



# postnote

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## DYSLEXIA & DYSCALCULIA

**Dyslexia is a learning difficulty involving problems in acquiring literacy skills. Dyscalculia involves specific difficulties in acquiring arithmetical skills. Dyslexic and dyscalculic learners<sup>1</sup> may have educational needs that differ from those of other learners. Strategies to improve literacy and numeracy might therefore benefit from taking these groups into account. This POSTnote presents recent research on dyslexia and dyscalculia and outlines current educational policies relating to both. It also examines issues such as early identification and ongoing support for dyslexic and dyscalculic students throughout their education.**

### Background

Dyslexia was identified earlier than dyscalculia and is better understood. There is greater general awareness of dyslexia, with guidelines and strategies aimed at helping dyslexic people at all stages of education. By contrast, awareness of dyscalculia is not so widespread and there are few strategies relating to it.

### What is dyslexia?

Dyslexia is a learning difficulty characterised by specific problems in learning to read, write and spell, despite sufficient educational experience. It can often be managed effectively with targeted teaching and support, but if children with dyslexia are not identified early they can suffer frustration and low self-esteem. Without intervention, literacy problems can continue into adult life, often impacting on job prospects.

Estimates of prevalence vary, from 2% to 15% of the population. This is because different studies identify cases based on different cut-off points on the continuum between mild and severe dyslexia.

The prevalence of dyslexia is higher in English speakers than in speakers of many other languages. In English, the relationship between the way a word is written and the way it sounds is inconsistent. One letter can represent several different sounds. For example, the

letter 's' is pronounced differently in each of the words 'sun', 'sugar' and 'lens'. Research suggests that the nature of dyslexia is the same in all countries, but that languages with more consistent letter-sound relationships (such as Finnish) allow mild cases to remain 'hidden'.<sup>2</sup>

### Brain differences in people with dyslexia

- An area of the brain known as the left *planum temporale* is smaller in dyslexic people than in others. The area is normally active during listening and reading.
- Dyslexic people also tend to show small neuronal abnormalities in other areas of the brain thought to be involved in reading and speech processing.
- During reading, dyslexic people typically show less activation than others in areas of the left side of the brain that are traditionally associated with reading.
- Dyslexic people tend to show larger reading-related activation in areas towards the front of the brain than non-dyslexic people. The involvement of these frontal areas might suggest that reading is a more effortful, less automatic process for dyslexic people.

### Possible causes of dyslexia

Dyslexia is now widely recognised as having a genetic component. For example, if one of a pair of twins is dyslexic, the other twin is more likely to be dyslexic if the twins are identical than if they are non-identical. As outlined in the box above, dyslexia is associated with brain differences in areas specialised for language processing.

The main result of the brain differences associated with dyslexia is a difficulty (known as the phonological deficit) in the ability to process speech sounds (phonemes). For example, whereas non-dyslexic children make spelling errors consistent with the sound of the word (for example, 'woz' for 'was'), dyslexic children tend to make less systematic errors (such as 'wsa' for 'was'). This suggests that dyslexic children attempt to spell by rote, memorising the letters of each word without relating them to the word's component phonemes. The

phonological deficit does not apply only to reading and writing. For example, dyslexic people are slower at naming pictures presented in quick succession. Dyslexia therefore seems to involve a general deficit in relating the spoken or heard form of a word to its visual form.

Some dyslexic people also have problems in processing visual, auditory and/or motor information. Several theories of dyslexia claim that the phonological deficit described above is linked to these problems.

People with dyslexia are thought to be more likely than other people to have other difficulties such as attention deficit disorder and dyspraxia (which involves problems in making coordinated movements). Many dyslexic people also have numeracy difficulties related to their dyslexia, and some may have dyscalculia. The reasons for this possible clustering of difficulties are not yet understood. Indeed, at present researchers are not sure even of the numbers of people with dyslexia who also have another difficulty.

#### *Interventions for dyslexia*

Most teaching programmes aimed at helping people with dyslexia target the phonological deficit. Multi-sensory approaches, in which the student is encouraged to become familiar with the written, heard and spoken forms of each phoneme, can be very effective, particularly for people with mild to moderate dyslexia. Interventions focusing on visual and auditory processing can also be effective in some cases.

