Scientists learn much about humans from birds' singing lessons

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Why wasn't this intruder getting the message? The lord of the manor had warned him repeatedly to back off, with threatening gestures and loud admonitions. But the trespasser just sat there - singing.

The time for detente was past. In a flurry of feathers, the resident sparrow dived for his challenger's head.

"They have personalities," said Michael Beecher, watching from a few feet away as the furious bird pecked and clawed at the rival male. "Some are more laid back, but this is an attacking bird."

The University of Washington biologist stepped in to terminate the brawl, retrieving the stuffed sparrow and mini-speaker that tricked the real bird into believing his territory had been overrun.

Foe vanquished, the sparrow fluffed himself up, perched high in a tree and let loose a cascade of trills and whistles.

"That's the king-of-the-mountain song," Beecher said.

Beecher understands better than most the messages that pass between song sparrows. He and his students have been studying the birds' communication patterns in Seattle's Discovery Park for more than 25 years. The duel he orchestrated on a recent morning provided an opportunity to record the sotto voce song that males use only when confronting interlopers - a kind of in-your-face undertone that hisses: I

mean business.

Celebrated by poets and welcomed as a harbinger of spring, the seasonal outpouring of bird song also is a focus of research for scientists interested in animal behavior, like Beecher - and those who want to understand human thought and learning. Nineteenth-century poet Percy Shelley couldn't have guessed he was foretelling a branch of neuroscience when he hailed the skylark: "Teach me half the gladness that thy brain must know."

The way birds learn their songs is similar to the way babies learn to talk and adults master a golf swing, University of Washington brain researchers say. And studies of the seasonal changes in bird brains are revealing neurological twists that one day might be harnessed to heal human brains damaged by stroke, Alzheimer's disease and other disorders.

"The strength of the songbird system is that you can go down to the very detailed, micro-level ... then explain how that leads to changes in behavior," UW neurobiologist David Perkel said. "That's something not a lot of neuroscience can do."

It was research on songbirds that upset the long-held notion that most animals - and most certainly humans - were born with all the gray matter they would ever have. Working with canaries and chickadees in the 1980s, Fernando Nottebohm at Rockefeller University found brain regions associated with song and the ability to locate hidden caches of food were constantly birthing new cells.

Scientists soon discovered neurons sprouting in other brain areas and in the brains of other animals - including Homo sapiens.

But nothing in the human brain comes close to the transformation male

birds undergo as they ride a roller coaster of hormones that peaks this time of year, said Eliot Brenowitz, UW professor of biology and psychology. Brenowitz is working to understand how a spring spike in testosterone causes the parts of the brain that control song to double or triple in size.

"It's the brain's version of an athlete bulking up on steroids," he said.

In the white-crowned sparrows Brenowitz studies, the birds' vocal skills improve in concert with the changes inside their heads. In winter, their songs are scratchy and jumbled. By early March, everyone is following the appropriate score and performing like Pavarotti.

"If you go out now," Brenowitz said, "the songs are clean, they're crisp and they're beautiful to listen to."

The birds produce new neurons year-round, but the testosterone surge enables more of those cells to survive and grow at a time when males need maximum brainpower to attract a mate, fight off rivals and defend territory - all of which demand bravura vocalizing. Perkel's studies show that the brain cells also undergo electrochemical changes that make them more responsive and better able to link up in networks.

After the chicks fledge in late summer and the father birds relax, their testosterone levels drop and song neurons die off like falling leaves. That's when things get really interesting to Brenowitz. The death of brain cells seems to accelerate production of replacements. Few of the new cells survive in the fall and winter, when testosterone levels are low. But the phenomenon tracks what happens in people who have lost brain cells to a stroke. Other parts of their brains begin producing new neurons. The effect isn't robust enough to heal the damage, but bird studies may reveal ways to give it a boost, Brenowitz said.

"There's a lot of hope that this will lead to a way to try to repair damaged brains," he said.

Many birds, such as gulls and flycatchers, are hatched with vocalizations hard-wired into their brains. But the 4,000 species that comprise the songbirds, considered the most melodious crooners, must learn how to sing properly. Perkel's research focuses on zebra finches, which study and memorize the songs of adults. At first, the fledglings jabber or sing snippets, gradually improving until what comes out of their beaks matches the template in their memory banks.

"It's a model for speech learning in humans," Perkel said.

Charles Darwin was among the first to suggest a connection, noting similarities between the babbling of baby birds and the nonsense syllables of human infants. Perkel is convinced the parallels extend to all types of learning that require practice and feedback, from memorizing multiplication tables to honing a golf swing or ski jump.

"We think that by cracking this circuit in birds," he said, "it will have a large impact on our understanding of the brain mechanisms involved in learning a broad variety of skills."

In the lab, Perkel and his colleagues can change a bird's singing behavior by manipulating levels of the neurotransmitter dopamine, linked to mood and disorders such as Parkinson's disease in humans. A tiny dose of a dopamine blocker delivered to the brain locks male finches into practice mode and prevents them from singing the polished song used to court females.

Zebra finches sing a single tune throughout their lives, but species such as larks and thrushes have hundreds in their repertoires. Male song sparrows produce up to 10 distinct songs, which they learn by

eavesdropping on adults in much the same way human babies soak up and mimic sounds. Beecher wants to know how young males choose their role models.

This spring, he's recording the songs of all 50-some youngsters in his study area and comparing them with grown-ups. Beecher converts the recordings to sonograms - hieroglyphiclike notations that reflect the pitch, intensity and duration of musical phrases that pour out too quickly for the human ear to distinguish. "It's easier for us to see it than to hear it," he said.

Beecher discovered that some adults are surprisingly tolerant of young males before breeding season starts. He often sees them sitting side by side on a branch, with none of the turmoil his stuffed bird elicits during spring's fever pitch. Could being part of one of these odd couples help the young birds learn? "That's what we hope to figure out this year," he said.

His research so far has not been able to support the assumption that bird song is the acoustic version of the peacock's tail - a way to dazzle the ladies. Paternity testing of chicks reveals song sparrows, once considered a model of monogamy, do more than forage in the bushes. Beecher and his students find females are equal-opportunity cheaters, stepping out on a mate without regard to the size of his song catalogs.

"There's no evidence she gives a damn whether he sings one song or a dozen songs," Beecher said.

Blithe spirits, indeed.