Viewpoint

Specific learning disability

Michael McDowell1,2,3

1School of Medicine, University of Queensland, 2Child Development Network, Brisbane, Queensland, Australia and 3Neurodevelopmental and Behavioural Paediatric Society of Australasia (https://nbpsa.org/)

Abstract: Specific learning disabilities (SLD) have an impact on discrete areas of academic function. They result in a level of difficulty that is unexpected when considered in the context of a student’s overall intellectual and academic competence. A common example is dyslexia, an SLD that affects the acquisition of literacy. Medical professionals have an important role to play in the evaluation and management of SLD. The medical role is founded on the fact that these conditions are biologically based and have the potential to cause significant harm for the developing child. Even if details of biological causation are not possible to demonstrate for individual children, medical professionals may, nevertheless, make an important judgement call regarding the likelihood of aetiology. When learning problems are medically based, it is clearly unreasonable to expect children to do more than they are able and to learn faster than is reasonable. Advocacy around these biological presuppositions and their implications is a major contribution to the well-being of children who have SLD.

This review has been written with three goals in mind. The first is to promote the idea that specific learning disability (SLD) is not only a valid issue for medical assessment and management but also one where much can be achieved to benefit children. The second goal is to provide background information about SLD and, finally, the third is to summarise how the physician may become involved.

SLD is not a new problem for medical services. About 120 years ago, Dr Pringle-Morgan, an English general practitioner, published the following case report in the British Medical Journal:1

Percy F, a well-grown lad, aged 14, is the eldest son of intelligent parents, the second child of a family of seven. He has always been a bright and intelligent boy, quick at games, and in no way inferior to others of his age. His great difficulty has been - and is now - his inability to learn to read. This inability is so remarkable, and so pronounced, that I have no doubt it is due to some congenital defect. He has been at school or under tutors since he was 7 years old, and the greatest efforts have been made to teach him to read, but, in spite of this laborious and persistent training, he can only with difficulty spell out words of one syllable.

His father informs me that the greatest difficulty was found in teaching the boy his letters, and they thought he never would learn them. No doubt he was originally letter blind (caecitas literalis), but by dint of constant application this defect has been overcome.

This case description captures the essence of SLD as considered from a medical perspective. Note the unexpected degree of discrepancy between literacy skills compared to general intelligence and performance in other areas. The boy’s visual function and other relevant biological systems were normal on assessment. There was no history of acquired injury or lack of opportunity and effort to acquire literacy. Dr Morgan proposes a congenital rather than acquired causation, along with a neuroanatomical hypothesis. Finally, he describes neuroplasticity in learning, the boy’s acquisition of learning letters ‘by dint of constant application’. The interested reader is encouraged to read the full case report.1

Within medical practice, our understanding and management of reading disability, and SLD more generally, has not changed.

Correspondence: Associate Professor Michael McDowell, Child Development Network, Suite 14, 32 Park Road, Milton, Qld. 4066, Australia. Fax: +61 73369 3370; email: m.mcdowell@uq.edu.au

Conflict of interest: None declared.

Accepted for publication 4 July 2018.
significantly over the interceding years. One possible reason is that research technologies, such as genetic analysis and functional neuroimaging, have only been available in the last few decades. These technologies, however, are primarily for research and do not readily inform clinical practice. It is clear that parents are seeking opinions from paediatricians regarding their children’s learning. It is primarily an educational problem. Why should medical specialists become involved in the assessment and care of children with SLD?

**Why Doctors Should Be Involved**

Although SLD impacts function in an educational context, there are several reasons why medical specialists have a unique, positive contribution to the understanding and management of this set of problems.

1. **Biological**: Learning disabilities are the functional consequence of what is most commonly a biological aetiology (see below). Medical specialists are in the best professional position to consider the evidence and draw conclusions regarding biological causation. This provides a solid basis on which to advocate for the resulting implications (e.g. the child is not lazy, the family is not incompetent, the problem is not transient).

2. **Common**: Learning disabilities represent a heterogeneous set of conditions, and the determination of prevalence is difficult. A reasonable estimate is 1 child in 10.

3. **Current and future harm**: Learning disabilities are associated not only with functional and psychological struggle during childhood but also with problems into adult life that significantly impact physical and mental health services (see Table 1). They represent a substantial public health problem.

4. **Comorbid problems**: SLD are often associated with other problems that may require medical attention, particularly the medical treatment of attention-deficit hyperactivity disorder (ADHD) and mental health problems. A set of problems that are known to be causal for learning problems is summarised in Table 2.

