Non-Verbal Learning Disability

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The Non-Verbal Learning Disability (NLD) is a silent, complex and serious problem. Management can only be effective if based on a thorough understanding of the disorder.

This document discusses NLD, its diagnosis, causes and impact. Treatment and management of NLD are discussed elsewhere.

Introduction - Adam

Adam is now aged 9, and in the fourth grade. His parents are very worried about him. He is struggling with maths, his handwriting is poor, he is disorganised and distractible, his social friendships are slipping and Adam is becoming quite anxious. Although Adam can discuss and negotiate at quite an advanced level, his behaviour tends to be rather egocentric, toddler-like.

The story of Adam began quite differently. He seemed to be an intelligent boy early on. He was bright, happy and learned to talk well from an early age. After meeting with Adam, people would comment what a clever child he was. He loved to socialise, loved to learn and initially his parents were hopeful and proud.

The situation began to change not long after he began at school. Handwriting was difficult, and 'getting things done' a chore. Learning to read was not too difficult - in fact he is a fluent reader. The only concerns relate to his comprehension of what he reads.

Adam's enthusiasm began to wilt late in the second grade. In the third grade he started to say things like 'I'm dumb'. His written output was the most obvious weakness - his letters would vary in size and shape, his spatial planning of words and sentences on paper was poor and the whole act of putting words on paper a terrible chore. The difference between how well Adam could talk, and what he could put on paper was most obvious.

The dilemma for Adam and his parents is that of a boy whose development began with such promise, yet now, midway through the primary grades, he is struggling. Not only is the present difficult, but looking towards the future, his parents can only see matters worsening.

Diagnosis of Non-Verbal Learning Disability (NLD)

As with all developmental diagnoses, NLD is a criteria based diagnosis. To understand the diagnosis, it is useful to work through each criteria in turn:

Criteria 1: A statistically uncommon phenomenon.

For NLD, the statistically uncommon phenomenon is the discrepancy, or difference between different intellectual skills **within** the same brain. Specifically, children's ability with language related tasks is significantly ***better*** than their abilities on non-language testing.

Probably the most common intellectual assessment is the WISC (Weschler Intelligence Scales for Children). Results on this IQ test are broken into two broad groups - the ***Verbal*** scale, and the ***Performance*** scale. A statistically significant difference would meant that the verbal result is 15 points (one standard deviation) higher than the performance.

Sometimes, even with the disorder present, the assessment will not reveal this discrepancy until the child is old enough. This should occur by Adam's age of 9 to 10 years. Other tests which may be useful in revealing this discrepancy are discussed later in this document (tests).

Criteria 2: Impact on the child's life.

A learning disorder means that the child is struggling to achieve, in the area of concern, what might reasonably be expected for that child's overall intellectual ability. In the case of NLD, the areas of difficulty are diverse, and may vary considerably from child to child. They include:

- ***Maths***: Often children with NLD can achieve with maths in the early grades. It may not be until later in primary school that they struggle. The problem is maths concepts - they have difficulty understanding what the operations are trying to achieve, and, as a result, are very reliant on the step-by-step processes.
- ***Handwriting***. Getting thoughts onto paper can be a problem from the very start. This is because children can have trouble automating letter formation (so they always have to think about it), trouble organising the letters and words on paper (with varying size and placement), and trouble planning the whole process of putting their thoughts into sentences and words to write.
- ***Organisation***. Organisation means seeing large jobs in terms of all the little jobs. Cleaning the bedroom, for example may be to complex and overwhelming. By contrast, just picking up dirty clothes may be achievable. Children with NLD have trouble keeping the large job in mind as they work through the smaller jobs within that task.
- ***Attention***. Many children with NLD have difficulty maintaining attention. For some this is limited to situations where the material is difficult (or uninteresting).
- ***Social understanding***. Often children with NLD are enthusiastic and successful at socialising in the earlier years. As with maths concepts, it is not until the social demands exceed their abilities that they struggle. This may not happen until the later primary grades. Specifically they struggle to read the non-verbal information in peoples facial expressions, body language, tone of voice, choice of words etc. As a result, they miss the emotional states behind the words, and do not pick up more subtle messages such as sarcasm.
- ***Anxiety and fear***. Anxiety is our brain's way of holding out a red flag that says '*beware - something is going on that could be a problem*'. For children with NLD, although they can communicate verbally with ease, their underlying understanding of the world may be relatively limited. As a result, they can feel a recurring sense of confusion. In social and other situations this confusion generates anxiety. In fact, as children become adolescents and adults, management of their needs is often dominated by the management of anxiety.
- ***Non-verbal and spatial thinking***. Many of our thought processes occur non-verbally, or entirely without words and language. A mechanic, for example, exploring problems with an engine, may be thinking about that engine in completely non-verbal terms - imagining it, picturing it. He may know what is wrong, yet struggle to put this understanding into words. For a child with NLD the situation is exactly the opposite. For some children, even basic concepts such as time and money may be difficult. Abstract scientific concepts such as the weather may be a struggle. For others the impact is more spatial - they get lost easily, have trouble with maps, and have difficulty with team sports where direction and movement are important.
- ***Motor co-ordination.*** Some children with NLD are clearly clumsy. Others may be well co-ordinated and struggle only in team situations where there is continuous and complex information about people and directions to be understood.

