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Residual activity 'hot spots' in the brain key for vision recovery in stroke patients

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Scientists know that vision restoration training (VRT) can help patients who have lost part of their vision due to glaucoma, optic nerve damage, or stroke regain some of their lost visual functions, but they do not understand what factors determine how much visual recovery is achieved.

New evidence published in *Restorative Neurology and Neuroscience* suggests that vision restoration depends mostly on activity of residual vision that is still left after the injury and that both local neuronal activity and activity in the immediate surround influence the development of visual recovery "hot spots." This shows that recovery of vision is mediated by partially surviving neurons.

Researchers from the Institute of Medical Psychology and Department of Computer Sciences, Otto-von-Guericke-University of Magdeburg, and the Max Planck Institute for Dynamics and Self-Organisation, Goettingen, Germany, conducted a retrospective analysis of multiple visual field tests before and after at least six months of VRT in 32 stroke patients with hemianopia, which is a loss of vision in half of the visual field. The test, known as high-resolution perimetry (HRP), presents visual stimuli on a computer monitor to which the patient has to respond by pressing a key on the keyboard.

The result is a map that indicates areas that are intact (unaffected by the injury), areas that are completely blind, and "areas of residual vision," where vision is reduced but not absent. Here, the response time is slower

or the correct response occurs only occasionally. Repetitive stimulation through daily one-hour vision training with VRT was directed at these "areas of residual function" to strengthen their performance.

"Hot spots" were defined as those locations that were initially impaired at baseline but then recovered after VRT training, while "cold spots" remained impaired where vision training did not help. Of almost 11,000 visual spots analyzed from the 23 patients, 688 were found to be hot spots while 3,426 were cold spots. The average absolute improvement due to VRT training was 6%.

The investigators used computer-based data mining technology to study which features of the baseline HRP charts obtained before vision training could predict vision recovery. They looked at different topographic features and found that visual field areas have a higher probability of becoming vision restoration "hot spots" if they had higher local residual vision at baseline, more residual activity in a spatially limited surrounding area (of 5 degrees of visual angle), and if they were located closer to the blind field (scotoma). Vision restoration was not influenced much by residual activity at further distances, say the authors.

"Our findings confirm the special role of residual structures in vision restoration, which is likely mediated by surviving cells in partially damaged brain tissue," says lead author Bernhard A. Sabel, PhD, of the Institute of Medical Psychology, Otto-von-Guericke-University of Magdeburg. Dr. Sabel suggests that the massive visual stimulation presented during VRT enhances visual recovery by forcing subjects to focus their attention on "compromised" sectors of the visual field which are partially damaged and repeating this daily helps recover vision loss. "This new understanding now allows us to offer vision training on the internet through online training," says Dr. Sabel.

More information: *Restorative Neurology and Neuroscience*, 2013.

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