#### **What is dyscalculia?**

People with dyscalculia have specific problems in learning arithmetical concepts and procedures, despite sufficient educational experience. A recent case study described a man with a university degree who could not report which of two single-digit numbers was the larger.<sup>3</sup> Children with dyscalculia are likely to struggle in maths lessons which often leads to anxiety and low self esteem. Numeracy problems impact more negatively on job prospects than literacy problems,<sup>4</sup> so dyscalculia is very likely to affect people into adulthood.

The best prevalence estimates for dyscalculia lie between 1% and 7%. As with dyslexia, different studies have used different criteria for identifying cases.

#### *Possible causes of dyscalculia*

There is evidence to suggest that dyscalculia may have a genetic component. If one identical twin has dyscalculia, there is a chance of around 70% that the other twin will also be dyscalculic. For non-identical twins (who have less genetic material in common than identical twins, yet also share the same environment) this chance is lower, at around 55%.

#### *Interventions for dyscalculia*

An intervention aimed at improving dyscalculic children's grasp of simple number concepts has only recently been developed and is currently being evaluated, with positive early results.<sup>5</sup>

## **Current strategies**

All educational institutions and Local Education Authorities (LEAs) must comply with the Disability Discrimination Act 1995 (as amended by the Special Educational Needs and Disability Act 2001) in providing equal access to the curriculum for students with disabilities. The Education Act 1996 also specifies procedures for identifying and supporting children with special educational needs (SENs), which schools and LEAs must follow. The processes by which dyslexic and dyscalculic people are identified and supported vary depending on the particular institution and LEA. The information below is intended to give a generalised picture of dyslexia and dyscalculia provision throughout education.

#### **Primary school**

The Primary National Strategy includes the National Literacy Strategy (NLS) and National Numeracy Strategy (NNS). The NLS was introduced in 1998 and is widely agreed to have had a positive impact on literacy levels in primary school. For example, the number of children leaving primary school with the expected level of achievement or higher in English rose from 65% in 1998 to 75% in 2002.<sup>6</sup> The strategy encourages 'phonics' teaching, where children are taught to recognise individual phonemes and blend them into words. The NNS was introduced in 1999 and has also raised standards significantly. For example, the number of children reaching the expected level of achievement in mathematics on leaving primary school rose from 59% in 1998 to 73% in 2002.<sup>7</sup> The strategy emphasises the importance of a lively, interactive approach to maths teaching, involving both small group and whole class discussion.

Both strategies include three levels of support. Children who struggle with the standard lessons (Wave 1) can be entered into small group interventions (Wave 2). The specifics of these interventions vary from school to school. Broadly speaking they focus on repeating material presented within the Wave 1 lessons at a slower pace and with more individual attention. Those children who do not catch up following Wave 2 are given an individually-targeted Wave 3 intervention, funded by the school's SEN budget and chosen by the school's SEN co-ordinator in consultation with other relevant staff. The Department for Education and Skills (DfES) has recently published guidelines on how to choose effective Wave 3 literacy interventions, and is currently piloting teaching materials suitable for Wave 3 numeracy interventions.

Children with dyslexia or dyscalculia are likely to be identified by this structured approach to literacy and numeracy teaching. However, those with moderate to severe dyslexia or dyscalculia are likely to struggle despite Wave 3 interventions. In these circumstances, a school can at present apply to the LEA for a statement of SEN, which allows for funding to provide further support. However, recent government policy aims to restrict statements of SEN to exceptional cases. This means that most dyslexic and dyscalculic children will be supported

by the school's own SEN provision. As specialist dyslexia support is rarely available full-time (and specialist dyscalculia support is not available at all), classroom teachers are expected to provide support. The DfES publishes guidelines for teachers of children with literacy and numeracy difficulties, and each school's SEN budget is intended in part to support further professional development for teachers in the area of SEN. The extent to which these opportunities are taken up depends on the individual school.

### **Secondary school**

Support is available from the LEA in secondary schools for children already identified as dyslexic (but not dyscalculic). However, in the absence of the structured approach provided by the Primary National Strategy, there is more variability in literacy and numeracy support at this level than at the primary level. On the whole, schools provide support for children with severe and very noticeable literacy difficulties, but those with less obvious problems are often not so well supported.

