus and to discriminate relevant from irrelevant information), divided attention (the ability to orient to more than one stimulus at a given time), sustained attention (the ability to maintain one's focus), and alternating attention (the capacity to shift focus between stimuli).

Attention problems in school-age children can manifest at any point in the process, from arousal through output. Children with diminished alertness and arousal can exhibit signs of mental fatigue in a classroom or when engaged in any activity requiring sustained focus. They might yawn, stretch, fidget, and daydream. They can become overactive in an effort to attain or maintain a higher level of arousal. They are apt to have difficulty allocating and sustaining their concentration, and their efforts may be erratic and unpredictable, with extreme performance inconsistency. These children can also have difficulty discriminating between important and unimportant information. Such weaknesses of determining saliency often result in focusing on the wrong stimuli, at home, in school, and socially, and can result in the child's missing important information and can impede their ability to take notes, to summarize information, or to recognize what to study for a test.

In the social context, poor attention may result in inept social interaction (e.g., because of factors such as not “hearing” what others say). Some children present with what has been termed sluggish cognitive tempo. Children with sluggish cognitive tempo have many inattentive features without a history of significant hyperactivity and/or impulsiveness. Some researchers believe that sluggish cognitive tempo may be a different disorder from ADHD, with its own characteristics, including hypoactivity, lethargy, confusion, and mental “fogginess.” Distractibility can take the form of listening to extraneous noises instead of a teacher, staring out the window, or constantly thinking about the future. These children often show evidence of superficial concentration, where their level of focus is not of sufficient intensity to capture specific information.

As a result, these children are often described as “forgetful” because directions and explanations need to be repeated and details (e.g., changes in operational signs in mathematics) may be missed. These children can also exhibit difficulties with cognitive activation and generalization, passively processing and not linking information with prior knowledge and experience, or over-relying on prior experience. Attention dysfunction can affect the output of work, behavior, and/or social activity. These children have a tendency to perform or act without previewing a likely outcome or thinking through the potential consequences of what they are about to do or say. Their impulsivity can lead to careless mistakes in academic work and unintended misbehavior. It is important to appreciate that most children with attention dysfunction also harbor other forms of neurodevelopmental dysfunction that can be associated with academic disorders (with some estimates suggesting up to 60% co morbidity).
ETIOLOGY OF ADHD

1. Genetic Factors- primarily implicated two genes
   a) Dopamine transporter gene (DAT-1)
   b) Dopamine-4 receptor gene
2. Structural and functional abnormalities of brain-
   a) Dysregulation of frontal sub cortical circuit
   b) Small cortical volumes in frontal region
   c) Wide spread small volume reduction throughout brain
3. Perinatal complications
4. Maternal Smoking and alcohol use
5. Prenatal or postnatal exposure to lead
6. Psychological family stress

CLINICAL MANIFESTATIONS AND DIAGNOSIS

Deciding if a child has ADHD is a several-step process. There is no single test to diagnose ADHD, and many other problems, like anxiety, depression, and certain types of learning disabilities, can have similar symptoms.

If you are concerned about whether a child might have ADHD, the first step is to talk with a healthcare professional to find out if the symptoms fit the diagnosis. The diagnosis can be made by a mental health professional, like a psychologist or psychiatrist, or by a primary care provider, like a pediatrician.

The American Academy of Pediatrics (AAP) recommends that healthcare professionals ask parents, teachers, and other adults who care for the child about the child’s behavior in different settings, like at home, school, or with peers. Read more about the recommendations.

The health professional should also determine whether the child has another condition that can either explain the symptoms better, or that occurs at the same time as ADHD.

