

Animal Magicians

Humans are not the only species to use visual trickery to their advantage

In the forests of Australia and New Guinea lives a pigeon-sized creature that is not only a master builder but a clever illusionist, too. The great bowerbird (*Chlamydera nuchalis*)—a cousin of crows and jays—has an elaborate mating ritual that relies on the male's ability to conjure forced perspective.

Throughout the year he painstakingly builds and maintains his bower: a 60-centimeter-long corridor made of twigs, leading to a courtyard decorated with gray and white pebbles, shells and bones. Some species also add flowers, fruits, feathers, bottle caps, acorns, abandoned toys—whatever colorful knickknacks they can find. The male takes great care to arrange the objects according to size so that the smallest pieces are closest to the bower's entrance



and the largest items are farthest away.

The elaborate structure is not a nest. Its sole purpose is to attract a female for mating. Once construction is complete, the male performs in the courtyard for a visiting female, who—poised like a critical *American Idol* judge—evaluates the routine from the middle of the corridor. He sings, dances and prances, tossing around a few select trinkets to impress his potential mate. Her viewpoint is very narrow, and so she perceives objects paving the courtyard as being uniform in size. This forced perspective makes the choice offerings appear grander and therefore all the more enticing.

The offerings, and the male himself, appear larger than life because of an effect that visual scientists call the Ebbinghaus illusion, which causes an object to look bigger if it is surrounded by smaller objects. In 2012 ecologists Laura Kelley and John A. Endler, both then at Deakin University in Australia, confirmed that among the great bowerbirds in Queensland, how well a male gener-

ates these illusions can predict his mating success.

Visual deception is not unusual in the animal kingdom, which is perhaps why so many cultures have tales of trickster creatures—the wolf in *Aesop's Fables* from ancient Greece, Old Man Coyote from Plains Indian myths and Brer Rabbit stories from the Southern U.S., to name a few. As is often the case, though, reality surpasses fiction. Bowerbirds are just one of many animals that routinely employ visual duplicity to stay alive and reproduce. These adaptations support the case that illusions are not simply errors of perception but can provide significant advantages, too.

Some animals change their environment, as the bowerbird does, but many others transform their appearance or behavior to dupe a potential enemy or unsuspecting meal. Here we review the three main illusions animals use to change their looks—crypsis, masquerade and mimicry—and survey a few of the most spectacular examples of each. **M**



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MASQUERADE



Some animals are less appealing to predators because they look like familiar inanimate or inedible objects. For instance, the larva of the giant swallowtail butterfly (*Papilio cresphontes*) (left) masquerades as a bird dropping, as does the orb web spider (*Cyclosa ginnaga*).

The larva of the feathered thorn moth (*Selenia dentaria*) (center) masquerades as a twig. Not only does it resemble a twig in color and shape, it also holds itself at an angle much like those of actual twigs in the host plant. Similarly, birds from the genus *Nyctibius*, with bark-colored plumage, masquerade as tree stumps by sitting motionless during the day.

A few species have the flexibility to match different unappetizing objects in their surroundings. Cuttlefish, like their octopus kin, have remarkable camouflaging talents and can suddenly change their skin color. They can readily disguise themselves as rocks or seaweed. Peppered moth larvae (*Biston betularia*) can also, chameleonlike, vary their coloration to match different twigs in their vicinity.

Some predators make use of this trick, too. The ghost mantis (*Phyllocrania paradoxa*) (right) masquerades as a dead leaf to fool unsuspecting flies.

CRYPISIS

Some animals blend into their environment to go undetected by predators. This technique, called crypsis, relies on the failure of another animal to perceive the deceiver. (In contrast, masquerading and mimicking creatures are not hard to spot, but the animal that sees them miscategorizes them as another species or inanimate object.)

There are a variety of ways in which cryptic animals, such as this lichen-mimicking katydid (right), avoid detection through camouflage. Thanks to disruptive coloration and patterns in their skin or exoskeleton, many creatures effectively disappear into the background. Others also deploy cryptic behaviors, hiding in burrows or covering themselves in sediment.



MIMICRY

Eyespots—concentric circles resembling vertebrate eyes—are ubiquitous among moths and butterflies, but they can be small and marginally located or large and central. Smaller eyespots may attract a predator's attention away from the head or other vital body parts. Larger eyespots tend to look like the eyes of a predator's enemy, which suggests they serve to intimidate potential attackers.

In 2014 biologist Sebastiano De Bona of the University of Jyväskylä in Finland and his colleagues concluded that eye mimicry—rather than the conspicuousness of an eyespot—was responsible for averting predators. They showed various images on a computer screen to great tits (*Parus major*), birds that prey on butterflies. The photographs included owls (which prey on great tits), as well as several different butterflies. Some of these butterfly pictures featured natural-looking eyespots, others had none, and a third group showed digitally manipulated spots that had the same color contrast as real spots but looked less like eyes. The birds produced equivalent aversive responses to mimetic eyespots and to the true eyes of owls. They responded less dramatically to the modified eyes.

So-called Batesian mimics are harmless creatures that, by virtue of their sound, appearance, behavior or smell, trick predators into mistaking them for noxious or dangerous species. For example, the syrphid fly mimics the patterns and colors of the honeybee. Predators that have learned to stay away from painful stings will be motivated to leave this mimic alone.

MORE TO EXPLORE

- **Illusions Promote Mating Success in Great Bowerbirds.** L. A. Kelley and J. A. Endler in *Science*, Vol. 335, pages 335–338; January 20, 2012.
- **Animal Visual Illusion and Confusion: The Importance of a Perceptual Perspective.** L. A. Kelley and J. L. Kelley in *Behavioral Ecology*, Vol. 25, No. 3, pages 450–463; May–June 2014.
- **Predator Mimicry, Not Conspicuousness, Explains the Efficacy of Butterfly Eyespots.** S. De Bona, J. K. Valkonen, A. López-Sepulcre and J. Mappes in *Proceedings of the Royal Society: Biological Sciences*, Vol. 282, No. 1806, Article No. 20150202; May 2015.
- **Masquerade.** J. Skelhorn in *Current Biology*, Vol. 25, No. 15, pages R643–R644; August 3, 2015.