EBERHARD KARLS UNIVERSITÄT TÜBINGEN

CIN Werner Reichardt Centrum für Integrative Neurowissenschaften

Press Release

Not Blinded by the Light: Rods in the Retina Contribute to Daylight Vision

Findings of international research team may be beneficial for new treatments for patients suffering from loss of vision in bright light

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An international research team headed by Thomas Münch of the Institute for Ophthalmic Research and Werner Reichardt Centre for Integrative Neuroscience of the University of Tübingen found the contribution of rod photoreceptors in mouse retinas to be much greater than previously assumed. One cannot distinguish colors with rods. They were thought to become useless as light levels increase, while vision in daylight conditions is based on cone photoreceptors. The new study – published in *Nature Communications* – shows that rod function can even increase in bright light.

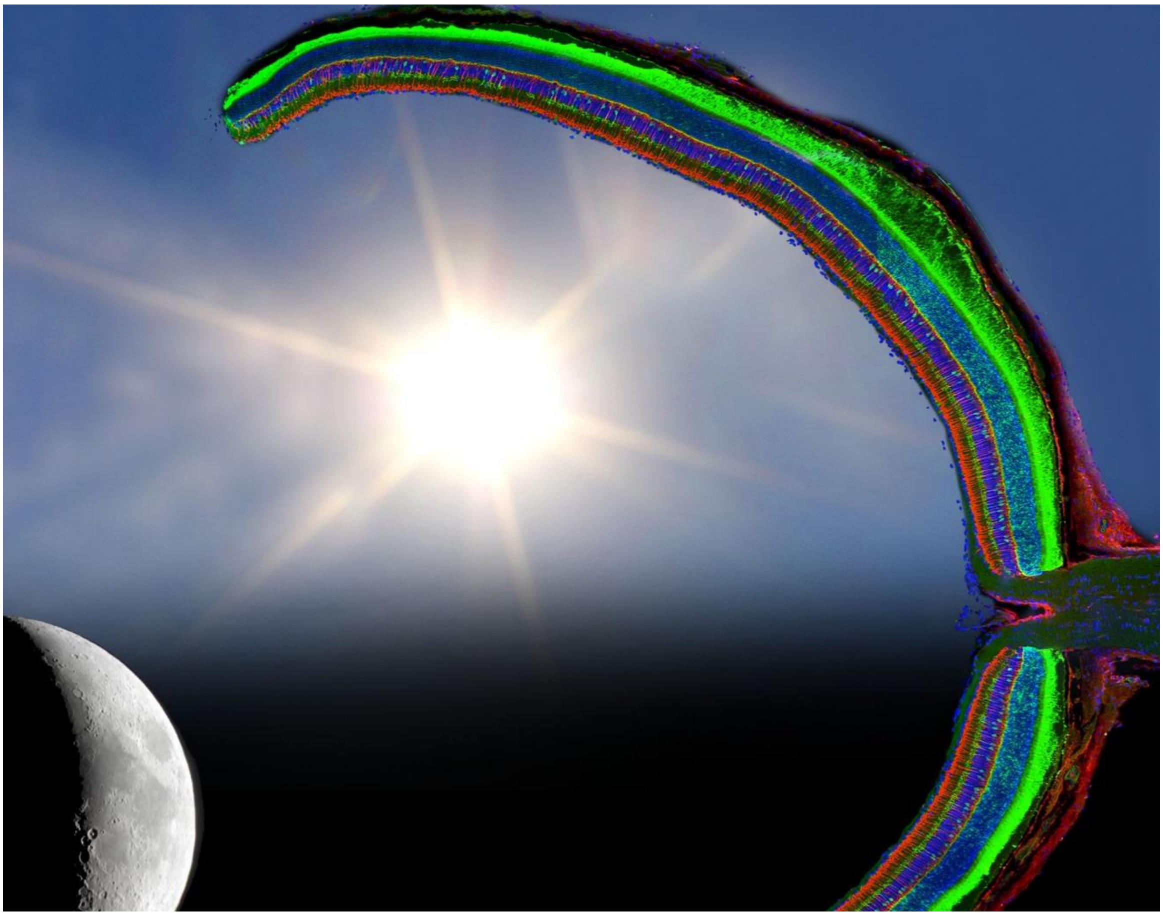
The photoreceptors in the retina, at the back of the eyes, are the primary light sensitive cells that allow us to see: they convert light into electrical signals. There are two types, rods and cones, and it has generally been assumed that rods are responsible for seeing in dim light conditions, whereas cones allow vision in bright light. This division of labor between rods and cones can be found in virtually every biological and medical text book.