5. **Opportunity to help**: Beyond the benefits of medical treatments, intelligent advocacy from a medical professional may lead to understanding and rational intervention. The medical professional can help prevent what may go wrong due to lack of understanding and contribute to long-term optimisation. They have the potential to make a powerful beneficial difference not only in the lives of individual children but also at the level of population health.

**How Are Learning Disabilities Defined?**

Interpretation of the term learning disability (LD) depends on where it is used. In the UK, LD refers to global cognitive or intellectual impairments. In Australasia and the USA, LD is usually a synonym for the Diagnostic and Statistical Manual of Mental Disorders (DSM–5) diagnosis SLD. To avoid confusion, the term SLD will be used in this paper.

The predicament for children who have SLD, as noted in the case report, is an unexpected degree of difficulty acquiring learning in one or more curriculum areas. The term ‘unexpected’ is important. The student’s degree of struggle is not explained by overall intellectual capacity, identifiable medical limitations (such as visual impairment, illness), lack of opportunity to learn to the expected degree or any other reasonable explanation.

Any area of learning may be affected. Diagnostic nomenclature has historically attempted to define problems by subject area (see Table 3). This approach has been superseded with the terminology of SLD. Diagnosis is now based on four criteria (DSM-5).

<table>
<thead>
<tr>
<th>Type of harm</th>
<th>Description and examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning</td>
<td>Slow rate of learning, poorer function in the affected area/s into adult life</td>
</tr>
<tr>
<td>Pedagogic</td>
<td>Default curriculum is not adjusted for actual level of learning (e.g. provided maths curriculum at grade 5 level when skills are grade 2). Further limits rate of progress in the affected area. The child may also suffer consequences of misunderstanding (e.g. detentions, additional work, public shame)</td>
</tr>
<tr>
<td>Collateral</td>
<td>Learning problems in one area may impact learning in other areas (e.g. weak literacy impact on maths and science learning)</td>
</tr>
<tr>
<td>Self-concept</td>
<td>The developing child not only has to deal with the learning struggle on a daily basis but also the accumulated load of harmful attribution (e.g. overall poor intellect, lazy, poor attitude) and its consequences (e.g. bullying)</td>
</tr>
<tr>
<td>Motivation</td>
<td>After time, there is a risk of losing motivation, giving up, avoiding hurt</td>
</tr>
<tr>
<td>Adaptive</td>
<td>Maladaptive adjustment over time, such as behaviour that is disruptive or antisocial, or coping strategies such as substance abuse</td>
</tr>
<tr>
<td>Adult</td>
<td>Risk in many areas of adult function beyond learning, including mental and physical health, social relationships, vocational achievement, criminal behaviour</td>
</tr>
</tbody>
</table>

1. Duration of struggle for more than 6 months in at least one of the key learning areas and in the presence of appropriate teaching.

2. The degree of struggle is significant. This significance combines clinical (functional harm, inability to access curriculum) as well as statistical significance (standardised measures on testing).

3. Age of onset appropriate for the nature of the problem – different ages for different curriculum areas as children are unable to meet expectations.

4. Exclusion of alternative explanations (such as intellectual disorders, health problems impaired sensory function, adverse life experiences or inadequate education).

This change in definition represents an important advance over two earlier diagnostic strategies. The first was the ‘delay’ model, where diagnosis required a failure to progress for a longer period of time. An example is the child more than 2 years behind expected ability. Substantial harm may have already occurred during this time.
The second historical method, still used but considered unnecessary in the DSM-5 diagnostic criteria, was to just consider learning in the context of intellectual potential (IQ-achievement discrepancy), an approach that also has a number of potential pitfalls.20

What Is Known About Causation? The Example of Reading Disability

Any detailed examination of biological aetiology for all SLD is well beyond the scope of this overview paper. Reading disability is arguably the best understood and is presented as an example.

During the 1960s, the US neurologist Norman Geschwind was studying relationships between neurology and cognition.21,22 During the 1960s, the US neurologist Norman Geschwind was studying relationships between neurology and cognition.21,22

Example of Reading Disability

What Is Known About Causation? The Example of Reading Disability

Any detailed examination of biological aetiology for all SLD is well beyond the scope of this overview paper. Reading disability is arguably the best understood and is presented as an example.

