Medical Xpress

Facebook concepts indicate brains of Alzheimer's patients aren't as networked

June 27 2008

This is your brain on Facebook. Researchers at the Stanford University School of Medicine used concepts borrowed from the popular social networking site to analyze the brains of people with Alzheimer's disease. They found that patients' brains were less well-connected than the brains of people without the disorder.

The test, which relies on common brain-imaging techniques, may be the first step toward a new diagnostic tool to differentiate early-stage Alzheimer's disease from other disorders.

"People can struggle with memory loss as a part of healthy aging," said Michael Greicius, MD, assistant professor of neurology, "or as a result of depression or non-Alzheimer's dementia. It's important to be able to tell the difference."

About 4.5 million Americans are living with Alzheimer's disease. Symptoms include memory loss and changes in thinking and behavior. Although there is no cure for the disorder, an early diagnosis can help patients and their family members prepare for the future and treat symptoms as they arise. However, the mild indicators of early-stage disease can be difficult to diagnose correctly.

The researchers used a technique called functional magnetic resonance imaging, or fMRI, which examines patterns of oxygen use in the brain to analyze brain activity. Unlike many studies, in which patients are asked to visualize certain events, listen to music or perform certain mental

tasks during fMRI, Greicius, along with Vinod Menon, PhD, and other colleagues simply analyzed the normal, ongoing chatter that occurs in a resting brain. That made the test easier for patients with mild dementia to take and researchers to analyze.

The research will be published in the June issue of the journal *Public Library of Science-Computational Biology*. Greicius and Menon, associate professor of psychiatry and behavioral sciences and of neuroscience, are the senior authors of the work. Graduate student Kaustubh Supekar is the first author.

Previous research has indicated that brain signals travel along neural paths connected by hubs - a concept known in the informatics world as small-world networking. "Each hub connects to several other hubs, and a signal chooses among several options to find the shortest path to its destination," said Supekar. Social networking sites operate on similar principles. The Facebook example might be one of, "I'm friends with your cousin's hairstylist - want to hang out?"

The researchers compared the path length and number of hubs between 21 people with early-stage Alzheimer's disease and 18 unaffected age- and gender-matched control subjects. They discovered that, although the path lengths of signals in the resting brain were similar among all study subjects, the people with Alzheimer's disease had fewer functional hubs.

It's like taking the hairstylist out of the mix in the Facebook example - you might still be able to get to the same person quickly (because you also know her brother's girlfriend), but the nature of the background chatter, and number and type of potential relationships that could occur, might be quite different

"These regional connections appear to be compromised in people with Alzheimer's," said Greicius, who speculated that the deficit may

continue to worsen as the disease progresses. A breakdown of regional connectivity and the resulting less-than-optimal conversation that occurs between neurons may explain the memory loss and confusion that are the hallmark of the disorder.

But the body fights back. The researchers observed a compensating increase in connectivity in the frontal lobes of the brains of people with Alzheimer's, a region that may escape the early ravages of the disease.

"Our study shows for the first time that this type of network study can be used to characterize functional disorganization and reorganization in Alzheimer's disease," said Menon. "Furthermore, quantitative, image-based analysis of large-scale brain function may be a useful way to distinguish healthy aging from the disorder."

The researchers found that, using their test, they could correctly identify patients with Alzheimer's disease about 72 percent of the time and identify those who didn't have the disease about 78 percent of the time. While these numbers are good, they're not good enough yet to use as a screening test. Furthermore, the researchers need to study more patients to determine whether the differences they observed between the two study groups are specific to patients with Alzheimer's disease, or if patients with other forms of dementia would exhibit similar changes.

"This study represents a first pass," said Greicius. "Now we'll home in on more specific regions and nodes that are likely to give more information in terms of distinguishing Alzheimer's from normal aging or other forms of cognitive impairment."

More generally, Menon says, "network analysis offers a new paradigm to compare integrative brain function and dysfunction in individuals with neurological, psychiatric and neurodevelopmental disorders with that of normal, healthy people."

Source: Stanford University Medical Center