Erich D. Jarvis, Ph.D.

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The ability to speak has allowed our species to pass knowledge between generations, articulate complex ideas, and build societies. Jarvis uses song-learning birds and other species as models to study the molecular and genetic mechanisms that underlie vocal learning, including how humans learn spoken language. He is interested in how their brains, and ours, have evolved to produce this complex behavior.

Unlike songbirds, the vast majority of animals—including common model organisms like mice and fruit flies—either cannot imitate novel sounds or have limited vocal flexibility, limiting their usefulness in the study of spoken language. To advance research in this field, the Jarvis lab has developed a suite of experimental tools for songbirds and other species to probe the genetics underlying vocal learning. By combining behavioral, anatomical, electrophysiological, and molecular biological techniques, Jarvis hopes to advance knowledge of the neural mechanisms of vocal learning and, more broadly, gain a deeper understanding of how the brain generates, perceives, and learns complex behaviors.

Beyond his work with songbirds, Jarvis uses genomics to understand how vocal-learning and vocal non-learning species are related, providing insight into how vocal learning and other complex behaviors have evolved. As the co-leader of a consortium of over 200 scientists, from 101 institutions in 20 countries, Jarvis helped oversee the genome sequencing of species representing nearly all avian orders. These findings led to an overhaul of the bird family tree, and support the idea that vocal learning evolved at least three times among birds: in songbirds, parrots, and hummingbirds. Jarvis aspires to sequence the genomes of all 10,500 bird species, and eventually those of all 71,000 vertebrates, to understand how species are genetically related and how their unique characteristics evolved. To accomplish this goal, Jarvis chairs the international Vertebrate Genomes Project. Jarvis also collaborates on a project to generate a new human pangenome reference representing over 90% of genetic diversity.

Working with results from the avian genomics project, Jarvis and his colleagues discovered that hundreds of genes have similarly evolved in both the song-learning circuits of songbirds and the speech circuits of humans, and that many of the changes to these genes are not found in the brains of their close living bird and primate relatives. Some of these genes, when mutated, are associated with speech disorders in humans, and are predicted by Jarvis's studies to control the development of speech brain circuits. These findings have significant implications, suggesting that work in songbirds has direct relevance to humans.

The Jarvis lab also studies the molecules that guide neuronal connections, called axon guidance molecules. Jarvis hypothesizes that these molecules make the difference between a vocal learner and non-learner by directing the formation of a crucial neural circuit. This motor circuit, which has been linked to vocal organs, is believed to make fine motor control in the larynx possible, allowing the production of imitated speech. The Jarvis lab and others predict that the presence or absence of this circuit is one of the key transformations in the brain that enables vocal learning, and that axon guidance molecules are responsible for its creation. One of the Jarvis lab's long-term goals is to use these molecules to induce a vocal-learning circuit in a species that can't normally imitate speech, such as mice.

EDUCATION

B.A. in biology and mathematics, 1988
Hunter College

Ph.D., 1995
The Rockefeller University

POSTDOC

The Rockefeller University, 1995–1998

POSITIONS

Assistant Professor, 1998–2005
Associate Professor, 2005–2016
Professor, 2016
Duke University

Professor, 2016–
Director, Field Research Center for Ethology and Ecology, 2016–
The Rockefeller University

Investigator, 2008–
Howard Hughes Medical Institute

AWARDS

NSF Alan T. Waterman Award, 2002

NIH Director's Pioneer Award, 2005

Brilliant Ten, *Popular Science*, 2006

Ruth and A. Morris Williams Faculty Research Prize, Duke University, 2009

Ernest Everett Just Award, American Society for Cell Biology, 2015

NIH Director's Transformative Research Award, 2019

SELECTED PUBLICATIONS

Wang, T. et al. The Human Pangenome Project: a global resource to map genomic diversity. *Nature* 604, 437–446 (2022).

Rhie, A. et al. Towards complete and error-free genome assemblies of all vertebrate species. *Nature* 592, 737–746 (2021).

Jarvis, E.D. Evolution of vocal learning and spoken language. *Science* 366, 50–54 (2019).

Chabout, J. et al. A Foxp2 mutation implicated in human speech deficits alters sequencing of ultrasonic vocalizations in adult male mice. *Front. Behav. Neurosci.* 10, 197 (2016).

Pfenning, A.R. et al. Convergent transcriptional specializations in the brains of humans and song-learning birds. *Science* 346, 1256846 (2014).