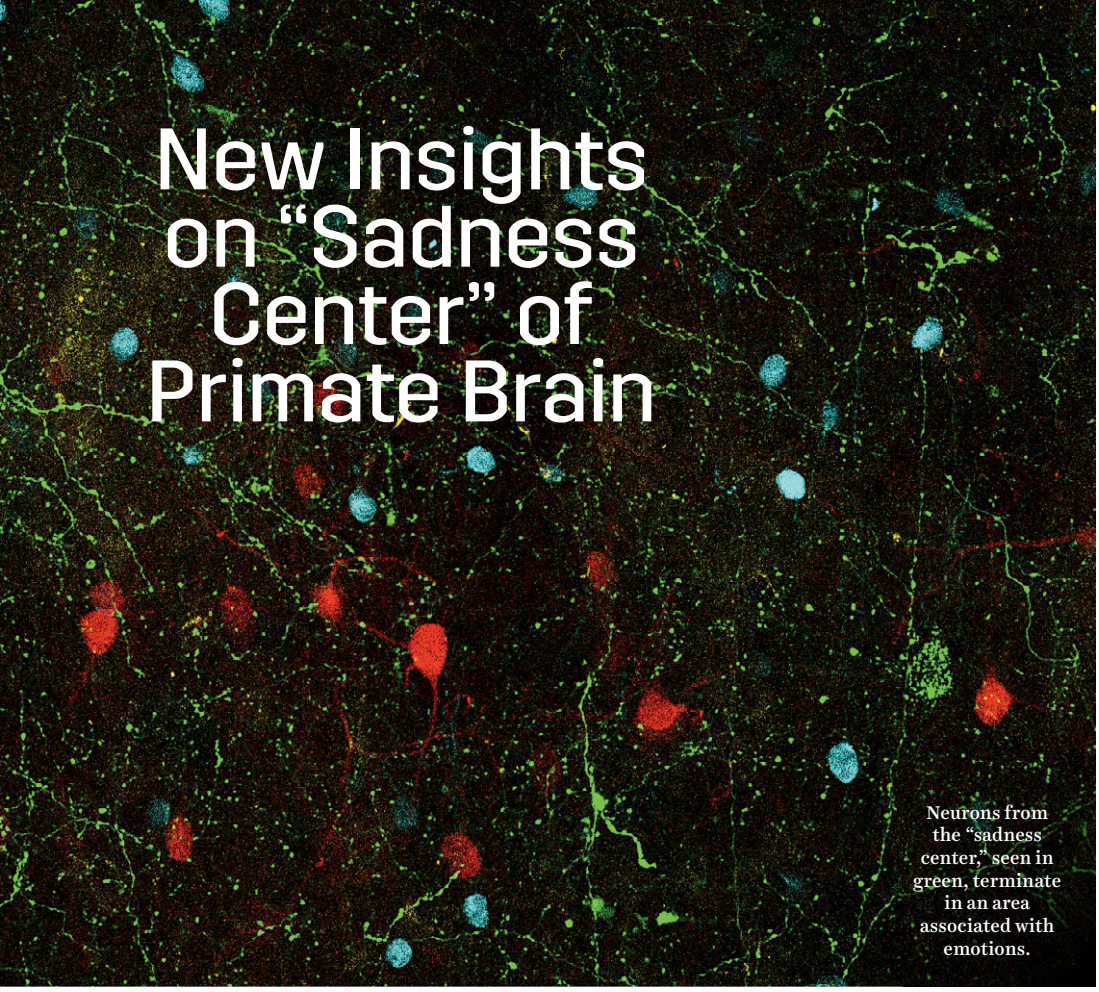
New Insights on "Sadness Center" of Primate Brain



Neurons from the "sadness center," seen in green, terminate in an area associated with emotions.

MARY KATE JOYCE AND HELEN BARBAS, BOSTON UNIVERSITY

Map of neural connections may offer clues on mechanics of depression / BY BARBARA MORAN

In the early 1900s, German neurologist Korbinian Brodmann began to study the architecture of the human brain. He divvied up the cerebral cortex—the outer, convoluted brain region that plays a key role in higher functions, such as memory, attention, and consciousness—into 52 distinct regions.

