Cracking the spatial memory code

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Researchers have shown that they can tell where a person is "standing" within a virtual reality room on the basis of the pattern of activity in the brain alone. The findings, published online on March 12th in *Current Biology*, a Cell Press publication, offer compelling evidence that the hippocampus, a region of the brain critical to navigation, memory, and imagining future experiences, works in a structured and predictable way. That discovery is contrary to what many experts had previously suspected, according to the researchers.

"You can predict where someone is standing by reading the patterns in their brain activity," said Demis Hassabis of University College London. "You can track what is purely an internal thought."

"With this kind of research, we are approaching the realm of mindreading," added Eleanor Maguire, also of University College London.

In the new study, Hassabis, Maguire, and their colleagues asked four participants to navigate to target locations within a virtual reality room while their brains were scanned with a functional magnetic resonance imager (fMRI). fMRI measures blood flow related to neural activity in the brain. They then applied a sophisticated analytical procedure known as multivariate pattern classification to see if they could relate the pattern of brain activity to each individual's location in virtual space.

And it worked. The pattern they uncovered reflected the participants' memory for where they were, the researchers explained, since once they

had reached their final destination, there were no visual cues to discern one target spot from another. The activity they examined spanned some two to five million of the 40 million or so cells in the hippocampus, Hassabis noted.

Earlier studies done primarily in rats had suggested that spatial memories stored in the hippocampus had neuronal representations that were uniform and randomly distributed. But if that were the whole story, the predictions made in the new study would not have been possible.

Now that they have shown that such a predictable functional structure exists in the hippocampus, additional studies will seek to crack that neural code for other memories. Indeed, spatial representations of the type investigated in the study are thought to form the scaffold upon which memories of our personal experiences, known as episodic memories, are built.

"By showing it is possible to detect and discriminate between memories of adjacent spatial positions, our combination of non-invasive in vivo high-resolution fMRI and multivariate analyses opens up a new avenue for exploring episodic memory at the population level," the researchers wrote. "In the future it may be feasible to decode individual episodic memory traces from the activity of neuronal ensembles in the human hippocampus."

"We know that the hippocampus is critical for remembering our life experiences," Maguire said. This discovery "opens a whole world of possibility previously thought inaccessible to human brain imaging."

Source: Cell Press (news : web)