

Distribution of photoreceptors in the retina of mice

December 5 2013

Guppies, hyenas and mice share one particular retinal specialization in their eye: Photoreceptors ("cones") sensitive to 'green' light are largely located in the top half of the eye, whereas cones sensitive to 'blue' light dominate the bottom half. Since the lens inverts the image as it enters the eye this arrangement seems to make intuitive sense: blue light from the sky is detected by the blue cones, while the greenish light from the ground falls onto the green cones. Scientists led by Thomas Euler at the Werner Reichardt Centre for Integrative Neuroscience at the University of Tübingen have investigated this retinal specialization in mice.

In their study, just published in the journal *Neuron*, they show that this arrangement is not an adaptation to the predominating 'colors' of the sky and the ground, as was previously thought. Their experiments showed that the apparent match between 'color' and differential cone distribution brings the animals no advantage. "The green cones would 'see' the [light](#) in the sky just like the blue cones", explains Thomas Euler. Instead, this specialized distribution of cones appears to subserve a much more fundamental aspect of vision: the detection of dark-light contrasts.

As photographers will know, there is a very substantial difference between the sky and the ground in terms of brightness and contrast. On the ground average brightness is rather low in comparison with the sky, and light is reflected from things such as leaves and the earth, so that contrasts of bright and dark are roughly equally frequent. Light from the sky, however, is usually direct, with objects appearing as dark silhouettes against a bright background. So it would make sense for different parts

of the eye to be adapted to the predominant distribution of contrast below and above the horizon.

"Indeed, this is the case: Green cones in the mouse [retina](#) respond similarly to dark and light stimuli, but blue cones respond more strongly to dark ones", clarifies the scientist. The 'blue'-sensitive, sky-oriented lower half of the mouse retina is tuned to spot dark objects against a bright background. These objects can be, for example, birds of prey. The results match very well with two recent studies in which it was shown that mice either freeze or run and hide as soon as something dark appears above them. This instinctive reaction occurs within less than 200 milliseconds, which is too short a time to allow for a thorough 'assessment' of the situation. Therefore, the researchers think that this behavior is based on very fast visual processing, as it might be provided by a signal path specializing in dark contrasts that begins at the first synapse, with the cones.

More information: Tom Baden, Timm Schubert, Le Chang, Tao Wei, Mariana Zaichuk, Bernd Wissinger, Thomas Euler: A Tale of Two Retinal Domains: Near-Optimal Sampling of Achromatic Contrasts in Natural Scenes through Asymmetric Photoreceptor Distribution. *Neuron* (2013), [dx.doi.org/10.1016/j.neuron.2013.09.030](https://doi.org/10.1016/j.neuron.2013.09.030)

Provided by Universitaet Tübingen

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