Transgenic songbirds provide new tool to understand the brain

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(PhysOrg.com) -- Over the decades, scientists have learned a lot about the basic life processes shared by many animals — including people — by manipulating the DNA of the "lower" species, such as mice and worms. But to date, they have been unable to readily probe the genetic contribution to one higher cognitive capacity of particular interest — the ability to learn language from one another. Now scientists have worked out a method for altering the genes of the zebra finch, one of the handful of social animals that learn to "speak" in a way that is analogous to humans.

After decades of studying the behavior and anatomy of vocal learning, scientists will be able to use the technique to explore vocal learning at the molecular level. The new tool, reported in Proceedings of the National Academy of Sciences, may also reveal secrets about exactly how, when and why some neurons are replaced in the adult brain.

“The roadblock had been that you couldn’t manipulate the genes,” says Fernando Nottebohm, Dorothea L. Leonhardt Professor and head of the Laboratory of Animal Behavior at The Rockefeller University, where the research was conducted. “Ultimately, you have to understand how things are working at the most basic molecular level, and this will take our research there.”

Nottebohm, Research Associate Robert Agate and colleagues adapted a method used to introduce genes into quail for use in the finch. An HIV-based lentivirus can be used as a vehicle to carry and insert genes into the genome of the hosts it infects, including quail. To prove the method works in finches, the scientists rigged the virus to deliver a gene that produces a green fluorescent protein in cells throughout the body. However, they found that several modifications to the method were required to get it to work in the songbirds, including the number and location of the viral injections into the finch embryos.

With these refinements, they produced several birds that had incorporated the genes into their germline cells, meaning they could pass them along to their offspring. These “founder” transgenic songbirds did not suffer any obvious side effects from the genetic experiment: They developed normally, learned to sing and mated. But because of the fluorescent protein produced throughout their bodies, they glow green when exposed to a specific wavelength of blue light. The green can be best seen before the hatchlings’ feathers grow in, but can still be glimpsed in the eyes, legs and around the beaks of the older, feathered birds.

The transgenic songbirds will enable Nottebohm, who discovered neuronal replacement in the adult vertebrate brain and described the neural circuitry by which songbirds learn to sing, to investigate the genes that control these processes. “With transgenic songbirds, we hope to have a splendid tool to get into the molecular biology of vocal learning and neuronal replacement in an adult vertebrate brain,” Nottebohm says.

Provided by Rockefeller University (news : web)