# Scientists find evolution in butterfly eye dependent on sex

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By analyzing both the genes that control color detecting photoreceptors and the structural components of the eye itself, University of California, Irvine evolutionary biologists have discovered male and female butterflies of one particular species have the unique ability to see the world differently from each another because of sex-related evolutionary traits.

The study, which appears in the journal *Molecular Biology and Evolution*, offers new insights into these selective environmental pressures that guide butterfly eye evolution.

Led by Adriana D. Briscoe, UCI professor of ecology & evolutionary biology at the Ayala School of Biological Sciences, researchers discovered that the butterfly species Heliconius erato possesses a distinct set of visual photoreceptors based on species sex. Females of the species contain two types of the ultraviolet opsin gene (UVRh1 and UVRh2), while males lack UVRh1.

The findings were surprising to the group, as no other animal has been found to have a sex-linked difference in the make-up of its eye that depends on the suppression of an opsin gene. The researchers also noted that the violet receptors controlled by the expression of the ultraviolet opsin genes may help facilitate species recognition between Heliconius erato and other butterflies.

"We are only now beginning to appreciate that male and female

Heliconius see the world through different eyes," said Briscoe. "Pollinator preference can have a huge impact on the evolution of flower coloration, just by virtue of which flower gets visited. Flowers may change their colors to match what butterflies can see; and sex differences add another layer to the story of these interactions."

Briscoe and her colleagues were astonished by the sex differences found in the Heliconius erato species; however, it remains to be determined why such differences would evolve in the first place. Their findings shed light on a fascinating way that environmental pressure can give rise to the origins of a new visual receptor.

"We think this study will inspire visual ecologists to look more closely at the behavior of each sex - how they see each other, how they see flowers and how they find places to lay their eggs," she said. We are testing this hypothesis by giving male and female Heliconius butterflies color vision tests in the lab."

Briscoe and study co-leader, UCI post-doctoral scholar Kyle McCulloch, added "Finding this level of color receptor diversity in closely related butterflies supports other studies showing that eye evolution is not always a slow and conservative process. As a field, we are still not sure why some lineages diversify and use many more color receptors than others, but with this study, we can frame new hypotheses to answer these questions. In particular it will be exciting to learn what mechanisms during development lead to these sex and species differences in the eye, and what selection pressures - mate choice, foraging, oviposition - lead to these differences in Heliconius."

**More information:** Kyle J. McCulloch et al, Sexual Dimorphism and Retinal Mosaic Diversification Following the Evolution of a Violet Receptor in Butterflies, *Molecular Biology and Evolution* (2017). DOI: 10.1093/molbev/msx163

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