During the 1960s, the US neurologist Norman Geschwind was studying relationships between neurology and cognition.21,22 During the 1960s, the US neurologist Norman Geschwind was studying relationships between neurology and cognition.21,22

Table 2 Disorders that affect learning

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Potential impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADHD (particularly inattentive subtype)</td>
<td>ADHD is increasingly recognised for its impact on learning through impaired attention, organisation and planning, task initiation and maintenance and working memory. This potentially impacts all curriculum areas, particularly as organisational demands increase</td>
</tr>
<tr>
<td>APD</td>
<td>This is a set of problems attributable to the impaired central interpretation of auditory information. It is similar to trying to hear, understand and remember spoken information when there is strong background noise. Whilst APD may interfere with hearing accuracy and memory, it does not necessarily cause SLD themselves</td>
</tr>
<tr>
<td>Dyspraxia</td>
<td>This is a general term for impairments of motor co-ordination that may functionally impact handwriting, fine motor skills more generally, speech and oculomotor and/or gross motor skills</td>
</tr>
<tr>
<td>Language-based learning disorder</td>
<td>This term describes the impact of language disorders on learning. In addition to struggles with comprehension and production of spoken language, there are likely to be equivalent struggles with comprehension and production of written language</td>
</tr>
<tr>
<td>Medical conditions with associated brain damage</td>
<td>In addition to brain damage from trauma, learning disabilities are likely to occur if brain development is involved in a medical condition, for example, epilepsy, fetal alcohol spectrum disorder, consequences of prematurity</td>
</tr>
</tbody>
</table>

ADHD, attention-deficit hyperactivity disorder; APD, auditory processing disorder; SLD, specific learning disabilities.

With his colleague Albert Galaburda, they studied the postmortem brains of individuals who had lived with developmental dyslexia, finding distinct neurological abnormalities23 in brain regions close to where Dr Morgan had predicted in 1896. With the availability of greater technologies, there is now vast research literature exploring dyslexia. The strongest examples involve genetics24 and neuroimaging.25,26 The work of Sally and Bennet Shaywitz is recommended for further reading.27

These technologies do not advance the question of why the developmental skill of reading is differentially affected. Abnormalities of visual information processing28 were the original focus of study. Important work in this area has been undertaken by the Australian researcher William Lovegrove.29 This work has helped understand the limited role that visual function and processing plays in SLD. Collectively, the work on visual processing has demonstrated that visual filters, such as Irlen lenses, play only a limited role in the management of reading disability, limited to cases where there is a perceptual sensitivity that blurs visual clarity.30 In general, the visual causation hypothesis is only of marginal utility. It has not been successful as the primary path to, or explanation for, reading disability.

Table 3 Specific learning domains and diagnoses

<table>
<thead>
<tr>
<th>Domain</th>
<th>Diagnosis</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literacy</td>
<td>Dyslexia</td>
<td>Multiple subtypes have now been identified. Adult, or ‘residual’, dyslexia may impact less on literacy and more on spelling/written output</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Dyscalculia</td>
<td>Different subtypes impact ‘higher-order’ conceptual maths and/or the automation and accuracy of early maths</td>
</tr>
<tr>
<td>Handwriting</td>
<td>Dysgraphia</td>
<td>Motor control disorder of fine motor learning and automation</td>
</tr>
<tr>
<td>Handwriting, maths and organisation</td>
<td>Non-verbal LD</td>
<td>NVLD is a complex and pervasive learning disability impacting multiple areas of learning where the literal comprehension of language is not involved. As time progresses, comprehension of social information as well as abstract academic concepts may be impacted. It carries a risk of significant anxiety. It overlaps with inattentive ADHD and disorders of social comprehension</td>
</tr>
</tbody>
</table>

ADHD, attention-deficit hyperactivity disorder; LD, learning disability; NVLD, non-verbal learning disorder.
A parallel line of research has investigated the role of neurological processing where precision timing is important. Deficits of motor timing have been identified in developmental dyslexia, along with weaknesses of perceptual temporal discrimination. Building on this early work, extensive literature has now identified the central role of phonological perception in the causation of dyslexia. Phonological perception problems have a general impact on literacy, not restricted to the English language.

Reading disability appears to arise from a broad set of possible neuropsychological processes, in addition to phonological processing problems. These include auditory working memory and a complex set of processes necessary to visually recognise letters and automate sight words.

Each child may struggle with reading for individually different reasons. This biological and neurophysiological heterogeneity has important implications for selecting interventions intended to remediate weaknesses through repetition-based (neuroplastic) training. One size does not fit all.

**What the Doctor Can Do**

1. **Suspect:** SLD do not necessarily present with learning as the central issue. The concerns leading to referral may relate to consequences, such as behaviour or poor mental health. Consideration of learning should be part of the history and differential for these other concerns in school-aged children.

2. **Assessment – What you can do:** If SLD is a possibility, it is beyond the scope of paediatric assessment to clarify the question in full. Depending on interest, however, it is useful to gain an impression using simple, standardised tests of learning (e.g., single-word reading levels). In selecting and using such tests, however, several strategies are recommended.