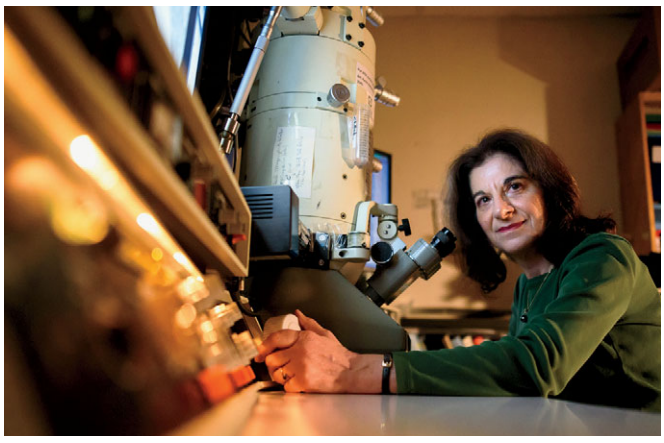
ONE OF THESE, A SLIVER OF TISSUE buried deep inside, became known as Brodmann area 25. More colloquially, it's known as the brain's "sadness center."

"When somebody is transiently sad for a reason, let's say something happened to a family member or a friend, it's normal to be sad, and this area lights up," says neuroscientist Helen Barbas, a Sargent College professor of health sciences and a graduate program in neuroscience faculty member. "But in people who are depressed, this area stays active. It's on all the time."

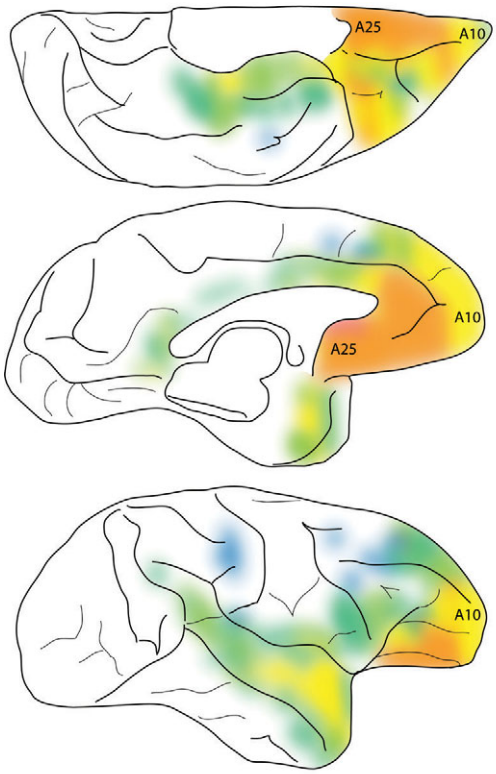
Barbas, whose specialty is charting the pattern of circuits in the brain, and her student Mary Kate Joyce (MED'19) have created a new, finely detailed map of the neural pathways leading to and from area 25 in nonhuman primates. This work shows strong connections between area 25 and other regions involved in emotional regulation, memory, internal states, and stress response.

Barbas and Joyce also found a moderate connection between area 25 and frontopolar area 10, a part of the brain that helps regulate emotions and is smaller in humans with major depression. While these findings represent preliminary work in nonhuman primates, they suggest that strengthening the link between these two areas may offer a possible target for treating chronic depression.

"This is an area that people may look at for some kind of therapeutic intervention, and it doesn't have to just be drugs. It could be activating the frontopolar area 10 noninvasively, maybe using transcranial magnetic stimulation," says Barbas, whose work is funded by the National Institutes of Health. She notes that neurologists have used deep brain stimulation in area 25 to treat drug-resistant depression, and suggests that frontopolar area 10's location closer to the brain's surface may make it an easier target for such treatment.



