Sight Recovery After Blindness Offers New Insights on Brain Reorganization

16 May 2008

Studies of the brains of blind persons whose sight was partially restored later in life have produced a compelling example of the brain's ability to adapt to new circumstances and rewire and reconfigure itself.

The research, conducted by postdoctoral researcher Melissa Saenz of the California Institute of Technology along with Christof Koch, the Lois and Victor Troendle Professor of Cognitive and Behavioral Biology and professor of computation and neural systems, and their colleagues, shows that the part of the brain that processes visual information in normal individuals can be co-opted to respond to both visual and auditory information. That brain reorganization persists even if the blind subjects later regain their vision--for example, through technologies such as corneal stem-cell transplants, retinal prosthetics, and gene therapy.

"Sight-recovery patients can face many challenges in using restored vision because of brain reorganization that occurs during prolonged blindness. Understanding this brain adaptation will be useful for helping patients make the best use of their restored vision," says Saenz.

Researchers scanned the brains of two individuals whose sight had been recovered decades after having been lost. One volunteer, Michael May, was blinded in a chemical accident at the age of three, and then he had his vision partially restored in his left eye at age 46 through a corneal stem-cell transplant. The second subject, a 53-year-old woman, had been blind since birth because of damage to the retina and cataracts. At age 43, sight in her right eye was partially restored by cataract removal.

Each subject listened through headphones to several types of sounds including speech, frequency sweeps (simple tones whose frequency changes), and sounds that appeared to be "moving" horizontally from one side of the head to the other (the illusion was created by increasing the volume or timing of sounds delivered to either the left or the right speaker) while lying in a magnetic scanner.

This allowed Saenz to monitor changes in blood flow that are closely linked to the underlying neuronal activity in a region of the brain called MT+/V5, which is specifically involved in visual motion processing. Ten test subjects with normal vision were similarly studied.

Only in the two individuals with recovered sight did the MT+/V5 region light up in response to sound. No response was seen in the control subjects.

"Previous studies had shown that a variety of new sensory functions move into the visual cortex when a person loses their vision, especially when vision is lost as a young child, when the brain is very adaptable," says Saenz. "Our data show for the first time what happens to the new sensory responses if a blind person has the chance to see again. The sound responses didn't go away. They persisted together with the restored visual responses, even after many years with regained sight."

Most interestingly, the MT+/V5 region reacted only to auditory motion, but not to other types of auditory stimuli. In other words, moving sound activated a part of the brain that is normally reserved for processing moving visual images.

"This wasn't a random takeover. We didn't find responses to all types of sounds, but specifically to moving sounds. This brain reorganization was efficient and took advantage of this region's specialized role in motion processing," she says.

"Our volunteers with sight recovery gave us the unique opportunity to answer the question of whether the different sensory response in a blind person activates a specific visual area (MT+/V5). Normally, the location of this area is variable and is identified in sighted people by how it responds to visual stimulation, not based on anatomical landmarks alone. So we couldn't convince a critic that we identified this area in someone who was still blind."

In fact, According to Saenz, such multitasking may contribute to the strong ability to perceive motion--as opposed to the poor visual acuity--that has been seen before among patients who have recovered their sight after a lifetime of blindness.

"This study demonstrates the plasticity inherent in even adult brains and the very tight linkage between neural activity in particular pieces of gray matter and the subject's perception in the privacy of his and her mind," Koch says.

"When my vision was restored after 43 years of being totally blind, I had no idea of the complexity of how our brain sees," says test subject Michael May. "It is through vision scientists that I have had a front-row seat in learning about how I perceive the world with my new vision. Turns out that the integration of all my senses, tools, and techniques has been the key to a maximum life experience."

The paper, "Visual motion area MT+/V5 responds to auditory motion in human sight-recovery subjects," was published in the May 14 issue of the *Journal of Neuroscience*.

Source: Caltech

APA citation: Sight Recovery After Blindness Offers New Insights on Brain Reorganization (2008, May 16) retrieved 24 June 2021 from https://medicalxpress.com/news/2008-05-sight-recovery-insights-brain.html