# A window into the brain: Researchers use MRI to track memories

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When we absorb new information, the human brain reshapes itself to store this newfound knowledge. But where exactly is the new knowledge kept, and how does that capacity to adapt reflect our risk for Alzheimer's disease and other forms of senile dementia later in our lives?

Dr. Yaniv Assaf of Tel Aviv University's Department of Neurobiology is pioneering a new way to track the effect of memory on brain structure. "With a specific MRI methodology called 'Diffusion Imaging MRI,' we can investigate the microstructure of the tissue without actually cutting into it," he explains. "We can measure how much capacity our brain has to change structurally, what our memory reserve is and where that happens."

His study, presented at the Annual Meeting of the Human Brain Mapping Organization in San Francisco, has been pivotal to the way scientists view the effect of memory on the brain. Scientists used to believe that the brain took days or weeks to change its microstructure. Dr. Assaf's new observations demonstrate that the microstructure can change in mere hours.

"It gives us a quantifiable measure of the plasticity of each individual brain," he says. "It's possible that before a person experiences any memory loss, the plasticity is affected -- that is, the ability of one's brain to adapt to change. A lack of ability for change in the brain could mean susceptibility to dementia. Now, we have the means to monitor this ability."

## The need for speed

In order to track changes in the brain, Dr. Assaf developed a study that focused on spatial learning and memory. "Usually, scientists distinguish between functional and structural plasticity," he says. Functional plasticity refers to neuronal activity in the brain, while structural plasticity refers to the physical shape of the brain itself. "From animal studies we know that spatial memory tasks have consequences for both."

First, study volunteers were scanned by Diffusion Imaging MRI. Then, they were asked to play two hours of a race-track video game, going over the same virtual race track 16 times. "This measured a special form of memory — spatial memory," says Dr. Assaf. "Each time they circled the track, the time they took to complete it decreased. At the end of the two hours, we put them back into the MRI to see the difference."

Dr. Assaf and his team saw a marked change measured by Diffusion Imaging MRI in the characteristics of brain microstructure. The memorization of the virtual race track affected the hippocampus, motor and visual areas of the brain. "The most striking thing about this study is that it shows structural plasticity happening in only two hours," he says. "This changes what we think structural plasticity is. It shows that memory is rapidly changing the structure of the cells, and that may lead to a lasting effect on the brain."

## An early warning system for Alzheimer's disease and dementia

According to Dr. Assaf, most of the research on Alzheimer's disease and dementia focuses on its aftereffects. Diffusion Imaging MRI, he believes, could be used for early detection of the disorder.

"We can study the memory capacity of an individual at high risk for these disorders, and compare it to the morphological plasticity of people who are not at risk," Dr. Assaf says. "Such an approach may allow us to develop an intervention at an early stage, possibly in the form of drugs, one that may not be appropriate at a later stage." One parallel study, now being pursued in collaboration with Tel Aviv University's Prof. Daniel M. Michaelson, involves working with MRI and animals with mutations of Alzheimer's.

Dr. Assaf's work was done in collaboration with his Ph.D. students Yaniv Sagi, Tamar Katzir, Efrat Sasson and Ido Tavor.

Source: Tel Aviv University (news : web)