Steroids, not songs, spur growth of brain regions in sparrows

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Neuroscientists are attempting to understand if structural changes in the brain are related to sensory experience or the performance of learned behavior, and now University of Washington researchers have found evidence that one species of songbird apparently has something in common with a few baseball sluggers. Both rely on steroids, birds to increase the size of song production areas of their brain and some players, apparently, to knock a fastball out of the park.

Writing last month in the *Journal of Neuroscience*, Eliot Brenowitz and his colleagues showed that the Gambel's white-crowned sparrow uses testosterone, a naturally occurring steroid, to trigger the seasonal growth of these brain regions. Birds use song to attract mates and mark their territory.

Their finding is counter to some previous work with other birds and rodents that indicated environmental factors can influence brain development and create more neuronal connections.

"We would like to think that if we shape the environment we can guide the brain's structure," said Brenowitz, a UW professor of psychology and biology. "But the idea that experience can drive growth of the brain regions that control song behavior in birds was disproved by this study. You can change the experience and the behavior, but you don't change the structure of the brain."The UW scientists found that the three brain regions in white-crowned sparrows that had been deafened were just as large as those regions in normal sparrows. However, the deafened birds

only sang one-eighth the number of songs that the hearing birds sang.

To show this, the researchers captured 19 adult male white-crowned sparrows during their fall migration and housed them in short-day light conditions to mimic winter for 12 weeks. Eleven of the birds then were surgically deafened. A week after the surgery, all of the birds were given testosterone implants and were shifted to long-day light conditions, similar to what they would encounter during their breeding season in Alaska.

The birds' three song-control regions are called the HVC, RA and X. All are located in the forebrain and grow quickly and in sequence. The brains of the birds were examined after 7 and 30 days, and the volume of the song production areas did not differ between the deafened and the hearing sparrows. Even though the deafened birds sang considerably less often, there was no degradation in the structure of their songs, according to Brenowitz.

Another major finding of the study is that seasonal growth of these song production areas of the brain does not require hearing or high levels of singing. "This is surprising to a lot of people because many thought seasonal growth of song nuclei was related to the rate of singing," he said.

While the research was conducted on birds, it also has potential long-term human applications, addressing the broad issue of environment enrichment supporting brain plasticity.

"This study suggests that playing tapes of recorded speech to try to help a person recover language after a stroke might not be productive. But perhaps we could use neutrophins, growth-inducing proteins whose synthesis by brain neurons is stimulated by testosterone. In sparrows, brain areas are directly stimulated by these hormones to grow and one

day such hormones might possibly help repair brain damage caused by strokes or neurodegenerative diseases," said Brenowitz.

Source: University of Washington