DSM-5 CRITERIA FOR ADHD

People with ADHD show a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development:

1. Inattention: Six or more symptoms of inattention for children up to age 16, or five or more for adolescents 17 and older and adults; symptoms of inattention have been present for at least 6 months, and they are inappropriate for developmental level:
   - Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or with other activities.
   - Often has trouble holding attention on tasks or play activities.
   - Often does not seem to listen when spoken to directly.
   - Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., loses focus, side-tracked).
   - Often has trouble organizing tasks and activities.
   - Often avoids, dislikes, or is reluctant to do tasks that require mental effort over a long period of time (such as schoolwork or homework).
   - Often loses things necessary for tasks and activities (e.g. school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones).
   - Is often easily distracted
   - Is often forgetful in daily activities.

2. Hyperactivity and Impulsivity: Six or more symptoms of hyperactivity-impulsivity for children up to age 16, or five or more for adolescents 17 and older and adults; symptoms of hyperactivity-impulsivity have been present for at least 6 months to an extent that is disruptive and inappropriate for the person’s developmental level:
   - Often fidgets with or taps hands or feet, or squirms in seat.
   - Often leaves seat in situations when remaining seated is expected.
Often runs about or climbs in situations where it is not appropriate (adolescents or adults may be limited to feeling restless).
- Often unable to play or take part in leisure activities quietly.
- Is often "on the go" acting as if "driven by a motor".
- Often talks excessively.
- Often blurs out an answer before a question has been completed.
- Often has trouble waiting his/her turn.
- Often interrupts or intrudes on others (e.g., butts into conversations or games)

In addition, the following conditions must be met:

- Several inattentive or hyperactive-impulsive symptoms were present before age 12 years.
- Several symptoms are present in two or more setting, (such as at home, school or work; with friends or relatives; in other activities).
- There is clear evidence that the symptoms interfere with, or reduce the quality of, social, school, or work functioning.
- The symptoms are not better explained by another mental disorder (such as a mood disorder, anxiety disorder, dissociative disorder, or a personality disorder). The symptoms do not happen only during the course of schizophrenia or another psychotic disorder.

Based on the types of symptoms, three kinds (presentations) of ADHD can occur:

Combined Presentation: if enough symptoms of both criteria inattention and hyperactivity-impulsivity were present for the past 6 months.
Predominantly Inattentive Presentation: if enough symptoms of inattention, but not hyperactivity-impulsivity, were present for the past six months.
Predominantly Hyperactive-Impulsive Presentation: if enough symptoms of hyperactivity-impulsivity but not inattention were present for the past six months.

Because symptoms can change over time, the presentation may change over time as well.

Differential Diagnosis of ADHD

1) Psychosocial
   Response to physical or sexual abuse
   Response to inappropriate parenting practices
   Responses to parental psychopathology
   Response to Inappropriate classroom setting
2) Diagnosis Associated With Disorder Behaviors
   Fragile X Syndrome
   Fetal alcohol syndrome
   Pervasive developmental disorders
   Obsessive-Compulsive disorder
   Tourette syndrome
   Attachment disorder with mixed emotions and conduct
3) Medical and Neurological Conditions
   Thyroid disorders
   Auditory and visual processing disorders
   Heavy metal poisoning (including lead)
   Neurodegenerative disorder
   Adverse effects of medications
   Post traumatic head injury

Treatment of ADHD

The therapeutic approach to ADHD has been shifting. In some cases, environmental restructuring and behavioral therapy alone has been effective. Developments in behavioral parent training (BPT) and behavioral classroom management (BCM) have also proven useful. Furthermore, behavioral psychotherapy often is successful when used in conjunction with an effective medication regimen. The medications of choice are stimulants, and for adults with
ADHD stimulants represent the best first-line therapeutic option. For related areas of functioning, such as social skills and academic performance, medications combined with behavioral treatments may be indicated. Pharmacotherapy includes the following:

**STIMULANTS (METHYLPHENIDATE, DEXTROAMPHETAMINE)**

Regarding medication for ADHD, stimulants are the first-line therapy and probably the most effective treatment. All stimulants have similar efficacy but differ by dosing, duration of action, and adverse effect profiles in individual patients. Care should be made to start at the lowest dose and titrate up for clinical efficacy or to intolerance. Targeted symptoms include impulsivity, distractibility, poor task adherence, hyperactivity, and lack of attention. Some stimulants come in sustained-release preparations, which may decrease the number of total daily doses. Otherwise, dosing should be spaced every 4-6 hours.

