

Dyscalculia and Dyslexia

Two different issues, or part of the same problem?

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Dyscalculia is noted as an unexpected difficulty that some people have in dealing with mathematical problems. At its simplest we may note a child whose age and intellect suggests that he or she will be able to undertake a certain range of skills, but who in effect is unable to handle maths problems that we would expect to be well within his or her grasp.

As a general introduction to the topic we may note that according to the American Journal of Paediatrics in 2001 dyscalculic children have “Normal or advanced language and other skills, often good visual memory for the printed word, (and) poor mental maths ability often with difficulty in the use of money, such as balancing a chequebook, making change and tipping. Often there is a fear of money and its transactions and difficulty with maths processes (e.g. addition, subtraction, multiplication) and concepts (e.g. sequencing of numbers). There is sometimes poor retention and retrieval of concepts, or an inability to maintain a consistency in grasping maths rules, poor sense of direction, easy disorientation, as well as difficulty with reading maps, telling the time and grappling with mechanical processes, difficulty with abstract concepts of time and direction, schedules, keeping track of time and the sequence of past and future events.” These children make, “Common mistakes in working with numbers including number reversals and omissions,” (and) “May have difficulty learning musical concepts, following directions in sports that demand sequencing or rules, and keeping track of scores and players during games such as cards and board games. Dyscalculia can be quantitative which is a deficit in counting and calculating, qualitative, which is a difficulty in the conceptualising of math processes, and intermediate which is the inability to work with numbers or symbols.”

We can note the lack of reference to literacy difficulties herein. This clear statement from such a prestigious journal makes it obvious that we are thinking about something that has no direct connection with literacy skill problems. There is nothing in this description to suggest that dyslexics cannot be dyscalculic, and vice versa, but everything to suggest that the two are separate.

Miles and Miles noted in 1982 that “some dyslexics can be extremely successful mathematicians.” It was a puzzle to Miles and Miles and others researching this field as to how this could be the case, for they (in common with many others, but contrary to the earlier neuropsychological work which showed links between the ability to be very good at maths and the ability to be a very good musician, but not a link between problems with maths and problems with literacy skills) had assumed that dyslexia and problems with maths must in some way be linked. They were thus unable to explain their findings and struggled with the notion that somehow dyslexics who were good at maths had taught themselves to overcome their inevitable mathematical problems. It was not an argument with any supporting evidence, as they generously acknowledged.

However perhaps unknown to Miles and Miles, at the same time as they were writing what became an early definitive text on maths and dyslexia, research by Joffe (1981) and then Fleischner et al in 1982 confirmed that (as predicted by the brain and behaviour researchers) the link between maths and dyslexia did not actually exist.

It was following the publication of these findings (and a further report by Joffe in 1983) all of which contradicted the early approach to dyslexia, that the definitive study in the field of the relationship between dyscalculia and dyslexia was undertaken by Steeves 1983 who compared the mathematical abilities of a group of dyslexic boys with a suitably matched group of non-dyslexics. Steeves found that “about 10% of dyslexics are likely to be really successful in mathematics, and about 30% exhibit no particular difficulty.” This research changed the thinking about dyslexia and maths and since 1983 it has been the standard view of almost all writers on the subject that dyscalculia is a separate issue from dyslexia. This work has been supported by other studies since, including most notably Joffe in 1990.

The results show beyond any doubt that many dyslexic children in the groups tested were gifted mathematically while others were of average mathematical ability for their age and intelligence, despite their dyslexia. Further Steeves and later Joffe very coherently argued that despite having a high mathematical potential some dyslexic children were handicapped at mathematics by those parts of the subject which call for memorizing ability. Thus those dyslexics who were under achieving in maths might be doing so for any one of several reasons including:

1. because they were failing to read the words of the question in the archetypal “if it takes three men four days to dig a trench...”
2. Because they had a short-term memory problem which itself may be associated with dyscalculia but is not the same as saying someone is dyscalculic.

Thus these findings showed once and for all that large numbers of dyslexics are completely free of any sign of mathematical disability or dyscalculia, and suggested that many of the dyslexics who do suffer from apparent problems in maths do so, not because of the genetic deficit known as dyslexia but because of other problems. In other words the number of dyslexics who genuinely have dyscalculic problems was in reality probably less than one in four.

Similar findings come from Ackerman et al in 1986. The argument that all these children were dyslexic but had somehow overcome the mathematical problems that go with dyslexia was now so out of touch with the findings that they could not be continued.

