Brain simulation raises questions

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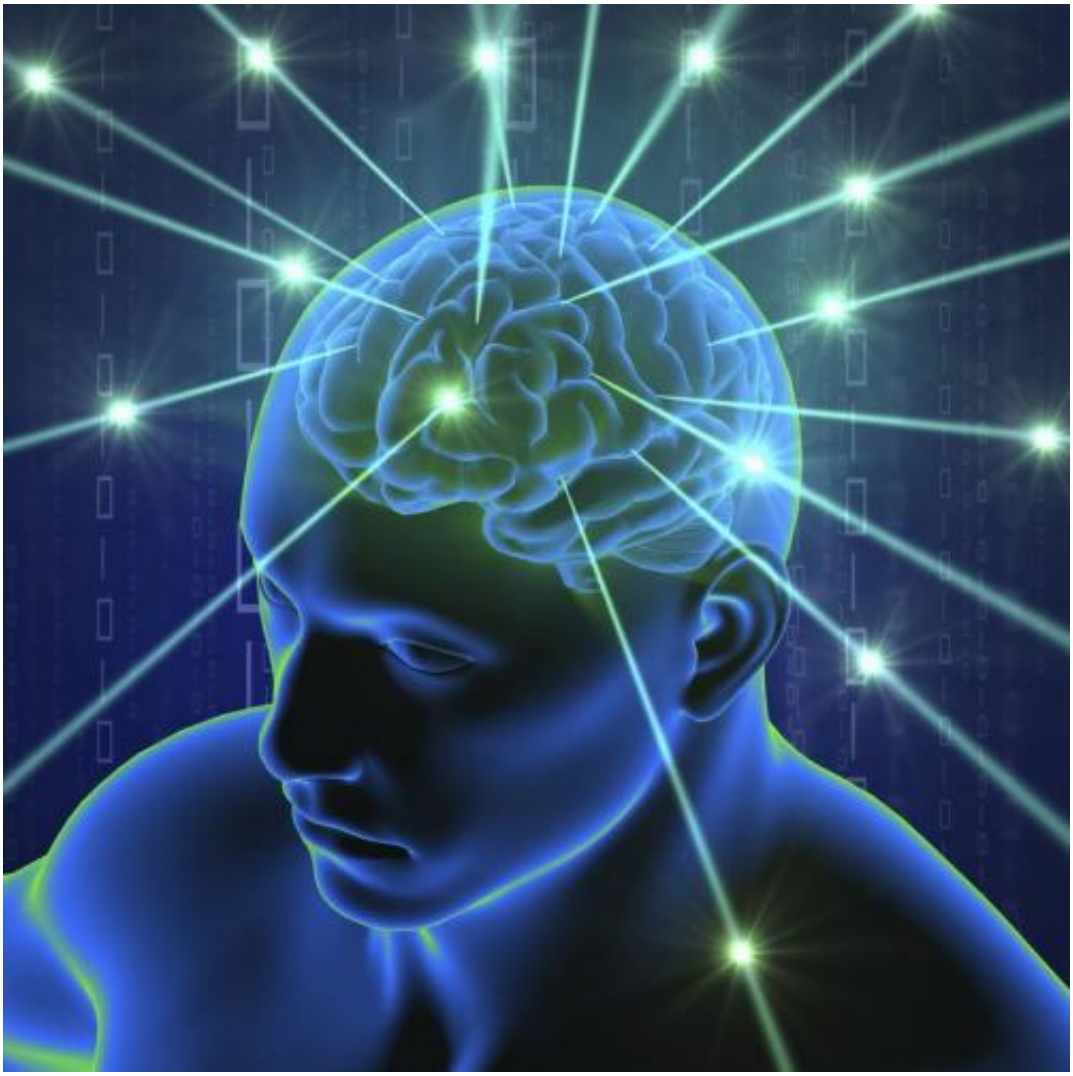

Credit: Rice University

What does it mean to simulate the human brain? Why is it important to

do so? And is it even possible to simulate the brain separately from the body it exists in? These questions are discussed in a new paper published in the scientific journal *Neuron* today.

Simulating the brain means modeling it on a computer. But in real life, brains don't exist in isolation. The brain is a complex and adaptive system that is seated within our bodies and entangled with all the other adaptive systems inside us that together make up a whole person. And the fact that the brain is a brain inside our bodies is something we can't ignore when we attempt to simulate it realistically. Today, two Human Brain Project (HBP) researchers, Kathinka Evers, philosopher at the Centre for Research Ethics and Bioethics at Uppsala University and Yadin Dudal, neuroscientist at the Weizmann Institute of Science, publish a paper in *Neuron* that discusses the questions raised by brain simulations within and beyond the EU flagship project HBP.

For many scientists, understanding means being able to create a mental model that allows them to predict how a system would behave under different conditions. For the brain sciences, this type of understanding is currently only possible for a limited number of basic functions. In the article, Kathinka Evers and Yadin Dudal discuss the goal of simulation. In broad terms it has to do with understanding. But what does understanding mean in neuroscience?

As it dwells inside our bodies, the brain is always a result of what the individual has experienced up to that point. That is why, when we simulate the brain, we have to take this 'experienced brain' into account and try and reflect that.

According to Kathinka Evers, leader of the Ethics and Society part of the Human Brain Project, neglecting this experience would severely limit the outcome of any brain simulation. But if we are to include experience we have to simulate real-life situations.

"That is a daunting task: a large part of that experience is the brain's interaction with the rest of the human body existing and interacting in a still larger social context", says Kathinka Evers.

What outcome would be realistic to hope for in the Human Brain Project's simulation? In neuroscience, computer simulations of specific systems are already in use. These simulations are a complement to other tools scientists use.

But there are some warnings to issue here. According to Kathinka Evers and Yadin Dudal, our knowledge to date is still very limited. There are many neuroscientists who think that it is too early for large scale brain simulations. Collecting the data we need for this is not an easy task. Another problem is whether we truly can understand what we are about to build. There are also technical limitations: there simply isn't enough computing power available today.

But if we do manage to simulate the brain, would that mean we have created artificial consciousness? And can a computer be conscious at all? According to Kathinka Evers and Yadin Dudal, that depends on what consciousness is: If it is the result of certain types of organization or functions of biological matter, like the cells in the human body, then a computer can never gain consciousness. But if it is a matter of organization alone, without the need for biological matter, then the answer could be yes. But it is still a very hypothetical stance.

More information: Dudai et al.: "To Simulate or not to Simulate: What are the questions?", *Neuron* (2014)

Provided by Uppsala University