Songbirds may hold key to advances in treatment of brain degeneration

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Ongoing research at Lehigh University may one day help make strides toward therapeutic advances in the treatment of diseases that involve the loss of memory and brain degeneration such as Alzheimer's, Parkinson's, and stroke.

Colin Saldanha, associate professor of biological sciences, was named a recipient of a five-year grant from the National Institutes of Health (NIH) for "Synaptic Aromatase: A Novel Form of Estrogen Delivery." The $1.8 million grant extends a five-year NIH grant that was first awarded to Saldanha in 2002, and will allow Saldanha to move to the next phase of research.

"The brain has been mysterious for a long time and we're just starting to pick away at it," says Saldanha, who is exploring how hormones, particularly estrogen, affect the brain. "In 150-odd years, we've learned a lot about how hormones work, and the science we do here is a modest and gentle nudge toward extending the field."

Once believed to be produced exclusively in the gonads, it is now known that some hormones are being made in the synapses of the brain. "Estrogens are typically synthesized in the cell bodies of specialized cells in the ovaries, testes, adipose tissue and neurons. These modes of estrogen delivery underlie many, but not all, of the multiple actions of estrogens on the brain," Saldanha says.

Saldanha is hoping to unlock these mysteries further by exploring zebra

finches—vocal songbirds that use their song as a mating call. Among these birds, the males sing, but females can't. Male songbirds will learn their song from their father, and retain their song for life.

Pre-synaptic boutons in many vertebrates contain the enzymes that make estrogen, and Saldanha has discovered that there are more pre-synaptic boutons in male songbirds than in females.

"All songbirds make high levels of estrogen in their brains," says Saldanha. "The parts of the brain that make estrogen are often the very same parts that show dramatic cycles in size. At times, some songbirds even almost double the size of particular parts of their brain."

Using transmission electron microscopy, Saldanha, along with a team of post-doctoral, graduate and undergraduate students, examines structures and chemicals inside neurons, synapses and glial cells within the brain. Using a variety of testing methods, Saldanha was able to test his synaptic hypothesis, and is ready to start on the next phase of research.

Going forward, research will seek to understand the contribution of synaptically produced estrogen to local brain areas, their source, and their physiological function. Further study will shed light on the role of synaptic estrogen in learning, memory and neuroprotection.

"Our research is basic in nature, and not clinically applied. We want to understand the phenomenon and how this is working. We know it exists, but now we need to know what it does, where it exists and how it affects behavior," Saldanha says. "We may be able to understand how hormones regulate the process of learning and memory, which is relevant to Alzheimer's, stroke and perhaps even Parkinson's."

Source: Lehigh University