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Cathy Smith, R.T.(R)(CT),
is the magnetic resonance
imaging technologist at the
Mind Research Network.

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Mind Over Matter

fMR Imaging Peers into the Brain's Activities

BY JENNA R. FROSCH, ASRT ASSOCIATE EDITOR

Approximately 6 percent of Americans suffer from a debilitating mental illness, according to the National Institutes of Health, and in a given year, approximately one-quarter of adults are diagnosed with one or more disorders. Using imaging technology, the Mind Research Network is trying to discover and advance clinical solutions for preventing, diagnosing and treating mental illness and other brain disorders.



IMAGES: KIP MALONE

**Mind Research Network's
MR technologist Cathy Smith.**

"The vision of MRN is to be a hub of neuroimaging, genetic and clinical data sharing within the United States," said Jody Roberts, MRN director of research and clinical operations. "This is so that the incredibly valuable data collected here and in other research labs can be easily accessed and reused for other studies, while protecting subject confidentiality."

The not-for-profit institution based in Albuquerque, N.M., is set apart by its dedication to sharing data across well-known laboratories: Massachusetts General Hospital's Martinos Biomedical Imaging Center (Harvard University and the Massachusetts Institute of Technology), the University of Minnesota, the University of New Mexico and

MRN uses several imaging modalities to study brain function, including magnetic resonance imaging, diffusion tensor imaging, functional MR imaging, MR spectroscopy, magnetoencephalography and electroencephalography.

Los Alamos National Laboratory. This means a common database is used for storage and access to brain structural and functional data, giving investigators data sets that come from hundreds of subjects rather than just 20 to 40 subjects in a typical imaging study.

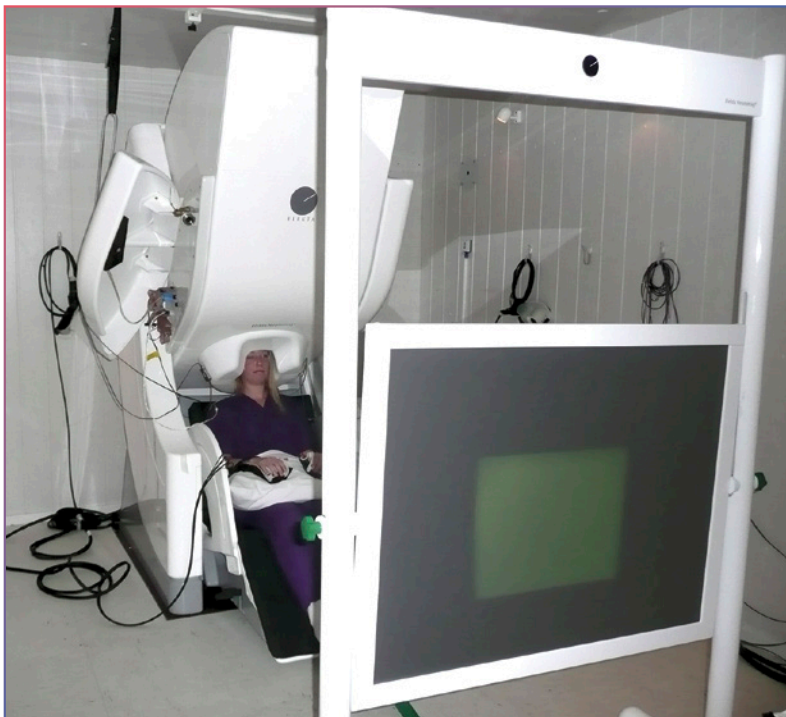
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tion, including magnetic resonance imaging, diffusion tensor imaging, functional MR imaging, MR spectroscopy, magnetoencephalography and electroencephalography.

"These techniques directly measure brain function and electrophysiology on a time scale of milliseconds," Jody said. "When used in combination with structural and functional MR, these methods allow MRN to track brain activity in health and disease." For example, Jody said these methods show that the temporal interactions between a range of brain areas are disrupted in conditions like schizophrenia, multiple sclerosis, autism and fetal alcohol syndrome.

