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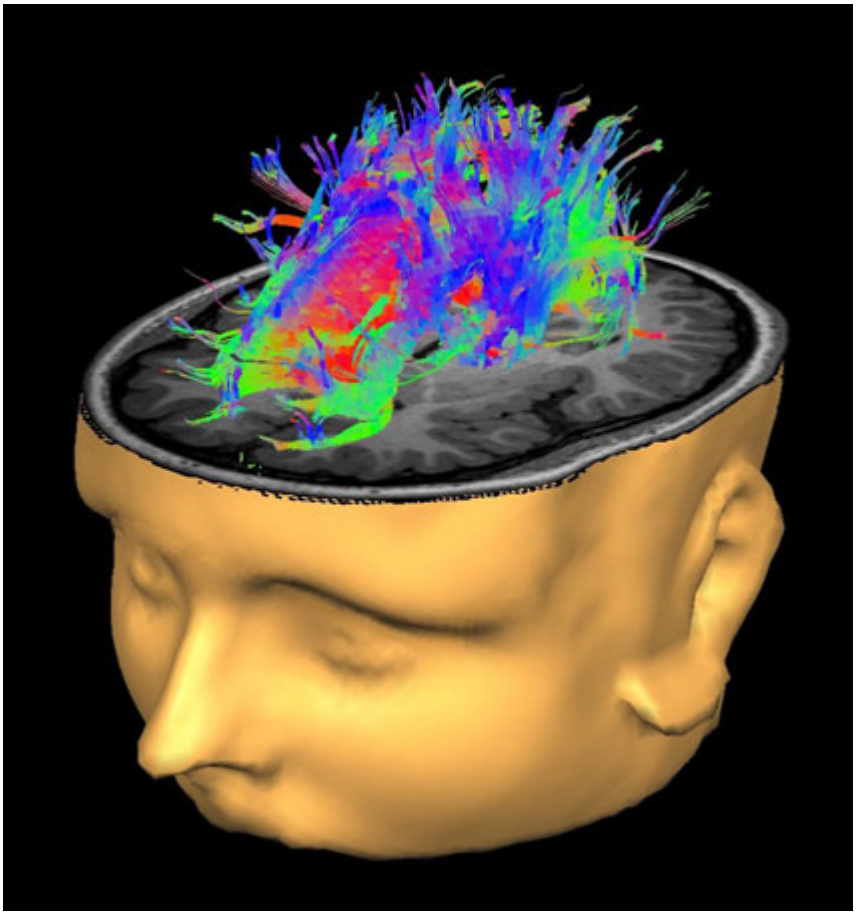
How the brain adapts

A new faculty member uses brain imaging to understand the hand.

Story by Greta Lieske

Every day we perform functions with our hands without giving it a second thought — typing, punching elevator buttons, waving hello to friends or eating. Mizzou newcomer Scott Frey not only thinks about those seemingly simple acts, but also studies them. Frey joined MU in fall 2011 as the first University of Missouri Miller Family Endowed Chair in Cognitive Neuroscience. He came from the University of Oregon to direct the MU Brain Imaging Center, teach and perform research. The center houses an advanced



MU's Brain Imaging Center uses an advanced imaging technique called diffusion tensor imaging to visualize neural pathways

magnetic resonance imaging (MRI) system devoted exclusively to research.

connecting regions of the brain. This scan shows pathways passing through the corpus callosum, a large bundle of neural fibers connecting the brain's left and right hemispheres. Red represents fibers running primarily left-right; blue is up-down; and green is front-back. Scan courtesy of Shawn Christ, assistant professor of psychological sciences.

Frey also will teach as a professor in psychological sciences and serve as an adjunct professor of neurology, psychiatry and physical medicine. He brought along several studies and his research team from Oregon. Together they investigate brain mechanisms involved in using the hands to better understand the potential of the mature brain to compensate for injuries to the brain or body.

He looks at basic mechanisms that allow our brains to refine manual skills, including reaching, grasping, manipulating objects, making gestures and using tools.

"Our hands can create and use tools and technologies, and these abilities have allowed us to re-engineer our environments," Frey says. "We do a host of remarkable things from microsurgery to playing instruments. The desire to understand behaviors that define who we are as a species is a driving force of our work."

The flip side of the work is the goal of applying his team's basic research to the problem of improving rehabilitation for people who have difficulties resulting from neurological diseases or injuries. For instance, the team works not only with stroke victims but also with amputees, including some who have received hand transplants. "We've been one of the few groups in the world to have studied how the brain learns to control and feel sensations with a transplanted hand," he says. Frey studied one patient who lost his right hand in an industrial accident 35 years before receiving a transplanted hand. He discovered that, as early as four months after the transplant, the patient was using the area of his brain that had controlled his native hand to process incoming sensory signals from the transplanted hand. "These results suggest that changes occurring in the brain after an amputation have the potential to be reversed, even many years later and in a fully mature brain," Frey says. His work with these rare patients will continue at MU.

For Frey, this is an exciting time in the history of neuroscience because technology — including the center's MRI machine — allows scientists to peer into the brain. "We can see the structure of the brain and how it changes with development, aging and disease. We can look at brain function and study how it reorganizes in response to things like training or various rehabilitative interventions. Or we can use this tool to look at brain chemistry. It still amazes me that we can do all of this non-invasively. Prior to the availability of such imaging techniques, we were restricted to studies of animal models or post-mortem investigations of the human brain."

Through the center's educational mission, Frey wants to introduce students to his field's techniques and expose the next generation to the challenges and rewards of cognitive neuroscience. The world-class imaging center offers MU researchers and other institutions

the facility, infrastructure and resources for conducting studies using MRI technology.

The center is not used for diagnostic scanning, as a hospital might do. “It’s all research, all the time,” Frey says. The facility is part of the Department of Psychological Sciences but is widely used by researchers from medicine, veterinary medicine, exercise science and nutrition.

Frey says MU’s reputation as a comprehensive research university drew him to campus, but the depth and collaborative nature of the campus research community has exceeded his expectations. “Given my research interests, there is an enormous advantage to being on a campus that has not only arts and sciences and psychological sciences, but also collaborators in engineering and the medical school. I don’t get any sense of this being an internally competitive environment where people are protective of ideas and resources. Instead it’s the opposite. People are forthcoming and work together to achieve greatness. That’s going to make for some exciting collaborative potential that I couldn’t have imagined.”

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