Medical Xpress

Researchers find the blind use visual brain area to improve other senses

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People who have been blind from birth make use of the visual parts of their brain to refine their sensation of sound and touch, according to an international team of researchers led by neuroscientists at Georgetown University Medical Center (GUMC).

Published today in the journal *Neuron*, the scientists say this finding helps explain why the blind have such advanced perception of these senses – abilities that far exceed people who can see, they say.

Using functional magnetic resonance imaging (fMRI), the researchers found that the blind use specialized "modules" in the visual cortex that process the spatial location of an object when a person localizes it in space. More generally, they believe that the different functional attributes that make up vision, such as analysis of space, patterns, and motion, still exist in the visual cortex of blind individuals. But instead of using those areas to understand what the eyes see, the blind use them to process what they hear and touch because the same components are necessary to process information from those senses.

"We can see that in the blind, large parts of the visual cortex light up when participants are engaged in auditory and tactile tasks. This is in addition to the areas in their brain that are dedicated to processing sound and touch," says the study's lead investigator, Josef P. Rauschecker, PhD, professor in the Department of Physiology and Biophysics at GUMC.

"This shows us that the visual system in the blind retains the functional organization that was anatomically laid out by genetics, but that the brain is plastic enough to use these modules to analyze input they receive from different senses,' he says.

In this experiment, which included researchers from Belgium and Finland, 12 sighted and 12 blind participants agreed to perform a set of auditory or tactile tasks. "We know that in the blind, the brain reroutes other sensory inputs to unused portions of the brain to compensate for loss of sight, but we wondered what specifically the visual cortex in these individuals was doing," Rauschecker says. "The visual cortex is one of the largest and most powerful parts of the brain, with about 40 different specialized modules. By comparison, the auditory processing center in the brain only has about 20 modules."

In one task, volunteers wore stereo headphones while in the fMRI machine, and they reported where in space the variety of sounds they heard came from. In the other test, they wore piezo-electric vibrators on each finger, and the goal was to report which finger was being gently stimulated.

"We found that the visual cortex in the blind was much more strongly activated than it was in the sighted, where visual cortex was mostly deactivated by sounds and touch," Rauschecker says. "Furthermore, there was a direct correlation between brain activity and performance in the blind. The more accurate blind people were in solving the spatial tasks, the stronger the spatial module in the visual cortex was activated.

"That tells us that the visual cortex in the blind takes on these functions and processes sound and tactile information which it doesn't do in the sighted," he says. "The neural cells and fibers are still there and still functioning, processing spatial attributes of stimuli, driven not by sight but by hearing and touch. This plasticity offers a huge resource for the blind."

Clinically, the results suggest that these powerful senses may potentially be harnessed to help the blind better navigate in their world, Rauschecker says. For example, GUMC researchers, collaborating with colleagues in Belgium, are developing goggles that process visual stimuli and turn them into auditory cues that help guide the blind. This sensory substitution device is now being tested in volunteers.

Provided by Georgetown University Medical Center