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The Human Brain Functions Like a Computer

It better processes digits than words

The parietal zone (forehead) of the brain's cortex was thought for 10 years as the center for representations of numeric quantities, digits or as written words. Damage to this zone or reduced gray matter in adulthood due to low birth weight are connected with calculation deficits but whether the parietal cortex processes numeric value independent of notation is still unproven. Recent investigation points to the fact that the cortex handles easier symbolic notation to other numeric representations. "Knowing how we represent numbers is very important for education, to have rehabilitation, to know exactly what is the core of deficit and know how we can train [dyscalculia sufferers] (a learning disability characterized by severely impaired mathematical ability)." says researcher Roi Cohen Kadosh, a cognitive neuroscientist at University College London. Two investigations using functional magnetic resonance imaging (fMRI) were done based on "fMRI adaptation": the brain decreases reactivity as a stimulus turns familiar and then reactivates when a new stimulus is presented. Cohen Kadosh submitted 12 subjects to a sequence of two numbers, presented as either the digits (2 or 6) or words (two or six). Digit 2 was followed either by the word two or by the numeral 2. Digit representation was flashed for 350 milliseconds, followed after 1,300 ms by the symbol flash. The values were also presented in different patterns, in which the 2 could be followed by the word or the digit 6. The left parietal lobe of the brain appeared very activated at changes regardless of notation. "In the right lobe, however, the adaptation effect was stronger in trials involving digits than it was for written words", said Cohen Kadosh. "There are different neuronal populations for digits and different populations for written numbers." he added. In another approach, researchers at France's National Institute of Health and Medical Research exposed 14 volunteers for 30 seconds to a specific range of numbers (like, 17 to 19) in the same notation; either numerals or a cluster of dots. Over the next 90 seconds, some deviant quantities could be inserted while staying within the same range; for example, 17 dots in a sequence of numerals between 17 and 19. After that, there was a shift to a new range of numbers, like 47 to 49, although the expression, dots or numerals, remained consistent. After 30 seconds necessary for the volunteers to adapt to the new range, deviants (of the previous range or a different notation) could appear once again. When a deviant quantity was farther from the adapted quantity, the rebound activation in the brain lasted longer with no connection to notation. But the left parietal region was more active when deviant dots emerged in a set of numerals than when numerals appeared in a set of dots. "At least in the adult brain, numerical symbols and nonnumerical numerosities converge onto shared neural representations."There are "shared neuronal populations" that can decode symbols onto nonsymbolic quantities. Both investigations show "that the left parietal lobe is more finely tuned to the symbolic representation of numerical magnitude." said Daniel Ansari, a cognitive scientist at the University of Western Ontario in Canada.