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Researchers seek to map the brain patterns of Alzheimer's disease

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Researchers at UC Davis have launched an innovative study to determine whether closer examination of magnetic resonance imaging (MRI) scans can detect the onset of Alzheimer's disease even before patients begin to show the symptoms of cognitive decline that are the hallmarks of the condition.

The study also will look at whether MRI scan analysis can be used to predict the likely rate at which Alzheimer's disease patients' brains will deteriorate, and how quickly they will lose their ability to think and reason.

"We want to 'squeeze more juice' out of MRIs that are used to detect the presence of Alzheimer's disease," said Owen Carmichael, an assistant professor in the Department of Neurology and an adjunct professor in the Department of Computer Science. "We also want to predict the likely rate of decline."

Alzheimer's is a progressive and fatal brain disease affecting as many as 5 million Americans. It destroys brain cells, causing problems with cognition — memory, logical reasoning and other mental skills. It is the most common form of dementia, and there is no cure.

There also is no definitive way of determining whether or not a person has Alzheimer's disease in its early stages. Currently, physicians ask patients to perform a series of cognitive tests to diagnose the condition. But some loss of memory is normal in healthy aging individuals, so it can

be difficult early on to determine whether or not a person has Alzheimer's.

MRI imaging is used to detect atrophy of a portion of the brain called the hippocampus, which is vital to learning and memory. But some atrophy — or shrinkage — of the hippocampus occurs in normal aging. Carmichael, who is the principal investigator for the study, hopes to use MRI to detect the distinct pattern of shrinkage across the hippocampus that occurs in the brains of Alzheimer's patients.

"Alzheimer's disease tends to make the hippocampus atrophy in a specific pattern — it spreads from one hippocampus region to another, killing cells as it goes. We can quantify not only the overall size of the hippocampus, but also localized patterns of damage. That's what I mean by 'squeezing more juice' out of the MRIs," he said.

Carmichael and his colleagues will test a new, computational method of measuring atrophy in various sub-regions of the hippocampus to see whether Alzheimer's produces distinct spatial patterns of hippocampal atrophy that would distinguish it from patterns of mild cognitive impairment found in normal aging.

"We hope that using this technique we can provide a method for differentiating people who will experience healthy cognitive aging from those who will experience cognitive decline due to diseases like Alzheimer's. For those who will experience cognitive decline, we hope to predict its rate of progression," Carmichael said.

The researchers will test the efficacy of the new computational MRI imaging method, called Localized Components and Analysis (LoCA), developed by Carmichael and colleagues Nina Amenta, an associate professor in the Department of Computer Science, and computer science graduate student Dan Alcantara.

The researchers will use LoCA to analyze MRI scans of 800 adults who are part of a large, publicly available database called the Alzheimer's Disease Neuroimaging Initiative (ADNI). The database contains more than 4,000 MRI scans of the brains of patients diagnosed with Alzheimer's, adults with mild cognitive impairment, and those without symptoms. They will examine whether the spatial patterns of hippocampal atrophy differ among the three groups.

They also will analyze in more detail the MRI brain scans of adults who underwent expensive, experimental imaging tests that try to detect aspects of Alzheimer's pathology in the brain to determine whether LoCA can tell the difference between those who appear to have the pathology and those that do not. They will use the results of these comparisons to analyze additional MRI scans from the ADNI database, to see whether the method can predict rates of cognitive decline in Alzheimer's.

"Once diagnosed, patients, physicians and families have no reliable method for anticipating how fast cognitive functioning will decline," Carmichael said. "We hope that this method will change that."

Source: University of California - Davis