Researchers discover second depth-perception method in brain

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It's common knowledge that humans and other animals are able to visually judge depth because we have two eyes and the brain compares the images from each. But we can also judge depth with only one eye, and scientists have been searching for how the brain accomplishes that feat.

Now, a team led by a scientist at the University of Rochester believes it has discovered the answer in a small part of the brain that processes both the image from a single eye and also with the motion of our bodies.

The team of researchers, led by Greg DeAngelis, professor in the Department of Brain and Cognitive Sciences at the University of Rochester, has published the findings in the March 20 online issue of the journal *Nature*.

“It looks as though in this area of the brain, the neurons are combining visual cues and non-visual cues to come up with a unique way to determine depth,” says DeAngelis.

DeAngelis says that means the brain uses a whole array of methods to gauge depth. In addition to two-eyed “binocular disparity,” the brain has neurons that specifically measure our motion, perspective, and how objects pass in front of or behind each other to create an approximation of the three-dimensional world in our minds.

The researchers say the findings may help instruct children who were born with misalignment of the eyes to restore more normal functions of binocular vision in the brain. The discovery could also help construct more compelling virtual reality environments someday, says DeAngelis, since we have to know exactly how our brains construct three-dimensional perception to make virtual reality as convincing as possible.

The neural mechanism is based on the fact that objects at different distances move across our vision at different speeds due to a phenomenon called motion parallax, says DeAngelis. When staring at a fixed object, any motion we make will cause things nearer than the object to appear to move in the opposite direction, and more distant things to appear to move in the same direction.

To figure out the real three-dimensional layout of what it sees, DeAngelis says the brain needs one more piece of information and it pulls in this information from the motion of the eyeball itself.

According to DeAngelis, the neurons in the middle temporal area of the brain are combining visual information and physical movement to extract depth information. As the dragon illusion demonstrates, the motion of near and far objects can be confused. But if the eye is moving while tracking the overall movement of the group of objects, it gives the middle temporal neurons enough information to grasp that the object moving fastest in the same direction must be the closest object, and the one moving slowest must be the farthest, says DeAngelis.

“We use binocular disparity, occlusion, perspective, and our own motion all together to create a representation of the real, 3D world in our minds,” says DeAngelis.

Source: University of Rochester