Study shows songbird prefers singing in harmonic series similar to humans

November 4 2014, by Bob Yirka

Hermit Trush. Credit: Daniel Berganza/Wikimedia

(Phys.org) —A team of researchers with members from Germany, the U.S. and Austria has found that male hermit thrush appear to sing following a harmonic series similar to the way humans produce music. In their paper published in *Proceedings of the National Academy of Sciences*, the team describes how they studied bird songs recorded by various people over the past half century and then compared the way the birds sang to the way people create music.

When human beings create music, whether it's singing, or using instruments, we tend to follow a harmonic series, which is where notes that follow a base note are multiples of that base note—doubles, triples, etc. Generally an entire piece of music is made from the notes that belong to scales based on a particular note—the C Major scale, for example, starts with the note C, and the music for such a scale would generally be in the key of C. In this new effort, the researchers have found that at least one species of songbird adheres to roughly the same set of rules when creating and performing its songs—which would make it the first time any other animal besides humans have been found to do so.

The researchers discovered this unique attribute of the male hermit thrush by analyzing song samples found in Ohio State's Borror Laboratory—researchers there have been collecting audio samples for the past fifty years. All told, they looked at 71 different songs made by 14 individual males. They found that 57 of those songs, when analyzed mathematically, followed a harmonic series—a much higher percentage than can be attributable to chance. They also noted that only 5 percent of the songs consisted of what appeared to be random noise making.

The researchers noted that the anatomy of the songbirds' throat clearly allows for playing a far wider range of notes, thus, the birds appear to be choosing notes from a particular scale when singing their songs, allowing them, like us humans to remain on key. This suggests, they add, that

song-making in humans is likely more biological than due to custom.

More information: Emily L. Doolittle, Bruno Gingras, Dominik M. Endres, W. Tecumseh Fitch. Overtone-based pitch selection in hermit thrush song: Unexpected convergence with scale construction in human music. *Proceedings of the National Academy of Sciences* (*PNAS*). November 2014. www.pnas.org/cgi/doi/10.1073/pnas.1406023111

Abstract

Many human musical scales, including the diatonic major scale prevalent in Western music, are built partially or entirely from intervals (ratios between adjacent frequencies) corresponding to small-integer proportions drawn from the harmonic series. Scientists have long debated the extent to which principles of scale generation in human music are biologically or culturally determined. Data from animal "song" may provide new insights into this discussion. Here, by examining pitch relationships using both a simple linear regression model and a Bayesian generative model, we show that most songs of the hermit thrush (Catharus guttatus) favor simple frequency ratios derived from the harmonic (or overtone) series. Furthermore, we show that this frequency selection results not from physical constraints governing peripheral production mechanisms but from active selection at a central level. These data provide the most rigorous empirical evidence to date of a bird song that makes use of the same mathematical principles that underlie Western and many non-Western musical scales, demonstrating surprising convergence between human and animal "song cultures." Although there is no evidence that the songs of most bird species follow the overtone series, our findings add to a small but growing body of research showing that a preference for small-integer frequency ratios is not unique to humans. These findings thus have important implications for current debates about the origins of human musical systems and may call for a reevaluation of existing theories of musical consonance based on specific human vocal characteristics.

Press release