Criteria 3: No alternative explanation.

If a child is struggling in several of the areas outlined above, and to a degree greater than what would be expected for their overall intellectual ability the next step is to ensure that there is no alternative explanation. This is achieved by considering each of the alternative possibilities.

- ***Attention Deficit***. Sometimes just having ADHD can lead to the pattern of problems outlined above - particularly if small non-verbal weaknesses are present which become amplified by the attention problems. The way to be sure of this is to treat the ADHD and see if children improve.
- ***Intellectual Disability***. Sometimes, if children are clever verbally, early intellectual assessments may overestimate their IQ. Only later testing will reveal their true abilities.
- ***Anxiety / abuse***. Children who are temperamentally anxious, or who are in abusive situations causing anxiety may have difficulty in the areas outlined above. As with ADHD, for these children, if their anxiety settles their skills can usually catch up to some degree.
- ***Lack of opportunity to learn.*** For a few children, the reason why they struggle with maths and handwriting is that they never learned the basics properly. With some additional support, these children usually catch up.
- ***Asperger Syndrome***. The difference between Asperger Syndrome and NLD is not clear cut. Although children with Asperger syndrome are fluent verbally, this does not mean that they have trouble with maths, handwriting, attention and organisation. If we are unsure, and social skills are the greatest problem, we will choose the diagnostic category that best helps understand the child and leads to the best level of support.
- ***Semantic-Pragmatic language disorder***. This is a type of language problem where more complex language is impaired, leading to difficulties in comprehension and the social use of language. As with Asperger Syndrome, there are no clear boundaries with NLD, except that semantic-pragmatic disorder does not usually include problems with maths, handwriting, organisation and attention.

Criteria 4. A consistent pattern.

As with all developmental disorders, what we are looking for here is a consistent picture over time and different contexts. With NLD this is a little tricky because children often use their language skills to compensate their non-verbal weaknesses up to the early primary grades. This gives the false impression that there was no problem until school years.

A brief history

The NLD pattern has been known for many years. Adults who suffer damage to the right side of their brain often experience the same pattern of problems - compared to their intelligence and verbal skills, they struggle with maths, social skills, handwriting, organisation, attention, spatial motor planning and the emotional consequence of anxiety.

Knowing this pattern from adult head injuries, some researchers have called NLD the Right-Hemisphere Learning Disability Syndrome. This is clearly true for some children - who, on neurological examination, show differences between their left and right sides. For other children this is not so clear, and we can only presume that the problem lies within the right side of their brain.

Another line in history has been the 'Developmental Gerstmann Syndrome' which included the 4 problems of handwriting (dysgraphia), poor maths (dyscalculia), confusion about left and right, and difficulty localising touch to specific fingers (finger agnosia). The word Developmental implies that the cause was disordered brain development rather than acquired brain damage. This diagnostic term has now fallen out of common use.

The core problem

Most of the symptoms of NLD can be understood as the consequence of a single type of problem within the brain. This is a level of impairment in the ability to take multiple pieces of information and pull them together to form a single, integrated 'picture'. This is the ability to see the 'whole' as the 'sum of the parts', or to understand how many pieces of information fit into a single explanatory pattern.

To take the example of learning maths. What we do is provide children with many examples of a new concept (e.g. fractions). Children with good non-verbal understanding learn the concept quickly, from only a few examples. They can then use these concepts to work out the answers to new questions. Children with poor non-verbal thinking skills may learn how to do the problem but struggle to get that 'click' of understanding what the issue (in this case fractions) is all about. They remain confused about numbers above and below the line. They can answer questions by following the step-by-step processes, but cannot use their understanding to answer questions that very in process.

