

Scientists shed new light on how retina's hardware is used in color vision

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Biologists at New York University and the University of Würzburg have identified, in greater detail, how the retina's cellular hardware is used in color preference. The findings, published in the latest issue of the *Proceedings of the National Academy of Sciences (PNAS)*, enhance our understanding of how eyes and the brain process color.

Light can serve as an attractive or repulsive landmark for orientation—we identify an object or a light source at a certain location in visual space, then approach it or retreat from it. This process, called phototaxis, was the focus of the *PNAS* study.

Conducted by biologists at New York University's Center for [Developmental Genetics](#) and the Department of Genetics and Neurobiology at the University of Würzburg in Germany, the research specifically examined the [photoreceptor cells](#) in the retinas of the fruit fly *Drosophila*. *Drosophila* is a powerful model for studying the [color vision](#) process as it is amenable to very specific genetic manipulations, allowing researchers to analyze how its visual system functions when different elements of its retina are affected.

The visual systems of most species contain photoreceptors with distinct spectral sensitivities that allow animals to distinguish lights by their spectral composition (i.e., color). In *Drosophila*, six of these (R1-R6) are responsible for motion detection and are sensitive to the brightness or dimness of a broad spectrum of light. Two others (R7 and R8) are used for color vision by comparing ultraviolet light (UV), detected by R7,

with green or blue light detected by two types of R8. The NYU and University of Würzburg biologists investigated how [photoreceptor](#) types contribute to phototaxis by blocking the function of either R7 or R8, or a combination of a range of photoreceptors (R1-R6, R7 and/or R8).

In the study, they constructed two sets of "Y-shaped mazes" with two different types of light at the ends of each: UV and blue in one and blue and green in the other. Under this arrangement, the fly would show a preference for certain type of light (UV vs. blue in one maze; blue vs. green in the other) by moving toward it. The researchers could then link specific preferences to the make-up of each fly's visual system.

In a "UV vs. blue" choice, flies with only R1-R6 and flies with only R7/R8 photoreceptors preferred the blue to the UV light. This finding suggested that these two sets of photoreceptors (R1-R6 and R7/R8) function separately in phototaxis as flies with only one of these sets showed similar preferences. In addition, flies without a functioning R7 photoreceptor preferred the blue to the UV light, whereas flies without R8 preferred UV. In the "blue vs. green" maze, flies without a functioning blue R8 photoreceptor preferred green, whereas those with a defective for green R8 photoreceptor preferred blue. This shows that each subclass of photoreceptors [R1-R6, R7, R8 (blue), R8 (green)] is used by the fly to distinguish colors and setup its innate color preference. In a previous work, the same authors had shown that motion detection only involves R1-R6 and not R7 and R8, suggesting that there are two independent channels in the fly visual system—one for motion and one for color.

"This simple insect can achieve sophisticated color discrimination and detect a broader spectrum of colors than we can, especially in the UV," said NYU biologist Claude Desplan, one of the study's authors. "It is a great model system to understand how the retina and the brain process visual information."

Provided by New York University

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