

Millions of years ago, mammals and birds had the same kind of brain. Research shows that regions such as those controlling vocal learning are still similar. **Jim Robbins** on its significance

Imagine a chicken that could speak or a pigeon with a voice rivaling that of the most musical songbirds.

Granted, the world probably doesn't need any gossiping chickens or pigeons breaking out in song. But why some birds learn to create a deep repertoire and others are unable to has long been a research focus of neurobiologist Erich D. Jarvis. "Vocal learning, just like spoken language itself, is a rare trait," said Jarvis, who directs the Neurogenetics of Language laboratory at Rockefeller University in New York, US.

He studies the small group of species capable of speech, focusing on birds and mice, and he has long hoped to genetically engineer an animal that can vocalise in new ways.

Introducing manipulated genes into the brain of a bird or a mouse that doesn't vocalise could create that ability and provide new clues into the origins of speech. It may one day help in finding treatments for people with speech problems or brain disorders.

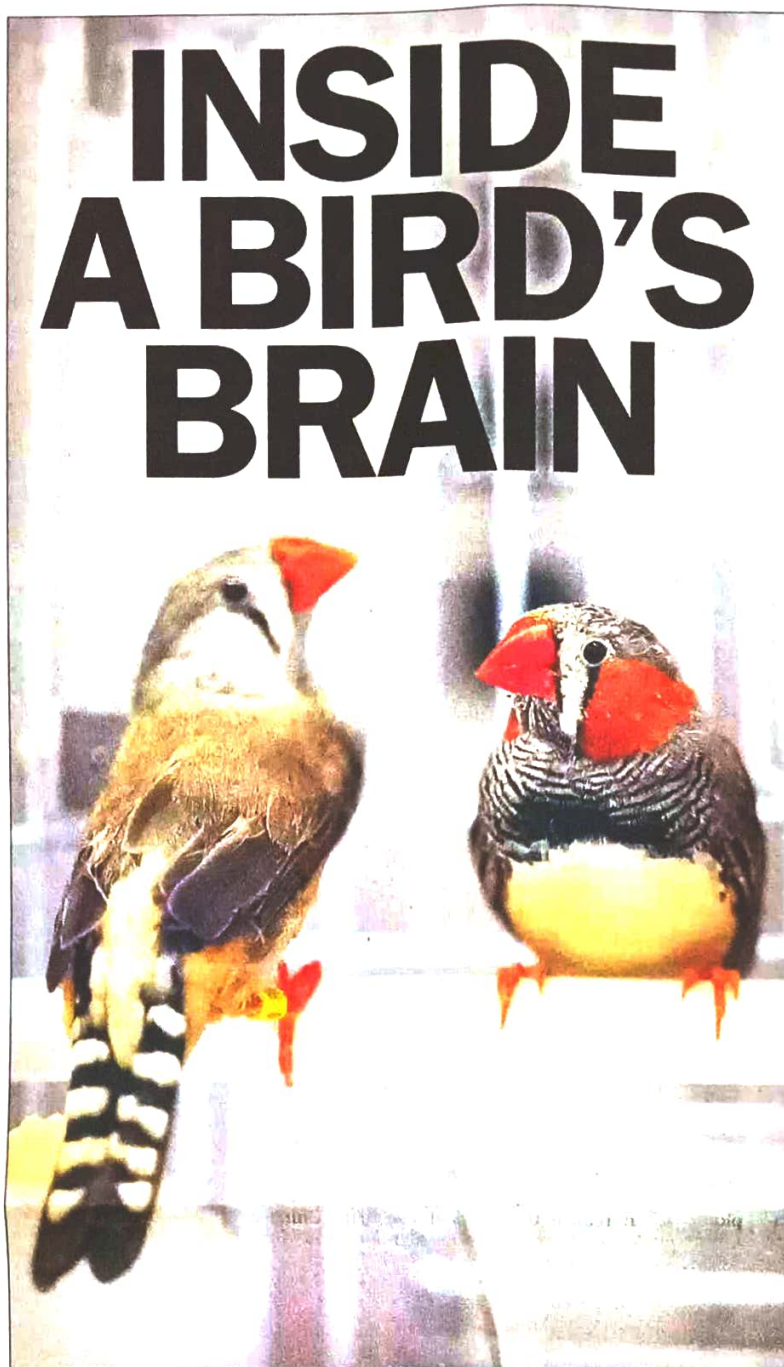
Jarvis, 60, didn't start his career in neuroengineering. He once hoped to become a professional dancer, performing ballet at Manhattan's renowned High School for the Performing Arts and then studying at the Alvin Ailey dance school. He was a member of the Westchester Ballet Company when he began wondering how the brain was able to create dance movements.