### **Further and higher education**

There is little support for dyscalculic students in further and higher education, and provision for dyslexic students varies considerably depending on the institution. Within further education, institutions receive funds with which to support students with learning difficulties as appropriate. Higher education institutions also receive some funding to support recruitment and retention of students with disabilities. Higher education students can apply for a 'Disabled Students' Allowance' to provide resources, and many higher education institutions also run specialised dyslexia support initiatives.

### **Adult literacy, language and numeracy skills**

16% of the UK population aged between 16 and 65 (~5.2 million people) lack the skills needed to pass an English GCSE at any grade. The equivalent figure for Mathematics is as high as 47% (~15 million people).<sup>8</sup> These groups are likely to include relatively large numbers of dyslexic and dyscalculic people, although no firm figures are available. As at other levels of education, there are no strategies aimed specifically at dyscalculia, while dyslexia provision varies between institutions. The DfES has produced several publications intended to raise awareness of dyslexia among basic skills teachers and to provide them with the resources to deal with the challenges that dyslexia can present.

## **Current issues**

### **Dyslexia**

#### *Identification*

In the past, people were not identified as dyslexic unless their reading ability was found to be lower than expected, given their IQ. This approach was useful for researchers, as it identified specific difficulties that might be linked to distinct causal factors. However most experts now doubt that IQ can be used as a meaningful indicator of reading potential.<sup>9</sup> In most cases, a person who encounters severe difficulties in learning to read, write and spell will now be identified as dyslexic, regardless of IQ.

### *Early screening and identification*

Children currently receive individually-targeted literacy support only when they have already failed at Waves 1 and 2. These children are therefore usually several years into their primary education before receiving the support they need. They are also likely to have been adversely affected by their previous failures at Waves 1 and 2. A programme in which all children were screened for risk signs of dyslexia on school entry might speed up identification and prevent children failing before their problems are noticed. Early intervention for all SENs forms a main strand of the new DfES strategy, *Removing Barriers to Achievement*, and some schools are already working on early intervention programmes.

### *The National Literacy Strategy*

There is a wide consensus among dyslexia researchers and teachers that the emphasis of the NLS on phonics, along with the increase in use of small group work, has been helpful for children with problems in learning to read, including those with mild dyslexia. However, there is evidence that children with more severe literacy difficulties can find it hard to engage with the material presented within the literacy hour (see box below). Some researchers suggest that severely dyslexic children may benefit from being removed from these classes for individual literacy tuition, perhaps on a short-term basis or for ongoing support as required. Experts also highlight the importance of further training for classroom teachers in making literacy-based lessons accessible for children with literacy difficulties.

#### **Engagement with literacy lessons**

In a recent study, researchers observed children's behaviour during literacy-based lessons and calculated the amount of time children spent 'on task'.<sup>10</sup>

- Children with literacy difficulties spent twice as much time 'off task' as children without literacy difficulties.
- Children with literacy difficulties spent over 60% of their 'on task' time carrying out activities (such as pencil sharpening) which were related to the lesson but not central to it. By contrast, children without literacy difficulties spent only 40% of their 'on task' time on these types of activity.
- Overall, children with literacy difficulties were fully engaged with the lesson for only 24% of the total time. Children without literacy difficulties were fully engaged for 49% of the time.

### *Accreditation of interventions*

The marked prevalence of dyslexia in English-speaking countries causes a high level of demand for intervention programmes. The DfES has recently assessed many of the educational interventions currently available. However, few interventions have been scientifically evaluated using randomised control trials (possibly because this would involve withholding treatment from children who could benefit from it) and there is no systematic scheme of assessment and accreditation. The quality of support afforded by different interventions may therefore vary significantly.

### Teacher awareness

The 'SPELLIT' programme of research into literacy learning run by the Dyslexia Institute (an educational charity) found that teachers were aware of dyslexia and able to identify children with literacy difficulties. However, they often lacked the time and training necessary to follow up on the children whom they identified as requiring extra support. Initial teacher training courses are very short and rarely involve more than basic awareness training. Specialist dyslexia training can be accessed through professional development courses, if the school has sufficient resources. However, although some courses are independently accredited, there is no systematic scheme of accreditation, so courses may vary significantly.

