Two brain networks are activated while reading, study finds

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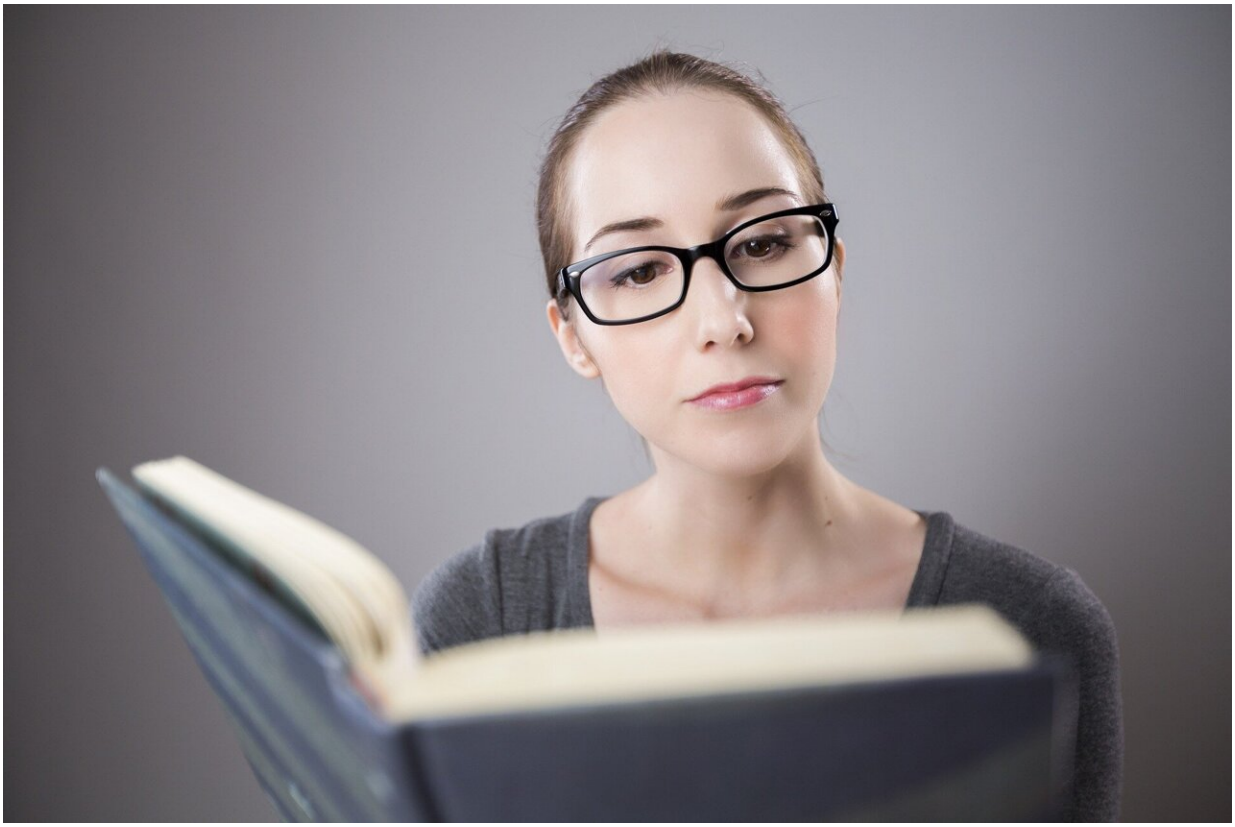

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When a person reads a sentence, two distinct networks in the brain are activated, working together to integrate the meanings of the individual words to obtain more complex, higher-order meaning, according to a

study at UTHealth Houston.

The study, led by Oscar Woolnough, Ph.D., postdoctoral research fellow in the Vivian L. Smith Department of Neurosurgery with McGovern Medical School at UTHealth Houston, and Nitin Tandon, MD, professor and chair ad interim of the department in the medical school, was published today in the *Proceedings of the National Academy of Sciences* (*PNAS*).

"This study helps us better understand how distributed hubs in the brain's language network work together and interact to allow us to understand complex sentences," said Woolnough, first author on the study and member of the Texas Institute for Restorative Neurotechnologies (TIRN) at UTHealth Houston. "Our brains are remarkably interconnected, and for us to understand language requires a precise sequence of rapid, dynamic processes to occur in multiple sites all across our brain."

In order to identify the specific roles and interactions of the brain areas involved in reading, the research team performed recordings from the brains of patients with electrodes surgically placed to localize epilepsy. The neural activity of these patients was measured while reading three forms of sentences: regular sentences; "Jabberwocky" sentences (based on Lewis Carroll's "Jabberwocky" poem), which use correct grammar and syntax but contain nonsense words, making them meaningless; and lists of words or nonsense words.

From these recordings, they identified two brain networks that play a key role in the reading process. One network involves a region of the brain's frontal lobe that sends signals to the temporal lobe, which shows progressive activation when a person is building up complex meaning along the length of a sentence.

The second network involves another region of the brain's temporal lobe that sends signals to an area of the frontal lobe, allowing understanding of the context of a sentence to enable easier comprehension and processing of each new word that is read.

"Implanted electrodes in the brain provide us an unparalleled insight into the inner workings of the human mind, especially for processes that are rapid, such as reading. Our work is making it clear that most processes—say comprehension or language generation—don't occur in a single region, but are best understood as very transient states that many separate areas of the brain achieve by very brief, yet critical, interactions," said Tandon, the study's senior author, who is also the Nancy, Clive and Pierce Runnels Distinguished Chair in Neuroscience of the Vivian L. Smith Center for Neurologic Research and the BCMS Distinguished Professor in Neurological Disorders and Neurosurgery with McGovern Medical School.

Understanding the science behind the highly rapid, complex process of reading will allow the researchers to learn more about how the brain functions during dyslexia. Ultimately, they hope their findings will help guide treatment options for the reading disorder, which affects approximately 15% of people living in the U.S.

More information: Woolnough, Oscar et al, Spatiotemporally distributed frontotemporal networks for sentence reading, *Proceedings of the National Academy of Sciences* (2023). DOI: 10.1073/pnas.2300252120

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