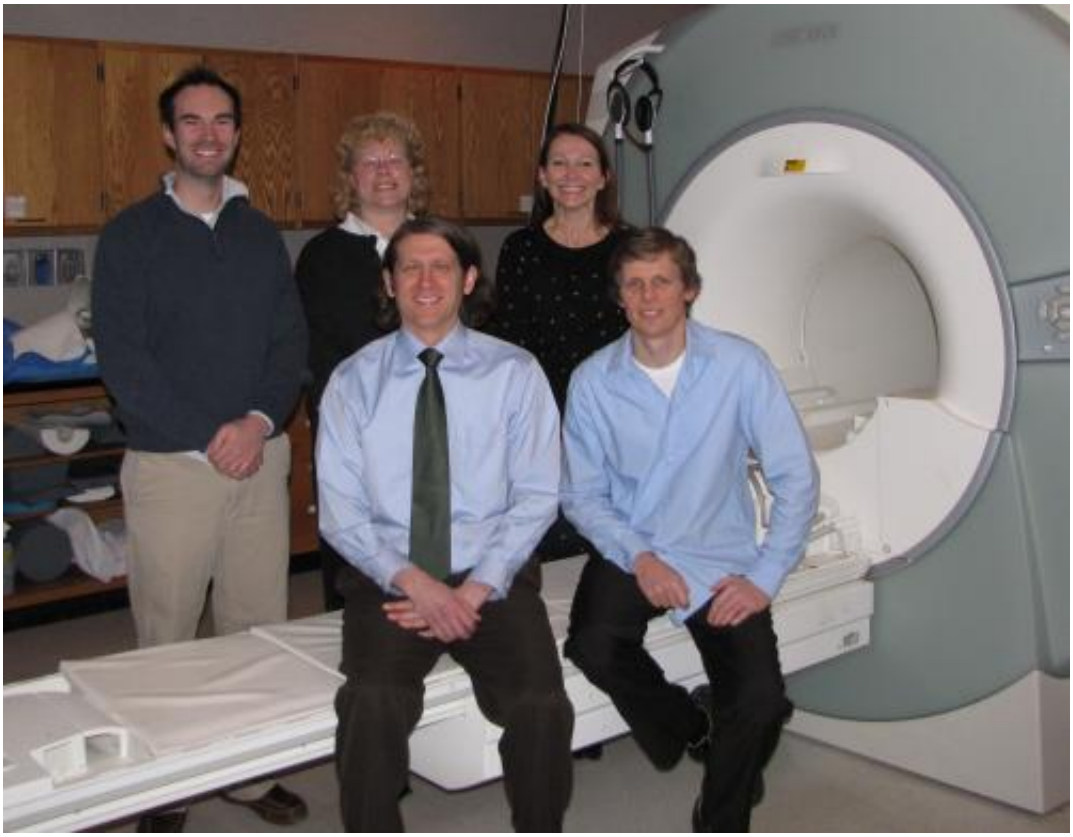
How does fitness affect the aging brain?

April 1 2014, by Mallory Powell



Doug Long, Jody Clasey, Alison Bailey, Dave Powell, and Nathan Johnson in the Magnetic Resonance Imaging and Spectroscopy Center.

We all know that exercise is good for us—it can help us lower blood pressure and cholesterol, maintain a healthy weight, and even improve mood and sleep. But can exercise improve the brain, especially as we age?

A multidisciplinary group of University of Kentucky researchers is working to answer that question. Led by Nathan Johnson, an instructor in anatomy and neurobiology, and Dave Powell, an assistant professor in anatomy and neurobiology, the team includes Jody Clasey, professor of kinesiology and health promotion; Alison Bailey, assistant professor of cardiology; Brian Gold, associate professor of anatomy and neurobiology; and Doug Long, research analyst and study coordinator.

While there is substantial scientific literature about declines in cognitive function and brain structure as we age, and some literature about the effects of physical activity in preventing age-related cognitive decline, there is little understanding about the mechanisms underlying the benefits of exercise in the aging brain. This diverse team of experts is hoping to find answers by using magnetic resonance imaging (MRI) technologies to examine the interplay of brain function and fitness in the aging process.

