A pacemaker for your brain

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By stimulating certain areas of the brain, scientists can alleviate the effects of disorders such as depression or Parkinson's disease. That's the good news. But because controlling that stimulation currently lacks precision, over-stimulation is a serious concern — losing some of its therapeutic benefits for the patient over time.

Now a Tel Aviv University team, part of a European consortium, is delving deep into human behavior, neurophysiology and engineering to create a chip that can help doctors wire computer applications and sensors to the brain. The chip will provide deep brain stimulation precisely where and when it's needed.

Prof. Matti Mintz of Tel Aviv University's Psychobiology Research Unit in its Department of Psychology is focusing on the behavioral-physiological aspects of the research. He and the rest of the international research team are working toward a chip that could help treat some diseases of the mind in just a few years. The platform, says Prof. Mintz, is flexible enough to provide a basis for a variety of clinical experiments, and tools which can be programmed for specific disorders. For example, the chip could restore lost functions of the brain after a traumatic brain injury from a car accident or stroke.

Reversing strokes, depression and aging

The team's methodology is straightforward — they record activity using electrodes implanted in diseased areas of the brain. Based on an analysis of this activity, they develop algorithms to simulate healthy neuronal

activity which are programmed into a microchip and fed back into the brain.

For now, the chip, called the Rehabilitation Nano Chip (or ReNaChip), is hooked up to tiny electrodes which are implanted in the brain. But as chips become smaller, the ReNaChip could be made small enough to be "etched" right onto the electrodes themselves.

For therapeutic purposes, though, only the electrodes will be inserted into the brain. "The chip itself can be implanted just under the skin, like pacemakers for the heart," says Prof. Mintz, who is currently conducting experiments on animal models, "ensuring that the brain is stimulated only when it needs to be."

One of the challenges of the proposed technology is the size of the electrodes. The researchers hope to further miniaturize deep brain electrodes while adding more sensors at the same time says Prof. Mintz. His Tel Aviv University colleague and partner Prof. Yossi Shaham-Diamond is working on this problem.

The international multidisciplinary team, includes other researchers from TAU -- Prof. Hagit Messer-Yaron and Dr. Mira Kalish -- and partners from Austria, England and Spain, regularly converge on the TAU campus to update and integrate new components of the set-up and monitor the progress of the chip in live animals in Prof. Mintz's lab.

A two-way conversation

The idea that a chip can interface between inputs and outputs of certain brain area is a very new concept in scientific circles, Prof. Mintz notes, although movies and TV shows about bionic humans have been part of the popular culture for decades. The researchers say that their ReNaChip could help people whose brains have deteriorated with age or been

damaged by injury and disease. The chip will not only provide a bionic replacement for lost neuronal function in the brain, under ideal conditions, it could significantly rehabilitate the brain.

Currently, the researchers are attempting to rehabilitate motor-learning functions lost due to brain damage. "We are attaching the chip to the brain to stimulate relatively simple brain behaviors," says Prof. Mintz. A controlled treatment for drug resistant epilepsy, based on the team's technology, could be only a few years away, he says.

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