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Snakes on a Brain

Biologist Zoltan Takacs pursues his boyhood fascination with reptiles.

By Chris Jozefowicz

Snakes on a Brain

Biologist Zoltan Takacs endures the bites of deadly snakes to study their poison.

Zoltan Takacs (TA-kach) was tromping through a Costa Rican rain forest in 1998 when he captured an eyelash viper, a small, yellowish tree snake. As Takacs was putting the venomous serpent in a bag, the animal lashed out and bit him.

Eyelash viper venom normally causes pain and swelling. But because Takacs had been wounded by poisonous snakes before, he had developed an allergy to snake venom. An allergic reaction to the eyelash viper bite could have sent him into *anaphylactic shock,* a fatal reaction in which the airways swell shut and breathing stops.

Takacs studies snakes for a living, so brushes with death are an occupational hazard for him. Two of his friends and colleagues have died from allergic reactions to snakebites.

Fortunately, Takacs had medicine on hand in the forest to calm the reaction. "It was my mistake, as usual," says Takacs, a professor of biology at the University of Chicago. "Most times, when researchers get bitten, it is because they are not being careful."

Some cobras expand their necks to look larger and more threatening.

SNAKE HANDLER

Growing up in Hungary, Takacs learned to be careful with snakes. A curious boy, he trapped all sorts of local amphibians and reptiles. In his teen years, he traveled to Romania and Bulgaria to collect creatures with more bite: poisonous snakes.

Today, he ventures even farther around the world gathering animals for research. And he worries about more than just being bitten. In some countries he has been to, such as Yemen and the Philippines, Takacs has hired guards to protect him from bandits and militiamen. Still, he calls such dangers "an interesting spice, not a major problem."

Takacs's adventures are driven by a simple question: Why are snakes resistant to their own venom? Snake venom is a mix of chemicals that have the power to incapacitate both prey and predators. Takacs's main interest is the resistance that snakes have to chemicals in their venom—*neurotoxins* that can disrupt a victim's nervous system and cause paralysis.

Scientists know that *vipers,* members of one major group of poisonous snakes, have special molecules in their blood that inactivate their own neurotoxins. Takacs's mission has been learning how *cobras,* members of another major group, protect themselves.

BLOCKED SIGNALS

Takacs knew that cobra neurotoxin, which has been well studied, kills by attacking a protein on the surface of muscle cells. That protein, the *acetylcholine receptor,* helps nerves communicate with muscles. Cobra venom induces paralysis by blocking the acetylcholine receptor, thereby stopping messages from reaching the muscles.

Why don't cobras paralyze themselves? Takacs compared a cobra's acetylcholine receptor with that of a mouse. Cobra venom can kill a mouse in minutes. Takacs discovered that the part of the receptor that cobra neurotoxin attacks in mice is blocked by a sugar molecule in cobras. "It is like you have a key and a lock," he explains. "The key is the toxin, and the lock is the receptor. If you put a small piece of foreign material [the sugar molecule] in the lock, the key won't work."

Takacs is now studying the ways in which other animals counteract cobra neurotoxin. Some kinds of *mongoose* (a small, weasellike carnivore) are resistant to cobra venom and can kill cobras in a fight. They, too, have acetylcholine receptors with a sugar attached that blocks the venom. Takacs is examining other mongooses and animals that prey on cobras to determine whether they block venom in the same way. Different animals may have independently evolved the same kind of defense—an example of *convergent evolution,* in which separate species develop the same traits. Or nature might have devised a unique solution for each animal.

Understanding how venom works, says Takacs, satisfies a curiosity in the natural world he has had since he was a boy. It also has the potential to help many people. "You can use this information for drug design," says Takacs. The receptors he studies are also involved in diseases of the nervous system. As scientists learn more about how nature modifies receptors, they may gain knowledge that can be used to craft drugs that treat diseases such as Alzheimer's and Parkinson's.

Takacs holds a banded sea krait, a sea snake that lives in the South Pacific. Sea snakes are relatives of cobras.

THE REAL WORLD

Takacs is a biologist with one foot in *herpetology* (the study of reptiles and amphibians) and the other in *toxinology* (the study of toxins produced by animals, plants, and microbes). He recommends that students who wish to study reptiles get an education in the basics of biology and chemistry first. That way, they have the knowledge necessary to tackle a variety of mysteries about the animals. "Make a strong foundation," he says, "and then you have the tools to study a specific question in herpetology."

What about learning how to track snakes in the wild? Takacs suggests going out and getting real-world experience. Budding herpetologists can easily find many nonvenomous snakes and lizards in the United States. "It's more fun to feed a snake than to play a video game," Takacs says. **CS**

Fearsome Fangs

***Viperids* and *elapids* are two of the major families of venomous snakes. Viperids, including vipers (above left), rattlesnakes, and adders, have long fangs that fold back when not in use. Elapids, including cobras (above right), mambas, and sea snakes, have fixed fangs that do not fold and are usually shorter than viperid fangs.**

Clockwise from left: Dorling Kindersley/Getty Images; Zoltan Takacs (2); www.seanthomas.net; C.W. Schwartz/Animals Animals