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DARWIN'S FINCHES AND THE EVOLUTION OF SMELL

Sequenced zebra finch genome hints that smell may play a role in the birds' communication

REHOVOT, ISRAEL – April 6, 2010 – Darwin's finches – some 14 related species of songbirds found on the Galapagos and Cocos Islands – will forever be enshrined in history for having planted the seeds of the theory of evolution through natural selection. Today, 150 years after Darwin's famous book, finches can still teach us a lesson about evolution. A large, international group of researchers, among them Prof. Doron Lancet and Dr. Tsviya Olender of the Department of Molecular Genetics at the Weizmann Institute of Science, recently produced the full genome of the zebra finch and analyzed it in detail. The report on the zebra finch genome, which appeared April 6 in *Nature*, is especially significant for what it reveals about learning processes for language and speech. For Prof. Lancet and Dr. Olender, however, the findings have provided an interesting twist on the evolution of the sense of smell.

Songbirds – like humans and a small number of other animals – are capable of complex, rich communication through sounds. The similarity between birdsong and human language makes birds a useful scientific model for probing how this ability developed, what neuronal mechanisms are required, and which genes encode them. Significantly, the scientific team found that a large percentage of the genes expressed in the finch brain are devoted to vocal communication. They also found that the expression levels of a number of genes, specifically those belonging to the important class of microRNAs, change after the bird is exposed to song. This implies that such genes might be involved in the birds' ability to learn new tunes.

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"The senses are sophisticated means of interacting with the environment, and this is why they are so fascinating. In our lab, we are primarily interested in smell," says Dr. Olender, who joined the project, along with Prof. Lancet, in order to map the genes encoding smell receptors in the finch. In doing so, the scientists were entering the fray on a long-standing debate over whether odor sensation is active and important for birds. Some positive evidence exists: homing pigeons have been shown to use smell to help them navigate back to their coops. In contrast, a computer-aided analysis of the chicken genome had shown that out of 500 genes encoding smell receptors, a mere 70 produce active proteins. Prof. Lancet and Dr. Olender have now conducted a similar analysis of the zebra finch genome. Their findings revealed that while the finch has the same total number of smell genes as the chicken, it possesses three times as many that are active: around 200 of the finch's genes can potentially produce functional smell receptors. This figure supports the claim that some birds do rely on the sense of smell.

A comparison of the zebra finch genome to those of other bird species sheds some light on how this sense evolved in the birds: unlike mammals, in which all the different species share most of their smell receptor gene families, 95 percent of the receptors in the finches appeared to belong to families unique to them. In other words, it is possible that each bird species evolved its own array of smell receptors separately, rather than using ones passed down from a common ancestor. Says Prof. Lancet, "This finding suggests that smells may be involved in the unique communications among individuals within the species, on top of the messages they send through their songs."

Prof. Doron Lancet's research is supported by the Helen and Martin Kimmel Center for Molecular Design and the Estate of Joe Gurwin. Prof. Lancet is the incumbent of the Ralph and Lois Silver Professorial Chair in Human Genomics.

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