Scans let Auburn, UAB scientists look inside the brain

Published: Sunday, February 06, 2011, 6:00 AM

By **Hannah Wolfson -- The Birmingham News**

UAB psychologist David Knight takes a scan of a subject's brain during an experiment looking at how people respond to fear. Here, he gets a baseline image before blasting the person with loud static to see how she responds. Knight is one of many researchers using the scans that were once used to understand the anatomy of the brain to delve more deeply into how the mind works. (The Birmingham News, Hal Yeager)

The hallways at Auburn University's new MRI center are quiet, the offices and laboratories half empty, and the room that will soon house the strongest brain-scanning device in the state is locked up tight.

But the scientists here and elsewhere in Alabama say the work they're doing in this silent space may unlock secrets of the brain.

Around the country and the world, researchers are using brain scans to map the brain's architecture, figure out how it transmits messages, and even look at why we eat what we eat, buy what we buy and learn the way we learn. Their work could lead to breakthroughs in treatments for depression, autism, traumatic brain injury and diseases like Alzheimer's and Parkinson's.

"What we're doing now is just the tip of the iceberg," said Thomas S. Denney Jr., the director of Auburn's Magnetic Resonance Imaging Research Center, which opened in the fall. "We've got this whole area below the surface."

The key to the work is a high-powered machine made for functional magnetic resonance imaging, fMRI. A step above the typical MRI scanner in a doctor's office, these magnets are able to track changes in the brain by measuring oxygen flow.

Originally put to use in the early 1990s, fMRIs give scientists a way to investigate many of the body's functions, including the heart and limbs. But they soon caught on in a range of fields, especially with psychiatrists, psychologists and other social scientists who realized they could provide insight into why people act the way they do.

In the 20 years since the machine came into use, the number of scientific papers citing fMRI studies has skyrocketed from zero to about 2,000 per year, according to the National Institutes of Health. And while early studies focused on the brain's basic anatomy, they're increasingly looking at emotion and higher-order cognition.

For instance, psychologists at the University of Alabama at Birmingham have examined why people choose cheeseburgers over salads, when schizophrenics may not respond to drugs and how autistic children deal with language. At Auburn, researchers with possible projects include a kinesiologist who wants to look at the effects of massage on the brain, a business professor interested in risk-taking and entrepreneurship and an artist curious about how learning art affects the brain.

Take David Knight, a psychologist at UAB who is studying emotional responses, especially fear. On a recent afternoon, Retta Watkins, a UAB undergraduate who volunteered for Knight's study, was strapped into the machine. Pads were stuck to her hands to measure how sweaty she got, and she was given a joystick.

After a quick scan of her basic brain architecture, a series of short tones was piped into the machine, followed by the occasional burst of unpleasant static. Using the joystick, Watkins was able to indicate when she thought she might hear static. Using the scanner, Knight and his team were able to see what happened in her brain when she was braced for the sound, and when she heard it unexpectedly.

"When you have an unpleasant event occurring, what regions of the brain are involved?" Knight asked. While the basic anatomy is largely understood, Knight's work has helped show that the response is larger when the event is unexpected, and the brain is quieter when it's a surprise. And that could have other applications: Knight is applying for funding from the Department of Defense to try a similar experiment on veterans with post-traumatic stress disorder. He's also working with a neuropsychologist to look at patients who've had traumatic brain injuries to see whether they process emotion differently.

While many researchers, like Knight, are doing specific experiments, others are working to catalog brains in their resting state, so scientists can compare a normal brain to one with, say, Alzheimer's, or match up a child's brain and a teenager's to see what's different.

Still other scientists, including Auburn's Gopikrishna Deshpande, who has a joint appointment in psychology and electrical engineering, are focused on the fibers that connect regions of the brain.

"It's a revolution in a certain sense, because there are aspects of the human brain that we couldn't study in animal models, and now with fMRI we can," Deshpande said.

But the fMRI comes with some limitations. First of all, scientists have to be careful not to read too much into the results, which may not always provide a direct link between cause and effect. Second, the scans aren't instantaneous, although future fMRIs may be able to capture shorter and shorter time spans and some researchers are combining fMRI with other devices to fill in the blanks.

Then there's the problem of the machine itself: Although the sleek white capsule looks innocuous, it can trigger claustrophobia and panic. Even the calmest subject may have trouble staying still enough for long stretches to capture clear images -- a wiggle more than a few millimeters can make the scan unusable -- and evaluating patients with certain disorders is even harder. Autistic subjects, for example, may react poorly to the machine's noise, and patients with tremors may move too much.

Experiments also have to be designed to be conducted within the machine, which contains a small computer monitor that can show simple images and a speaker to transmit sound.

"You can't do a typical psychological testing. For example, if you're looking at depression, you can't just say, 'How are you feeling?'" Knight said. "Instead, you have to find new and different ways to probe."

Experimental design is improving, researchers say, as is the strength of the machines themselves. Today, most research-level machines, like UAB's and the one in use at Auburn, are 3 Tesla -- the measurement of the magnet -- about twice as strong as those found in doctors' offices. Auburn is

expecting delivery this summer of the state's first 7 Tesla machine, the highest level used on humans, and UAB wants to create an imaging center with a 7 Tesla machine and other scanning equipment.

The bigger magnets require increased tweaking, Denney said, and Auburn engineers expect to specialize in working on the hardware and software to get good results. With a little time, scientists at NIH predict, the machines could become widely used for everything from evaluating education to lie detecting. Patients might even be able to get their brains scanned for customized treatments of depression and other disorders sooner than many think, Deshpande said.

"I envision this happening within the next 10 years," he said.

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