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News

Maths on the brain

Human beings seem to have an inborn mathematical ability. Research has shown that even tiny babies seem to have a built−in awareness of numbers. But is this the only way our brains process mathematics?

Researchers in France and America have recently confirmed that there are *two* distinct ways in which we deal with numbers and mathematical relationships: an "intuitive" mode, that may involve a visual component, and a "linguistic" mode developed later in life.

We use our intuitive ability to make rough estimates, or recognise obvious errors (such as 16 + 8 = 168) without specifically calculating, and to perceive relationships between quantities. We use our linguistic mode to perform more precise calculations and give us shortcuts (for example, knowing our times tables − which we learn verbally − allows us to avoid laboriously calculating products in our heads as a sequence of sums).

Earlier work with brain−injured patients had shown that some patients were able to subtract (a quantity−based operation) but not multiply (a verbally−based operation), and others were able to multiply but not subtract. This suggested that different parts of the brain were used for the two activities. It seemed that learning a multiplication table was like memorising a shopping list, whereas learning how numbers relate to each other might be tied to visual intuitions about space.

The more recent research has confirmed this two−mode theory and shown where the two different abilities are located in the brain. It seems that the verbal mathematical ability, the "linguistic" mode, is located in the left frontal lobe, which is the part of the brain known to be responsible for making connections between words.

However, mathematical estimation, the "intuitive" mode, was found to involve both the left and right parietal lobes, which are responsible for visual and spatial representation and also for controlling the fingers.

Interestingly, it has long been known that patients with damage to the parietal lobes suffer from "acalculia", a difficulty with basic number skills (for example, being no longer able to count). The recent research, locating mathematical estimation to the parietal lobes, helps to provide an explanation for this phenomenon.

Einstein's Brain

Albert Einstein, the greatest theoretical physicist of this century, claimed that his numerical ideas came to him as "images, more or less clear, that I can reproduce and recombine at will... The words or the language, as

they are written or spoken, do not seem to play any role in my mechanism of thought. The psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be 'voluntarily' reproduced and combined."

This description suggests that the intuitive, partly visual mathematical mode of his brain may have been exceptionally well developed. Intriguingly, recent examination of Einstein's actual brain (which was preserved for scientific study after his death in 1955) has found that this region was about 15% wider than average, and lacked a groove that normally ran through parts of this area.

"This unusual brain anatomy may explain why Einstein thought the way he did," said Professor Sandra Witelson, who led the research published in the Lancet.

AAAS Press Release
: Press release describing the recent research.

Einstein's brain
: Findings about the structure of Einstein's brain.

K.E.M.
