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from medical technology to commercial products

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In This Issue

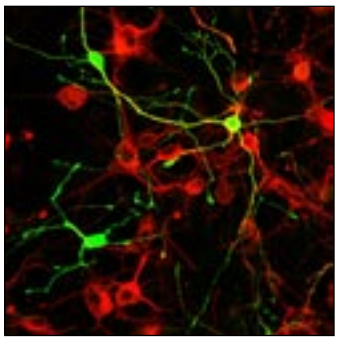
Departments

New Neuroimaging Tool Helps Locate Depression Circuit

by James Cavuoto, editor

A team of researchers at Stanford University has developed a new form of neuroimaging to help their quest to uncover the faulty brain circuits involved in depression. The technique, called voltage-sensitive dye imaging, allows intact brain circuits to be viewed in real time, enabling researchers to watch living neurons in action, across entire brain networks.

Writing in the July 6 issue of *Science Express*, the advance online publication of the journal *Science*, Karl Deisseroth, assistant professor of bioengineering and of psychiatry and behavioral sciences, along with Raag Airan, an MD/PhD student in Deisseroth's lab, described their effort to explain how a range of causes and treatments for depression converge.



Voltage-sensitive dye imaging process developed at Stanford helps researchers locate neuronal circuits involved with depression.

They found that in rats the differing mechanisms of depression and its treatment in the end appear to funnel through a single brain circuit. Changes in how the electrical signals spread through the circuit appear to be the cause of depression-related behavior, according to their study.

"I think this will help us make sense of how there can be so many different causes and treatments of depression," said Deisseroth. "It also helps us understand conceptually how something that seems as hard

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Task Force Addresses Access to New Neurotech Therapies

by James Cavuoto, editor

A newly organized task force representing clinicians, health service providers, payers, and neurotechnology vendors is seeking to expand the availability of neurotechnology devices for individuals with neurological and psychiatric disorders. The National Task Force on Consumer Access to Emerging Neurotechnologies held its inaugural meeting earlier this year and recently published a whitepaper specifically targeted to severe depression. Cyberonics, Inc., the Houston, TX manufacturer of vagus nerve stimulation systems, provided funding for the initial meeting but the group is currently seeking sponsorship from other neurotech device vendors.

The members of the new task force include several clinicians and academics involved with treatment-resistant depression, including Roger Haskett, a professor of psychiatry at University of Pittsburgh, Lawrence Cohen, a professor of pharmacotherapy at Washington State University, and Darin Dougherty from Massachusetts General Hos-

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Conference Report

Neuroscientists and Philosophers Discuss Consciousness at ASSC Meeting

by James Cavuoto, editor

Several hundred researchers and academics attended the 11th meeting of the Association for the Scientific Study of Consciousness June 22-25 in Las Vegas, NV. While much of the program was devoted to more abstract presentations on human consciousness, several presenters discussed the use of neurotechnology tools as a means of measuring and evaluating brain states.

Among the featured lecturers at the conference was Michael Gazzaniga from UC Santa Barbara. Gazzaniga spoke on the structure of human consciousness, proposing a theory that conscious experience emerges from the dynamic interactions of specialized component processes via a distributed neuronal network. His model seeks to address the dichotomy presented by the segregation of neural processing into specific brain regions on one hand and the integrative multi-modal processes that overcome modular segregation on the other hand.

Alison Gopnik from UC Berkeley addressed the question of consciousness in babies, arguing that babies are more conscious than adults since there is less inhibition of phenomenological experience.

Several clinical specialists used their experience with neurological disorders as a platform for evaluating conscious states. Fabien Perrin from the Laboratoire de Neurosciences Sensorielles in Lyon, France, presented a paper on sensory discrimination in patients with severe brain damage, Perrin and colleagues used electrophysiological studies with 14 brain-damaged patients. He noted a P300 response to hearing the patient's own name in locked-in individuals or minimally conscious state, and most of the patients in a vegetative state.

George Mashour from the department of anesthesiology at the University of Michigan spoke of his experiences using tools such as Aspect Medical's BIS index for depth of anesthesia. While the incidence is rare, in about one to two cases out of 1000, surgical patients may be aware of intraoperative events without the presence of any objective indices. Labeling these individuals "inverse zombies," Mashour discussed the challenge of ensuring the absence of qualia and its implications for the study of human consciousness.

Stephen Macnick from the Barrow Neurological Institute in Phoenix, AZ presented an intriguing paper on the role of feedback in visual masking, visual awareness, and attention. Macnick and his colleague Susana Martinez-Conde examined the neurophysiological mechanisms accompanying visual masking tasks in primates. They propose a feedforward model of visual masking, suggesting that the ratio of feedback versus feedforward connections in the visual system may be explained solely by the critical need for top-down attentional modulation.

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developing a novel technology based on stimulating the sphenopalatine ganglion to induce cerebral vasodilation.

Harry moved to the position of executive vice president and chief technology officer. James Niemi, who previously had worked with Harry at NMT Medical, is now VP of research, and Scott Kellogg is VP of product development. The company has eight employees, and plans to add staff as the products under development approach commercialization.

Although Afferent is initially concentrating on the stroke, diabetic, and elderly balance markets, the company sees its technology as a new class of devices for treating a variety of chronic neurological dysfunctions. In addition to the immediate benefit of improving the sensitivity of mechanoreceptors, the company is pursuing the possibility that subthreshold sensory stimulation can produce permanent changes in neural pathways and restore functions in the brain through the process of neuroplasticity. One of the critical factors in successful recovery of function after stroke or brain injury is the flow of appropriate sensory information from the peripheral limbs. Increasing the sensitivity of the sensory pathways with either electrical or mechanical stimulation could improve standard rehabilitation efforts. If current animal and human studies show positive results, Afferent plans to initiate a pivotal study to determine the benefits in stroke rehabilitation of combining sensory stimulation with physical therapy.

Mechanical and electrical stimulation devices are both under development. A device that combines mechanical and electrical stimulation is being investigated. In such a device, a mechtrode on the skin would generate surface mechanical stimulation to the skin and electrical stimulation to deeper structures. Another approach being developed by Afferent is the use of implanted electrodes to boost sensorimotor functions in patients with more severe sensory loss and motor dysfunction.

The company's technology base attracted the attention of a major orthopedics company, Stryker Corp., which invested an undisclosed amount in Afferent in January 2007. For its investment, Stryker gains an insider's view of the technology as it unfolds. The deal was negotiated by Stryker Development, which finds new business opportunities for its parent.

According to Hable, the Stryker investment is an important validation of Afferent's technology. "They see the neuro area as an attractive, strategic market, both for stand-alone applications and for areas that are complementary to their existing product lines," he said in an interview with *Neurotech Business Report*.

Stryker's revenue was $5.4 billion in 2006, and about one-third came from outside the U.S. It operates two major divisions, orthopedic implants, and medical and surgical equipment. Stryker also operates almost 500 outpatient physical therapy centers in the U.S. When Afferent is ready to market a vibrating insole or an electrical stimulation device to improve balance in the elderly, it is possible that Stryker's physical therapy centers would be an ideal way to reach a large customer base. Similarly, when Afferent develops implanted devices, Stryker's orthopedic group might offer to market them.

The Stryker deal also will help smooth the way for Afferent's Series B round, which is expected to raise $15 million for product development and clinical trials that could pave the way for FDA approval of Afferent's first product.