Song and Dance

by Beth Geiger

Erich Jarvis turned from an education in dance to studying the biology of songbirds.

Cross the United States and you'll hear a chorus of regional accents. Some people say *car*; others say *cah*. Some say *butter*; others *buttah*. Even the country's songbirds have their own dialects, says Duke University biologist Erich Jarvis.

Songbirds learn to express themselves vocally by imitating adults, just as people do. That ability, called *vocal learning*, fascinates Jarvis. "Vocal learning is a rare trait," he explains, shared by just a few animals. Each species of songbird has its own signature tune with local variations that offspring learn from their parents.

Many researchers who study how birds learn songs focus on behavior. But Jarvis, who studies brains, is tuned in to the biological side. How does a bird's brain change as it learns a song? What can that teach scientists about the human brain?

Performing Arts

Jarvis, a professor of *neurobiology*, the study of the structure and function of the nervous system, didn't start out in science. Growing up in New York City, he studied dance at the High School of Performing Arts. At graduation, he made a surprising decision. He turned down professional dance scholarships and headed to college to major in math and biology.

Why the sidestep? A love of magic as a kid had ignited an interest in science, says Jarvis, and he also liked nature. Most important, he believed he could make more of a difference as a scientist than as a performer. "My mother always encouraged me to do something that might have a measurable impact," he says.

Jarvis attended Hunter College in New York City. There, he conducted laboratory research in *molecular biology*, the study of the molecular building blocks of life. The idea of scientific discovery began to excite him.

Bird Brains

Jarvis's research started going to the birds when he was working toward his doctorate at The Rockefeller University. "I wanted to understand how the brain controls complex behaviors," he says, and vocal learning is one of the brain's most complex behaviors. "My main interest wasn't birds," Jarvis told *Current Science*. "My main interest was the genes that control vocal learning." Genes are the basic units that determine how a body functions.

Not all genes are active at the same time. When a gene *is* functioning, though, it produces telltale by-products in the form of proteins. Those by-products are called *gene expressions*.

To learn which genes are active when a bird learns to sing, Jarvis freezes a bird's brain within minutes of when it has learned or produced a new song. Then he searches for gene expression changes to pinpoint the genes that control vocal learning.

Magic Seven

Today, Jarvis is looking for more than active genes. He's trying to identify the places in the brain where the activity takes place. "We call this 'behavioral molecular brain mapping,'" he says.

Three types of birds exhibit vocal learning: songbirds, parrots, and hummingbirds. Using behavioral molecular brain mapping, Jarvis uncovered a startling coincidence. Though the three types are barely related, each uses the same seven brain structures to learn how to vocalize. That is an example of **convergent evolution**-unrelated species that evolve similar features.

"It's a remarkable finding," Jarvis told *Current Science*. "How can Mother Nature come up with the same solution three different times?"

Wings are another example of convergent evolution. Wings have evolved multiple times on wildly different creatures-pterosaurs, bats, birds, and insects. Yet no matter what the animal, the wings are always attached near its *center of gravity* (the center of a body's mass).

Jarvis made another important discovery: He and his collaborator Constance Scharff found that birds have a gene that is nearly identical to a human gene called FOXP2. They found that in songbirds, the expression of the FOXP2 gene increases as the birds learn a new song. "The gene helps them learn songs," says Jarvis.

In humans, the FOXP2 gene is involved in language. When the FOXP2 gene *mutates*-is randomly altered-people lose their ability to learn or express language well.

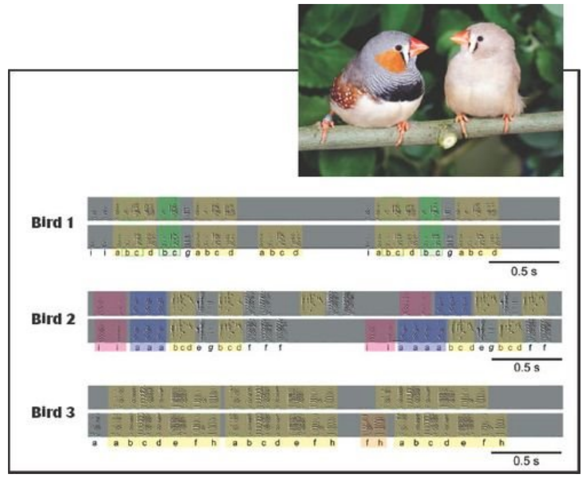
Do birds respond to FOXP2 mutations the same way humans do? To find out, Scharff damaged the gene in laboratory songbirds. Sure enough, the songbirds developed vocalization problems similar to those that affect people with FOXP2 mutations. Jarvis hopes his work will someday help stroke victims who lose the ability to say what they are thinking.

Jarvis's songbird research has struck a chord in the scientific community. He runs a world renowned research lab and has won several major awards.

Small Leap

Though dance may seem an odd beginning for a scientist, for Jarvis the leap was smoother than it sounds. "Both dance and science require a tremendous amount of discipline and the drive to keep trying," he says. He also emphasizes that science, like art, is highly creative.

Above all, Jarvis's work has shown that, brain-wise, birds are not the featherweights they've always been labeled. "Being called a birdbrain," he says, "should not be an insult."



Sound Bites

These sound readings show the differences between the songs that three young male zebra finches learned from their fathers.