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Centrum für Integrative
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Press Release

From Mice to Men – Lessons in Color Vision

Retinal neurons sensitize to colors preferred by nearby photo-receptors. Results in mice may explain primates' red-green vision

Public Relations Department
Myriam Hönig
Director

Antje Karbe
Phone +49 7071 29-76788
+49 7071 29-76789
Fax +49 7071 29-5566
myriam.hoenig@uni-tuebingen.de
antje.karbe@uni-tuebingen.de
www.uni-tuebingen.de/aktuell

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Our eyes are complicated organs, with the retina in the back of the eyeball comprising hundreds of millions of neurons that allow us to see, and to do so in color. Scientists have long known that some retinal ganglion cells – neurons connecting the retina to the rest of the brain – are tuned to specific wavelengths of light (colors). In humans and other primates they are excited by red and inhibited by green, for example. An important question is: how are these "color-opponent" cells wired to discriminate wavelengths so that we perceive colors?

Scientists in the lab of Thomas Euler, professor at the Werner Reichardt Centre for Integrative Neuroscience and the Institute for Ophthalmology at the University of Tübingen, have been working on the problem of retinal color processing for several years. Their article in the journal Neuron shows that whether or not ganglion cells become color-opponent depends on the chromatic preference of the light-sensitive photoreceptor cells in the vicinity. The research looked at mice, which have a striking distribution of photoreceptors across their retina, with a green-sensitive upper half and blue-sensitive lower half. This differs from most mammals, yet they are an excellent model system for studying important aspects of mammalian color processing.

Researchers found that when stimulated with light, ganglion cells that have never before been implicated in color vision become color-opponent if they are located close to the border between the green- and the blue-dominated retina halves, but nowhere else. Their findings show that color vision can arise from neural circuits in the retina that are not specifically "wired" for color processing.

Although these findings were made in mice, they represent an important contribution to our understanding of color processing in humans and other primates, which are considered the color specialists among the mammals. Such random wiring has long been proposed for primate red-green color vision, which resulted from a gene duplication event that occurred quite recently on an evolutionary time scale – possibly leaving

not enough time for a specific neural circuit to evolve. The new findings support this idea and suggest more similarities in the general principles of color discrimination in mice and primates than previously thought.

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Original Article: Le Chang, Tobias Breuniger, Thomas Euler. ‘Chromatic Coding from Cone-type Unselective Circuits in the Mouse Retina’ Neuron Volume 77 Issue 3 6 February 2013.

Contact:

Prof. Dr. Thomas Euler
Tübingen University
Werner Reichardt Centre for Integrative Neuroscience
Otfried-Müller-Straße 25 · 72076 Tübingen
Phone: +49 7071 29-85028
thomas.euler[at]cin.uni-tuebingen.de

Information about the CIN:

Dr. Ivan Polancec
Tübingen University
Werner Reichardt Centre for Integrative Neuroscience
Otfried-Müller-Straße 25 · 72076 Tübingen
Phone: +49 7071 29-89105
ivan.polancec[at]cin.uni-tuebingen.de

www.cin.uni-tuebingen.de

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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.