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Adult brain processes fractions 'effortlessly'

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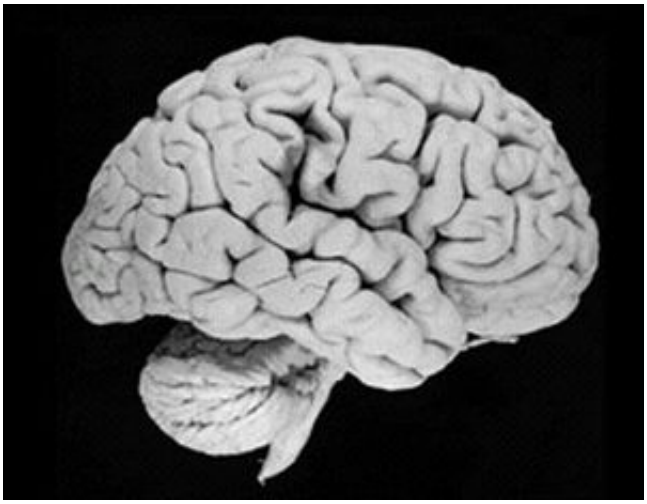

Modern human brain. Image source: Univ. of Wisconsin-Madison Brain Collection.

Although fractions are thought to be a difficult mathematical concept to learn, the adult brain encodes them automatically without conscious thought, according to new research in the April 8 issue of *The Journal of Neuroscience*. The study shows that cells in the intraparietal sulcus (IPS) and the prefrontal cortex — brain regions important for processing whole numbers — are tuned to respond to particular fractions. The findings suggest that adults have an intuitive understanding of fractions and may aid in the development of new teaching techniques.

"Fractions are often considered a major stumbling block in math education," said Daniel Ansari, PhD, at the University of Western

Ontario in Canada, an expert on numerical cognition in children and adults who was not affiliated with the study. "This new study challenges the notion that children must undergo a qualitative shift in order to understand fractions and use them in calculations. The findings instead suggest that fractions are built upon the system that is employed to represent basic numerical magnitude in the brain," Ansari said.

The study authors, Simon Jacob, MD, and Andreas Nieder, PhD, at the University of Tübingen in Germany, scanned the brains of adult participants as they watched fractions flashed on a screen. The researchers used a technique called functional MRI adaptation (fMRA) to identify brain regions that adapt — or show decreased activity — to the same stimulus presented over and over again.

When the researchers rapidly and repeatedly presented study participants with fractions that equaled approximately 1⁄6, they found decreased activation in the IPS and prefrontal cortex. Then, the researchers showed the participants fractions that deviated from 1⁄6. The more the fraction differed from 1⁄6, the greater the activity in IPS cells. The rapid presentation of each fraction and small variations in fraction value ensured that study participants directly processed the fractions, rather than calculating their values.

These findings suggest that fractions automatically activate the IPS and prefrontal cortex in adults. The researchers found that distinct groups of cells in these brain regions responded to different fraction values. Moreover, the cells responded the same way, whether fractions were presented as either numbers (1⁄4) or words (one-fourth).

The study builds on previous findings showing that human babies and nonhuman primates understand proportions.

"These experiments change the way we should think about fractions,"

said study author Jacob. "We have shown that our highly-trained brains represent fractions intuitively, a result that could influence the teaching of arithmetic and mathematics in schools," he said.

Future research will determine whether children process fractions the same way as adults, who may have learned to do so through experience.

More information: www.jneurosci.org/

Source: Society for Neuroscience