Care should be taken to not dose too close to bedtime because stimulants may cause significant insomnia. Other common adverse effects include appetite suppression and weight loss, headaches, and mood effects (depression, irritability). Stimulants may exacerbate tics in children with underlying tic disorders.

Whether growth might be affected while a child is taking stimulants remains unclear. Drug holidays (during summer or on weekends) may or may not be recommended to allow periods of normal growth. The decision is based on the child’s growth rate chart and behavior and cognition off medication. There has been a long concern that the use of stimulant therapy leads to substance abuse. Recent studies have demonstrated that stimulant therapy does not increase the risk of future substance use or abuse. Furthermore, 112 people with ADHD were observed for a period of 10 years. At the time of the follow-up assessment, 82 (73%) had been treated previously with stimulants and 25 (22%) were undergoing stimulant treatment. No statistically significant associations were noticed between stimulant treatment and alcohol, drug, or nicotine use disorders. The findings revealed no evidence that stimulant treatment increases or decreases the risk for subsequent substance use disorders in children and adolescents with ADHD when they reach young adulthood. Stimulant medications do enhance mental executive functions for those with ADHD.

**OTHER MEDICATIONS**

Atomoxetine (Strattera) has become a second-line and, in some cases, first-line treatment in children and adults with ADHD because of its efficacy and classification as a nonstimulant. However, studies have reported that the overall effect of atomoxetine has not been as extensive as that reported of stimulants.

Recent data suggest that bupropion or venlafaxine may be effective. Dosages are similar to those used to treat depression.

Tricyclic antidepressants (imipramine, desipramine, nortriptyline) have been found effective in numerous studies in children with ADHD; however, because of potential adverse effects, they are rarely used for this purpose. If these agents are used, obtain a baseline ECG because these agents can affect cardiac conduction. A few reports have described sudden death in boys taking desipramine, but the exact cause of death was unclear and may have been unrelated to desipramine use.

Clonidine and guanfacine have been used with mixed reports of efficacy. Sudden deaths have been reported in children taking clonidine with methylphenidate at bedtime. Again, the etiology of these deaths is unclear, and this remains a controversial topic. In September 2010, the FDA approved clonidine extended-release (Kapvay) for ADHD as adjunctive therapy to stimulants or as monotherapy.

Modafinil (Provigil) has recent placebo-controlled data supporting its efficacy in children with ADHD. This medication may currently be used as a third- or fourth-line treatment.

Magnesium pemoline (Cylert) had been used in the 1990s, but concerns of rare, potentially fatal hepatotoxicity have made it a rarely used medication.

Blader et al evaluated the ability of divalproex to reduce aggressive behavior in children with ADHD and a disruptive disorder. Children with persistent aggressive behavior that was underresponsive to psychostimulant therapy were randomly assigned to receive divalproex or placebo in addition to stimulant therapy for 8 weeks. A higher proportion of improved behavior was observed in the divalproex group (8 of 14 [57%]) compared with placebo (2 of 13 [15%]). A larger trial is needed to further study the use of divalproex to ameliorate aggressive behavior in patients with ADHD.
BEHAVIORAL PSYCHOTHERAPY

Behavioral psychotherapy often is effective when used in combination with an effective medication regimen. Behavioral therapy or modification programs can help diminish uncertain expectations and increase organization. Working with parents and schools to ensure environments conducive to focus and attention is necessary. For adults with ADHD, working to establish ways of decreasing distractions and improving organizational skills may be helpful.

