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BEHAVIOUR

Neurons change their tune

Male songbirds sing even when they are alone, but in the company of females they subtly modulate their song to make the best impression. Doupe and colleagues now show that underlying this change is a switch in the activity of individual neurons in the lateral magnocellular nucleus of the anterior nidopallium (LMAN, a 'cortical' nucleus in the song control circuitry) — from variable firing to more precise firing.

Previous studies had shown that activity in the LMAN is greater and more variable when males sing alone ('undirected singing') than when they sing to females ('directed singing'), but it was not known whether this is due to a change in the firing properties of individual neurons. Here, recording from single LMAN neurons in zebra finches, the authors found that the average single-neuron firing rate was higher during undirected singing than during directed singing, mostly owing to increased burst firing.

Zebra finch songs are stereotyped, consisting of a number of repeated 'motifs' that each contain the same sequence of 'syllables'. Neuronal recordings over multiple renditions of a song showed that during directed singing individual LMAN neurons were preferentially active during particular syllables in a motif, resulting in reproducible firing patterns for each neuron. These patterns were less strong during undirected singing. In addition, the timing of the spikes in a syllable was less precise and the firing rates across trials were more variable during undirected singing.

Although LMAN neuron activity clearly varied more from trial to trial during undirected singing, the average firing pattern of each neuron recorded over multiple renditions of a song was similar during directed and undirected singing. This suggests that LMAN neurons might have characteristic patterns of activity regardless of whether the bird is singing alone or singing to a female. When the authors directly compared the singing-related activity patterns of different LMAN neurons in the same bird they found that these patterns differed greatly between neurons, suggesting that (subsets of) LMAN neurons might encode particular features of a song and relay this information to the motor pathway.

These findings show that individual LMAN neurons send patterned, song-related information to the motor system, and that the level of variability in this signal can rapidly change depending on the social context. The authors speculate that the high variability during undirected singing might be indicative of a 'motor-exploratory' state, whereas the precise, reliable activity patterns during directed singing might indicate a targeted motor output state. What remains to be discovered is the mechanism by which social context regulates the LMAN neuron activity.

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ORIGINAL RESEARCH PAPER Kao, M. H., Wright, B. D. & Doupe, A. J. Neurons in a forebrain nucleus required for vocal plasticity rapidly switch between precise firing and variable bursting depending on social context. *J. Neurosci.* **28**, 13232–13247 (2008)

STOCKBYTE