



## fMRI Helps Researchers

## Understand Obesity

BY DAN HARVEY

In recent years, health researchers have concluded that obesity is a disease—not simply the result of poor eating habits or lack of willpower. Still, no one has been able to fully define the nature of the disease. However, recent research involving functional magnetic resonance imaging (fMRI) is leading an increasingly health-conscious nation to a better understanding of the condition.

The work is especially timely. In the United States, obesity among adults aged 20 to 74 has doubled from 15% of the population to almost 27%, according to the Centers for Disease Control and Prevention. The American Medical Association reports that the condition causes 280,184 deaths per year in the United States. The recent research not only helps explain obesity, but also suggests different and more effective treatment approaches.

By employing fMRI, researchers at the

University of Texas Health Science Center at San Antonio, the University of Florida's department of psychiatry and neuroscience, and the Evelyn F. and William L. McKnight Brain Institute of the University of Florida in Gainesville have demonstrated a link between the brain and eating that is critical in understanding the causes of obesity. The study's findings suggest that obese individuals experience a delayed feeling of fullness and that this delay is related to neuroendocrine mechanics. For most people, the researchers note, a feeling of fullness—or satiety—occurs approximately 10 minutes after they begin eating. For obese people, it may take roughly four minutes to nine minutes longer. Specifically, it involves delayed hypothalamic response to glucose.

The research is significant not only for the findings, but also for the methodology—it involved a relatively new use of fMRI. Generally, researchers have previously employed fMRI to analyze patterns of brain activation associated with sensory-motor and cognitive tasks and skills. Few have used it to investigate the relationship between the nervous system and the endocrine system, as these researchers did.

Particularly noteworthy, the research has led to the development of a new mathematical model—temporal clustering analysis (TCA)—to better understand when the brain responds to food ingestion. Thanks to TCA and fMRI, the researchers mapped the location and time

of brain activity—the neuronal events and hormonal signals—in vivo that accompanies eating. Previously, it was difficult to predict when an endocrine change would create brain response. fMRI coupled with TCA appears to have alleviated this problem. TCA, explains Jia-Hong Gao, PhD, associate professor of radiology at the University of Texas' Research Imaging Center and a corresponding author of the study, helps provide the time element. "When brain activation occurs, a group of pixel elements reach their maximum," he says. "With TCA, you can draw a time course of the maximums, and then you can find the timing of when the brain is activated."

After TCA identifies the time maximum, fMRI mapping techniques help localize the active brain regions.

The temporal information—the "when"—can lead to a better understanding of how the brain tells the stomach that it is full. "The brain senses a biochemical change after eating, but we didn't know when this happened," reports Gao.

In the study—reported in the February issue of *Psychiatry Annals*—subjects underwent a continuous functional scan with simultaneous blood sampling following glucose ingestion. "TCA was developed to find the time when the brain responds to the sugar," says Gao. "At first, we didn't know, so we developed this technique to effectively detect when the brain responds."

Led by Yijun Liu, PhD, assistant professor of the University of Florida's department of psychiatry and neuroscience, researchers scanned the brains of 30 subjects (10 obese adults and 20 normal-weight adults). Each volunteer received approximately 350 scans over the course of 35 minutes. Glucose was injected intravenously after the first five minutes to trigger the food response. Researchers discovered that the food responses in the hypothalamic region of the obese patients'

# RADIOLOGY T O D A Y

Introduces

Today's **C E**

**The easiest way to earn CEs online anytime!**

*RadiologyToday.net* has partnered with *RTPortal* and *EduMed* to bring you an affordable, convenient way to earn CEs in any modality.

Just visit [www.radiologytoday.net](http://www.radiologytoday.net) and click on the Today's CE link, and you will be on your way to achieving your goals.

Log on to [www.radiologytoday.net](http://www.radiologytoday.net) today!

*Working together to simplify your life!*

RT  
portal.com

RADIOLOGY  
T O D A Y

EduMed  
Connecting the Medical World Through Education

The Today's  
CE program  
provides:



- Annual package discounts for all RTs and department purchases.
- Automatic tracking and documentation for ARRT compliance.
- Immediate test results and certificates via e-mail.
- No stress! 3 attempts to pass at no additional cost.

brains were not only weaker, but also significantly delayed.

The research supports theories that the brain's pathways for registering satiety are weaker than the pathways that prompt eating. Further, it suggests that loss of control over eating and obesity produces changes in brain chemistry similar to those produced by drugs when abused. Essentially, overeating affects the pleasure centers of the brain in much the same way as alcohol and drugs. That is, the act creates neurotransmitter changes similar to those involved in other addictions, even gambling. In fact, the similarities are so remarkable that overeating, for many, can be considered substance abuse. Overeating, like alcohol or drug addiction, involves recently discovered hormonal messengers such as leptin and galanin. Both disorders involve similar brain systems, behaviors, and emotions. Like alcoholics or drug addicts, obese patients describe classic symptoms of abuse that include loss of control, compulsive behavior, and denial. The recognition of these similarities, researchers believe, could lead to improved treatment of obesity.

Researchers believe that traditional methods of treating obesity—such as dieting—are largely unsuccessful. A more

effective approach would be similar to the one embraced by recovering alcoholics and drug addicts, which includes significant lifestyle and behavioral changes. For the obese, the changes would include con-

**The study's findings suggest that obese individuals experience a delayed feeling of fullness and that this delay is related to neuroendocrine mechanics. For most people, the researchers note, a feeling of fullness—or satiety—occurs approximately 10 minutes after they begin eating. For obese people, it may take roughly four minutes to nine minutes longer.**

dition-specific tactics such as eating only when hungry, eating slowly, and eating smaller portions. The obese may also need to restructure their day-to-day living—taking it, as alcohol and drug counselors often advise, “one day at a time.” Treat-

ment may even require profound lifestyle changes including altering, and even terminating, certain personal relationships.

Meanwhile, researchers are excited about the potential of TCA and fMRI applied to the study of other brain functions, as well as the effects of medicinal and nutritional treatment protocols. They believe their findings will influence the direction of research on diabetes and other eating disorders, such as bulimia and anorexia nervosa. Better understanding of brain mechanisms can lead to more effective behavioral modifications and the creation of better therapeutic drugs.

Beyond eating, TCA itself, Gao feels, can be applied to other types of brain activation. He reports that any time when and in any case where the brain demonstrates activation to a stimulus, TCA would be applicable. “There is a potential for many future applications. It can be applied to any kind of brain activation where you don't know the timing. For instance, you can study the act of dreaming and determine when a dream occurs.”



— Dan Harvey is a contributing writer to **Radiology Today.**