Another example is social skills. As human relationships become more complex, we rely increasingly on non-verbal information to journey through the maze. This means using our knowledge of people (what they know, like), their facial expressions, their gestures and body language, their tone of voice, their eye contact, their choice of words and many other pieces of information. We put all these pieces of information together to work out what that person is thinking, feeling and wanting. NLD make the process of putting all this information together difficult. Without knowing what others are thinking and feeling, children may assume that others are thinking and feeling the same as themselves.

This same type of discussion can be applied to organisation (seeing the overall task as the sum of many smaller tasks), and writing (seeing the component pieces of letters, words, layout, sentences and message, and how they all fit together).

Variations

It is important to note, as indicated above, that no two children who meet this diagnosis criteria are the same. For some children the problem may rest predominantly with their maths and handwriting. For others it may be more organisation, attention, behaviour and social skills. For some the motor problems are significant whilst for others they are non-existent.

Given this diversity in clinical manifestation, the question arises as to whether there is any benefit in using this diagnostic label. The short answer to this question is yes, but only if it significantly improves understanding of the individual child. For further information on this question see diagnostic labels.

Intelligence

One key variable in this variation is a child's overall intellectual ability. Essentially the cleverer children can use their intelligence to overcome some of the underlying problems. This does not mean they fix the problem - just that they learn to achieve the goals in other ways. With maths, for example, they may memorise the rules, and use their verbal skills to quietly work their way through maths problems, step by step, without a full understanding of the problem itself.

Age

In the younger years, the problems from NLD may not be seen. For example, children with NLD can be good at maths until the work becomes too conceptual. Similarly, their social skills when they are young are often very good. Usually the handwriting problems are present from the outset.

Attention

Some children with attention disorders (ADHD) can present with a clinical picture similar to NLD. This is probably because their poor attention hinders handwriting, organisation, social skill development and the other areas where children with NLD struggle. When this group of children are treated with stimulant medication, however, their skills in these NLD weak areas usually catch up, indicating they do not have a true learning disability.

Anxiety

In a manner similar to ADHD, children with significant levels of anxiety can present like NLD. Again, addressing their anxiety may allow them to improve and catch up in the areas of learning difficulty.

NLD and Language Disorder

In some cases, particularly where there is no cognitive testing, NLD can be mistaken for a language disorder. It is surprising that such a mistake can be made (given that language is the strength for children with NLD), however the problem lies in the highest and most abstract levels of language. Specifically, when tested in isolation, the abstract problem language abilities are usually poor. If there is no broader picture of the child (including their non-verbal conceptual skills), the erroneous conclusion may be drawn that the child's language is the problem.

NLD and Dyslexia (Reading Disorder)

Another unusual presentation of NLD, particularly in the earlier grades of primary school, is that of a reading disorder (see dyslexia). Children may be able to do the easier Maths just fine, and struggle with reading. The reason they struggle with reading comes to the visual component - recognising letters and whole words. This type of problem slows the acquisition of a sight word vocabulary. Poor attention control can also be a contributing factor - making it difficult to 'pull the skills together' that are necessary to learn to read.

In this case, usually the picture changes over time. Children with NLD usually learn to read, and as time progresses their writing and maths become more problematic.

NLD and Aspergers Syndrome

Aspergers Syndrome (AS) is considered a variant of Autism where children have normal intelligence, and normal language skills at the building block level of grammar and vocabulary. In AS, the primary challenge for children is social. They struggle to understand social situations, and how to deal with these. They struggle particularly to intuitively understand the other person's thoughts and feelings. Both NLD and AS can produce problems in social skills. In fact, many academics believe the two syndromes to be variations of the same underlying brain pathology. It is possible for individual children to meet criteria for both disorders.

The social skills of children with NLD tend to differ from AS in the following ways:

- Social skills in early childhood tend to be normal (in AS children are often 'unusual' from the very outset).
- Social 'desire' is often higher in NLD - children want to socialize.
- Children with NLD usually do not have the rigidity and fixed obsessional interests that are seen in AS.

Medical Causes

It has been proposed (Professor Byron Rourke, Canada) that NLD is the result of white-matter problems in the brain. White matter is the 'wiring' of the brain, carrying information from one place to another. If this is not working properly, he proposes, it interferes most with brain processes that require a lot of communication from many parts of the brain at the same time. As discussed above, this seems to be the core issue for NLD. Language functions do not need much communication around the brain - they are tightly localised on the left hand side.

