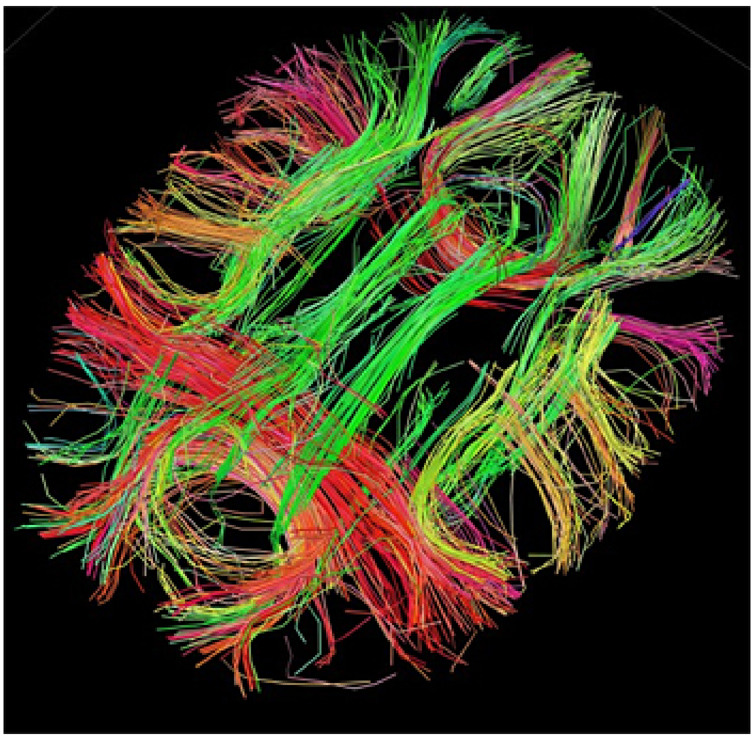
Medical Xpress

'Inner GPS' study may aid diagnosis of brain diseases

November 2 2015



White matter fiber architecture of the brain. Credit: Human Connectome Project.

A new Dartmouth study sheds light on brain cells in our "inner GPS," which may improve understanding of memory loss and wandering behavior in people with Alzheimer's and other neurodegenerative diseases.

The findings, which appear in the journal *Current Biology*, contribute to our understanding of the neural mechanisms underlying our ability to navigate our environment.

In recent decades, researchers have discovered brain cells that establish our location (place cells), direction (head direction cells) and paths through the environment (grid cells), and that together guide our navigation. Place cells and grid cells are part of the brain's "inner GPS," which tracks our location within the environment. Specifically, grid cells fire relative to multiple locations and form a repeating grid-like lattice that covers the entire environment.

In their new study, Dartmouth researchers studied the relationship of theta rhythm (an EEG activity generated by the brain) and grid cell function. Theta rhythm is necessary for grid cells to express their repeating pattern of activity. But the information conveyed by theta rhythm is not fully understood. For example, theta rhythm is controlled by the speed of an animal, and faster movement is associated with faster and stronger theta rhythm. The researchers wanted to know what was important about theta—is rhythmic activity sufficient or does the rhythm need to be modulated by the animal's speed? The researchers found that moving an animal around in a clear cart on wheels (like pushing someone around in a wheel chair) eliminated grid cell firing patterns. Simultaneously, the animal's movement velocity no longer modulated theta rhythm activity, but left it at a low static level that was comparable to low movement velocity. Therefore, rhythmic activity was spared but was insufficient to support grid cell activity. Thus, the velocity modulation of theta rhythm conveys some critical information for the generation of the grid cell signal.

"This is important because it provides insight into the functional role of grid cells in navigation," says Professor Jeffrey Taube, the study's senior author. "Current opinion is that grid cells actively track the animal's location and provide the neural computations to support GPS-like activity. Our results, however, suggest grid cells may be more involved in tracking the distance traveled by an animal rather than their precise location within the environment."

A better understanding of how the brain processes spatial information and memory may improve diagnosis and treatment of neurodegenerative diseases, says lead author Shawn Winter, a postdoctoral fellow in Psychological and Brain Sciences. For example, in Alzheimer's disease, memory loss may result from degeneration of the hippocampus, which receives direct input from grid cells. Wandering behavior may result from degeneration of the entorhinal cortex, the brain area where grid cells are found. Therefore, drugs may be targeted at the entorhinal cortex to alleviate some of the wandering behavior.

More information: Shawn S. Winter et al. Passive Transport Disrupts Grid Signals in the Parahippocampal Cortex, *Current Biology* (2015). DOI: 10.1016/j.cub.2015.08.034

Provided by Dartmouth College