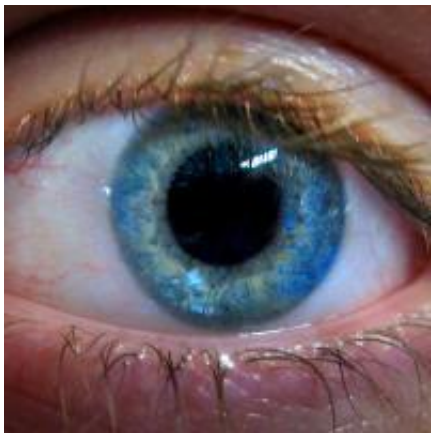
JHU biologists identify new neural pathway in eyes that aids in vision

21 May 2014



A type of retina cell plays a more critical role in vision than previously known, a team led by Johns Hopkins University researchers has discovered.

Working with mice, the scientists found that the ipRGCs – an atypical type of photoreceptor in the retina – help detect contrast between light and dark, a crucial element in the formation of visual images. The key to the discovery is the fact that the cells express melanopsin, a type of photopigment that undergoes a chemical change when it absorbs light.

"We are quite excited that melanopsin signaling contributes to vision even in the presence of functional rods and cones," postdoctoral fellow Tiffany M. Schmidt said. Schmidt is lead author of a recently published study in the journal *Neuron*. The senior author is Samer Hattar, associate professor of biology in the university's Krieger School of Arts and Sciences. Their findings have implications for future studies of blindness or impaired vision.

Rods and cones are the most well-known photoreceptors in the retina, activating in different light environments. Rods, of which there are about 120 million in the human eye, are highly sensitive to light and turn on in dim or low-light environments. Meanwhile the 6 million to 7 million cones in the eye are less sensitive to light; they drive vision in brighter light conditions and are essential for color detection.

Rods and cones were thought to be the only light-sensing photoreceptors in the retina until about a decade ago when scientists discovered a third type of retinal photoreceptor – the ipRGC, or intrinsically photosensitive retinal ganglion cell – that contains melanopsin. Those cells were thought to be needed exclusively for detecting light for non-image-dependent functions, for example, to control synchronization of our internal biological clocks to daytime and the constriction of our pupils in response to light.

"Rods and cones were thought to mediate vision and ipRGCs were thought to mediate these simple light-detecting functions that happen outside of conscious perception," Schmidt said. "But our experiments revealed that ipRGCs influence a greater diversity of behaviors than was previously known and actually contribute to an important aspect of image-forming vision, namely contrast detection."

The Johns Hopkins team along with other scientists conducted several experiments with mice and found that when melanopin was present in the retinal ganglion cells, the mice were better able to see contrast in a Y-shaped maze, known as the visual water task test. In the test, mice are trained to associate a pattern with a hidden platform that allows them to escape the water. Mice that had the melanopsin gene intact had higher contrast sensitivity than mice that lack the gene.

"Melanopsin signaling is essential for full contrast sensitivity in mouse visual functions," said Hattar. "The ipRGCs and melanopsin determine the

threshold for detecting edges in the visual scene, which means that visual functions that were thought to be solely mediated by rods and cones are now influenced by this system. The next step is to determine if melanopsin plays a similar role in the human retina for image-forming visual functions."

More information: Paper: www.cell.com/neuron/abstract/S0896-6273%2814%2900252-9

Provided by Johns Hopkins University