His mentor at Rockefeller was Fernando Nottebohm, the researcher who discovered in the early 1980s that songbird brains generate new neurons each spring to enable them to sing. That revolutionary understanding of neurogenesis led to further findings that all brains, including human ones, grow new neurons throughout life. Until then, it had been scientific gospel that people came into the world with a fixed number of neurons.

From 2002 to 2005, Jarvis helped lead the Avian Brain Nomenclature Consortium, a project that renamed the regions of the avian brain to show that it was remarkably sophisticated. The research undermined the use of "bird brain" as a pejorative.

That same year, he won the Alan T. Waterman Award, and then he won the National Institutes of Health Director's Pioneer Award three years later.

Jarvis' efforts to understand birdsong have led him to other projects, including ones that are working with high-quality genome assemblies — maps that allow researchers to identify which genes are related to different traits.



AUDIO NOTES: A female and a male zebra finch in a cage in an animal behaviour research room at Erich Jarvis's (below) lab at Roosevelt University in Manhattan, US. Orange and gray zebra finches, raised in captivity, are the species of choice for brain research as their neural networks are strikingly similar to those of humans. But the lab has also studied the brains of wild birds

Because of that, he was appointed as chair of the Vertebrate Genomes Project, a global effort to sequence the genomes of 70,000 vertebrate species.

The project involved building the Genome Ark, a reference database for research and conservation, especially for endangered species. The first sequencing phase of that project, involving 260 species, is nearly complete. Jarvis is also working to sequence the genomes of all bird species, which number about 10,500.

Parsing the smallest components of vocal learning is part of that work. Jarvis and fellow researcher Robert B. Darnell, also of Rockefeller University, announced in February 2025



that they had discovered an amino acid in a single gene that might have contributed to the evolution of complex human language.

Swapping an altered gene into a mouse "changed how the mice spoke to each other", Darnell said. "Baby mice called to their mothers differently, and male mice looking to lure a female for mating tried to attract her attention with altered vocalisations."

Mammal and bird brains descended from one source brain before a divergence took place more than 320 million years ago. They took separate evolutionary paths from there and now appear very different.

The structure of human brains is likened to a layer cake while bird brains re-

semble a fruit cake. But some regions are remarkably similar, including those where vocal learning mechanisms are located. Independently acquiring similar traits is called convergent evolution.

"If we study that convergence and find the similarities, it would mean that we can understand human speech from studying these birds," Jarvis said.

Matt Biegler, a postdoctoral researcher in Jarvis' lab, listed some questions needing answers: "What are the origins of speech? How did it evolve? Why did it evolve? And what exactly are the mechanisms that make it happen?"

To that end, Jarvis and his colleagues were also able to engineer a new vocal pathway in a mouse, as documented in a paper published by the lab. "We have been able to change the expression pattern of that gene

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in the mouse brain, make it more human and songbird-like," he said. "These mice are singing a greater diversity of variations."

"The goal is to be able to move this ability to species that wouldn't have it," said Matt Davenport, a postdoctoral researcher in Jarvis' lab. "It opens up a brave new world where higher-order traits are engineerable. It gives us new insights into communication disorders, autism and stuttering."

Jarvis used to lure hummingbirds to a feeder with sugar water. "They'll find the food source and in the morning, as part of the dawn chorus, they will sing next to it" to claim their territory, he said.

The song activates a messenger molecule. If the brain could be removed and examined quickly enough, preferably within a half-hour, Jarvis could trace the chemical that created the song.

Gaining a better understanding of vocal learning circuitry holds significant promise, he said, adding that it was worth the sacrifice of some birds.

"If we can figure it out in birds, we can figure out how to similarly repair circuits damaged in stroke and trauma in people," Jarvis said. "I probably won't finish this in my lifetime but I am going to try," he added.