COGNITIVE THERAPY FOR ADULTS WITH ADHD

Metacognitive therapy involves the principles and techniques of cognitive and behavioral therapies to enhance time management. In doing so, these have made adult patients with ADHD better able to counter the anxiety and depressive symptoms they experience in task performance. Metacognitive therapy has proven to be more effective than supportive interventions and represents a viable therapeutic approach.

PSYCHOSOCIAL INTERVENTIONS

A number of psychosocial treatments are effective. These include behavioral parent training (BPT) and behavioral classroom management (BCM). These are best used in conjunction with psychopharmacological approaches. Emerging evidence shows that non-pharmacological treatments should be considered the first treatment for children with ADHD. For preschoolers, intervention is best with parental training. For school-aged children, interventions of group training for parents and classroom behavioral approaches might be enough. Severe cases benefit from medication and behavioral interventions.

AN ASSESSMENT OF NON-PHARMACOLOGICAL INTERVENTIONS

Concern about medications to treat ADHD has increased interest in alternative treatments. Sonuga-Bark and colleagues conducted a systematic review and meta-analyses of randomized controlled trials of dietary and psychological treatments of non-pharmacological interventions for ADHD. They have concluded free fatty acid supplementation demonstrated significant reduction in symptoms, although small. Further studies are needed. A larger effect was observed with artificial food color exclusion, but this was seen in individuals selected for food sensitivities. Further studies are needed to assess behavioral interventions, neurofeedback, cognitive training, and restricted elimination diets.

LEARNING DISORDERS

**Definition**- Learning disorder in a child is characterized by academic under achievement in reading, written, expression or mathematics in comparison with the overall intellectual ability of the child. When academic achievement testing is administered along with a measure of intellectual capability, this psychoeducational assessment can identify learning problems. Learning disorders affect at least 5% of school age children. DSM-IV includes four diagnostic categories of learning disorder-

1) Reading disorder
2) Disorder of reading expression
3) Mathematics disorder
4) Learning disorders not otherwise specified

(A) READING DISORDER (DYSLEXIA)

Dyslexia, also known as reading disorder, is characterized by trouble with reading despite normal intelligence. Different people are affected to varying degrees. Problems may include difficulties in spelling words, reading quickly, writing words, "sounding out" words in the head, pronouncing words when reading aloud and understanding what one reads. Often these difficulties are first noticed at school [4]. When someone who previously
could read loses their ability, it is known as alexia. The difficulties are involuntary and people with this disorder have a normal desire to learn.

The cause of dyslexia is believed to involve both genetic and environmental factors. Some cases run in families. It often occurs in people with attention deficit hyperactivity disorder (ADHD) and is associated with similar difficulties with numbers. It may begin in adulthood as the result of a traumatic brain injury, stroke, or dementia. The underlying mechanisms are problems within the brain's language processing. Dyslexia is diagnosed through a series of tests of memory, spelling, vision, and reading skills. Dyslexia is separate from reading difficulties caused by insufficient teaching; or either hearing or vision problems.

Prevalence is 5-10% in school age group children. Reading disorder accounts for 80% of all learning disorders. It is slightly more common in boys than girls. Co morbidity- ADHD (25%)

Disruptive Behavioral disorder
Depressive disorder
Anxiety disorder

ETIOLOGY

Dyslexia has been linked to certain genes that control how the brain develops. It appears to be an inherited condition — it tends to run in families. These inherited traits appear to affect parts of the brain concerned with language, interfering with the ability to convert written letters and words into speech.

