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Predator or Prey: Proof is in the Pupil

Scrutinizing the connection between pupil shape and ecological niche



by Savannah N. Miller

Have you ever noticed in scary movies the villain is portrayed with vertically slit pupils? This distinct feature often gives the antagonist a “creepy” vibe, even if the viewer does not consciously notice it, and science may provide the reasoning behind this unsettling trend. A new study published in *Science Advances* by Martin S. Banks and colleagues has shown that animals’ pupils may indicate whether they are predator or prey in the food chain. The study surveyed 214 terrestrial animals, and it was found that vertical slits are often features of carnivorous animals, like cats, while horizontal pupils are usually characteristic of herbivorous prey, like goats.

“...variations in pupil shape are adaptations that correspond with the animals’ daily needs...”

These variations in pupil shape are adaptations that correspond with the animals’ daily needs, much like any other evolutionary trait. Pupil shape determines how much the pupil can change in size, thus giving the animal a greater ability to adapt to changes in lighting. Elongated pupils can increase in area up to 300-fold allowing ample light into the eye for better vision in dim to dark settings.

According to the study, a horizontally orientated pupil “improves image quality for horizontal contours [defined shapes] in front of and behind the animal and ... also facilitates a horizontally panoramic view for detecting predators approaching along the ground.” These combined characteristics aid the animal in spotting potential threats. According to similar studies, vertical pupils, such as those on animals that ambush their prey, are better suited to maintaining a specific focus and depth of field. This is an evolutionarily significant adaptation, as these animals must measure the distance to their prey accurately before an ambush.



The biological mechanisms for the gradual development of differing pupil orientations are currently unknown. However, it is apparent that horizontal and vertical-slit pupils have coevolved. Coevolution is defined as the phenomenon where a biological adaptation in one species spurs an adaptation to evolve in another. For example, bobcats have adapted to have vertically slit pupils that give them a greater ability to spot potential prey, like sheep. In a non-predacious population, the individuals with the best vision are able to spot and evade predators quicker than most. These individuals have a greater chance of surviving predatory attacks and can pass on “good” traits, in this case exceptional vision, to subsequent generations. This pattern likely occurred over time as a response to predation and resulted in horizontally slit pupils, a counter-adaptation to vertically slit pupils, in sheep and other herbivorous species.

In contrast to elongated pupils, circular pupils can only change in area about 15-fold and are controlled by fewer eye muscles. This means that animals that sport circular pupils, like humans, have less pupil control and thus inferior vision due to a lack of light reception in the eye. This is not to say those with circular pupils have inadequate eyesight compared to other animals; they simply do not have a need for such specific visual control in their niche. Thus, science has concluded what screenwriters have known all along: stay away from animals with vertical slit pupils, or their eyes might be the last things you see. 🐾

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