CHRIS MCINTOSH



MARY KATE JOYCE AND HELEN BARBAS

▲ A map of connections to area 25, with warmer colors indicating stronger connections. One of Helen Barbas' most surprising findings was the moderate connection between area 25 and frontopolar area 10, also shown, which helps regulate emotions in humans.

To create their map, Barbas and Joyce injected four tracers of different colors and characteristics in primate area 25. The brain cells at the site of injection absorbed the tracers into their cell bodies, then sent them down their long axons to their branching endpoints in other areas. The brain cells absorbed other tracers backward, through axons at the injection site, into the parent cell bodies. The experiment allowed researchers to see which areas receive signals from area 25, which areas send signals to area 25, and which circuits looped both ways. The scientists then fed that information into computational analyses to measure the strength and patterns of the connections.

"The pattern of connection is very important," says Barbas. Area 25 "acts like a feedback system" to most cortical areas, she says. However, it feeds signals forward to certain memory-related areas, like some near the hippocampus. "That means area 25 is probably triggering personal memories through those areas," she says.

◀ Helen Barbas and her student have created a map of neural pathways leading to and from the brain's "sadness center."

The moderate connection between area 25 and frontopolar area 10, a region best known for juggling complex working memory tasks, surprised the scientists. "We think that it may help modulate area 25, exercise some kind of control," Barbas says. "So this is why it's relevant."

IN PROGRESS

Diagnosing Ebola; Soda's Effects on Fertility; the Impact of Robots on Jobs; the Search for Extraterrestrial Life

DIAGNOSING EBOLA BEFORE SYMPTOMS APPEAR

The 2014 Ebola epidemic in West Africa killed more than 11,000. There is no way to diagnose Ebola until symptoms arrive—and the fever, severe headache, and muscle pain can strike victims between 2 and 21 days after exposure. Researchers studied data from monkeys exposed to the virus and discovered a common pattern of immune response among the ones that got sick. This response occurred four days before the onset of fever and suggests a possible biomarker for early diagnosis.

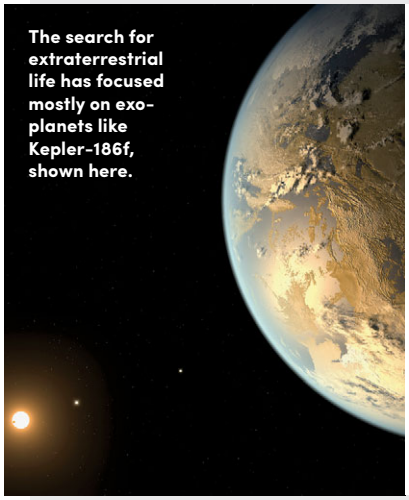

Ebola virus

IS SODA BAD FOR FERTILITY?

Drinking sugar-sweetened beverages has been linked to weight gain, type 2 diabetes, and other problems. A new study on the relationship between these drinks and fertility has found that consuming one or more per day—by either partner—is associated with a decreased chance of getting pregnant. Identifying modifiable risk factors, including diet, could help couples conceive more quickly and reduce the psychological stress and financial hardship related to fertility treatments.

ROBOTS AND JOB LOSS

Research led by economist Pascual Restrepo reveals that the adoption of just one industrial robot eliminates nearly six jobs in a community. The study examined job losses between 1990 and 2007 in 19 industries that introduced industrial robots, such as car manufacturing and pharmaceuticals. Restrepo says his research doesn't foretell the demise of human work. Rather, it shows that communities exposed to automation tend not to do well in terms of employment and wages. Many workers became discouraged and stopped looking for a job.


The search for extraterrestrial life has focused mostly on exoplanets like Kepler-186f, shown here.

THE SEARCH FOR EXTRATERRESTRIAL LIFE

For decades, astronomers have been searching distant exoplanets—worlds outside our solar system, circling a distant star—for signs of life, mostly by looking for water. But College of Arts & Sciences astronomer Michael Mendillo and his colleagues suggest looking instead at an exoplanet's ionosphere, the thin, uppermost layer of atmosphere, which is whizzing with charged particles. Find one like Earth's, they say, packed with single oxygen ions, and you have found photosynthesis.

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