Size matters: Length of songbirds' playlists linked to brain region proportions

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Call a bird "birdbrained" and they may call "fowl." Cornell University researchers have proven that the capacity for learning in birds is not linked to overall brain size, but to the relative size and proportion of their specific brain regions.

Songbirds with upper brain regions that are larger in relation to lower regions have a greater capacity for learning songs. Higher brain areas control the majority of cognitive and learning functions, while lower brain areas control more motor functions, according to the new study published in the Proceedings of the National Academy of Sciences.

The research shows that when a bird's higher cortex-like brain area called the high vocal center (HVC) is larger relative to the lower brain area called RA, or if the RA is large relative to an even lower area called N12, the species is able to learn dozens of different notes. Such species as mockingbirds, catbirds, European blackbirds and European warblers can learn hundreds of notes because they have those relative size differences in both sets of areas.

"HVC size by itself only modestly predicts capacity for song learning, but relative size is a very strong predictor," said Tim DeVoogd, professor of psychology and of neurobiology and behavior and the paper's senior author. Jordan Moore, a graduate student in DeVoogd's lab, was the paper's lead author. "Our work is the first to demonstrate a basic principle of evolution using a specific behavior – having greater cortical control of brain function gives greater behavioral flexibility,

including enhanced learning."

In bird species with great capacities for song learning, higher brain areas likely became built up over lower areas as a result of sexual selection, he said, where females mated with males that had more elaborate songs. Repeated over millions of generations, the structure of the brains of these species changed such that higher brain areas became larger relative to lower areas.

The research suggests that relative brain area sizes may offer a mechanism by which a prominent form of evolution has worked. In birds and perhaps in humans, selection for increased learning capacity may have acted by prolonging the development of the last parts of the brain to grow. Humans are able to speak and to set and achieve complex goals because of prolonged development of higher brain areas, such as the cortex and frontal cortex in particular. These areas of the brain are the last to mature and do not fully develop until humans are in their early 20s, DeVoogd said.

In the study, the researchers collected three males each from 49 common species representing an extensive variety of songbirds from the United States, Europe and South Africa, where each bird was actively singing to attract females as part of his reproductive cycle. They then examined and measured the brain areas.

More information: "Motor pathway convergence predicts syllable repertoire size in oscine birds," published Sept. 12, 2011 in the Proceedings of the National Academy of Sciences.

Provided by Cornell University