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1: The concept of dyscalculia

Dyscalculia is the name given to the problem suffered by people whose ability to handle mathematical concepts is significantly lower than we might expect it to be, when taking into account that individual's age and intelligence.

This definition makes it clear that dyscalculia is not a term intended to be used for everyone who is poor at maths. But as we will see later, many of the methods of teaching that have been devised for helping pupils who are dyscalculic will work with all pupils who have difficulties with maths, irrespective of the cause of the problem.

However just because the best ways of working with children who have difficulties with maths are almost always the same, this does not mean that we should be too ready to use the word "dyscalculia" in cases where it does not apply.

It is obvious that everyone sits somewhere on a continuum of mathematical ability, which we might arbitrarily number from 0 to 100. Anyone at position 100 is a mathematical genius. A person at position 0 has no mathematical ability whatsoever. A person at point zero has no concept of number and therefore no ability to see how a number such as "2" relates to "4".

From this point it is possible to devise a spread of mathematical ability for all age groups. If (for the sake of this exposition) we accept that the level mathematical ability in each age group is a normal curve then we will have most people with an ability rating of 50 and ever smaller numbers of people as we get further and further away from position 50.

Even if reality doesn't quite match the standard pattern suggested above, we would expect to have a small number of people at each end of the curve, and we might choose to give a special name (such as dyscalculia) to the people who are at the low end. The giving of a name in this way will inevitably have the appearance of separating out this low achieving group, but the name does not of itself signify that there is anything particularly different about these people, other than the fact that they are at the lower end of the spectrum.

The most likely factor that binds together those who fall towards the end of our 0 to 100 scale at any particular age is intelligence. It seems reasonable to start from the belief that at any given age, the lower the level of intelligence, the lower the level of mathematical ability.

If the match between intelligence and mathematical ability were perfect there would be no need for a concept such as dyscalculia. However, what we do find is that there are some children who appear to have a mathematical ability which is much lower than we would expect given their intelligence. From this finding we can begin to see that there might be a specific learning difficulty which some children have in relation to maths.

If dyscalculia represents a specific learning difficulty one might expect that some people who appear at the bottom of the ability range in mathematics might well be at or near the top of the ability range in other areas of study. From such a view we might speculate that some of those people who are at or near the bottom of the scale in mathematical ability within a certain age group suffer some sort of genetic

dysfunction which makes it difficult or impossible for them to learn mathematics in the way that others of the same age will do.

At first sight this seems very reasonable. Belief in such an approach has been heightened by the belief among researchers into dyslexia that dyslexia itself is genetic in origin. The definitions and ideas above make dyscalculia seem like a mathematical version of dyslexia. We might also be encouraged by a body of neuropsychological research which has shown that mathematical ability is particularly associated with specific areas of the brain.

What's more, we also know that there is a link between higher levels of ability in maths and a particular ability in music – and this suggests that a particular part of the brain might well be responsible for the ability to handle specific types of abstract activity, in this case mathematical and musical concepts. A failure in this area of the brain can then lead to a much lower than expected ability in maths.

Thus we might expect to find that a percentage of the population is significantly worse at maths than we might otherwise expect when IQ score and age is taken into account. *Dyscalculia becomes the behavioural outcome of a genetic disorder.* We might note that those involved in working with children who have dyslexia speak on occasion of 10% of the population being dyslexic, and we might assume that a similar figure applies with dyscalculia.

However we must also note that for every ten children who are diagnosed as dyslexic there is probably only one for whom the term dyscalculia is applied. Does this suggest that our opening hypothesis is wrong? Or could it be that there are other factors at work here? Or does dyscalculia simply affect fewer people than dyslexia? Or is it simply that we are less open to the notion that failure in maths is a sign of a specific learning difficulty?

Certainly far fewer educational psychologists are administering tests for dyscalculia than there are administering tests for dyslexia. A review of the literature shows that there are only a handful of books on the subject of dyscalculia, as opposed to thousands of texts on the subject of dyslexia. Even as we put this book together the Times Educational Supplement carries a front page story about a supposed "cure" for dyslexia. Such claims, such stories simply do not exist for dyscalculia.

In part this might be explained by the impact being dyscalculic has on a pupil, as opposed to the impact of being dyslexic. A dyscalculic pupil fails at maths – but this may have no impact on the child's ability in history and geography, where the use of number is very limited. But a dyslexic pupil will fail at history and geography because written English is the very medium of those subjects. It is therefore possible that there has simply been less pressure for support for dyscalculic pupils because their disability affects the teaching and learning in a smaller number of subject areas.

Issues relating to the impact of dyscalculia, and the publicity that it gains in the educational and national press, are quite possibly part of the explanation for the lack of awareness and action taken on behalf of dyscalculic pupils. But these pointers do not help us understand what dyscalculia really is. Is it a specific learning difficulty? Is it genetically based? To answer these points we now turn to the link between dyscalculia and dyslexia.

2: Maths and dyslexia: is dyscalculia a side-effect of dyslexia?

