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# UC Irvine scientist has an eye for evolution

Adriana Mejia Briscoe studies butterflies' vision, searching for biological adaptations.

**By GARY ROBBINS**

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IRVINE – "Ooh, Ooh, look at *this.*"

Adriana Mejia Briscoe steps lightly into her flower garden and moves amid salvias and penstemons until she reaches a particular Brazilian verbena. There, she crouches and leans close to the plant, fixing on a painted lady butterfly that has alighted on one of the verbena's purplish stems.

The butterfly's wings are orange and black and speckled with spots of orange, red and black. Its mere presence enchants Briscoe, an assistant professor of ecology and evolutionary biology at UC Irvine. But her interest runs deeper. She studies butterflies, exploring questions that don't occur to most of us: how do these insects see? What do they see? And what does this tell us about evolution?

Briscoe, who recently published an important paper explaining an aspect of monarch butterfly migration, paused recently to discuss her work.

**Q. I know that some humans have troubling identifying specific colors. But I didn't know that this is true of some butterflies. Is color blindness widespread in nature**?

A. When we refer to colorblindness in humans we are usually referring to the difficulty some people have in distinguishing colors in the green, yellow, orange and red part of the spectrum. For some animals, including some species of butterflies, this kind of colorblindness is really normal. But for others it's not. We are trying to figure out how widespread this trait is.

**Q. Why does it matter whether some butterflies are colorblind?**

A. In order to understand why human red-green color vision evolved, you need to have a feel for how generally useful that trait is in nature, so we look at other animals to see how they use this trait. We look at monarchs and swallowtails and butterflies like the painted lady.

For animals that lack that trait, who are colorblind, we ask what are they doing instead?

**Q. Let's talk about the painted lady butterfly, which is prevalent in Orange County. Is it colorblind and, if so, how does it compensate?**

A. A visiting Chilean graduate student in my lab showed in behavioral tests that *Vanessa atalanta*, a close relative of the painted lady butterfly, is blind to colors in the green to red part of the spectrum. It seems to compensate by being able to discriminate colors well in the blue to ultraviolet part of the spectrum.

Because we could detect no differences genetically between the two species that would produce differences in their visual system, we think that painted ladies probably prefer to visit flowers that reflect blue, violet and ultraviolet light because it is easier for them to see those colors than flowers that are red reflecting.

**Q. Are there advantages for a butterfly to being colorblind?**

A. Butterflies have to compete for food with other animals, such as hummingbirds, which have huge daily nectar requirements. For instance, although they will also visit other flowers with a wide range of colors, hummingbirds seem to prefer flowers that are mostly red-reflecting. If a butterfly has difficulty seeing flowers that the hummingbirds prefer, perhaps that is a good thing because it might more usefully spend its time foraging on flowers that it can see, and which might have more nectar.

**Q. Was the painted lady always colorblind, or did that evolve over time? And how can you tell?**

A. We do think that probably the painted lady was always red-green colorblind because most butterflies, skippers and moths that have been examined are colorblind in this part of the spectrum. Moths and skippers are the closest relatives of butterflies.

However, over tens of millions of years, some butterflies, such as swallowtails, which you will also see flying around Orange County, evolved red-green color vision by simple genetic changes.

Interestingly, this parallels the situation in primates, where most mammals such as dogs and cats are colorblind, but Old World primates, which include chimpanzees, gorillas and humans, evolved red-green color vision through a similar genetic mechanism as found in the swallowtail butterfly. One of our active areas of research is to try and figure out how many millions of years ago red-green color vision in butterflies evolved, and whether this date correlates with any events in the evolution of land plants that would explain why the trait was passed on to their descendants.

**Q. Are you colorblind? Do you have anything in common with a butterfly?**

A. No, I'm not. But I do share a certain fondness for growing the kinds of flowers in my garden that butterflies and other pollinators like.

**Q. What's your favorite butterfly, and why?**

A. Right now, my favorite butterfly is a rather small and dark-brown riodinid with white specks on its wing margins. Because they are so rare and I have only ever once seen one in Orange County. I'd like to figure out what its host plant is and grow some in my yard.

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