CLINICAL FEATURES AND DIAGNOSIS

1. AGE 5-9 YEARS- Slow to learn the connection between letters and sounds
   Confuses basic words (run, eat, want)
   Makes consistent reading and spelling errors
   Transposes number sequences and confuses arithmetic signs (+, -, x, /, =)
   Slow to remember facts
   Slow to learn new skills, relies heavily on memorization
   Unstable pencil grip
   Trouble learning about time (time management)
2. AGE 10-12 YEARS- Reverses letter sequences (soiled/solid, left/felt)
   Slow to learn prefixes, suffixes, root word and other spelling strategies
   Avoids reading aloud
   Trouble with word problems
   Difficulty with handwriting
   Awkward, fist like or tight pencil grip
   Avoids writing assignments
   Slow or poor recall of facts
   Difficulty making friends

ASSESSMENT

1. A detailed case history- interviewing the parents and caregivers, child's birth, development, family status, earning environment, medical history.
2. Evaluation of the child- Child's functional skills, motor skills, speech language, sensory deficit, cognitive-perceptual and academic skills
3. Psychological testing - Woodcock-Johnson Psycho-Educational Battery-Revised, Peabody Individual Achievement test-Revised
TREATMENT

Treatment for dyslexia consists of using educational tools to enhance the ability to read. Medicines and counseling usually aren't used to treat dyslexia. An important part of treatment is educating yourself about the condition. The earlier dyslexia is recognized and addressed, the better. Starting treatment when a child is young can improve reading and may even prevent reading problems in the first years of school. But reading will likely not ever be easy for a person with dyslexia.

When a child age 3 years or older has been diagnosed with dyslexia, federal law requires that public school personnel create an Individualized Education Program (IEP) that's tailored to the child's needs. The first step in developing the IEP is talking with your child's school to create a treatment team made up of you, the teacher, and other school personnel, including school counselors and special education teachers. Your child's personalized IEP will detail specific disabilities, appropriate teaching methods, and goals and objectives for the academic year. It is evaluated at least once a year, with changes made based on your child's progress. Parents have the right to appeal if they don't agree with their child's IEP. Preparing children for further education, employment, and independent living is also required by law. This should start no later than age 16.

If you seek special education assistance for your child, it's handy to keep copies of:

- Your child's school records and health history.
- Test results.
- State and federal special education laws.

A combination of educational methods is the most effective way to teach children to read. These methods include teaching phonics—making sure that the beginning reader understands how letters are linked to sounds (phonemes) to form words. Guided oral reading, in which the student reads aloud with guidance and feedback, is also important for developing reading fluency. The child must clearly understand the instructions being given, and the instructions must be repeatable or systematic in order to improve the child's reading abilities.

MATHematICS DISORDER (DYScalcULIA)

Children with mathematics disorder have difficulty learning and remembering numerals, cannot remember basic facts about numbers and are slow and inaccurate in computation.

EPIDEMIOLOGY

1% of school children, approximately one of every five children and more commonly seen in girls

CLINICAL FEATURES AND DIAGNOSIS

What are the symptoms of dyscalculia?
Because there has been so little work on dyscalculia, there is no definite list of symptoms. But there is still a lot that we do know. I have listed symptoms below according to how we know about them, and the level of certainty we have. Of course not all children may show all symptoms, and we know little about what symptoms remain in adolescence and adulthood (apart from the obvious of difficulty with mathematics).

Symptoms established by research
The following are seen in primary school, and well established by educational researchers:
1. Delay in counting. Five to seven year-old dyscalculic children show less understanding of basic counting principles than their peers (e.g. that it doesn't matter which order objects are counted in).
3. Difficulties in memorizing arithmetic facts. Dyscalculic children have great difficulty in memorizing simple addition, subtraction and multiplication facts (eg. 5 + 4 = 9), and this difficulty persists up to at least the age of thirteen.

These symptoms may be caused by two more fundamental difficulties, although more research is needed to be sure: 1. Lack of “number sense”. Dyscalculic children may have a fundamental difficulty in understanding quantity. They are slower at even very simple quantity tasks such as comparing two numbers (which is bigger, 7 or 9?), and saying...
how many there are for groups of 1-3 objects. The brain areas which appear to be affected in dyscalculia are areas which are specialised to represent quantity.

2. Less automatic processing of written numbers. In most of us, reading the symbol "7" immediately causes our sense of quantity to be accessed. In dyscalculic individuals this access appears to be slower and more effortful. Thus dyscalculic children may have difficulty in linking written or spoken numbers to the idea of quantity.