   Your role is to screen, and better understand, rather than undertake definitive assessment. Accordingly, consider your assessment of a child’s learning to serve the purpose of obtaining a clinical impression, just as physical examination precedes imaging studies. Testing for reliable quantitative results requires appropriate training.

   Second, it is preferable to use tests that are also utilised and understood within local school systems. In this way, communication of findings is more likely to be understood and accepted by educators.

   Finally, it is worthwhile to consider how to best communicate the information you have (either from your own evaluation or standardised test results). Standardised scores or severity categories (e.g., mild, moderate) are not necessarily well understood by parents and teachers. An alternative, more intuitive nomenclature is to use age- or grade-equivalent levels of function (e.g., the child is in grade 4, but her reading decoding skills are at an early grade 2 level).

   **History and examination** should consider and exclude alternative explanations (illness, sleep problems, failure of educational opportunity, sensory abnormalities). A family history is helpful in building certainty as genetic problems are the most common explanation for SLD. Even with clear symptoms in family members, this may not have been recognised as a form of SLD.

3. **Formal assessment:** If history and observations support the possibility of SLD, referral for further assessment (if available) is beneficial to clarify what is going on. Educational and developmental psychology can evaluate intelligence and learning achievement. Looking deeper, neuropsychology is able to examine specific aspects of learning, such as working memory, phonological awareness, visual perception and integration and higher-order conceptual thinking. Speech pathologists are able to examine language, literacy, phonological awareness and reading comprehension; however, this set does not necessarily extend into other relevant aspects of learning such as visual-spatial working memory. Similarly, occupational therapists may clarify what should already be evident with handwriting; however, to this author’s knowledge and experience, the relationship between visual perception testing results and learning is not necessarily clear or useful either to understand the problem or inform remediation.

   Two specific investigations are worth mentioning. These are often recommended, particularly by educators. Behavioural optometry has been examined by the US College of Ophthalmology and has been found to be essentially ineffective for SLD. Although there may be reliable findings of movement or focus dysfunction, this is more likely to be an epiphenomenon or comorbid problem to the SLD. For this reason, therapeutic exercises contribute little to remediation even if they improve the ocular symptoms.

   Beyond consideration of phonological processing, auditory processing disorders (APD) impact hearing accuracy for language, particularly in complex acoustic environments. Whilst commonly present in learning problems, they are rarely explanatory for SLD, nor are remedial approaches likely to help core learning deficits. Some APD may be an expression of the underlying SLD. For these reasons, it is unlikely that APD assessment will clarify either the presence or causation of SLD or provide a pathway to the useful remediation of learning problems.

4. **Diagnose:** If the information is consistent, a documented ‘medical’ diagnosis is recommended. This can accommodate the implicit uncertainty. For example: ‘Clinical information, along with assessment results, meet the DSM-5 criteria for SLD in literacy. This has important implications. It is likely that this child’s learning problems result from underlying medical causes. This means that it is not likely he/she will ‘grow out’ of the problem in the near future. He/she will need individual curriculum adjusted to level of literacy, along with individualised intervention to build his/her literacy skills’.

5. **Comorbid problems:** If a child has problems of learning, the probability of other neurodevelopmental and mental health problems is higher than background. Some of these may be causal to varying degrees (Table 2). The common associated problems include ADHD, anxiety and poor mental health, motor co-ordination and sleep problems. It may be necessary to address complicating problems (such as sleep, ADHD or mental health) before the learning problems can be managed appropriately.

6. **Immediate management:** Before remediation (activities intended to accelerate learning in the affected area), several preliminary steps provide a foundation for ongoing success:

   o **Common understanding:** Consider the set of people involved in the child’s care (parents, teachers, tutors, relatives) and ensure a communication strategy that enables
them all to understand the child’s SLD in the same way. The easiest way is to write a ‘plain English’ letter that can be shared around this group.

- Adjusted expectations: How can you take pressure off the child? If they read at a grade 1 level, for example, how much of their current grade curriculum is just too difficult for them? Adjustments can be either a lowering of expectations (simpler curriculum) or the use of alternative/bypass strategies to work around the SLD areas (e.g. keyboarding, reading assistance software). The child needs to know that what will be expected of them in day-to-day education will be both achievable and sustainable. Some parents and teachers have concerns about making these adjustments structurally. The reason often given is that ‘taking the pressure’ off a child will permanently forego the opportunity to catch up and predestine the child to a trajectory of poorer learning. This thinking reflects lack of understanding about the cause and nature of the child’s SLD. Learning expectations need to be fair and reasonable.