Specifically, they're interested in the relationship between aerobic fitness and the microstructural integrity of white matter in the brain. For example, a 2012 paper based on Johnson's dissertation at UK explained that cardiorespiratory fitness is positively correlated with the microstructural integrity of white matter in the brains of healthy seniors.

"We were one of the first groups to look at the relationship between white matter microstructural integrity and cardiorespiratory fitness using diffusion tension imaging, and we had one of the first three published papers that explored this relationship," said Johnson.

With pilot funding from the Center for Clinical and Translational Science, their current study, "Is Aerobic Fitness Associated with White Matter Integrity and Cerebral Perfusion in Healthy Older Adults?", builds upon Johnson's 2012 paper to determine if seniors with higher levels of aerobic fitness have better cerebral perfusion (blood flow in the

brain) and structural integrity in the brain's white matter, compared with counterparts who have lower fitness levels.

Johnson explains that they're trying to construct a holistic understanding of how the heart and brain are associated by using multiple measures of overall health, including clinically based assessments of heart function via echocardiograms and multiple MRI techniques, such as diffusion tensor imaging and arterial spin labeling. To the knowledge of Johnson and his colleagues, this study is one of the first to combine such clinical measures and imaging modalities in an effort to better understand the relationship between cardiorespiratory fitness and the structural and functional integrity of the brain.

Their findings could potentially impact treatment efforts aimed at ameliorating age-related declines in cognition that lead to a loss of functional independence.

"Maybe you don't have to use drugs to treat all these deteriorations associated with aging," said Powell. "Maybe we should focus more on a healthy lifestyle. We'd like to show that, even if you've had a mediocre or poor lifestyle, exercise could still make a difference in your cognitive function even if you intervene in your 60s."

The team plans to use the data from the current study to obtain funding from the National Institutes of Health to develop an intervention study that combines multiple intervention strategies.

Their work epitomizes the value of mentorship in this type of clinical and translational research: When Johnson was a graduate student at UK, Powell and Dr. Brian Gold were key mentors in addition to the team that was established during his dissertation—the same team that is working on the current study.

"Dave [Powell] has been essential for me in both getting my degree and extending this research beyond my dissertation," Johnson said. "Dr. Gold continues to mentor me as I prepare for my new faculty position in the College of Health Sciences, and I am looking forward to establishing a new relationship with Dr. Charlotte Peterson, [the associate dean for research in the College of Health Sciences] who is also interested in how fitness impacts age-related declines in health."

Powell and Johnson also state that they look forward to establishing more collaborations with many of the aging experts at the Sanders-Brown Center on Aging (SBCoA). Powell is already working with one SBCoA faculty member, Dr. Elizabeth Head. They are using many of the same MRI techniques to explore how Down syndrome impacts the structural and functional integrity of the brain.

These collaborative efforts also reflect the evolving technological capacity and faculty expertise related to biomedical imaging at UK, which has recently acquired a research-dedicated human scanner and a small animal scanner in the Magnetic Resonance Imaging and Spectroscopy Center (MRISC), a service and consultation center supporting basic and clinical research at UK.

"It's an area that we're really moving forward in," Powell said. "MRI is a unique modality with regard to translational research because it can do things that other modalities can't—there's no ionizing radiation and it's not invasive. It can provide unique information from a diagnostic standpoint. And you need people who spend a large portion of their time working with MRI so that people who don't use MRI have expert collaborators."

Such collaboration has been critical to the success of their study, which is why Powell hopes that other UK faculty who are interested in collaborating will contact him with their ideas.

"That's what makes our team so strong—we've got experts in cardiology, exercise physiology, medical imaging, and cognitive neuroscience," said Powell.

Johnson furthermore explains that beyond their specific fields of expertise, in this case the members of team share a central interest in disease prevention.

"We are all very interested in preventative medicine. A myriad of research efforts focus on the pathophysiology of a specific disease process, which is obviously very important," he said. "However, we have focused our efforts on preventative medicine through lifestyle modification."

Provided by University of Kentucky