MRN has two MR imaging machines — a stationary Siemens 3T Trio and a mobile 1.5T Siemens Avanto scanner. The Trio comes with a 32-channel head coil and is capable of blood oxygen level dependent contrast in echo-planar imaging, diffusion tensor imaging, arteriole spin labeling, perfusion and diffusion imaging, and spectroscopy. The Avanto is the most advanced system of this strength and is integrated into a trailer equipped with functional imaging capabilities.

ASRT member Cathy Smith, R.T.(R)(CT), a research MR imaging technologist for MRN, calls working in neuroimaging a technological



The Elekta Neuromag Vector View 306 channel magnetoencephalography machine maps brain activity by recording magnetic fields produced by naturally occurring electrical currents in the brain. MRN uses the machine in many of its research studies.

feat. “I see myself as part technical, part problem-solver, part cheerleader and part patient care advocate,” she said.

Cathy works with research assistants at MRN to ensure the best possible data is collected. Using a network of computers, input devices, projectors and even an alcohol taste machine, she provides research subjects a variety of stimuli during imaging procedures. All of these components allow MRN investigators to observe how the brain reacts to the stimulus.

Because MRN often studies subjects with physical and mental challenges, it’s important that Cathy makes the study participants as comfortable as possible. “This is where the patient care advocate and cheerleader duties come into play,” she said.

Research includes studies of schizophrenia, fetal alcohol syndrome, traumatic brain injury, adult and teen chemical dependence, forensics and post-traumatic stress disorder, to name a few. In a recent study, investigators identified features in the brain to help discriminate different psychoses from each other and from healthy brains. The research examined structural and functional differences between schizophrenia and bipolar disorder, as well as common dysfunctions that separate both of the disorders from healthy function.

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Logis- tics

Mind Research Network



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In another study, investigators found that pediatric traumatic brain injury from sports and other events can have lasting detrimental effects. In the study, the investigators found that fMR imaging could provide very sensitive measures of decreased activation across various brain regions in pediatric traumatic brain injury patients who had no deficit in their clinical measures. This could serve as a biomarker for measuring the subtle injury caused by these traumatic brain injuries.

But, according to Jody, these studies don't just happen. "Before any research study can commence, the study aims, goals and procedures need to be reviewed by an internal and external review board," she said. The boards determine whether the study is in line with MRN's procedures and policies and whether the study is feasible. One of the most important factors is making sure the human-involved study is performed ethically and the risk-benefit ratio for the study is acceptable.

Cathy said there are similarities and differences in working in the research field compared to a traditional clinical practice. "In the clinical environment, our goal is to provide the best possible care while obtaining quality images to aid in diagnosis and treatment," she said. "On the research side, we maintain the goals of providing the best possible care and obtaining the best quality imaging, functional and spectroscopic data."

However, patient preparation is different. During the research process, patients have to be prepared for what to expect during an MR procedure and also for completing a variety of tasks using the peripheral equipment

while in the scanner. Many times, the subjects are taught a task outside of the scanner, then fitted with an MRN-patented hand response device, a special mirror and projection screen system in the scanner that enables them to complete the same tasks during fMR imaging sequences.

MRN was founded in 1998 with the support of former U.S. Sen. Pete Domenici of New Mexico. His original vision was to use state-of-the-art MR imaging and MEG along with genetic analysis to better understand and advance studies of mental illness. In the past 14 years, however, the mission has expanded well beyond the use of neuroimaging tools and technologies.

Continued funding is provided by federal, state and private sources, but the majority comes from competitive National Institutes of Health awards. Currently, MRN is working on about 60 active awards.

