ASU’s first human MRI enables breakthrough clinical studies

Researchers can now watch the brain in action

By Billy Hollander, ASU News
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Arizona State University researchers now have access to the university’s first MRI system approved for human scanning, opening new opportunities to study brain function, aging and disease.

Located in the Clinical Research Services core, one of ASU’s Core Research Facilities, the Siemens 3T Prisma stands out for its advanced functional MRI capabilities, supported by its high magnetic field strength and sensitive detection hardware.

While standard MRI produces detailed images of brain structure, functional MRI (or fMRI), which measures brain activity, provides insight into brain function by detecting changes associated with neural activity. During an fMRI scan, researchers can identify which regions of the brain show increased activity when a person is thinking, moving or resting.

The difference between MRI and fMRI is often compared to that between a photograph and a movie: A structural MRI captures a detailed snapshot of the brain, while fMRI reveals changing patterns over time, helping researchers observe how different regions contribute to ongoing processes.

One way ASU faculty are advancing these areas of study is by working toward developing new MRI pulse sequences — carefully designed patterns of radiofrequency pulses and timing. Different pulse sequences can emphasize specific tissue properties, allowing researchers to distinguish between muscle, fat and potential signs of disease. These innovations enable a range of MRI techniques, including functional imaging of brain activity and measurements of oxygenation and metabolism, helping ASU researchers study processes such as neuropsychiatric disorders, decision-making, the effects of mindfulness on brain activity and early indicators of disease.

It’s these stories that are allowing breakthroughs in chronic pain, movement disorders, autism, mental health and neurodegenerative disease treatment research.

Developing new ways to use MRI

Scott Beeman is an assistant professor with the School of Biological and Health Systems Engineering. His lab develops advanced MRI-based methods to study the body in a noninvasive, quantitative way. This allows researchers to measure, not just visualize, what's happening inside tissues.

Beeman shares the novel pulse sequences he and his lab develop with the broader research community, enabling researchers at ASU and beyond to study and better understand diseases such as neurodegenerative disorders, metabolic conditions and cancers.

Vikram Kodibagkar, professor with the School of Biological and Health Systems Engineering, is the head of the Prognostic Bioengineering (ProBE) Lab at ASU. ProBE's mission is to develop next-generation pulse sequence imaging technologies that enable early disease detection, engineer solutions for personalized medicine and train the next generation of imaging leaders.

The lab studies several areas of medical imaging research, including new ways to detect and study cancer at the cellular level. The team also works on improving the science and technology behind MRI itself. Alongside its research, the lab focuses on teaching students and trainees the scientific principles and technical skills needed to become future leaders in medical imaging.

Kodibagkar says that ASU's new MRI scanner would benefit the ProBE Lab's work on MRI-based prognostic imaging tools, particularly for measuring oxygenation and metabolic imaging. He says that the system's compatibility with the open-source PulseSeq platform would enable his team to develop and test new MRI pulse sequences before translating them to clinical applications.

The new pulse sequences developed by Beeman and Kodibagkar's teams will allow scientists to answer new questions across disciplines, ranging from autism and aging to neurodegenerative diseases and mental health.

Studying autism and aging

College of Health Solutions Associate Professor Blair Braden and her team are working to better understand how aging affects autistic adults and what changes may contribute to cognitive and behavioral differences over time.

"While we know a lot about how autism affects children, very little is known about older autistic people," Braden said.

Using neuropsychological cognitive assessments and multimodal MRI to understand age-related cognitive and brain changes, she hopes to understand how aging may uniquely impact autistic adults.

By comparing data between autistic and non-autistic adults, she and her team have identified some potential vulnerabilities where autistic adults may experience accelerated aging and higher rates of neurodegenerative conditions such as Alzheimer's and Parkinson's diseases.

"Having a machine in-house will be a game changer for accessibility," says Braden, referring to the Clinical Research Services core's imaging platform. It will make it easier for her and her team to collect multimodal MRI data, which they hope to use to predict which autistic adults are at the greatest risk for these adverse aging outcomes and prioritize them for tailored interventions and supportive care.

Eventually, they hope to target vulnerable brain networks with interventions that can help aging autistic adults maintain independence later in life. Recognizing the signs of decline early would make treatments more effective.

Detecting neurodegeneration earlier

College of Health Solutions Assistant Professor Edward Ofori and his team at the Pathomechanics & Neuroimaging Laboratory are studying neurobiological signatures of motor and cognitive vulnerability in aging and neurodegenerative diseases.

MRI allows medical professionals to identify the risk of Parkinson's and Alzheimer's disease before the classic symptoms begin to appear. Identifying the risk early is essential for preventive interventions and helps enroll patients in emerging therapeutic trials.

