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Expanding the Boundaries

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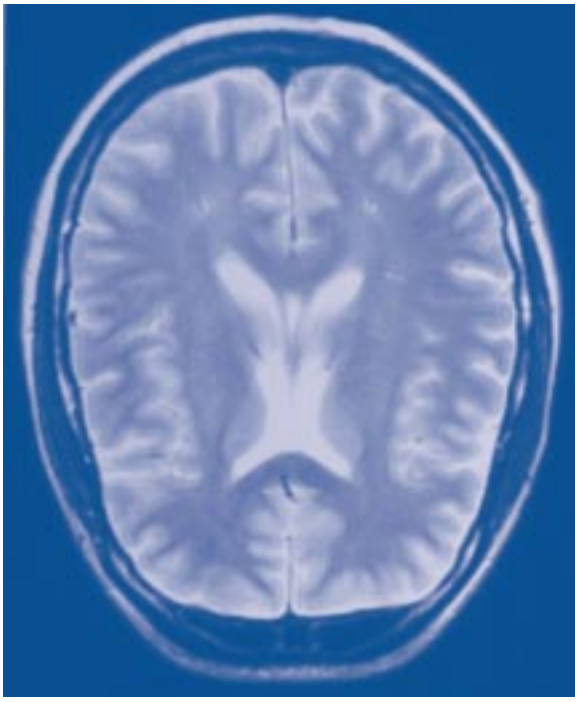
Moss Rehabilitation Research Institute

Functional Neuroimaging: Shedding Light on Brain Function

Researchers at MossRehab are using this advanced technique to understand brain injury and how healthy portions of the brain compensate for the areas that are impaired.

It sounds like a scene from a science fiction movie: technology that makes portions of a living, working brain "light up" on an imaging screen.

But fortunately for people with brain injury due to stroke or trauma, that technology is here today. It's known as functional neuroimaging. Researchers at Moss Rehabilitation Research Institute are using this advanced technique to understand brain injury and how healthy portions of the brain compensate for the areas that are impaired.



"Functional neuroimaging is a relatively recent advance in radiology that actually shows us how the brain works," says John Whyte, MD, PhD, Director, Moss Rehabilitation Research Institute. "Older imaging techniques, such as X-ray, CT scan and magnetic resonance imaging, simply provide information about the brain's structure. All too often though, an injured brain looks normal, but does not work well. We hope an improved understanding of neurologic function will lead to more effective treatments for people with brain injury."

A five-year grant from the National Institutes of Health, entitled "The Northeast Cognitive Rehabilitation Research Network" is allowing Dr. Whyte and his colleagues from MossRehab, the University of Pennsylvania, Bryn Mawr Rehab and Magee Rehabilitation Hospital to pursue this promising area of study. "This grant provides us with access to the technical expertise of the University of Pennsylvania's well-respected functional imaging program," he says. "The collaboration also gives Penn an incentive to apply their skills to the field of rehabilitation medicine."

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Blood Flow: Key to Pinpointing Brain Activity

Functional imaging highlights active areas of the brain by tracking blood flow. "We know that blood flow increases in any area of the body that is at work," says John A. Detre, MD, Associate Professor of Neurology and Radiology at University of Pennsylvania, and Principal Investigator of the Neuroimaging Core. "For example, if you are shoveling snow, blood flow to the arms increases. The same phenomenon can be observed in the brain. Areas that control mental processes, such as attention, undergo an increase in blood flow when activated." Areas of heightened blood supply appear to 'light up' on screen when the patient is scanned using functional neuroimaging techniques.

An important part of the research involves the scanning of normal subjects who do not have a brain injury. This is done to identify the areas that should be active in subjects with brain injury. These scans provide researchers with a template of normal brain activity.

Next, participants with brain injury are asked to complete evaluations called "Go/No Go" tasks. During scanning, they are shown a screen containing two lines that may be of equal or varying lengths. Subjects are asked to press a button when they see two lines of equal length. Researchers then document active areas of the brain, regions that are not working well and those that seem to compensate for damaged areas.

During the second phase of the study, researchers change the task so that the time interval between the appearance of matching lines is longer. This makes it more difficult for subjects to maintain their attention. A flashing light is also introduced on-screen as an added distraction.

Researchers give study participants tablets prior to the scanning. On one day, participants receive placebos without active ingredients; on a different day, they take Ritalin, a medication that is often used to reduce distractibility in children with attention disorders. Finally, participants are rescanned and their performance on the "Go/No Go" task is assessed. Previous non-imaging studies have shown that Ritalin can help patients with brain injury to complete computer-based and sorting tasks. This new study will help determine whether the drug has any effect on brain activity and if these changes improve the patient's ability to concentrate, resist distraction and complete tasks successfully.

MossRehab Researchers Study the Learning Process

Laurel Buxbaum, PsyD, Institute Scientist at Moss Rehabilitation Research Institute, is using functional neuroimaging to determine how normal individuals learn about the world around them and store information for future reference. Dr. Buxbaum and her colleagues hope to observe whether the brain warehouses different kinds of information in different locations.

"We suspect that certain things are represented in the areas of the brain responsible for vision, while others are stored in the areas responsible for movement," she says. "For example, if I say the word 'zebra,' chances are you'll conjure up a visual image, complete with black and white stripes. But if I say the word, 'hammer,' you'll be more likely to activate the motor areas of the brain. That's because we tend to learn about tools by using them, not by simply seeing them."

Dr. Buxbaum says that learning more about the way people store information may help researchers design better strategies for intervention following brain injury. "The hope is that we can target rehabilitation techniques that bypass damaged areas and make use of those that are intact."