Specific learning difficulties

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Specific learning difficulties (SLD) is a term commonly used to describe the 'unexpected' problems that some children experience in the academic arena. These children's difficulties are out of line with what might be 'expected' given their age and general cognitive ability. In contrast, the term learning disabilities (mental retardation in the USA) is used to describe learning problems that occur in the context of more global delays in cognitive development, signalled by low IQ. To describe a child as having a 'specific learning difficulty' carries no implication about the nature or aetiology of his or her problems. Rather SLD is a statistical definition that should be regarded as the starting point of a more detailed assessment of the child's strengths and difficulties. Indeed, there are many different kinds of specific learning difficulty; the present paper focuses on reading and spelling difficulties (dyslexia and dysgraphia), arithmetic problems (dyscalculia) and problems of motor coordination (dyspraxia). The syndrome of 'nonverbal learning disabilities' is also discussed.

Dyslexia

The 'discrepancy' definition

It has become conventional in clinical practice to distinguish children who have specific reading difficulties from children who have reading difficulties in the context of more general learning problems. A child is deemed to have a specific problem with reading if their reading attainment is significantly below that predicted from their mental age on the basis of the correlation between reading and IQ in the same population. Such children show a discrepancy between expected and actual attainment.

Prevalence **–** the prevalence of specific reading difficulties depends on the specific cut-off point taken as indicative of reading disability. Recent epidemiological data from a longitudinal study of Connecticut children reported prevalence rates of between 5.4% and 7% depending on age.[1] In contrast to earlier studies that reported 3–4 males to every female affected, this study reported a more even sex distribution. However, school records showed that more boys than girls in the sample had been referred for assessment, suggesting that boys with reading difficulties come to the notice of teachers more frequently than girls, perhaps because they compensate less well or behave more disruptively.

The term 'dyslexia' is often used as a synonym for specific reading difficulties. However, there are a number of problems with this practice; a child can fulfil the criteria for specific learning difficulties for several reasons, perhaps because of absence from school, because of poor engagement with learning or as a consequence of poor teaching. A further limitation that follows from defining a reading disorder in this way is that it tells us nothing about the manifestations of dyslexia in the preschool years or in adulthood when reading difficulties may be largely overcome but spelling problems persist.

Nature and causes of dyslexia

Despite continuing debate as to the precise criteria for the diagnosis of dyslexia, advances have been made in the understanding of its biological substrate. Findings of gene markers for dyslexia on chromosomes 6, 15 and 18 have been replicated in several independent studies, and differences in brain structure and function, particularly in left hemisphere temporal regions, have been observed when people with dyslexia have been compared with normal readers.[2] At the cognitive level, there is a consensus that dyslexic people show a phonological (speech)-processing deficit. The manifestation of this deficit at the behavioural level changes as the child develops, as shown in Figure 1. Evidence is also emerging that interventions can bring about changes in activation to the brain circuitry involved in reading in children with dyslexia.[3]

It has been suggested that dyslexic difficulties are the result of low-level visual impairments. However, reports of raised thresholds for contrast sensitivity and visual motion detection in dyslexia, or problems with ocular motor control, have not been consistently replicated. More recent research suggests there may be higher-level problems in the allocation of visual attention in at least some individuals. Another influential hypothesis is that the phonological deficit in dyslexia can be traced to impairments of basic auditory processing mechanisms; however, although there is evidence of an association between auditory and phonological processing deficits in some individuals, it is far from clear that the relationship is causal.[4] An alternative view traces the phonological deficits observed in dyslexia to a language-based difficulty in the mental representation of the spoken structures of words.[5] These difficulties compromise the child's ability to learn alphabetic mappings between sounds and letters for reading and for spelling. Increasing evidence suggests that English orthography, being highly inconsistent in these mappings, may aggravate dyslexia; dyslexic readers of German, Italian and other transparent languages display phonological deficits but have more accurate (but slow) reading and spelling. Figure 2 presents a framework adapted from Morton and Frith to illustrate the role of the cognitive deficit as the mediator of the brain–behaviour relationships and environmental interactions in dyslexia.[6]

Treatment

There is now a sizeable evidence base showing that the most effective interventions for dyslexia combine training in oral phonological awareness with highly structured reading practice using text, and linking phonological units to sounds through writing. Children at risk of reading failure need individualized intervention