Ofori and his team are identifying the invisible early markers of neurodegeneration using digital movement and cognitive assessments in addition to advanced imaging. MRI tools are essential because they help scientists understand how diseases develop and progress, confirm potential biological markers of disease and stay competitive when applying for major research funding.

"Access to the Siemens 3T in the CRS core strengthens the ability to support trainee development in advanced neuroimaging methods," says Ofori, adding that "it fosters interdisciplinary collaboration essential for team science in neurodegeneration research."

Exercise and Alzheimer's disease

Professor Fang Yu, director of the ASU Roybal Center for Older Adults Living Alone with Cognitive Decline at the Edson College of Nursing and Health Innovation, is studying how exercise affects people living with Alzheimer's.

Yu's team is conducting a 12-month study that tests the impact of various exercise types on cognitive and physical outcomes in older adults with early Alzheimer's disease. The study involves comprehensive baseline and follow-up assessments, including cognitive testing, blood biomarkers, physical function measures and neuroimaging.

Current participants complete most of their testing through the Clinical Research Services Core's infrastructure.

"Having MRI access right next door to our primary testing site would streamline the screening process, reduce scheduling barriers and make participation much more convenient for our older adult population," Yu said. This would ultimately help her enroll participants more efficiently, while improving the overall participant experience.

Blood biomarkers and mental health

While imaging has been instrumental in studying neurodegenerative diseases, it can also be used to investigate mental health.

School of Life Sciences Assistant Professor Candace Lewis and her team are researching how early-life experiences, stress and novel therapeutics — including psychedelics — may shape mental health trajectories across the lifespan. They are specifically investigating how accessible peripheral biomarkers, such as those measured in blood or saliva, relate to underlying brain structure, function and overall health.

With access to advanced MRI scanners like the one in the CRS core, researchers like Lewis can connect what they find in a blood sample with what's happening in the brain. They can compare molecules in the blood to measures of brain structure and activity to test whether these signals reflect changes in circuits involved in emotion regulation, decision-making and self-control.

By studying people across different ages, from adolescence to older adulthood, they aim to identify reliable, easy-to-measure biomarkers that could help track brain health and assess responses to treatment.

This type of multimodal research has the potential to improve how clinicians monitor mental health risk and recovery by developing more accessible, biology-informed tools that complement existing methods like MRI. Rather than replacing brain imaging, these approaches could make it easier to screen larger populations, predict treatment outcomes and evaluate long-term effectiveness.

Personalizing brain stimulation

The neural pathways in our brains are just as unique as our fingerprints, making it difficult for doctors to treat abnormal nerve activity, chronic pain, movement disorders and other neurological conditions.

Dr. Holly Lisanby, founding dean and foundation professor at the John Shufeldt School of Medicine and Medical Engineering, wants to change that.

Her translational research focuses on using neuroimaging, like the kind done by an MRI machine, to guide and personalize brain stimulation. Work conducted by her and her team allows doctors to use a patient's structural and functional MRI data to determine where to target Transcranial Magnetic Stimulation.

TMS is a noninvasive brain stimulation technique that uses magnetic pulses to activate specific areas of the brain. It is often used as part of a treatment plan for neurological disorders, including depression, anxiety, OCD, PTSD and chronic pain.

In addition to improving health outcomes for people living with neurological disorders, TMS' ability to target specific brain circuits gives scientists and clinicians a way to study how different parts of the brain contribute to mood, behavior and cognition. This better understanding of the brain gives them insights that will allow them to devise more effective TMS treatment plans and further improve patient health outcomes.

"The ability to do that work here in Arizona, close to the communities we serve, opens doors that simply weren't open before," says Lisanby, referring to the Core Facilities new Siemens 3T Prisma

MRI machine and its TMS-fMRI capabilities.

More than just research

For students at the John Shufeldt School of Medicine and Medical Engineering, proximity to CRS' machine is more than just a research opportunity — it's a training opportunity.

Kodibagkar, course director for Biomedical Signals and Systems with the John Shufeldt School, sees potential in this, noting plans to pursue NIH training grants and integrate the machine into the biomedical engineering graduate program and MRI course.

Lisanby says that "the physician-engineers of tomorrow need to understand not just how to use technologies like neuroimaging and brain stimulation, but how to innovate with them."

The new MRI machine at the Clinical Research Services core gives ASU's medical students a front-row seat to that future.

An MRI machine like the Siemens 3T Prisma in the Clinical Research Services core is a powerful tool for detecting and diagnosing disease. In the hands of ASU researchers, it is also a gateway to discovery, helping scientists better understand how the brain and body function, uncover early signs of cognitive decline and develop more precise treatments that could improve lives for years to come.

