Investigation on wavelength sensitivities and distributions of visual pigments in the four-layered retina in jumping spiders

Takashi Nagata, Mitsumasa Koyanagi, and Akihisa Terakita
Department of Biology and Geosciences, Graduate School of Science, Osaka City University, Japan.

Animal eyes have evolved to achieve various visual functions. The principal eyes of jumping spiders, which play major roles in courtship and prey-catching behaviors by serving acute vision and color vision, have a unique retina with four-tiered photoreceptor layers. However, how the four-layered structure underlies the spider visual functions still remains unclear although previous studies partially revealed its contribution to color vision. Here we determined functional visual pigments and their distribution to each layer to elucidate the molecular basis of the visual functions. The two deepest layers (Layers I and II) and the others (Layers III and IV) contained a green-sensitive and a UV-sensitive visual pigment, respectively. The arrangement of green-sensitive receptors behind UV-sensitive receptors against the incoming light agreed with that of focal planes separated by chromatic aberration of the lens, demonstrating that the tiered photoreceptor layers compensate chromatic aberration. Interestingly, our results indicate that Layer II is green-sensitive, although blue light was previously found to be focused on the layer. This mismatch found in Layer II might be involved in a visual function.