Some esteemed writers on dyslexia have suggested that the genetic disorder which leads to dyslexia also leads to failure in maths. They put forward a number of reasons as to why this is likely.

Firstly it is suggested that a number of the problems associated with dyslexia (for example difficulty with short term memory, and difficulty with sequencing) are as likely to affect the ability to cope with mathematical concepts as they are to affect the ability to handle the written word. Clearly there is a logic in this. Issues such as understanding multiplication tables which are at the heart of mathematics are sequencing issues. Numbers are dealt with as sequences – it is logical to see dyscalculia as a dyslexia problem. A child who has particular difficulty with multiplication tables often expresses the view that she can't remember where she was in the table – a clear indication that there might be a short term memory issue at work.

Secondly it is noted that in the UK we have traditionally taught and tested mathematics in a way that leaves the subject surrounded by written English. Many mathematical questions are posed as written questions, requiring the student to be competent in English before he or she can handle the maths. Maths is not just a question of knowing what symbols such as + actually mean. It is also a case of being able to read and understand and remember the meaning of "sum of", "add", "total", and "equals".

From arguments such as these we might begin to believe that a dyslexic child is also a dyscalculic child. Once a child has been diagnosed as dyslexic then support should be given in maths as well as written English.

Reviewing the evidence

Unfortunately there is some evidence to suggest that the link between dyslexia and dyscalculia is not as straightforward as we might hope. A few studies have suggested that instead of all dyslexic students being poor at maths, about 25% of dyslexic students are apparently above average at maths. This suggests that contrary to the above argument dyscalculia is a separate issue from dyslexia.

In the light of this evidence we might feel more inclined to say that dyscalculia and dyslexia are separate, but that some pupils – perhaps the majority of pupils – suffer from both dyslexia and dyscalculia.

Unfortunately the evidence which might translate these views which appear to be reasonable, into views supported by experiment and data, is hard to come by. Genetic science is not far enough advanced to give definitive answers and, where tests have been carried out on dyscalculic pupils, the number of people tested has often been extremely small.

This latter point is particularly worth remembering as it has bedevilled testing in relation to dyslexic students as well as dyscalculic students. The number of pupils and students examined in the research which is reported is often no more than a

dozen or so – a very small sample indeed and one from which it is very hard to draw serious implications.

But such evidence as there is does seem to keep coming back to the fact that while many dyslexics do also show signs of dyscalculia there is this sizeable minority (the 25% figure is regularly quoted) which, far from being way below the expected level in mathematical ability, is actually considerably above that level.

However we should also note that although some research has revealed this figure to be correct in surveys on dyslexic pupils, this is a figure which has now started to be handed down as if it is an absolute proven fact – when it is not. Again this is a problem that afflicts dyslexia as much as dyscalculia. It is commonplace for organisations that seek finance or support for dyslexics to quote "facts" such as the view that Einstein was dyslexic. This like many other such claims is based on virtually no evidence but is handed down from one speaker to another along with many other urban myths.

Steeves 1983 cites a boy who in a few seconds could calculate the number of squares on a piece of squared paper, but who was profoundly dyslexic and this is often cited as "evidence" of the separation of dyslexia and dyscalculia. Along similar lines Griffiths in a paper in 1980 cited the issue of a university lecturer in physics who in his 50s could not repeat his six times table. In this case the suggestion is that dyscalculia is therefore a separate concept from difficulty in understanding scientific principles and formulae.

Indeed I could add my own contribution to this type of debate. One of my daughters has been diagnosed as profoundly dyslexic by suitably qualified educational psychologists on two separate occasions. She suffered the traditional problems of having difficulty with maths, but it was perfectly evident when one spoke with her on a one-to-one basis that she had a perfect grasp of mathematical principles. What she had was some difficulty with sequencing, and a significant amount of difficulty reading the text of the maths questions she was given. Because of these difficulties she was placed in a group at secondary school that was entered into maths GCSE to take papers which could at best only give the pupils a Grade C pass. Such was her grasp of the subject that she was awarded the rare distinction of a B from the marks gained on these exams. Meanwhile it was considered that her dyslexia was so bad that in other subjects she was allowed a reader in the exams who would read her the questions!

I cite the case of my own daughter not to prove that dyscalculia is separate from dyslexia, but rather to show the dangers of accepting much of the "evidence" that currently surrounds the subject. Evidence from individual cases cannot be used as proof that there is independence of dyscalculia from dyslexia for with the simple use of two observations the opposite can be argued:

Firstly, we may note that a number of people who are dyslexic are drawn in their work and interests to activities which use the written word. It is not at all unknown for dyslexic children to select for A level study the very subjects that we might expect them to seek to avoid, such as English and history. It is not unknown for people who are writers by profession to show all the signs of being dyslexic. It is not at all impossible for my own interest in maths to have impressed itself on my daughter, and that she determined to sort out her maths problems with me. In other words she was dyscalculic, but through the application of good teaching and learning techniques, she overcame it.