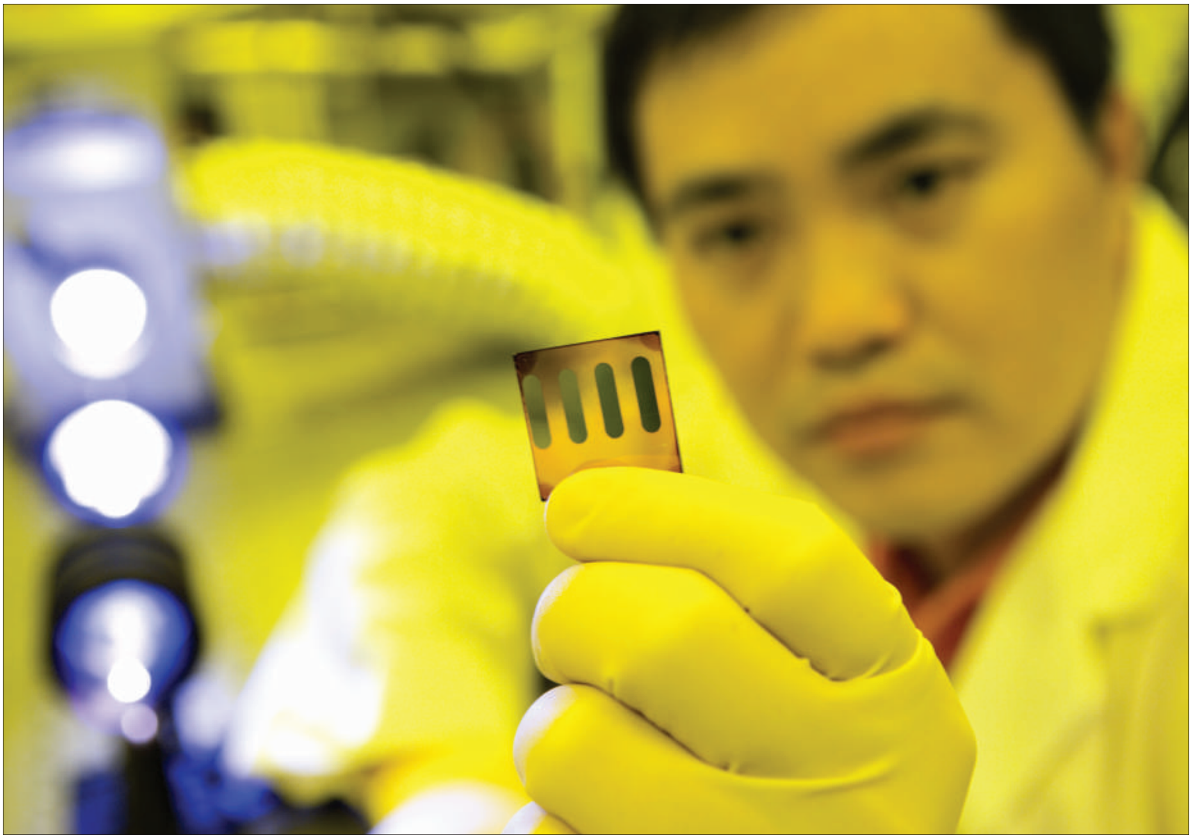

Singapore Journal of

Scientific Research

ISSN: 2010-006x

science alert

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Researchers Can Predict Your Video Game Aptitude by Imaging Your Brain

Researchers report that they can predict "with unprecedented accuracy" how well you will do on a complex task such as a strategic video game simply by analyzing activity in a specific region of your brain.

The findings, published in the online journal PLoS ONE, offer detailed insights into the brain structures that facilitate learning, and may lead to the development of training strategies tailored to individual strengths and weaknesses.

The new approach used established brain imaging techniques in a new way. Instead of measuring how brain activity differs before and after subjects learn a complex task, the researchers analyzed background activity in the basal ganglia, a group of brain structures known to be important for procedural learning, coordinated movement and feelings of reward.

Using magnetic resonance imaging and a method known as multivoxel pattern analysis, the researchers found significant differences in patterns of a particular type of MRI signal, called T2*, in the basal ganglia of study subjects. These differences enabled researchers to predict between 55 and 68 percent of the variance (differences in performance) among the 34 people who later learned to play the game.

"There are many, many studies, hundreds perhaps, in which psychometricians, people who do the quantitative analysis of learning, try to predict from SATs, GREs, MCATS or other tests how well you're going to succeed at something," said University of Illinois psychology professor and Beckman Institute director Art Kramer, who led the research. These methods, along with studies that look at the relative size of specific-brain structures, have had some success predicting learning, Kramer said, "but never to this degree in a task that is so complex."

"We take a fresh look at MRI images that are recorded routinely to investigate brain function," said Ohio State University psychology professor Dirk Bernhardt-Walther, who designed and performed the computational analysis together with Illinois electrical and computer engineering graduate student Loan Vo. "By analyzing these images in a new way, we find variations among participants in the patterns of brain activity in their basal ganglia," Bernhardt-Walther said. "Powerful statistical algorithms allow us to connect these patterns to individual learning success. Our method may be useful for predicting differences in abilities of individuals in other contexts as well," he said. "Testing this would be inexpensive because the method recycles MRI images that are recorded in many studies anyway."

After having their brains imaged, participants spent 20 h learning to play Space Fortress, a video game developed at the University of Illinois in which players try to destroy a fortress without losing their own ship to one of several potential hazards. None of the subjects had much experience with video games prior to the study.

The game, which was designed to test participants' real-world cognitive skills, is quite challenging, Kramer said. It forces players to frequently shift their attention to pursue various goals or avoid threats. When they are first learning to play, study subjects "tend to start out with negative 2,000 points," he said. After 20 h of training and practice, all the players' scores go up significantly. Some do much better than others, however, a difference that can be predicted to a large degree by analyzing activity in parts of the basal ganglia.

"We predict up to three times as much of the variance (in learning) as you would using performance measures," Kramer said. The researchers tested their results against other measures and replicated the findings in new trials with different study subjects.

The brain regions the researchers analyzed include the caudate (CAW'-date) nucleus and the putamen (pew-TAY'-min). These brain structures are active when one is engaged in learning new motor skills, such as moving a joystick, but they also are important in tasks that require one to strategize and quickly shift one's attention. A third region, the nucleus accumbens (ah-COME'-bins) is known to process emotions associated with reward or punishment.

The researchers found that patterns of activity in the putamen and caudate nucleus were better predictors of future performance than those in the nucleus accumbens. They also found that analyzing white matter (the axons and dendrites that carry signals between neurons), but not gray matter (the cell bodies), offered the best predictive power.

"Our data suggest that some persistent physiological and or neuroanatomical difference is actually the predictor of learning," Kramer said.

The findings should not be interpreted to mean that some people are destined to succeed or fail at a given task or learning challenge, however, Kramer said.

"We know that many of these components of brain structure and function are changeable," he said.

Source: PLoS One, 14 Jan 2011 DOI: 10.1371/journal.pone.0016093