*Issue:* ***March 2012***

# Why Do Zebras Have Stripes?



***by Andrew Hitchings***



Why do zebras have stripes? The explanations range from camouflage to temperature regulation. One hypothesis is that the stripes disrupt the image of a group of zebras, making it harder for a predator to pick out any one zebra from the herd. Like most of the other explanations, though, there is little evidence to back this up.

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**The explanations for zebra stripes range from camouflage to temperature regulation. One hypothesis is that the stripes make it harder for a predator to pick out any one zebra from the herd. Now, research suggests that the dense, narrow zebra stripes actually repel bloodsucking horseflies.**

Now, research suggests that the stripes do disrupt the vision of hungry animals, but animals that are much smaller than lions. Adam Egri from Eötövos Loránd University in Budapest and his colleagues tested how often horseflies, common parasites of grazing animals, landed on surfaces with thicker or narrower stripes. Their findings, published in *The Journal of Experimental Biology* in March 2012, show that dense, narrow stripes such as those on zebras are perfect for repelling flies. The stripes look striking to us, but may make zebras less visible to horseflies.

## More Than Pests

Biting insects can be a serious threat to animals' survival. Swarms of flies can get so irritating that animals won't leave the shade to graze. The greater danger, though, is what is borne by the insects. Bloodsucking insects can spread deadly diseases among their hosts. Where animals live in large herds, as in much of Africa, it's easy for flies and their deadly microbes to make the jump from one animal to another.

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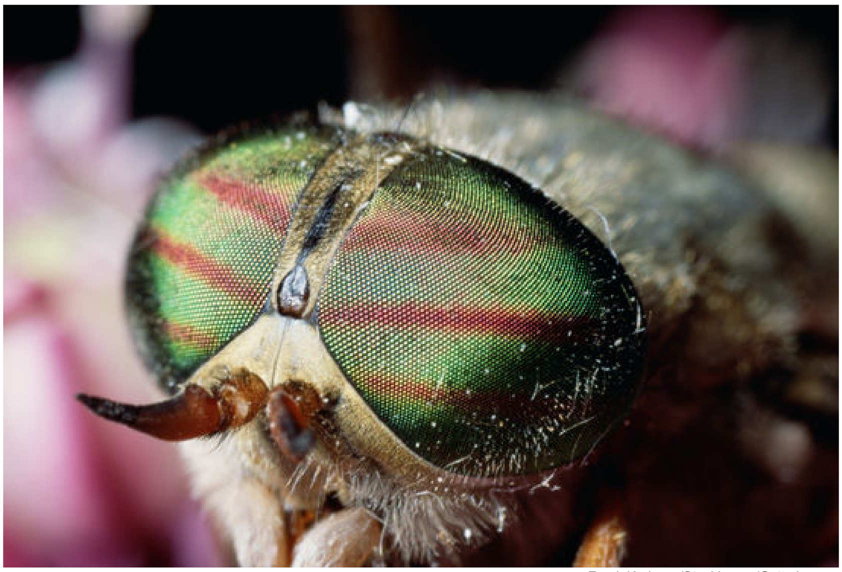
Creatures that could avoid parasites would be healthier and would stand a better chance of passing on their genes. Earlier researchers had observed that tsetse flies, another kind of biting fly notorious for carrying sleeping sickness, attacked zebras less frequently than they did other grazing animals. In experiments, tsetse flies avoided landing on stripes but tended to land on solid colors. Egri and his team wanted to see if the same would be true for other biting flies, namely horseflies. And they also wanted to know, if the stripes did afford partial protection, what was the reason for that?

### A Fly's Eye View

The researchers decided to investigate if the answer could lie in how the flies perceive certain forms of light. A female horsefly needs to find blood to nourish her eggs, as well as water where they can hatch. A dark-furred animal and a watering hole don't look similar to us, but to horseflies they both shine out in the same way. Each attracts horseflies by giving off polarized light, something our eyes can't perceive. Light comes in waves, which oscillate like ripples on a pond. Unlike water waves, which can only oscillate up and down, light can oscillate in any orientation. When a high fraction of the light waves bouncing off of an object oscillate in the same direction, the light is said to be polarized. Our eyes are able to detect the length of these waves (color) and their height (brightness), but not their orientation.



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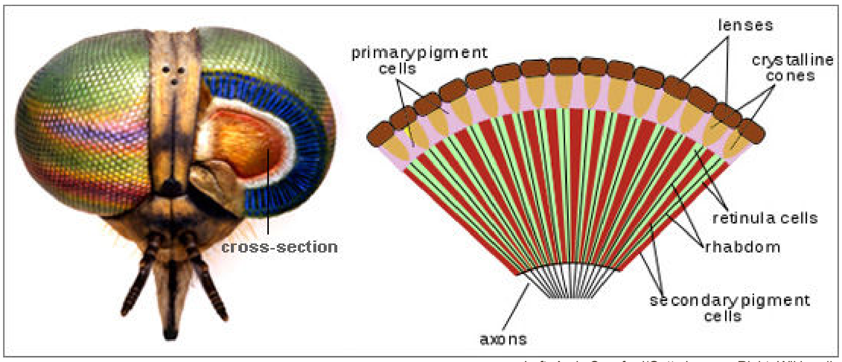

Left: Andy Crawford/Getty Images; Right: Wikimedia

Sunlight starts out unpolarized; the waves are at random angles. Light becomes polarized once it's reflected. Reflected light can become polarized in one of two ways, depending on whether it's reflected from the surface of an object or from its subsurface layers. Each reflects polarized light at a different angle. Brightly colored objects reflect light equally from both layers, and the polarization cancels itself out. Dark-colored objects mostly reflect light from their surface, not from the subsurface. This means more of their light is polarized in one orientation than the other, and the light as a whole is polarized.

