About Dyscalculia: Brian Butterworth

I first met Charles (not his real name), when he was 30 years old, and proud possessor of a degree in psychology. Getting a degree was an achievement, but entry to university in the first place even more of one, since he had, despite his best efforts, failed the normal condition for entry, Maths GCSE.

Charles is hard-working and intelligent, but his poor number skills have always been a severe handicap. Shopping is a constant embarrassment: he doesn't understand the prices, and has no idea of the total cost of his shopping basket. When he comes to the till, he has no idea of how much money to tender or whether the change is correct. Charles, we discovered, added and multiplied using his fingers, and was unable to do two-digit written arithmetic problems such as 37-19. What really surprised us was couldn't tell that 9 was bigger or smaller than 3, and had to use his fingers to work it out.

Charles is an example, a severe example, of a condition known as "dyscalculia" that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding even very simple numerical ideas. They may find the daily maths lesson a source of enormous anxiety since they struggle to understand what is obvious to all their classmates.

Unfortunately, dyscalculia is not widely recognised. For dyscalculics, the situation is rather like that for dyslexics 30 years ago. Teachers, parents, the world at large, think they must be stupid not to understand ideas and methods easily acquired by the rest of us. People may regard the label "dyscalculia" the kind of excuse middle-class parents make for their underachieving children, just as people used to regard the label "dyslexia".

However, with the British Dyslexia Association, we managed to persuade the National Numeracy Strategy to publish guidance notes for dyslexia and dyscalculia which has been sent out to all schools.

The DfES define dyslcalculia as, "A condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number

facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence." This captures what many dyscalculics, like Charles, feel about maths. It is incomprehensible.

Although these guidance notes will help to raise the profile of dyscalculia, there is still a very little research on its nature and causes. Without an understanding of the condition, we will not be able to help these disadvantaged children. And disadvantaged they certainly will be. The Basic Skills Agency published a report three years ago showing that poor numeracy is a bigger handicap to getting a job, keeping a job than poor literacy. This is not really surprising when poor numeracy can mean the employee will transport the wrong number of goods, or fail to ensure that the correct payment has been received or paid out, and these can cost their company serious money.

Dyscalculia is a big problem not just for individuals who suffer from it, but for the nation. The best current estimates suggest that about 5-6% of children of average to superior intelligence will have a real specific learning deficit for maths. This is a similar prevalence to dyslexia.

Dyscalculia seems to be particularly rife among dyslexics, with around 40% of children with reading difficulties also having difficulties in learning maths. This is a double whammy for them. It is also a serious puzzle for science. After all, the other 60% have no more problems than normal. Indeed, dyslexics can be outstanding mathematicians. What is the difference between those dyslexics who do suffer from dyscalculia and those who do not? What is it about dyslexics that puts them at risk of dyscalculia at all?

On the other side of the equation, something like 1-2% of children with no reading difficulties, and with normal cognitive abilities, are two years behind their peers. So, although there is an association between dyslexia and maths learning difficulties, the latter can occur alone.

It is worth noting that learning about numbers is different from learning to read in an important way. We are born with basic numerical abilities. Infants, even in the first week of life, are sensitive to changes in the number of things they are looking at. We know this because they will look longer at a display when we change the number of things, but often will not when we change one of the things but keep the same number. Babies also seem to

be able to do very simple arithmetic. If the baby sees a doll place behind a screen, and then another doll placed behind it, it can be shown that the baby expects there to be two dolls (1 + 1) when the screen is removed. Babies look longer at things they don't expect, and will look longer at one doll or three dolls in this situation. So there is evidence of an innate capacity for numbers. One hypothesis to explain dyscalculia is a lack this innate capacity.

However, we are not born with a specialised capacity for reading. Reading is a complex skill made up from a variety of brain systems set up to do other tasks – such as language, recognising visual patterns, sequencing, and so on. Some of these are used in learning arithmetic in school, and deficits in them may also affect maths learning.

Here is a list of some of things we need to know to be reasonably numerate in this society.

- How to count: both reciting the number words in the correct order and enumerating sets objects

- How to read and write numerals (to learn to translate from the name value system of English – 10, 10 x 10, and 10 x 10 x 10 are named by special words while the same symbols are used to represent them in place value numerals – 10, 100, 1000)

- Number magnitudes (ordering numbers by size)

- Meanings of operation symbols (+, -, x, ÷, =)

- Number facts (e.g. 8 + 7=15, 8 x 7=56)

- Numerical procedures (e.g. counting on to add, borrowing, carrying)

- Principles, concepts and laws of arithmetic (for example, that addition is commutative, but subtraction is not)

Now some of these may be more vulnerable to dyslexic-type problems than others: those that depend on language coding – such as learning the sequence of number words, or the times tables; while other may be more vulnerable to visuo-spatial difficulties such as creating a mental number line. The NNS Guidance notes are particularly helpful in identifying potential

difficulties for dyslexics.

What we need urgently is a way of diagnosing dyscalculia, and separating it from all the other causes of maths problems, including inappropriate teaching. Once we can identify these children reliably, we can begin systematic research on how best to help them. Charles was not diagnosed as dyscalculic until he came into our lab, and, like many other dyscalculics, felt himself first to be incredibly stupid for not being able to do what all his friends could do easily. This was not good for his self-esteem, of course. Later he began to realise that there was something else wrong, but was completely in the dark as to what it could be. Better for his self-esteem, but of little practical help. We do not yet know how many severe cases like Charles there are, but we are slowly getting there.

Further reading:

Butterworth, B (1999) The Mathematical Brain. London: Macmillan:

[website]

National Numeracy Strategy (2001) Guidance to support pupils with dyslexia and dyscalculia.. DfES 0512/2001:

[website or .pdf]

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