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Part Of Human Brain Functions Like A Digital Computer, Professor Says

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A region of the human brain that scientists believe is critical to human intellectual abilities surprisingly functions much like a digital computer, according to psychology Professor Randall O'Reilly of the University of Colorado at Boulder.

The finding could help researchers better understand the functioning of human intelligence.

In a review of biological computer models of the brain appearing in the Oct. 6 edition of the journal *Science*, O'Reilly contends that the prefrontal cortex and basal ganglia operate much like a digital computer system.

"Many researchers who create these models shun the computer metaphor," O'Reilly said. "My work comes out of a tradition that says people's brains are nothing like computers, and now all of a sudden as we look at them, in fact, in a certain respect they are like computers."

Digital computers operate by turning electrical signals into binary "on and off states" and flexibly manipulating these states by using switches. O'Reilly found the same operating principles in the brain.

"The neurons in the prefrontal cortex are binary -- they have two states, either active or inactive -- and the basal ganglia is essentially a big switch that allows you to dynamically turn on and off different parts of the prefrontal cortex," O'Reilly said.

The brain as a whole operates more like a social network than a digital computer, with neurons communicating to allow learning and the creation of memory, according to O'Reilly.

However, the computer-like features of the prefrontal cortex broaden the social networks, helping the brain become more flexible in processing novel and symbolic information, O'Reilly said.

The prefrontal cortex is the executive center of the brain and supports "higher level" cognition, including decision making and problem solving. Researchers believe that the prefrontal cortex is critical to human intellectual ability, and better understanding it is crucial to understanding more about human intelligence, according to O'Reilly.

If researchers can gain a better understanding of this synthesis of the prefrontal cortex and the brain as a whole, they could be on the way to a better understanding of human intelligence.

The best way to do this, O'Reilly says, is by developing more biologically based computer models of the brain to help researchers understand how the biology of the brain works, and eventually provide insights into what makes us so smart.

"Modeling the brain is not like a lot of science where you can go from one step to the next in a chain of reasoning, because you need to take into account so many levels of analysis," O'Reilly said.

O'Reilly likens the process to weather modeling.

"Most weather models don't exactly represent what happens in a low-pressure system, but they do capture some global features," he said. "If you capture the essence of it, it tells you a lot about how the system works. It's the same premise when it comes to modeling of the brain."

Source: University of Colorado at Boulder