To summarise thus far, researchers now all agree is that there are some children who suffer from dyslexia, some suffer from dyscalculia, some from both, and some who appear to suffer from both, but are actually suffering from the side effects of dyslexia, rather than proper dyscalculia. The position that by and large researchers are coming to in relation to dyslexics is that

- 10% of dyslexics excel at maths, above that expected for their intelligence and age
- 30% of dyslexics are at the level of maths expected for their intelligence and age
- 10% of dyslexics appear to be below average at maths due to short term memory problems, rather than any other difficulty, and once they are taught to overcome these their maths problems disappear
- 25% of dyslexics appear to be below average at maths, but this is just a side effect of their problems reading English. When given simple remedial maths, and then tested in ways that avoid written English their maths problems disappear.

Of course through the early 1990s one occasionally saw populist articles which argued that, despite regular finding that anything between 10% and 40% of dyslexics have no

mathematical difficulty, all dyslexics struggle with maths. In order to accommodate the often replicated findings about students with dyslexia who are good at maths, they argued that the mathematical problems the dyslexic children suffer come not from dyslexia, but from a difficulty in handling number sequences caused by short term memory problems. The children who have no signs of mathematical problem in their lives, these writers claim, have taught themselves to overcome the short term memory problem. These arguments are convoluted and tenuous at best, and are certainly not countenanced in any research centre that I am aware of. They were finally discounted completely from an academic point of view when genetic research revealed in 1996 a clear link between genetic abnormality and dyslexia. To the best of my knowledge, no one with any serious claim to in depth knowledge of how the brain works seriously argues that dyslexia and dyscalculia are the same thing.

What kept the old argument about a link between the two disabilities alive going for as long as it did was probably the fact that although dyslexia and dyscalculia are two separate genetic disorders they do share this similar feature – short term memory difficulty. However what we must always be clear about is the fact that although dyslexic children have short term memory disorders, not all children with short term memory disorders are dyslexic. Likewise it is possible (but not certain) that most dyscalculic children have short term memory problems, but not all children with short term memory problems are dyscalculic. Not all dyscalculic children are dyslexic.

The one point on which researchers disagree is just how many dyslexic children can be significantly above average at maths when their age and intellect is taken into account. Chinn and Ashcroft for example, now quote a figure of 25%. The reason for dispute here is the issue of the final group of students – those who are dyslexic and thus may be having problems reading the questions, or who may have difficulties with short term memory. These children may appear to be dyscalculic but are not. They may account for 25% of the dyslexic students tested for maths disability.

The above data should be enough to prove my point, but I think it is worth noting the interesting work in this area that has been undertaken recently by Professor Brian Butterworth of UCL. Professor Butterworth is not only the most highly regarded researcher and writer on dyslexia in the UK at present, he is also a man who works with the British Dyslexia Association.

Writing for the BDA in October 2001 Professor Butterworth noted: “While dyslexia is now widely recognised in the area of literacy, in the area of numeracy it is most definitely not. Further there appears to be a second congenital condition that has not even been discussed. This is dyscalculia: its effects on the learning of numerical skills can be very profound. The current best estimates (from England and elsewhere) indicates a prevalence of between 3% and 6% of the population. These estimates are derived from the proportion of children who have special difficulty with maths despite good performance in other curriculum areas....

“Preliminary evidence suggests that there may be a specific dyscalculia genotype – that is a genetic anomaly that may result in specific deficit in the learning of numerical skills.”

An earlier report (reference M01) from the BDA entitled *Dyslexia Dyscalculia and Mathematics* was published in September 2001. This publication takes the research of Joffe 1981 as its starting point, and comments “of the 40% of dyslexics who don’t seem to have maths difficulties, about 11% of the dyslexics excel in mathematics. The rest (29%) do as well as children of the same age, who have no learning difficulty.” As with other researchers the BDA quite reasonably take this as the indication that dyscalculia and dyslexia are totally different genetic conditions, which have a certain overlap in those who suffer from them.

As they later add, “most dyscalculic children and adults will have cognitive and language abilities in the normal range. They may excel in non-mathematical subjects.” This is perhaps the clearest statement that there can be about the difference between the two genetically inherited disabilities.

Further information on these developments come from the Numeracy and Literacy Group within the Institute of Cognitive Neuroscience. This group studies the brain processes involved in mathematics and reading, with the aim of identifying the most basic and universal neuropsychological processes that underlie both skills. Work from this unit such as Cipolotti, Butterworth and Denes 1991 is worthy of study at this point.

The Dyscalculia Group at First and Best are always interested in hearing from teachers and researchers who have insights into dyscalculia, or have other material that could be published on this web site, or in book form.

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