OTHER SYMPTOMS

If you have read other websites on dyscalculia you may have seen quite a few other symptoms listed. Many of these are not yet proved to be symptoms (although this does not mean they might not be later on). This is because they have been reported by teachers or special education workers, but haven't yet been studied in detail by researchers. Based on my knowledge of dyscalculia and cognition I have listed likely and unlikely symptoms below.

The following are likely to be symptoms of dyscalculia:
1. Difficulty imagining a mental number line
2. Particular difficulty with subtraction
3. Difficulty using finger counting (slow, inaccurate, unable to immediately recognize finger configurations)
4. Difficulty decomposing numbers (e.g. recognizing that 10 is made up of 4 and 6)
5. Difficulty understanding place value
6. Trouble learning and understanding reasoning methods and multi-step calculation procedures
7. Anxiety about or negative attitude towards math (caused by the dyscalculia!)

All these symptoms (bar the last) are related to quantity.

The following may sometimes be ASSOCIATED with dyscalculia, but not in all cases:
1. Dyslexia, or difficulty in reading
2. Attention difficulties
3. Spatial difficulties (not good at drawing, visualization, remembering arrangements of objects, understanding time/direction)
4. Short term memory difficulties (the literature on the relation between these and dyscalculia is very controversial)
5. Poor coordination of movement (dyspraxia)

The following are NOT likely to be symptoms of dyscalculia:
1. Reversals of numbers - this is a normal developmental stage which all children go through and is no cause for alarm in itself
2. Difficulty remembering names - no evidence to suggest that long term verbal memory has anything to do with dyscalculia

TREATMENT

Currently the treatment for mathematics disorder combines teaching mathematics concepts with continuous practice in solving mathematic problems. Mathematics instruction is most helpful when focus is on problem solving activities, including word problems, rather than only computation.

(C) DISORDER OF WRITTEN EXPRESSION (DYSGRAPHIA)

Written expression is the most complex skill acquired to convey an understanding of language and to express thought and ideas. Disorders of written expression is characterized by writing skills that are significantly below the expected level for a child's age and intellectual capacity. These difficulties impair the child's academic performance and writing on everyday life. Components of writing disorder include poor spelling, errors in grammar and punctuation and poor hand writing. Spelling mistakes are the most often phonetic errors, an erroneous spelling that sounds like the correct spelling. Example- fone for phone, believe for believe.

CLINICAL FEATURES AND DIAGNOSIS

The symptoms to dysgraphia are often overlooked or attributed to the student being lazy, unmotivated, not caring, or having delayed visual-motor processing.
To diagnose Dysgraphia, one must have more than one of the following symptoms:

1. Cramping of fingers while writing short entries
2. Odd wrist, arm, body, or paper orientations such as creating an L-shape with your arm
3. Excessive erasures
4. Mixed upper case and lower case letters
5. Inconsistent form and size of letters, or unfinished letters
6. Misuse of lines and margins
7. Inefficient speed of copying
8. Inattentiveness over details when writing

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**TREATMENT**

Treatment for writing disorder includes direct practice in spelling and sentence writing and review of grammatical rules. Intensive and continuous administration of individually tailored, one on one expressive and creative writing therapy is most effective. The effectiveness of a writing intervention is dependent on relationship between child and writing specialist.

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**3. PERVERSIVE DEVELOPMENTAL DISORDER AND AUTISM SPECTRUM DISORDER**

1. Autism- Delayed and disordered communication, atypical social interaction, restricted range of interests, onset before 3 years of age
2. Asperger's Syndrome- Similar to autism except language skills relatively intact, usually not cognitively delayed
3. RETT'S SYNDROME- Almost always affects girls, regression in skills between 6 to 18 months of age.
4. Childhood Disintegrative Disorder- Clinically significant regression in skills language, social skills, bowel and bladder control, play motor skills), before 10 years of age.
5. Pervasive Developmental Disorder - Not Otherwise Specified

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**(A) AUTISM**

Signs And Symptoms- Autism spectrum disorder (ASD) is a developmental disability caused by differences in the brain. Scientists do not know yet exactly what causes these differences for most people with ASD. However, some people with ASD have a known difference, such as a genetic condition. There are multiple causes of ASD, although most are not yet known.