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Manifestation of dyslexia across the lifespan

Pre-school	Early school years	Middle school years	Adulthood
Delayed speech	Poor memory for verbal instructions	Subtle speech problems (e.g. on polysyllabic words)	Poor verbal memory
Immature sentence formation	Difficulties with common sequences (e.g. days of the week)	Word-finding difficulties	Word-finding difficulties/make malapropisms
Poor expressive language relative to comprehension	Poor letter knowledge	Difficulty learning tables and number facts	Slow reading
Poor rhyming skills	Poor phonological awareness	Slow reading	Slow speed of writing
Little interest in or knowledge of letters	Poor phonics (word-attack skills) even if reasonable sight vocabulary	Poor decoding skills when faced with new words	Poor proof-reading skills
	Idiosyncratic spelling	Phonetic spelling	Difficulty committing ideas to paper
	Problems with copying	Slow at copying	Poor organization of written work

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from school entry to prevent them falling behind their peers, and support in mainstream classrooms to ensure they can properly access the curriculum.[7]

Dysgraphia

Spelling skills in dyslexia

The spelling skills of dyslexic children are almost always impaired; moreover, dyslexic children often commit dysphonetic spelling errors that are phonetically unacceptable (e.g. geography > georafy). A second source of spelling difficulty is poor knowledge of orthographic conventions. Since English is an opaque orthography in which spelling–sound correspondences are not consistent, phonetic spelling errors are frequently observed (e.g. biscuit > biskit; chaos > kaos).

Specific spelling disabilities

Spelling problems can sometimes be experienced in children who are not dyslexic. Such children who read well but have specific spelling problems have been described as dysgraphic. Dysgraphic children tend to spell phonetically and they have difficulty selecting the correct spelling from two plausible alternatives (e.g. successful/succesful; necessary/necessery). It has been proposed that dysgraphia may arise as the consequence of a 'hidden' reading problem; indeed, people with poor spelling do not read in a detailed way. Typically, they rely heavily on context, and they are bad at proof-reading. There is also some evidence that such people have subtle visual memory deficits.

Dyscalculia

The term dyscalculia is used to refer to specific difficulties with numeracy skills. Dyscalculia is characterized by a problem in learning number facts and hence with arithmetic. The incidence of underachievement in arithmetic is less well documented than for reading. Figures of around 6% have been reported, but these figures do not take into account the common comorbidity with reading problems. In fact, although 'pure' dyscalculia is rare, there is no strong evidence that it differs in nature from dyscalculia with dyslexia.

Normal development of number skills

Adopting a developmental framework provides a useful way of considering children's problems with arithmetic.[8] By the age of 6, most children can use a 'counting on' strategy to add, sometimes using their fingers to monitor this process. Later, as they learn number facts, they can begin to retrieve these automatically. Importantly, the development in long-term memory of an association between the problem integers (e.g. 3 + 4) and the answer that is generated (7) requires practice in the execution of basic computations. With each execution, the probability of direct retrieval of that number fact increases. It follows that children who have difficulty with basic computation will have difficulty establishing a database of number knowledge, and hence, in becoming numerate. Moreover, since more advanced mathematics builds on a foundation of basic arithmetic skills, child who fall behind in the early stages have difficulty understanding and using more advanced concepts. They also often suffer anxiety about mathematics.

Nature and causes of dyscalculia

Children with dyscalculia typically show the following characteristics:

- use the same strategies as younger children for calculating but are error-prone
- slow at counting and at calculating
- difficulty retrieving number facts
- do not know their tables
- poor at monitoring their counting and at detecting computational errors
- problems switching between different strategies when completing mathematical problems.

The cognitive causes of dyscalculia are not as extensively researched as those of dyslexia. Theoretically, there are grounds for distinguishing a non-verbal magnitude system (thought to be controlled by right hemisphere processes) from a verbal number system (putatively in the left hemisphere). In line with this view, some children have difficulties in learning mathematical concepts, while others have selective deficits of the calculation system.

Some researchers view working memory difficulties as candidate causes of arithmetic problems, since numbers have to be held in short-term memory during the process of mental calculation,