How plastic is your brain? UH engineer seeks answers

April 27 2007

It may seem easy to change your mind, but if it's your brain we're talking about, maybe it's harder than we think. A University of Houston professor is looking into this with research into something called 'brain plasticity.'

Valery Kalatsky, assistant professor of electrical and computer engineering in the Cullen College of Engineering at UH, is collaborating with Hubert Dinse, a cognitive neurobiology professor with Ruhr University in Bochum, Germany, to predict the extent of recovery from brain injuries. Kalatsky has created a new device that more quickly and accurately reveals how "plastic," or adjustable, adult brains are. The duo's work is supported by a three-year, $750,000 grant from the Human Frontiers Science Program, an organization dedicated to bringing together scientists with expertise in different fields and from different parts of the world.

Brain plasticity is at its peak with infants, when brains are most capable of adjustment. Babies who suffer significant brain trauma, for example, may make near-complete recoveries, but adults with similarly severe injuries seldom recover as well. That's because babies' brains are in the process of organizing themselves and are able to assign tasks normally performed by the damaged areas to the still-functioning portions.

Because adult brains are already organized, they have much less plasticity and make much smaller adjustments when damaged. Recent research, however, has called into question the long-held dogma that the adult brain is almost "hard-wired," but there's no consensus on just how plastic it is, Kalatsky said.

Kalatsky and Dinse are working to measure systematically the level of adult brain plasticity by directly stimulating the visual cortex, which controls sight, and using an optical imaging device developed by Kalatsky to record changes in and around the stimulated areas.

To study plasticity, researchers use various techniques and tools to produce maps that outline exactly which sections of the brain control what functions. When studying the visual cortex, an orientation map tells researchers what part of the cortex prefers objects oriented to specific angles, such as horizontally and vertically aligned objects.

Using standard tools, it traditionally takes scientists hours to create a single orientation map. They then stimulate an area of the brain, causing it to reorganize, and create additional orientation maps that again takes hours. As a result, these researchers usually are able to acquire only a few maps that show the cortex's functional structure before and after reorganization.

"The drawback to this method is analogous to that of trying to photograph a squirrel with low-speed film," Kalatsky said. "If you want to capture a tortoise, long exposures are not a problem, but if you want to capture a squirrel, you have to be really fast."

Kalatsky and Dinse's approach will provide a much more comprehensive picture of adult brain plasticity, because Kalatsky's device creates orientation maps 30 times faster than standard methods. This project also distinguishes itself by how much and what kind of data it will collect.

With this device, Kalatsky and Dinse will take an initial reading of the visual cortex. A small section of the visual cortex then will be directly stimulated, resulting in that section and the surrounding areas reorganizing themselves. The imaging device, because of its speed, will create orientation maps every few minutes during reorganization, providing a much more dynamic understanding of brain plasticity.

"With this approach, we'll be able to see the reorganization as it happens," Kalatsky said.

These maps will help scientists determine how much recovery from brain injury is possible without the assistance of medication. It also will give scientists the foundation to conduct research into not just the plasticity of the adult brain, but also how that plasticity can be manipulated.

"This research may yield new medicines and treatments that could help repair brain damage," he said. "First you have to understand the baseline and determine how plastic the adult brain is on its own, and then you can to try to increase the level of plasticity through therapies that may or may not involve pharmacology."

Source: University of Houston

Citation: How plastic is your brain? UH engineer seeks answers (2007, April 27) retrieved 19 April 2024 from https://phys.org/news/2007-04-plastic-brain-uh.html

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