Medical Xpress

Scientists find new, inexpensive way to predict Alzheimer's disease

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Your brain's capacity for information is a reliable predictor of Alzheimer's disease and can be cheaply and easily tested, according to scientists.

"We have developed a low-cost behavioral assessment that can clue someone in to Alzheimer's disease at its earliest stage," said Michael Wenger, associate professor of psychology, Penn State. "By examining (information) processing capacity, we can detect changes in the progression of mild cognitive impairment (MCI)."

MCI is a condition that affects language, memory, and related mental functions. It is distinct from the ordinary mental degradation associated with aging and is a likely precursor to the more serious Alzheimer's disease. Both MCI and Alzheimer's are linked to a steady decline in the volume of the hippocampus, the area of the brain responsible for long term memory and spatial reasoning.

MRIs -- magnetic resonance imaging -- are the most reliable and direct way to detect hippocampal atrophy and diagnose MCI. But for many, the procedure is unavailable or too expensive.

"MRIs can cost hundreds of dollars an hour," Wenger said. "We created a much cheaper alternative, based on a memory test, that correlates with hippocampal degradation." Wenger and his collaborators at the Mayo Clinic College of Medicine, Rochester, Minn., detail their findings in a recent issue of the *Journal of Mathematical Psychology*.

From a computer model of an atrophying hippocampus, the researchers determined how to estimate capacity with a statistical measure of how quickly tasks are completed. Applying this analysis to a memory test for people with MCI, the researchers were able to gauge their hippocampal capacity and compare it to the progression of their ailment.

"My collaborators at the Mayo Clinic backed up this study with MRIs for the MCI group," Wenger said. "These capacity measures we developed showed a reliable relationship to the hippocampal volume measurements, so we know we are on the right track."

The scientists began by modeling the hippocampus as a complex electrical circuit. Equations governing electric current and voltage mimicked the electrical firing of neurons within the circuit. The researchers switched off neurons in the simulation to model atrophy of the hippocampus.

With fewer cells available to process electrical signals, the model hippocampus slowed down, but its capacity for processing information decreased at an even faster rate. Capacity was the most sensitive measure of how the hippocampus was deteriorating, more than the average processing speed.

"We then applied this to the gold standard of the field -- the Free and Cued Selective Reminding Test (FCSRT)," Wenger said. "This is a test that can discriminate between normal age-related memory changes and changes caused by impairment."

The researchers gave this test to five groups of participants: college students, healthy middle-aged adults, healthy elderly individuals, people with diagnosed cases of MCI, and a control group of age-matched individuals without MCI. The first three groups each had 100 members and the last two each had 50.

During the FCSRT, the researchers showed the participants descriptive words, such as "part of the body" and "artery" and asked the participants to choose the picture that fit these cues from a set of 24 images, in this case, a picture of a heart. The psychologists then asked the subjects to recall as many items as they could. For objects they failed to remember, the psychologists provided the category cues, providing more information and testing the limits of the subjects' capacity.

The researchers analyzed the response times for the tasks and the number of items that were recalled, with and without additional cues. The MCI group showed the greatest sensitivity to added cues - the additional input either substantially helped or inhibited their performance. But like the computer model, estimates of capacity highlighted the greatest cognitive difference between the MCI group and the others.

This study's approach to defining processing capacity is unusual. The scientists combined disparate principles of engineering and statistics, mathematically translating processing capacity into what is called the "hazard function."

The hazard function is well known in engineering, but relatively new for fields like psychology. It gives the probability that a task that is not yet completed will be completed in the next interval of time.

By measuring how long it takes a participant to recall the objects during the FCSRT, the psychologists fit a model based on the hazard function to each participant and obtain a measure of his or her capacity for the memorization task.

The difference in hazard function measures between the MCI group and all other groups was statistically much more pronounced than the differences between all groups in the number of items they recalled.

These hazard function differences also outweighed the contrasts between all groups in their response times. The hazard function model proved to be the most sensitive diagnostic for cognitive distinctions in the groups, making it a reliable indicator of capacity and a better signal of the underlying hippocampal atrophy than processing speed alone.

The researchers' results are valid for every person, not just for the whole group. Since the modified FCSRT relies on personal reaction times, hazard analysis and performance, it can track the progression of MCI for anyone, anywhere there is access to a computer.

"These results are still preliminary, but very encouraging," Wenger said. "We plan to study what this approach can tell us about mental impairments related to other conditions, like iron deficiencies, in the future."

Provided by Pennsylvania State University

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