There is often nothing about how people with ASD look that sets them apart from other people, but they may communicate, interact, behave, and learn in ways that are different from most other people. The learning, thinking, and problem-solving abilities of people with ASD can range from gifted to severely challenged. Some people with ASD need a lot of help in their daily lives; others need less.

A diagnosis of ASD now includes several conditions that used to be diagnosed separately: autistic disorder, pervasive developmental disorder not otherwise specified (PDD-NOS), and Asperger syndrome. These conditions are now all called autism spectrum disorder.

ASD begins before the age of 3 and last throughout a person's life, although symptoms may improve over time. Some children with ASD show hints of future problems within the first few months of life. In others, symptoms may not show up until 24 months or later. Some children with an ASD seem to develop normally until around 18 to 24 months of age and then they stop gaining new skills, or they lose the skills they once had. Studies have shown that one third to half of parents of children with an ASD noticed a problem before their child’s first birthday, and nearly 80%-90% saw problems by 24 months of age.

It is important to note that some people without ASD might also have some of these symptoms. But for people with ASD, the impairments make life very challenging.

Possible “Red Flags”

A person with ASD might:
- Not respond to their name by 12 months of age
- Not point at objects to show interest (point at an airplane flying over) by 14 months
- Not play "pretend" games (pretend to "feed" a doll) by 18 months
- Avoid eye contact and want to be alone
- Have trouble understanding other people's feelings or talking about their own feelings
- Have delayed speech and language skills
- Repeat words or phrases over and over (echolalia)
- Give unrelated answers to questions
- Get upset by minor changes
- Have obsessive interests
- Flap their hands, rock their body, or spin in circles
- Have unusual reactions to the way things sound, smell, taste, look, or feel

DSM-5 Criteria for Autism Spectrum Disorder - Currently, or by history, must meet criteria A, B, C, and D.
A. Persistent deficits in social communication and social interaction across contexts, not accounted for by general developmental delays, and manifest by all 3 of the following: 1. Deficits in social-emotional reciprocity 2. Deficits in nonverbal communicative behaviors used for social interaction 3. Deficits in developing and maintaining relationships.
B. Restricted, repetitive patterns of behavior, interests, or activities as manifested by at least two of the following: 1. Stereotyped or repetitive speech, motor movements, or use of objects 2. Excessive adherence to routines, ritualized patterns of verbal or nonverbal behavior, or excessive resistance to change 3. Highly restricted, fixated interests that are abnormal in intensity or focus 4. Hyper-or hypo-reactivity to sensory input or unusual interest in sensory aspects of environment.
C. Symptoms must be present in early childhood (but may not become fully manifest until social demands exceed limited capacities).

EPIDEMIOLOGY

Prevalence rate of all PDD (63.7/10000) are approximately 1 in 150. Disorder specific prevalence rate includes AD (20.6/10000), Asperger's syndrome (6/10000), PDD-NOS (37.1/10000), Rett's disorder (0.5-1/10000 females).

ETIOLOGY

Autism spectrum disorder has no single known cause. Given the complexity of the disorder, and the fact that symptoms and severity vary, there are probably many causes. Both genetics and environment may play a role.
- **Genetic problems.** Several different genes appear to be involved in autism spectrum disorder. For some children, autism spectrum disorder can be associated with a genetic disorder, such as Rett syndrome or fragile X syndrome. For others, genetic changes may make a child more susceptible to autism spectrum disorder or create environmental risk factors. Still other genes may affect brain development or the way that brain cells communicate, or they may determine the severity of symptoms. Some genetic problems seem to be inherited, while others happen spontaneously.
- **Environmental factors.** Researchers are currently exploring whether such factors as viral infections, complications during pregnancy or air pollutants play a role in triggering autism spectrum disorder.