### Support beyond primary school

At stages of education beyond primary school, literacy support becomes more fragmented, varying significantly between different institutions.

### Severe cases

Although phonological awareness training can be very effective for people with mild to moderate dyslexia, more severe dyslexia is likely to persist despite such interventions. In these cases, people are likely to benefit from additional practical support, such as training in the use of word processing and voice recognition software.

## Dyscalculia

### Further research

As dyscalculia research is at a relatively early stage, very few related guidelines or strategies have been produced. More accurate prevalence estimates, as well as further information on the efficacy of interventions, would allow for more effective provision.

### Responses to numeracy lessons

In a study of children's thoughts on the daily mathematics lesson,<sup>11</sup> head teachers and SEN coordinators from five schools selected groups of 8 and 9-year-olds with high, medium and low maths ability. Researchers then carried out interviews with each group, in which they discussed children's thoughts about numeracy lessons. Below are selected quotes from the low ability groups (likely to include dyscalculic children):

- "I feel like screaming and saying 'why are you doing this, why are you doing this?' and I feel like punching the teachers".
- "It makes me feel left out sometimes.... When I don't know something, I wish that I was like a clever person and I blame it on myself."
- "I would cry and I wish I was at home with my mum and it would be – I won't have to do any maths."

### Distinguishing dyscalculia from low maths ability

Some experts question whether it is practical from an educational point of view to distinguish dyscalculic people from others with low maths ability. Others suggest that such differentiation is important because dyscalculic people need training on very simple number concepts which other people (including those who have low maths ability for other reasons) take for granted.

### The National Numeracy Strategy

The NNS is thought to have had a positive impact on numeracy teaching for children with SENs, mainly through the increased use of practical and small group work. However, children with very low maths abilities (including those with dyscalculia) appear to struggle with the NNS's daily mathematics lesson (see box below). Some researchers suggest that these children may benefit from being removed from numeracy lessons for one-to-one teaching. However, experts also emphasize the importance of further teacher training to make numeracy lessons more accessible for these children.

## Overview

- Research into dyscalculia is at an early stage and few related guidelines or strategies have been produced.
- Earlier identification of children 'at risk' of dyslexia would avoid the situation in which they have to fail before specialised support is made available.
- The Primary National Strategy, with its structured approach to literacy and numeracy teaching, goes some way towards providing for the needs of children with mild to moderate dyslexia and dyscalculia.
- Children with more severe problems currently struggle in many of the literacy and numeracy lessons they experience.
- There is no specific support for dyscalculia at levels beyond primary school, and dyslexia provision is fragmented, varying significantly between institutions.

### Endnotes

- 1 The terms 'dyslexic' and 'dyscalculic' are used for economy of space
- 2 Paulesu, E. et al. (2001). *Science*, 291, 2165-2167
- 3 Butterworth, B. (1999). *The Mathematical Brain*. London: Macmillan
- 4 Bynner, J. & Parsons, S. (1997). *Do numeracy skills matter?* London: Basic Skills Agency
- 5 Unpublished research by Professor Brian Butterworth and colleagues, Institute of Cognitive Neuroscience, London
- 6 *The National Literacy Strategy: the first four years 1998-2002*. Ofsted, 2002. Available via [www.ofsted.gov.uk](http://www.ofsted.gov.uk)
- 7 *The National Numeracy Strategy: the first three years 1999-2002*. Ofsted, 2002. Available via [www.ofsted.gov.uk](http://www.ofsted.gov.uk)
- 8 *The Skills for Life Survey: A National Needs and Impact Survey of Literacy, Numeracy and ICT Skills*. DfES research report 490. Available via [www.dfes.gov.uk/research](http://www.dfes.gov.uk/research)
- 9 *Dyslexia, Literacy and Psychological Assessment*. Report by a Working Party of the Division of Educational and Child Psychology of the British Psychological Society
- 10 Unpublished research by Janet Hatcher and colleagues at the Centre for Reading and Language, University of York and at the Dyslexia Institute
- 11 Unpublished research by Professor Brian Butterworth and colleagues, Institute of Cognitive Neuroscience, London

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