### Catch More Flies With Salad Oil

This polarization means that horseflies are more attracted to darker animals than to lighter ones. To find out where zebras would fit on this scale, the researchers tested the flies' attraction to a variety of shades and stripe widths. Differently painted objects were covered in sticky substances to trap insects, and then left outside on a horse farm. By counting the number of horseflies trapped on each one, the team could tell which patterns were most attractive.

For the first tests, flies were trapped in trays of sticky salad oil. The insides of the trays were painted solid black, solid white, or black with several white stripes. Salad oil was chosen because it wouldn't affect the trays' polarization properties. As expected, the unbroken black surface attracted the most flies, and the white one attracted the least. The more white stripes the researchers added, the fewer flies were trapped. Even when two trays had the same proportions of black to white space, the one with more and narrower stripes was less attractive to the horseflies.

### Testing Patterns

Was any portion of the striped pattern particularly attractive or unattractive to the flies? The salad oil was no help here: Trapped flies would drift in the oil, making it impossible to tell where on the tray they had originally landed. To get a more precise picture of what had attracted the flies, the researchers used striped boards covered in glue. On real zebras, the pattern ranges from vertical or diagonal stripes on the body to horizontal bands on the legs. The researchers tested vertical, horizontal and diagonal stripes of various widths. Since polarization differs depending on the object's angle relative to the light source, they set up both horizontal and vertical boards.


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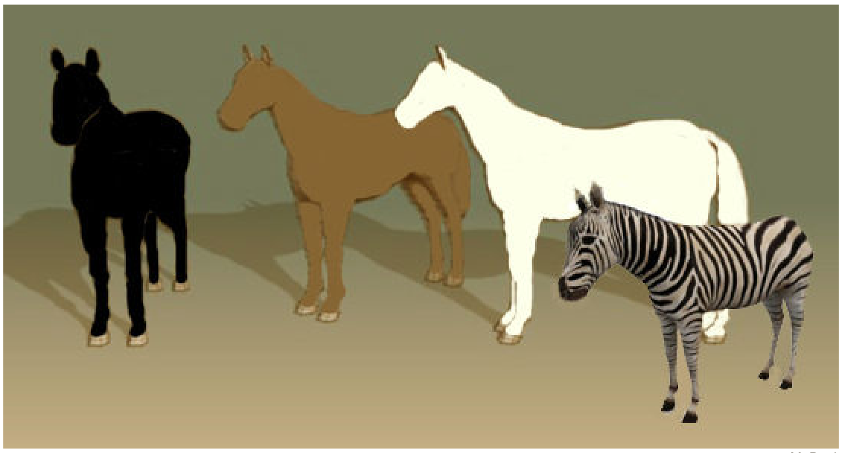
**The researchers emulated the zebra stripes using striped boards covered in glue. They tested vertical, horizontal and diagonal stripes of various widths.**

The flies flocked to boards with broader stripes, and more flies were found stuck to black stripes. No matter the angle of the stripes or board, the effect was the same: if the stripes were narrow enough, they kept the flies away. So far, the experiments haven't indicated whether this was due to polarization or shading.

To test the effects of polarization alone, the team set up boards that would appear as a series of grayish slats to humans. In reality, each was covered with strips of polarizing material. Each alternating strip polarized light at a different angle, creating a series of stripes. For the control, they created boards where all of the strips polarized light at the same angle, the polarization equivalent of a solid color. Here again, the researchers tested wider and narrower stripes, and found that flies avoided the narrower ones. It seems that stripes disrupted the flies' natural tendency to go towards polarized light.

### Three Horses and a Zebra

Of course, a flat tray or board looks quite different from a real animal. The team set up four model horses covered in the same glue used on the boards. Each was about four feet (1.2 meter) tall and all were painted realistically; one was black, one was brown, one was white, and one was zebra-patterned. To ensure accuracy, the zebra-like model's paint job was copied from an actual zebra skin. As expected, the black model attracted the most horseflies, followed by the brown one. The white model was unattractive to insects, and the zebra-like model was the least attractive.



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The results confirmed that stripes discourage horseflies from landing. As stripes become narrower, they become less and less attractive until eventually they are more effective at repelling flies than a white surface. The stripes break up the image, and the flies may not perceive the striped surface as a single object big enough for them to land. By looking at real zebra skins, the researchers confirmed that the stripes are in the range of widths where they would be most discouraging for flies. In fact, zebras have the narrowest stripes on their heads and legs, precisely where their skin is thinnest and most vulnerable to insect bites.

Of course, even with the horse models there were still crucial differences between the experimental setup and a real animal. It's unknown how much horseflies are guided by smell rather than vision. A zebra's scent might attract flies despite the effect of the stripes. The results also raise a puzzle. If stripes are so advantageous, why don't zebras' relatives have them? Why aren't all horses zebras?

### Discussion Questions

The researchers didn't control for the role of scent in attracting insects. How would you test the role of both scent and light in attracting horseflies?

### Journal Articles and Abstracts

*(Researchers' own descriptions of their work, summary or full-text, on scientific journal websites).*

"Polarotactic tabanids find striped patterns with brightness and/or polarization modulation least attractive: an advantage of zebra stripes." jeb.biologists.org/ content/ 215/ 5/ 736.abstract.

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### Keywords

zebra stripes, horseflies, polarization, Adam Egri

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