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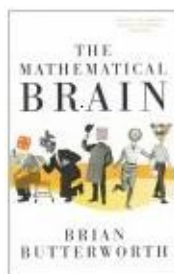
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Mar 2002

Reviews

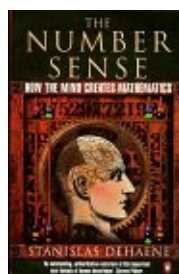
## Two books about mathematical thinking

reviewed by Helen Joyce



### The mathematical brain

**Brian Butterworth**



### The number sense

**Stanislas Dehaene**

Over the last decade, the discipline of neuropsychology has shed light on many aspects of human thought. Brain scans, carefully structured behavioural experiments, and the study of individuals who have suffered brain damage, have taught us much about which abilities are native to humans and which learned; which abilities can be lost and what happens when they are.

These two books describe what is currently known about the foundations of human mathematical ability, and speculate a little further than is known. Both are fascinating, full of the sort of information you feel impelled to pass on. They discuss careful and ingenious experiments on children, including newborn babies (don't let your imagination run away with you – these experiments involve nothing more sinister than observing where babies look and how hard they suck a dummy!), which show conclusively that some numerical abilities do not have to be learnt, but are present from birth, hardwired into our brains.

It seems that human beings are born with a few core numerical abilities – for example, we are innately able to tell without counting how many objects are in a small collection, and to predict correctly the results of adding to and subtracting from these small collections. It may well be that the whole abstract edifice of modern mathematics is built on these biologically innate foundations. Studies of patients suffering brain damage make it clear that these abilities are quite separate from general reasoning and language skills – there are unfortunate individuals who are literally unable to count to 2, although their IQ's appear to be normal, and

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others whose maths is still reasonable, despite their almost total lack of language.

*The mathematical brain* and *The number sense* cover much of the same ground. Both describe the experimental evidence – some behavioural, some from brain scans – for the existence of this core numerical ability, and its location within our brains (left parietal lobe, apparently). Brian Butterworth and Stanislas Dehaene both discuss the implications of this research for mathematics education, and both describe extraordinary case studies, casting light on our entire understanding of mathematics. In places both books are reminiscent of Oliver Sacks (*The man who mistook his wife for a hat; Awakenings*), with their meticulous and enlightening descriptions of bizarre and baffling deficits in stroke and accident victims.

However, the models of innate mathematical ability put forward by the two researchers don't fully agree. Butterworth's "number module" is an ability to recognise small cardinalities (that is, to see without counting when groups of objects consist of 1, 2 or 3 things) and to make arithmetic predictions about such small groups. Dehaene's "number sense" is based on an "accumulator" – an analogue procedure which allows us to keep track of quantities of various sizes, although accurately only for small quantities. Such disagreement is hardly surprising when you consider how new and active this area of research is, and no doubt the next few years will clarify the situation further.

The authors' differing backgrounds also show in the two books. Butterworth is a neuropsychologist who came to studying mathematical ability via his work on natural languages. He was intrigued by strange cases of brain-damaged patients – usually stroke victims – who had lost almost all language and reasoning abilities – except mathematical ones. Dehaene, on the other hand, started off as a mathematician, but became fascinated by the abstractness of his subject. He began to wonder where mathematical ability came from, and why some people are so bad at it, and others so good. He now works on the neuropsychology of maths, studying the physical basis for the mathematical abilities he earlier used for research.

Butterworth is a gifted writer, and his understated sense of humour makes *The mathematical brain* a pleasure to read. Clearly a man with a mission – to improve mathematical teaching and learning – he is closely associated with efforts to tackle the problem of dyscalculia (the number equivalent of dyslexia) and has advised the DfES on supporting dyscalculic children through the national numeracy strategy.

*The number sense*, on the other hand, is a translation from the French (by the author), and it shows. The English is idiosyncratic – but soon you stop noticing, because the content is so enjoyable. No doubt as a result of his background as a mathematical researcher, Dehaene is clearly interested in the philosophy of mathematics, and allows himself to wander off in his last chapter into (highly interesting) speculation about the provenance of advanced mathematical ability, and mathematical inspiration.

Why should you read these books? Firstly, because they are interesting. I rate both highly on the most meaningful scale for a factual book – the number of times I was inspired to say "did you know?" to friends and colleagues, all of whom were intrigued (or are implausibly good actors!). Secondly, because their subject really matters. Children are not blank slates, to be inscribed with mathematics according to whichever scheme is currently fashionable. Rather, cognitive science tells us that it is possible to teach mathematics in a way that fits with our psyche, a way that minimises maths-induced fear and boredom. Teachers, parents, politicians and voters (education ranks high on the list of public concerns, according to polls) need to hear what these authors have to tell us about maths education. And thirdly, because to anyone who cares about mathematics – which surely includes readers of *Plus* – the question "What is a number, that a man may know it, and a man, that he may know a number?" (Warren McCullough, quoted by Dehaene in *The number sense*) must surely resonate.

## Two books about mathematical thinking

### **Book details:**

*The mathematical  
brain*  
Brian Butterworth  
Paperback – 448 pages  
(2000)  
Papermac  
ISBN:  
0–333–76610–5

*The number sense*  
Stanislas Dehaene  
Paperback – 288 pages  
(1999)  
Penguin  
ISBN:  
0–14–026134–6



*Plus* is part of the family of activities in the Millennium Mathematics Project, which also includes the NRICH and MOTIVATE sites.