nature

BRAIN: THEY'RE PLAYING OUR TUNE

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How does your brain tell one tune from another? And why do different tunes evoke characteristic responses in different people?

For me, Beethoven's 6th symphony always hits me straight in the tear ducts, but it could leave you cold. On the other hand, *The Girl From Ipanema* (a tune I find banal in the extreme) might remind you of that brief, romantic encounter in Rio de Janeiro you had seven years ago (you know, the one that ended so unhappily), and leave you in sobbing inconsolably into your martini. As Noel Coward once said (and he, if anyone, ought to have known), there's no underestimating the power of "cheap music".

Songbirds, like people, know a good tune when they hear it, but the significance of song in the life of a bird is, if anything, greater than in humans - songs elicit a variety of behavioural responses in the listeners, ranging from acquiescence to mating to territorial violence. Female songbirds can tell the difference between the songs of males of their own species and those of other species. A wealth of field data shows that songbirds are attuned to the content of the songs. The 'syllables' of chirps and whistles, whether singly or in combination, and swooping modulations, are as full of meaning as any lyric.

This implies that birds can recognize different tunes: but how are tunes represented, or 'encoded' in bird brains? Are songs recorded as a string of standard syllables, or does each song evoke its own, custom pattern? The distinction is important, and can be appreciated by human music lovers: Beethoven's 6th Symphony and *The Girl from Ipanema* are both composed from the same, twelve notes of the western musical scale, but you can tell the difference between them.

In the same way, you can tell the difference between different orchestrations of the same work, even if they use completely different instruments. Beethoven's 6th Symphony played by the Berlin Philharmonic Orchestra would be recognizably different from the same piece played by - say three accordions with a continuo of contrabass crumhorn and dustbin lids.

Birds, like humans, can make these distinctions, as Claudio V. Mello and colleagues from the Rockefeller University in New York show in an elegant study in the journal *Neuron*. They investigated how different 'syllables' of canary song were related to patterns of neuronal firing in the mediocaudal neostriatum (NCM), a part of the bird brain involved with the processing of hearing, in the brains of listening canaries.

Remarkably, the patterns of firing were consistent: each syllable elicited its own spatial pattern of neuronal firing in the NCM. For example, high-pitched whistles tended to trigger neurons low down in the NCM, with progressively higher picthes leading to patterns of activation further up. But this simple, tonotopic map is not as simple as it sounds. In general, each syllable is recorded as a unique pattern, even if the syllable is composed of two simpler syllables, superimposed. That is, a 'chord' of two whistles played together produces a unique firing pattern, not a pattern that is the simple sum of the two whistles played singly.

In the same way that we can tell the difference between two orchestrations of Beethoven, canary brains can tell the difference between a genuine bird whistle, and a synthetic version of the same whistle. The difference is intriguing and of relevance to the bird's life: whistles that are less convincing will produce a pattern of firing that is both less intense and more diffuse than the pattern elicited by the genuine article.

To make the point further, the same note played on a guitar - which has sonic characteristics entirely different from a bird whistle - produces very little reaction at all. To sum up, birds are 'attuned' to listen to the sounds they need to hear. Thise sounds are the whistles and chirps of other birds. They never evolved to guitar solos. It is not that the birds tune them out, they probably don't even notice that they are there at all.

This observation raises philosophical questions about our perception of the real world. Do we see what's really there, or what we've evolved to notice? Obviously, these questions are particularly acute for researchers trying to learn about the perceptions of non-human animals.

Apart from that, the experiments have another, interesting implication. That is, if combinations of syllables elicit distinct, unique firing patterns - different from what one would expect from simply summing the firing patterns elicited by individual syllables - could one say the same things about entire birdsongs? If syllables combine into new, unique forms, could these combinations themselves combine into patterns unique to songs - different from what one would expect from a simple, linear sum of the firing patterns generated by individual combinations?

If so, this would be the analogy of our own feeling that Beethoven's 6th Symphony and *The Girl from Ipanema* are distinct entities, more than just the same twelve notes arranged in different orders. Time, and further experiments, will tell.

by Henry Gee

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