- Issues that interfere: Before any child is ready to learn, particularly to benefit from remedial intervention, any complicating problems must be dealt with first. These include comorbid problems as noted above. They also include issues within the school and family that the child may have to deal with. The child needs to be ready and able to learn, with sufficient balance and psychological ‘space’.

- Child’s self-beliefs: An important intervention that medical specialists can provide is an explanation to the child about themselves. It is likely they have misconceptions about the nature of their own struggle. An honest, compassionate explanation provides the foundation for the child’s participation in choices and intervention over time.

7 Intervention: Intervention refers to remedial activities intended to alter the child’s rate of learning onto a faster trajectory. Whilst detailed discussion about intervention is beyond the scope of this review, the same general principles tend to apply. The child needs to be ready and available (see above), with a balanced life-style that allows energy to flow to remediation. It is hard work.

Professional conversation tends to focus on which programme is best. This is like asking what combination of chemotherapy is best for cancer generally. Different strategies are better for different individual situations.

Consensus is emerging regarding the properties of successful remediation programmes. Some attributes are outlined in Table 4.

8 Resilience, balance, goals: Following set up and intervention, several factors influence a child’s developmental journey over time. Balance refers to sustainable pace. Doing too much in the short term may lead to later burn-out and demoralisation. An intentional process of setting, reviewing and re-setting goals will serve to keep the journey on track and provide points of reference along the way to evaluate progress. Resilience refers to the child’s psychological experience over time, building towards a future characterised by positive mental health, participation in areas of strength and interest and an objective self-understanding that leads to acceptance and self-efficacy.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Principles of successful remedial intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle</td>
<td>Explanation</td>
</tr>
<tr>
<td>Explicit</td>
<td>Each skill, or component sub-skill, is taught definitively rather than implicitly</td>
</tr>
<tr>
<td>Systematic</td>
<td>The sequence of component skills is taught in an appropriate developmental sequence</td>
</tr>
<tr>
<td>Multisensory</td>
<td>Knowledge and skills are more likely to be retained if they are the point of intersection for multiple pathways (vision, hearing, touch) as well as being associated with positive emotion</td>
</tr>
<tr>
<td>Flexible and adaptive</td>
<td>An adaptive approach evaluates response to intervention along the way, with the flexibility to change as this response dictates. This contrasts with many ‘packaged’ programmes that proceed along a rigid course</td>
</tr>
<tr>
<td>Utilised</td>
<td>As each new component is learned, it is applied and used in a broader learning context – for example, reading new and interesting material</td>
</tr>
<tr>
<td>Repetitive</td>
<td>Certain aspects of learning (e.g. multiplication tables, irregular sight words) can only be embedded and retained through repetition</td>
</tr>
<tr>
<td>Intensity: Session time, frequency and programme duration</td>
<td>The degree of work is sufficient to effect neuroplastic changes. A common reason for the lack of success for remedial programmes is simply not enough work. A simple guideline might include sessions of minimum 30 min, undertaken 4–5 days per week for several months⁴²</td>
</tr>
<tr>
<td>Accountable: Progress goals and feedback</td>
<td>Any remedial programme should have clear measurable goals and time frames, with measures of progress along the way. If a programme is characterised by ‘we will see how we go’ and ‘we seem to be making good progress’, there is a chance it is no better than placebo</td>
</tr>
</tbody>
</table>

When considering an intervention intended to improve (accelerate the trajectory of learning), the following principles tend to universally apply⁴³:

9 Long-term management: In Australia, the care of SLD is not a legislated educational entitlement as it is in the USA.⁴⁴ Even when support is in place, there is no guarantee it will persist. For this reason alone, the regular review of progress, and advocacy as needed, is a justifiable role for medical care, particularly
given a child’s right not to be discriminated against on the basis of disability.44 Beyond the management of psychotropic medication, regular medical reviews allow emerging problems to be addressed early. It enables reconsideration of short-term priorities and goals and the evaluation of progress towards the long-term goals for each child.

Conclusions

This paper argues that participation in the detection, diagnosis and immediate and longitudinal management of SLD is a valid, important and potentially successful area of medical care. There is also clinical satisfaction in caring for a child over time, from initial struggle to a resilient young adult who finds their place in society. It can be a privilege to work with families who love and care for their child and are able to utilise the information provided not only towards remediation but also the prevention of harm over time and the optimisation of what is possible.

Acknowledgement

The author acknowledges the helpful review comments of Dr Jane Lesslie and Dr Catherine Skellern (Child Development Network, Brisbane) in the preparation of this manuscript.

References

42 Vaughn S, Denton CA, Fletcher JM. Why intensive interventions are necessary for students with severe reading difficulties. Psychol. Sch. 2010; 47: 432–44.