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Birdsong in the music hall

Birdsong has been found to be the real thing, says S.Ananthanarayanan.

While birdsong and other sounds in nature have often inspired musicians, the question of whether birdsong can be classified as music has not been answered. While some birdsong is distinctly lyrical, research has even revealed patterns in pitch and rhythm, which are the hallmarks of musical passages. But a study (by ecologist Marcelo Araya-Salas of New Mexico State University in Las Cruces) recently concluded that despite specific patterns being repeated, the sounds in birdsong do not reveal formal arrangements, comparable with the 12 note scale used in music as we understand the term. And the question remains open.

Sarah E. Earp and Donna L. Maney of the Department of Psychology, Emory University, Atlanta, took a fresh approach – that sounds were music or otherwise not because of their own qualities but because of how they were perceived. For if the 12-note progression within an octave, which is common to most musical systems in the world, has been woven into concerts and operas, the rules that composers follow are derived from the effects of the sounds upon and the appreciation by the listeners. Earp and Maney

Sarah E Earp undergraduate at Emory and plays the viola

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followed up on work of imaging the effect of music on nerves and brain cells on humans, to see if birdsong had similar effects on the corresponding structures in the brains of songbirds. And they report in their paper in the journal, ***Frontiers of Evolutionay Neuroscience***, that birdsong and music seem to affect the same neural mechanisms in the respective listeners they are intended for.

Hearing response

Earp and Maney see birdsong as a signal, which has a sender and a receiver. What matters is not the structure of the signal but what effect it has on the receiver. One way of comparing birdsong and music, they reason, could thus be what the receiver experiences and how she or he responds, in the two cases. The case of music is evident – listeners love hearing music and will pay for tickets to go to the concert. In fact, the evolution of music is the story of refining and enriching its form to be more and more a rewarding experience for the listener. The behaviour of birdsong listeners is similar – many species of songbirds react by moving towards the source of birdsong that comes from others of

the same species. The ***female pied flycatcher*** and the ***European starling*** will fly up and enter nest-boxes where recordings of male song are played and the ***female zebra finch*** can be trained to peck a key to hear a song. In fact, male zebra finches show a learning phase when they learn sound patterns from other finches, usually the father, and even young males can be trained to switch on recordings, like the females.

The overt behaviour of the listener is one effect of the sound upon the listener. But behaviour can be modified by more signals than music. A more illuminating effect of sound, which is now available for study, would be the actual activity of nerve tissue within the brain when sounds are heard. ***PET*** and ***MRI*** are techniques of scanning the brain layer by layer and building up a 3-D image. When coupled with the ***BOLD response***, or the ***Blood Oxygen-Level Dependant*** change, the imaging pinpoints which portions of nerve tissue are 'lighting up' with activity. Using these methods, it is possible to look for increased activity and identify specific areas in the brain which react to the presence of a stimulus whose effect is being studied. Theses studies have shown time and again that the pathways in the brain that respond to pleasure and hence act as rewards to produce learning or repetition of the behaviour that brought the reward, are stimulated by music that is liked and more so at the portions of the music which creates intense pleasure.

Response of birds

Earp and Maney checked out whether there were similar responses in the brains of birds to different kinds of birdsong. But as bird brains are smaller in size, the areas that correspond to the music-sensitive areas of human brains are not practically accessible. The researchers hence used alternate markers – the proteins that arise from the effect of stimuli, rather than oxygen supply – to identify neuronal activity in birds. This alternative has been shown to correspond to the results of BOLD response and is a reliable means of mapping the portions of the brain that have been stimulated.

The study was carried out to quantify the neuronal responses in the relevant brain areas of male and female ***white-throated sparrows***, when exposed to birdsong from males of the same species. "This species sings a particularly musical-sounding song with heavy use of whistles with a sustained pitch," say the researchers in their paper. They explain that in normal times, song is used by both sexes of this species to establish and maintain dominance (mainly territorial) relationships. But during the breeding season, the response to song is different for males and females. A female hearing a male song is being courted while a male hearing the song hears a challenge – either by a territory holder asking intruders to keep out or an intruder trying to muscle in. The researchers proposed that females should react in the same way as a human hearing music, while this would not be the case with a male white-throated sparrow. The female response should also rise with the level of hormones that peak during breeding while in the case of males, their reaction to the song, which was to sing back, should depend on the level of testosterone, the male hormone.

With this functional and behavioral dependence of response to birdsong on the state of hormones of the birds in mind, the experimenters studied the rise and fall of stimulation of nerve cells along the pleasure and reward pathways in the brain, as the level of hormones were artificially varied. As increasing the levels in females should enhance their response, as to music, the measurement of neuronal activity in response to birdsong should rise with hormone levels in females while in the case of males, the music type response is already low and should not be affected by changes in the level of testosterone.

The results of the study confirmed that it was in female songbirds with breeding season levels of hormones that the response in the reward pathway in the brain was significantly greater to songs from other birds than to irrelevant control sounds. But this difference was not there in non-breeding females treated with a placebo, nor in the case of male birds. “We found that the same neural reward system is activated in female birds in the breeding state that are listening to male birdsong, and in people listening to music that they like,” says Sarah Earp. "Both birdsong and music elicit responses not only in brain regions associated directly with reward, but also in interconnected regions that are thought to regulate emotion. That suggests that they both may activate evolutionarily ancient mechanisms that are necessary for reproduction and survival," she adds.

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