Study finds decreasing activity in the eye can help overcome amblyopia

November 22 2016, by Helen Knight

Credit: Joshua Sariñana

The visual system can be "rebooted," offering hope for restoring sight to the visually impaired, according to research at MIT.

Amblyopia, also called "lazy eye," is the most common form of visual disability in children. Human vision is poor at birth, but improves steadily during infancy and childhood as connections between eye and brain mature.

But this maturation can go awry when inputs from the two eyes are out of balance; as a result of a cataract in one eye, for example, or a misalignment of the two eyes. When this happens, the connections from one eye fail to form correctly, and vision through that eye is impaired.

Even if surgery is carried out to correct the underlying cause, the changes to the brain's visual system persist.

To correct the disorder, ophthalmologists typically apply a patch or a drug called atropine to the stronger eye, forcing the child to use their weaker eye.

However, the effectiveness of this procedure is limited by poor compliance and variable outcomes. Additionally, if the amblyopia is severe, this treatment is ineffective if initiated after age 10. This presents a particular problem in developing countries, where there is often little or no early years health screening.

Now, in a paper to be published in *Proceedings of the National Academy of Sciences*, researchers in the Bear Lab at the Picower Institute for Learning and Memory at MIT and the Department of Psychology and Neuroscience at Dalhousie University in Canada, describe a novel technique to restore visual acuity in animals with amblyopia, by temporarily inactivating their retinas using an anesthetic.

The approach is analogous to restoring proper function to a computer or smartphone by turning it off and letting it "reboot." The new results show that temporarily turning off input from the eyes allows the brain to reboot, and enables the lazy eye to come back "online."

Once the anesthetic had worn off, the researchers found that visual acuity was restored to the previously deprived eye, without any penalty to the stronger eye.

When they subsequently monitored the animals into adulthood, they found that this recovery was permanent, according to lead author Ming-fai Fong, working in the laboratory of Professor Mark Bear at the Picower Institute.

"[The treatment] really does seem to be rebooting the visual system to start developing in a way that pays attention to information through that previously deprived eye," Fong says.

In order to determine whether the treatment is suitable for clinical use in humans, the researchers now plan to investigate whether it can be effective in older subjects than conventional eye patches.

They also plan to investigate how long the period of retinal inactivation must be to promote recovery. "We have used a minimum of two days (in the experiments), but if we could shorten that period of inactivation to around six hours, it would open the door to an array of anesthetics that are already used in humans," Fong says.

Classically, rehabilitation of deprivation amblyopia due to unilateral dense congenital cataract remains one of the most challenging problems in pediatric ophthalmology, according to Eileen E. Birch, a professor of opthalmology at the University of Texas Southwestern Medical Center.

"Failure to detect and remove the cataract by six weeks of age or any failure to achieve consistent optical correction and patching therapy throughout early childhood, even if the failure is temporary, leads to permanent monocular visual impairment," Birch says.

In their tour-de-force paper, the researchers have shown us a glimpse of future clinical treatments that may unlock the visual cortex of children, enhance plasticity, and restore vision, she adds.

The exciting study is one of very few so far that offers hope of a novel treatment for amblyopia, and one that might work at ages where conventional treatment is no longer effective, says Frank Sengpiel, a professor of neuroscience at Cardiff University in the U.K.

The approach builds on previous research that demonstrated that putting animals in the dark for 10 days triggered recovery from monocular deprivation, he says.

"However, the main problem with this potential treatment is that complete darkness is required for quite a long period of time, which is not easy to achieve in human patients," Sengpiel says.

More information: Ming-fai Fong et al. Rapid recovery from the effects of early monocular deprivation is enabled by temporary inactivation of the retinas, *Proceedings of the National Academy of Sciences* (2016). DOI: 10.1073/pnas.1613279113

This story is republished courtesy of MIT News (web.mit.edu/newsoffice/), a popular site that covers news about MIT research, innovation and teaching.

Provided by Massachusetts Institute of Technology https://medicalxpress.com/news/2016-11-decreasing-eye-amblyopia.html