This theory had not been proven. However it is clear that NLD can result from medical conditions medical conditions which seem to cause damage to right hemisphere function more than left. These include:

- ***Hydrocephalus*** (where the increased fluid pressure inside the brain may damage white matter more than grey).
- ***Turners Syndrome***. This is a genetic problem in girls where they only have one X chromosome instead of two. This can alter brain development, leading to a NLD pattern of problems.
- ***Fragile X syndrome***. This is another genetic disorder of the X chromosome, usually manifest in males. It can alter brain development, leading to different patterns of developmental problems including NLD.
- ***Tumors, calcification, cysts, brain injury***. Any process that selectively damages the right side of the brain can lead to the clinical picture of NLD. Rarely, cases have been described where damage was on the left side in foetal development. Somehow, the 'left' functions were taken over by the right side (so children could use language well) and the normal right side functions were impaired.
- ***Multiple Sclerosis, and other disorders of white matter***. These are very rare in childhood, and lead to many neurological problems.
- ***Agenesis of the corpus callosum.*** This is where the major communication fibres between the left and right side of the brain fail to develop correctly.
- ***Congenital Hypothyroidism.*** This is where the foetus is deprived of normal amounts of Thyroid Hormone during the pregnancy.
- ***Foetal Alcohol Syndrome.*** This syndrome is caused by alcohol damage to the developing foetus.
- ***Treatment for Leukaemia***. The chemicals and radiation used to treat Leukaemia in the brain can damage white matter.
- ***Others***, including Velocardiofacial Syndrome, Williams Syndrome, de Lange Syndrome, Sotos Syndrome.

Despite this list, for most children with NLD, we do not find a medical cause for their developmental disability.

Psychological tests used in the diagnosis of NLD

Intellectual

Intellectual assessments attempt to test all the cognitive skills necessary for academic success in school. These include language, memory, speed, attention and non-verbal thinking. The resulting overall IQ score is the combined results from all these different component tests. In addition to the overall IQ, results are often

organised into verbal and non-verbal (performance) scores. It is the difference between these that suggests NLD.

Unfortunately children do not always fall neatly into this pattern of results. Children with strong verbal intelligence can often use their language skills to compensate for their weaknesses non-verbally. Specifically, they 'talk themselves through' tasks that other children may achieve by pure visual intuition. For this reason, a smaller split for younger children between verbal and performance results is not necessarily evidence against an NLD.

Rey-Osterrieth Complex Figure

The Rey-Osterreith Complex Figure (ROCF) was devised in 1941 by the Swiss psychologist Andre Rey for the purpose of assessing perceptual organisation (how we integrate and organise what we see) and visual memory in brain injured subjects.

A number of American neuropsychologists have found a way to use this test with children. It is particularly interesting because it examines the processes children use in addition to the result they finally achieve. It can show how children with NLD perceive and remember information piece-by-piece rather than binding that information up into a single whole.

Wide Range Assessment of Memory and Learning (WRAML)

The Wide Range Assessment of Memory and Learning (WRAML), as the name suggests, directly assesses memory and the ability to learn. Its use for children with NLD is that it examines verbally and language information separately from visual information. Of interest is whether there is a difference between the two (i.e., children perform better on the verbal tasks).

Other assessments.

There is no single assessment that makes the diagnosis of NLD. It comes from the total body of evidence. Other tests which may be useful include:

- ***Academic Achievement***. Tests such as the WIAT (Wechsler individual achievement test) can give a fairly quick estimate of how a child is performing in reading, spelling, writing and maths. These are administered by psychologists.
- ***Language function***. Tests such as the CELF can give an estimate of overall expressive and receptive language abilities. These are administered by speech and language pathologists.
- ***Visual Perception***. Either psychologists or occupational therapists have several tests that examine visual perception and visual memory. One example is the Beery test of Visual-Motor Integration.

Executive Function. Neuropsychologists have a variety of assessment tools to examine the planning, organisation and memory skills that come from the frontal lobes of the brain

What happens over time.

The bad news with this disorder is that problems tend to worsen over time. As the academic curriculum, and life in general (socially, organisationally) becomes more challenging and complex, the difficulties for children with NLD increase.

With maths, for example, there is often a ceiling to comprehension, a point beyond which it becomes almost impossible to keep up with the curriculum. The demands on writing, organisation and general conceptual understanding increase in a cumulative way.

If the underlying disorder is not recognised and managed, the experience for children can be frightening. As indicated above, the disorder already seems to include a predisposition to anxiety. If not managed, the anxiety, fear and depression can develop during adolescence and adult life into major mental health problems.