Snakes on the Brain

By Lynne A. Isbell

DAVIS, Calif.

SNAKES hit a nerve in people. How else to explain why the movie "Snakes on a Plane" became an Internet sensation months before it was released in theaters? The very idea was all it took to rouse attention.

That humans have been afraid of snakes for a long time is not a fresh observation; that this fear may be entwined with our development as a species is. New anthropological evidence suggests that snakes, as predators, may have figured prominently in the evolution of primate vision — the ability, shared by humans, apes and monkeys, to see the world in crisp, three-dimensional living color.

The snake-detection hypothesis has grown, as scientific theories so often do, out of attempts to grapple with the flaws in earlier ideas about why primates have better vision than any other mammals. (Cats, dogs and horses can see objects well enough, but they lack the depth perception it takes to, say, perform brain surgery, or the visual acuity we humans use to read the fine print on a legal contract.)

Back in the early 1900's, scientists thought that natural selection may have favored sharp eyes in ancestral primates because these animals were presumed to have lived in the canopies of tropical trees, and would have needed excellent vision to negotiate that environment without falling.

This "arboreal theory" held sway for 50 years until, in the early 70's, scientists pointed out that plenty of mammals without such great vision live in trees — tree squirrels, for example. More likely, they said, primates developed their vision because they ate insects. It would have been important to see well, according to this "visual predation hypothesis," in order to stalk and grab prey as primates do. But as one can see from observing insect-eating primates today, these animals are quite capable of finding their prey using their ears or noses alone.

> Do we owe our keen eyesight to a deadly predator?

Other ideas came along in the 1990's, including one all-encompassing theory suggesting that primates needed good vision to eat insects, find fruit and spot the best branches to leap to. All the theories worked off the assumption that primates' superior vision evolved as a strategy to help them get food. But natural selection can also work to improve an animal's ability to protect itself.

Recently, comparative studies of primate brains have shown that the part of the primate visual system that has expanded most is not the part that's used for visually guided grasping and reaching —it's the part that's given primates keen vision and forward-facing eyes, both useful for distinguishing nearby objects from their backgrounds and for finding camouflaged objects. Needless to say, these are good skills to have if one wants to avoid stepping on a snake.

How did this happen? About 90 million years ago, some mammals adopted diets that set them on an evolutionary path to becoming primates: They began to eat fruits and nectar.

This change from a wholly insectivorous diet to a sugary diet of very sweet-smelling foods made it possible for their brains to evolve in such a way as to give greater priority to vision and less to the sense of smell. (Animals that needed to sniff out faint scents — as hedgehogs find earthworms or rodents track down seeds — could not afford to let vision become more important than olfaction.) So the visual parts of primate brains were allowed to expand and become more complex.

Now, it's worth pointing out that other creatures began eating fruit, too — tree shrews and neotropical fruit bats, for example — and that these animals did not develop great eyesight. It follows, then, that there had to be some further incentive for primates to develop their superior vision. My contention is that the push may have come from snakes. I base this on multiple observations, two of which I will mention here.

First, all animals have early-warning networks, neurological wiring that tells them they're in danger. These networks, however, are more hard-wired to the visual system in primates than they are in other vertebrates. What's more, there is evidence that, over time, the visual component of the primate warning system has grown more than it has in other creatures.

Second, the monkeys with the sharpest eyesight tend to be those who live in greatest proximity to venomous snakes. About 60 million years ago, primates had branched into two groups: the Old World monkeys and apes (including us) and the lemurs of Madagascar. Around the same time, venomous — as opposed to constricting — snakes appeared in Africa and Asia. (Of all the predators of modern primates, snakes were the first to appear, about 100 million years ago.)

The Old World monkeys then branched again about 35 million years ago, when some went to South America and became the New World monkeys. The Old World monkeys and apes were the ones most exposed to venomous snakes, and of the three major primate groups, the Old World monkeys and apes have the best vision.

You might chalk this up to coincidence, but what if you learned that the Malagasy lemurs have the least complex visual systems of the primates, and that venomous snakes have never lived in Madagascar? New World monkeys, in the meantime, have been exposed to venomous snakes on and off and on again for the past 60 million years, and the quality of their eyesight is better than that of lemurs but more variable than that of Old World monkeys and apes.

And so the idea that the need to detect and avoid snakes contributed to the evolution of our vision fits into a rather neat picture. The hypothesis draws further support from what we know about the evolution of raptors: Eagles that specialize in eating snakes have larger eyes — resulting in greater visual acuity — than eagles that don't.

The snake detection hypothesis also explains why New World and Malagasy monkeys are not nearly as terrified of snakes as their Old World counterparts. Consider the observations made nearly 100 years ago by the British scientists P. Chalmers Mitchell and R. I. Pocock, when they carried writhing snakes into a roomful of caged monkeys and lemurs. The lemurs were unperturbed, and the South American monkeys showed some fear. But the Old World monkeys "bolted panic-stricken, chattering loudly and retreating to their boxes or as high up as possible in the larger cages." The baboons jumped back, and the chimpanzees began to scream, "all keeping their eyes fixed on the snakes."

No wonder "Snakes on a Plane" hit a nerve. (Not to mention the story of Eve and the Serpent.) There's a deep connection between snakes and primates, one that may have shaped who we are — and how we see — today. □

Lynne A. Isbell is a professor of anthropology at the University of California, Davis.