Researchers find brain activity response different for virtual reality versus the real world

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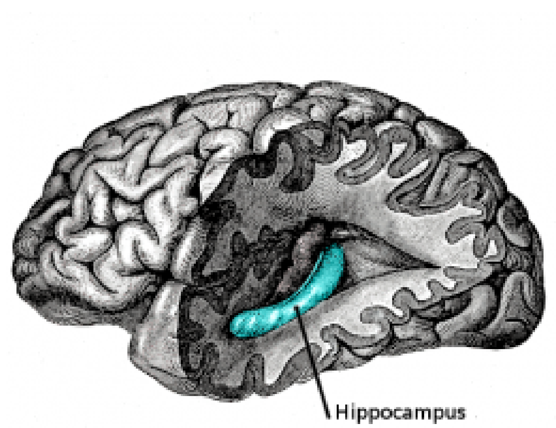

The hippocampus is located in the medial temporal lobe of the brain. Image via Wikipedia.

(Phys.org) —A team of researchers from the University of California has found that one part of the brain in rats responds differently to virtual reality than to the real world. In their paper published in the journal *Science*, the group describes the results of brain experiments they ran with rats. They found that "place" cells in the rats' hippocampus didn't light up as much when immersed in a virtual reality experiment as they did when the rats were engaging with the real world.

Researchers in many parts of the world are studying how virtual reality works in the brain. Some do so to better learn how the brain works, others are more interested in creating games or virtual reality environments to allow people to experience things they couldn't otherwise. In either case, despite the increase in processing power and graphics capabilities, virtual reality systems just don't live up to the real world. People can always tell the difference. To find out why, the researchers in this new effort turned to rats—most specifically, their hippocampus's—the part of the brain that has been identified as building and controlling cognitive maps.

The hippocampus has what are known as neural "place" cells. Researchers believe they are building blocks that are used to assemble cognitive maps—they become most active when a rat is introduced to a new environment. Once a mental map has been created, rats use them to recognize where they are. To find out if the place cells respond differently to virtual reality, the researchers created a virtual reality environment that was nearly identical to one that existed in the real world—including a treadmill type ball to allow for simulating movement. They then attached probes to the brains of several test rats and measured place cell activity as the rats were exposed to both the virtual reality environment and the real one.

The researchers found that the level of place cell activity that occurred was dramatically different between the two environments. For the real world runs, approximately 45 percent of the rats' place cells fired, compared to just 22 percent for the virtual reality runs.

These results weren't a surprise to the team as previous research has suggested that place cell activity is incited by at least three types of cues: visual, self-motion and proximal. Virtual reality in its current state isn't capable of generating the sensation of a breeze kicking up, the smell of bacon frying or the way the ground responds beneath the feet—all of these are part of proximal awareness. In order for virtual reality to become truly immersive, the research suggests, proximal cues must be added to the virtual reality experience.

More information: Multisensory Control of Hippocampal Spatiotemporal Selectivity, *Science* DOI: 10.1126/science.1232655

ABSTRACT
The hippocampal cognitive map is thought to be driven by distal visual cues and self-motion cues. However, other sensory cues also influence place cells. Hence, we measured rat hippocampal activity in virtual reality (VR), where only distal visual and nonvestibular self-motion cues provided spatial information, and in the real world (RW). In VR, place cells showed robust spatial selectivity; however, only 20% were track active, compared with 45% in the RW. This indicates that distal visual and nonvestibular self-motion cues are sufficient to provide selectivity, but vestibular and other sensory cues present in RW are necessary to fully activate the place-cell population. In addition, bidirectional cells preferentially encoded distance along the track in VR, while encoding absolute position in RW. Taken together, these results suggest the differential contributions of these sensory cues in shaping the hippocampal population code. Theta frequency was reduced, and its speed dependence was abolished in VR, but phase precession was unaffected, constraining mechanisms governing both hippocampal theta oscillations and temporal coding. These results reveal cooperative and competitive interactions between sensory cues for control over hippocampal spatiotemporal selectivity and theta rhythm.

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