New study shows brain's ability to reorganize

November 18 2009, By Mark Wheeler

(PhysOrg.com) -- Visually impaired people appear to be fearless, navigating busy sidewalks and crosswalks, safely finding their way using nothing more than a cane as a guide. The reason they can do this, researchers suggest, is that in at least some circumstances, blindness can heighten other senses, helping individuals adapt.

Now scientists from the UCLA Department of Neurology have confirmed that blindness causes structural changes in the brain, indicating that the brain may reorganize itself functionally in order to adapt to a loss in sensory input.

Reporting in the January issue of the journal *NeuroImage* (currently online), Natasha Leporé, a postgraduate researcher at UCLA's Laboratory of Neuro Imaging, and colleagues found that visual regions of the brain were smaller in volume in blind individuals than in sighted ones. However, for non-visual areas, the trend was reversed — they grew larger in the blind. This, the researchers say, suggests that the brains of blind individuals are compensating for the reduced volume in areas normally devoted to vision.

"This study shows the exceptional plasticity of the brain and its ability to reorganize itself after a major input — in this case, vision — is lost," said Leporé. "In other words, it appears the brain will attempt to compensate for the fact that a person can no longer see, and this is particularly true for those who are blind since early infancy, a developmental period in which the brain is much more plastic and modifiable than it is in adulthood."

Researchers used an extremely sensitive type of brain imaging called tensor-based morphometry, which can detect very subtle changes in brain volume, to examine the brains of three different groups: those who lost their sight before the age of 5; those who lost their sight after 14; and a control group of sighted individuals. Comparing the two groups of blind individuals, the researchers found that loss and gain of brain matter depended heavily on when the blindness occurred.

Only the early-blind group differed significantly from the control group in an area of the brain's corpus callosum that aids in the transmission of visual information between the two hemispheres of the brain. The researchers suggest this may be because of the reduced amount of myelination in the absence of visual input. Myelin, the fatty sheaf that surrounds nerves and allows for fast communication, develops rapidly in the very young. When the onset of blindness occurs in adolescence or later, the growth of myelin is already relatively complete, so the structure of the corpus callosum may not be strongly influenced by the loss of visual input.

In both blind groups, however, the researchers found significant enlargement in areas of the brain not responsible for vision. For example, the frontal lobes, which are involved with, among other things, working memory, were found to be abnormally enlarged, perhaps offering an anatomical foundation for some of blind individuals' enhanced skills.

Previous studies have found that when walking down a corridor with windows, the blind are adept at detecting the windows' presence because they can feel subtle changes in temperature and distinguish between the auditory echoes caused by walls and windows.

Leporé noted that scientists and others have long been curious about whether or not blind individuals compensated for their lack of vision by

developing greater abilities in their remaining senses. For example, the 18th-century French philosopher Denis Diderot wrote of his amazement with some of the abilities shown by blind individuals, in particular a blind mathematician who could distinguish real from fake coins just by touching them.

But it wasn't until the early 1990s that the suspicions of science began to be confirmed with the development of neuroimaging tools.

"That allowed researchers to probe inside the brain in a non-invasive manner, yielding insights into the impressive adaptive capacity of the brain to reorganize itself following injury or sensory deprivation," Leporé said.

Source: University of California - Los Angeles