Examining light contrast sensitivity of human retinal pathways in myopia

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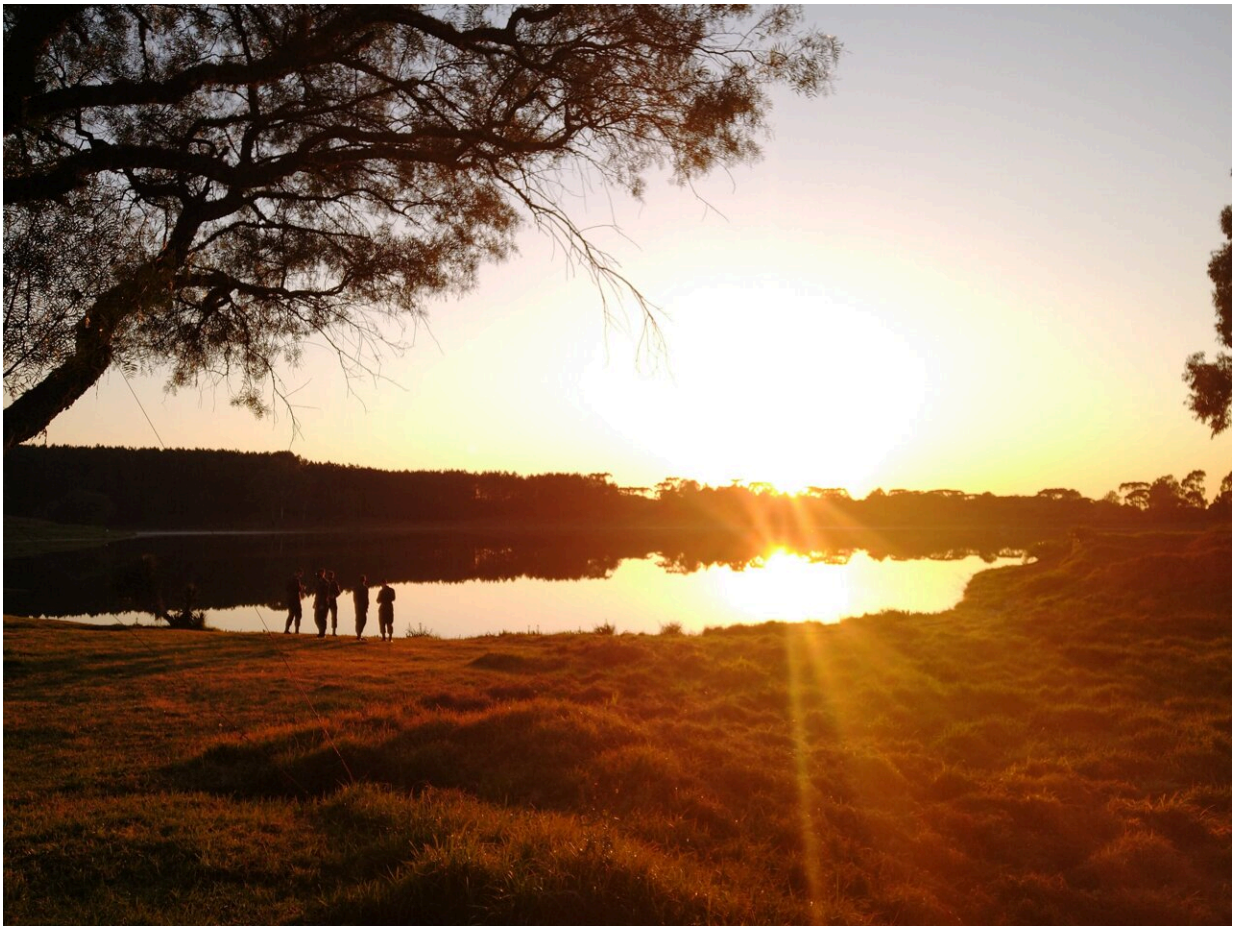

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Across the entire animal kingdom, visual images are processed by two

major neuronal pathways that extract light and dark stimuli from visual scenes—ON (light on) and OFF (light off) pathways.

Light stimuli are brighter than their background like a white cloud in a gray sky whereas dark stimuli are darker than the background like a black bird in a blue sky. The two pathways can extract stimuli with different contrasts but some pathways are more sensitive than others.

In carnivores and rodents, ON pathways are more sensitive to low contrasts than OFF pathways and, in our brightly-illuminated world, low contrasts are also more abundant among light than dark stimuli.

In a paper published in *The Journal of Neuroscience*, scientists at the State University of New York (SUNY) College of Optometry demonstrate that ON pathways are also more sensitive than OFF pathways in the human eye, but this higher sensitivity comes with a cost. It makes ON pathways vulnerable to loss of image sharpness under low light.

Poor image sharpness and low light are also risk factors in myopia (nearsightedness), a visual disorder that blurs vision at far distance. The new study demonstrates that human myopia is associated with pronounced deficits in ON pathway function.

As myopia becomes more severe, ON pathways become less sensitive, weaker and slower. Moreover, as would be expected from the weaker and slower ON pathways, the pupil reflexes driven by ON pathways also become weaker and slower. Pupil reflexes are important to navigate in bright visual environments and are needed to rapidly reduce the amount of light entering our eyes when scenes become brighter.

Spending time outdoors is known to protect against myopia, but the protection is not enough to stop progression for reasons that remain

unknown.

The new study suggests that deficits in pupil reflexes may limit the outdoor protection by reducing the amount of time that children spend looking at bright surfaces such as the sky, which strongly stimulate ON pathways. ON pathway deficits in contrast sensitivity could also make children less interested in looking at far targets because contrast decreases with viewing distance.

In turn, the reduction in far-distance vision should reduce exposure to bright light contrast driving ON pathways. Taken together with previous work, this study could lead to new approaches of myopia control based on ON-pathway natural stimulation.

The research was carried out by Sabina Poudel and collaborators in the laboratories of Jose-Manuel Alonso at the SUNY College of Optometry.

More information: Contrast sensitivity of ON and OFF 2 human retinal pathways in myopia, *The Journal of Neuroscience* (2023).

Provided by State University of New York College of Optometry