This story originally appeared on ASU News.

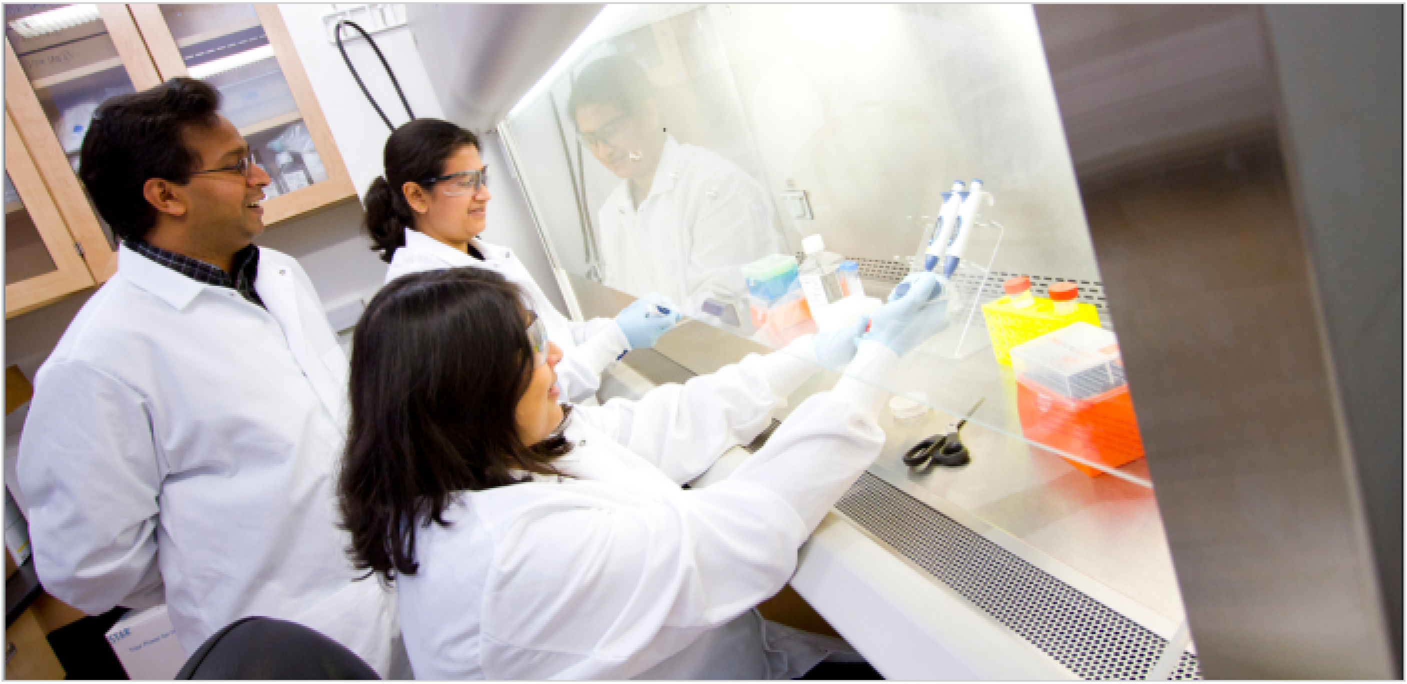
Main image

Associate Professor Blair Braden (right) and members of ASU’s Autism and Brain Aging Lab examine brain specimens used in neuroscience research. Photo courtesy of the Autism and Brain Aging Lab

Text image(s)

The Siemens 3T Prisma MRI system in ASU’s Clinical Research Services core supports advanced imaging research focused on brain function, aging and disease. Photo by Mariah Garcia/Clinical Research Services Core Facility

Scott Beeman



Associate Professor Vikram Kodibagkar (left) and members of ASU's Prognostic Bioengineering, or ProBE, Lab conduct experiments focused on developing advanced medical imaging technologies. Photo courtesy of the ProBE Lab

Associate Professor Blair Braden (center) and members of ASU’s Autism and Brain Aging Lab pose with brain specimens used in neuroscience research. Photo courtesy of the Autism and Brain Aging Lab

Assistant Professor Edward Ofori (center) and members of ASU’s Pathomechanics & Neuroimaging Laboratory discuss research focused on identifying biomarkers and early signs of neurological dysfunction. Photo courtesy of the Pathomechanics and Neuroimaging Laboratory

Fang Yu

Assistant Professor Candace Lewis (front, center) and members of ASU’s Brain, Epigenetics and Altered States Research, or BEAR, Lab pose for a group photo. The lab studies how stress, early-life experiences and novel therapeutics affect brain health and mental well-being. Photo courtesy of the BEAR Lab

Holly Lisanby