Now where did I leave my car -- and how do I get back there? How the brain translates memory into action

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(PhysOrg.com) -- When we emerge from a supermarket laden down with bags and faced with a sea of vehicles, how do we remember where we've parked our car and translate the memory into the correct action to get back there? Scientists have identified the part of the brain responsible for solving this everyday problem — and the results could have implications for understanding the functional significance of a prominent brain abnormality observed in neuropsychiatric diseases such as schizophrenia.

Different types of memory are formed in different parts of the brain. The repetitive car drive to work, back home or to the supermarket requires well-learnt place memory and involves different brain mechanisms than returning to your car in a car park which requires rapidly-learnt memory of a novel place.

In a study published in *PLoS Biology*, Tobias Bast of The University of Nottingham's School of Psychology worked with Iain Wilson and Richard Morris at the University of Edinburgh's Centre for Cognitive and Neural Systems and with Menno Witter at the Centre for the Biology of Memory at the Norwegian University for Science and Technology to investigate how such rapid place learning is translated into appropriate behaviour.

They focused on the hippocampus, an elongated, banana-shaped

structure beneath the brain's temporal lobe. The hippocampus contributes to conscious memory — so-called declarative memory. And it is especially important for the rapid learning of the ever-changing aspects of our everyday experiences — such as the place where we park our car on a specific occasion. How the hippocampus mediates such rapid learning has received a lot of attention. For example, a much-studied property of hippocampal neurons in rats is their striking place-specific firing. When rats move about in an environment, electrophysiological recordings from the hippocampus show that, within seconds to minutes, many hippocampal neurons come to fire when — and only when — the animal passes a specific place. This means that the hippocampus rapidly 'learns' and then codes for specific places. But, until now, the way this rapid place learning is translated into behaviour has received less attention.

In the new study, the researchers identified the part of the hippocampus that is responsible for this learning-behaviour translation. They found the critical part is the 'intermediate' or middle part of the hippocampus, which combines links to accurate visuo-spatial information — like the position of a car in a car park — with links to behavioural control necessary for returning to that car after a period of time.

To do this the researchers tested rats in a water maze experiment. The rats located and then returned to a platform in the water, with the platform location changing every day, mimicking car park conditions. Different parts of the rat's hippocampus were selectively 'lesioned', or disabled, using a neurotoxin. The effects on the rats' behaviour were then measured.

The study found that if roughly 30-40 per cent of neuronal tissue in the middle of the hippocampus — the intermediate region — was spared by the neurotoxin lesions, the rats could carry out the task with similar efficiency as with a fully intact hippocampus. But when the intermediate

hippocampus, or a substantial part of it, was disabled, sparing 30-40 per cent of tissue at the two ends of the hippocampus — the so-called 'septal' and 'temporal' hippocampus — the rats struggled with the task.

The researchers also found that the septal end of the hippocampus, featuring links to precise visuo-spatial information, can still rapidly form an accurate place memory — as reflected by the place-related firing of neurons in this region after the rest of the hippocampus was disabled. However, it cannot translate this memory into behaviour as without the intermediate hippocampus it lacks the relevant links to behavioural control.

Dr Bast plans to expand on the discoveries with research into how aberrant hippocampal activity that characterises many neuropsychiatric conditions, such as schizophrenia, contributes to symptoms.

“People often focus on memory deficits when thinking about the significance of aberrant hippocampal function,” he said. “But our new findings highlight the important hippocampal links to behavioural control. We plan to build on these findings and examine the possibility that aberrant hippocampal function — depending on where in the structure it occurs and to which extent — may give rise to selective memory deficits, as well as to more profound disruptions of behavioural control. “

Provided by University of Nottingham (news : web)