

Female butterflies go for sparkle - not size - when choosing to mate

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Size doesn't matter, at least not the size of the eyespots on a male butterfly's wings when female butterflies consider potential mates. Instead, females are attracted to the "sparkle" created by the ultraviolet reflectivity of the pupils, the white circles at the center of eyespots, according to new research from University at Buffalo biologists.

Image: UB researcher Kendra Robertson uses paint to change the size of the eyespot on the wing of a male butterfly (see inset).

The research, to be published online June 29 in the Proceedings of the Royal Society B: Biological Sciences, overturns previous work indicating that larger eyespots might be considered more desirable by female butterflies.

The purpose of the research was to explore some of the evolutionary reasons behind butterfly wing patterns in the African satyrid butterfly, *Bicyclus anynana*.

The findings were surprising in the context of the natural world, where dramatic colors and physical features often win the sexual-selection game, according to the UB researchers.

"This is one of the first studies to show that such a small pattern element really matters in female choice," said Antonia Monteiro, Ph.D. a co-author on the paper and UB assistant professor of biological sciences.

"We always think of something huge or ornamental as determining sexual choice," noted Kendra Robertson, co-author, who recently received her master's degree from the Department of Biological Sciences in the UB College of Arts and Sciences.

In a series of carefully controlled tests on both the dorsal and ventral sides of wings, Robertson induced a dozen subtle variations in the eyespot size and pattern of males and then studied how they influenced female's mating decisions.

"It's very easy to change the size, color composition and shape of these patterns, using artificial selection," said Monteiro. "The question then becomes, 'Why do these populations remain unchanged?' What are the

selective forces that maintain these patterns constant through time in any one species in nature?"

In this butterfly species, females make the ultimate decision about whether to mate.

The UB researchers altered wing-pattern elements through carefully painting the wings or by pairing males displaying traits of different size and color. They then tested female preference for wing size, eyespot size, quantity of eyespots on the wing, eyespot and pupil color, and pupil reflectivity.

"Once we found a trait that appeared to be important, we then would exaggerate it or reduce it to pin it down," said Monteiro.

None of the variations induced on the ventral side appeared to have any affect on the females' mating decisions, leading the researchers to conclude that the ventral side of the wing does not play a role in the decision making.

But when the researchers painted the white pupil on the dorsal side with black paint, thereby eliminating the pupil, these males were much less desirable to females by a ratio of two to one, demonstrating clearly that females preferred the presence of the white pupil.

However, a large white pupil, about twice the diameter of a natural pupil, also was not found desirable by females, indicating strong sensitivity to a set of rather narrowly defined features, such as eyespot pupils that measure approximately half of one millimeter.

The most conclusive finding resulted when the researchers painted the white pupils in male eyespots on the dorsal side with a plant extract, rutin, which maintained the pupils' whiteness, but eliminated their

ultraviolet reflectivity.

"When there was no UV reflectivity, which butterflies can see, females registered a strong distaste," said Monteiro. "Selection against the absence of UV reflectivity was as strong as selection against the absence of a pupil altogether."

The reasons for this phenomenon are complex, but Robertson noted that the UV reflectivity may be important in what is known as photic stimulation -- a flashing light effect -- during the series of events that lead up to mating.

"When the male approaches the female, he opens and closes his wings in rapid succession so she can observe his pupils," she explained. "We believe the purpose of the fluttering of his wings is two-fold: to spread pheromones to her antennae and to stimulate her visually. The female appears to be very sensitive to this rapid flickering, which probably looks to her like a strobe-light effect."

Robertson added that while these conclusions are applicable only to this particular species of butterfly, other species of related butterflies feature much broader UV reflective patterns on their wings in the form of blue or violet bands of coloration.

"Our assumption is that they are there for sexual selection purposes as well," she said, "but we still don't know what causes the change from a female's preference for relatively small pupils in this species to the likely female preference for much larger UV-reflective patterns in these other species."

Monteiro says her next step is to study the role of eyespots in male mate choice, since females also display them and it is not clear who actually has a chance to observe them, since the female butterfly usually hides

them at rest.

Source: University at Buffalo

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