NO LINK BETWEEN VACCINES AND ASD

One of the greatest controversies in autism spectrum disorder is centered on whether a link exists between ASD and certain childhood vaccines, particularly the measles-mumps-rubella (MMR) vaccine. Despite extensive research, no reliable study has shown a link between ASD and the MMR vaccine. Avoiding childhood vaccinations can place your child in danger of catching and spreading serious diseases, including whooping cough (pertussis), measles or mumps.

DIAGNOSIS

There is no specific investigation or test to diagnose autism.
1) Speech and language assessment
2) Psychological and psychiatric evaluation
3) If indicated, chromosomal analysis
4) EEG
5) Neuroimaging, Positron emission Tomography.

## TREATMENT

No cure exists for autism spectrum disorder, and there is no one-size-fits-all treatment. The range of home-based and school-based treatments and interventions for ASD can be overwhelming.

The goal of treatment is to maximize your child's ability to function by reducing ASD symptoms and supporting development and learning. Your health care provider can help identify resources in your area. Treatment options may include:

- **Behavior and communication therapies.** Many programs address the range of social, language and behavioral difficulties associated with ASD. Some programs focus on reducing problem behaviors and teaching new skills. Others focus on teaching children how to act in social situations or how to communicate better with others. Though children don't always outgrow ASD symptoms, they may learn to function well.

- **Educational therapies.** Children with ASD often respond well to highly structure educational programs. Successful programs often include a team of specialists and a variety of activities to improve social skills, communication and behavior. Preschool children who receive intensive, individualized behavioral interventions often show good progress.

- **Family therapies.** Parents and other family members can learn how to play and interact with their children in ways that promote social interaction skills, manage problem behaviors, and teach daily living skills and communication.

- **Medications.** No medication can improve the core signs of ASD, but certain medications can help control symptoms. For example, antidepressants may be prescribed for anxiety, and antipsychotic drugs are sometimes used to treat severe behavioral problems. Other medications may be prescribed if your child is hyperactive.

### ASPERGER'S SYNDROME

Described by Asperger as autistic psychopathy in 1944, it was characterized by the same kind of impairment of social activities and stereotyped features of behavior as is described in autistic children. There is no delay of speech and cognitive development. Often associated with marked clumsiness, there is a strong tendency for the abnormalities to persist into adolescence. Psychotic episodes occasionally occur in early adult life.

### RETT'S SYNDROME

The syndrome was described only in girls. Normal early development is followed by partial or complete loss of speech and of skills in locomotion and of use of hands, together with deceleration in head growth. In most cases onset is between 6 and 18 months of age. Loss of purposive hand movements, hand wringing stereotypes and hyperventilation. Social interaction is poor in early childhood but can develop later.

### PERSVASIVE DEVELOPMENTAL DISORDER NOT OTHERWISE SPECIFIED

A pervasive developmental disorder not otherwise specified (PDD-NOS) is one of the three autism spectrum disorders (ASD) and also one of the five disorders classified as a pervasive developmental disorder (PDD). According to the DSM-IV, PDD-NOS is a diagnosis that is used for "severe and pervasive impairment in the development of reciprocal social interaction or verbal and nonverbal communication skills, or when stereotyped behavior, interests, and activities are present, but the criteria are not met for a specific PDD" or for several other disorders. PDD-NOS are often called atypical autism, because the criteria for autistic disorder are not met, for instance because of late age of onset, atypical symptomatology, or sub threshold symptomatology, or all of these. Even though PDD-NOS are considered milder than typical autism, this is not always true. While some characteristics may be milder, others may be more severe.
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