MRN is instrumental in gathering research data to help researchers gain more knowledge about mental illness. In a degenerative disease such as Alzheimer's, MRN researchers are gaining ground. In one such study, investigators found a major structural network showing gray matter loss in Alzheimer's disease along with several genetic components that contributed to this loss. "The primary focus of MRN is to understand the foundations of brain disease, such as Alzheimer's disease, as needed to develop and evaluate new clinical treatments," Jody said. "Hopefully we can make a difference in someone's life with our research."



Developed and patented by MRN, this device is specifically designed for use in a functional magnetic resonance environment. It allows subjects to answer questions manually while being scanned.

WANTED: To Study Your Brain on Alcohol

Learning more about the Mind Research Network by becoming a research subject.



Found on Craigslist: Seeking individuals, 21 to 55 years of age, without nonremovable metal in their body, who are current drinkers. The study involves two appointments, both at the Mind Research Network. Earn cash.

I could always use extra cash. And I enjoy the occasional pint of beer or glass of wine. So, I thought, why not? I answered the Craigslist ad.

Little did I know, the study I would join would involve about 200 participants and take five years to conduct, according to Kent Hutchinson, Ph.D., professor of translational neuroscience and an investigator on the study.

Research studies have shown that about 80 percent of people who have undergone treat-

ment for alcohol dependency will have a relapse within 12 months of treatment. "We are trying to develop more effective approaches by developing new medications and by finding ways to match an individual with the treatment that is most likely to be effective for them," Kent said. "We are hoping that the MR imaging test or genetic tests may give us some clues about which treatment is most likely to work for an individual."

The study involved two appointments at the Mind Research Network. During the first one, I was asked a series of qualifying questions about my personal history and my drinking habits, including what my favorite alcoholic beverage was — pinot noir. Questions included “In the last year, when you drank alcohol, how many drinks did you consume on average on one occasion?” “Do you often have hangovers Sunday or Monday mornings?” and “How much sadness do you feel on average?” My responses were used to determine whether I would be a good candidate for the study, which was funded by the National Institute on Alcohol Abuse and Alcoholism, part of the National Institutes of Health.

When I completed the initial questionnaire and interview questions by the research assistant, I was

I spent the next hour in the MR unit, holding MRN’s input device and having my brain scanned while I performed various tasks.

told I would be contacted within a few days to schedule the actual functional magnetic resonance imaging procedure.

On my next visit, I was led to a room where the research assistant explained

the procedure and what I could expect, and then was asked if I had any questions. Admittedly, I felt a little silly going through all of this, but I was fascinated by the research and how I could somehow be a small part of the findings.

After the initial briefing, I was instructed to change into a hospital gown complete with booties, take off all of my jewelry and remove anything that contained metal. After the research assistant and the MR technologist verified that I had followed directions, I was taken into the dark exam room and given further instructions.

I spent the next hour in the MR unit, holding MRN’s input device and having my brain scanned while I performed various tasks. One was called the risky behavior task, where I was asked to play a risk-taking game “pumping” a balloon on each trial (and earning points) or banking the current points if I decided the balloon was full enough and any more pumping might make it

At MRN investigators are working hard to learn what they can about mental illness and a barrage of other disorders that affect adults and children.

burst. According to the researchers, this task predicts risky decision making.

Another task included a taste reactivity paradigm, where I was given small quantities of my favorite alcohol or a control beverage such as fruit juice. This task allowed the researchers to test whether there are brain activation differences between alcohol and nonalcoholic tastes.

The MR technologist warned me that I might feel claustrophobic while I was being scanned, but I’ve never felt scared inside small spaces. I also had undergone an MR scan of my left knee the year before, so I knew what to expect. But I didn’t expect the machine to be so loud — like a muffled machine gun being fired. Luckily, the technologist gave me earphones to communicate instructions and made sure I was comfortable.

In many ways, the experience was a rewarding one — not only because I was paid for my participation, but because at

MRN, investigators are working hard to learn what they can about mental illness and a barrage of other disorders that affect adults and children. With the knowledge they gain

from a simple scan like mine, they are taking steps to address these disorders and find the most effective ways to identify and treat them. And you know what? I helped!§

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