A new study challenges this traditional view: A group of researchers from the universities of Tübingen, Manchester and Helsinki led by Thomas Münch from Tübingen shows that rod photoreceptors do, in fact, contribute to daylight vision. Most surprisingly, their contribution even increases when the daylight becomes brighter, up to the brightest light levels that would ever be encountered in natural environs.

Using transgenic mice without functional cones, the investigators first measured rod-driven signals and could reliably detect them both in the retina and in the brain even at high light levels. Furthermore, they were subsequently able to show this bright-light rod contribution in mice with fully functional cones as well.

With this new data, it seemed obvious that the models used by most scientists beforehand must be incomplete. And indeed, much was already known about rod physiology that had not been included in the big picture, as it has been understood up to now. Adding this information, the research team arrived at a model that not only explains how rods see so well in dim light, but also their own findings: that rods continue to function in bright light.

“We showed that rods can function at bright light”, says Thomas Münch, “but it is true that cones can do this much better and much more reliably. However, these new insights may still open new avenues towards treatments for patients without functional cones, so-called rod monochromats.” People in modern times are exposed to artificial bright light for many hours each day. In the old paradigm, this has made reliance on rods for the development of treatments counterintuitive. With these new mechanistic insights into bright rod vision, however, there may be new possibilities for therapies for patients without functional cone vision.



In the retina, there are two types of photoreceptors, the rods and the cones, that support vision over a huge brightness range, from dim starlight to bright sunlight. It has been thought that rods function exclusively in dim light conditions. A new study by Tikidji-Hamburyan et al updates this concept and shows that rod photoreceptors can contribute to vision also in bright environs. The image on the right shows a cross section of a retina, in which different cell types are labeled with different color. The photoreceptors are the green cells on the right.
Moon picture by John French, Abrams Planetarium. Retina picture by Hartwig Seitter © AG Münch, University Tübingen

Publication:
Alexandra Tikidji-Hamburyan, Katja Reinhard, Riccardo Storchi, Johannes Dietter, Hartwig Seitter, Katherine E. Davis, Saad Idrees, Marion Mutter, Lauren Walmsley, Robert A. Bedford, Marius Ueffing, Petri Ala-Laurila, Timothy M. Brown, Robert J. Lucas, Thomas A. Münch: Rods Progressively Escape Saturation to Drive Visual Responses in Daylight Conditions. *Nature Communications* 2017 Nov 27; 8(1813). DOI: 10.1038/s41467-017-01816-6

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The University of Tübingen

Innovative. Interdisciplinary. International. Since 1477. These have always been the University of Tübingen’s guiding principles in research and teaching. With its long tradition, Tübingen is one of Germany’s most respected universities. Tübingen’s Neuroscience Excellence Cluster, Empirical Education Research Graduate School and institutional strategy are backed by the German government’s Excellence Initiative, making Tübingen one of eleven German universities with the title of excellence. Tübingen is also home to five Collaborative Research Centers, participates in six Transregional Collaborative Research Centers, and hosts six Graduate Schools.

Our core research areas include: integrative neuroscience, clinical imaging, translational immunology and cancer research, microbiology and infection research, biochemistry and pharmaceuticals research, the molecular biology of plants, geo-environment research, astro- and elementary particle physics, quantum physics and nanotechnology, archeology and prehistory, history, religion and culture, language and cognition, media and education research.

The excellence of our research provides optimal conditions for students and academics from all over the world. Nearly 28,000 students are currently enrolled at the University of Tübingen. As a comprehensive research University, we offer more than 250 subjects. Our courses combine teaching and research, promoting a deeper understanding of the material while encouraging students to share their own knowledge and ideas. This philosophy gives Tübingen students strength and confidence in their fields and a solid foundation for interdisciplinary research.

The Werner Reichardt Centre for Integrative Neuroscience (CIN)

The Werner Reichardt Centre for Integrative Neuroscience (CIN) is an interdisciplinary institution at the University of Tübingen funded by the DFG’s German Excellence Initiative program. Its aim is to deepen our understanding of how the brain generates functions and how brain diseases impair them, guided by the conviction that any progress in understanding can only be achieved through an integrative approach spanning multiple levels of organization.