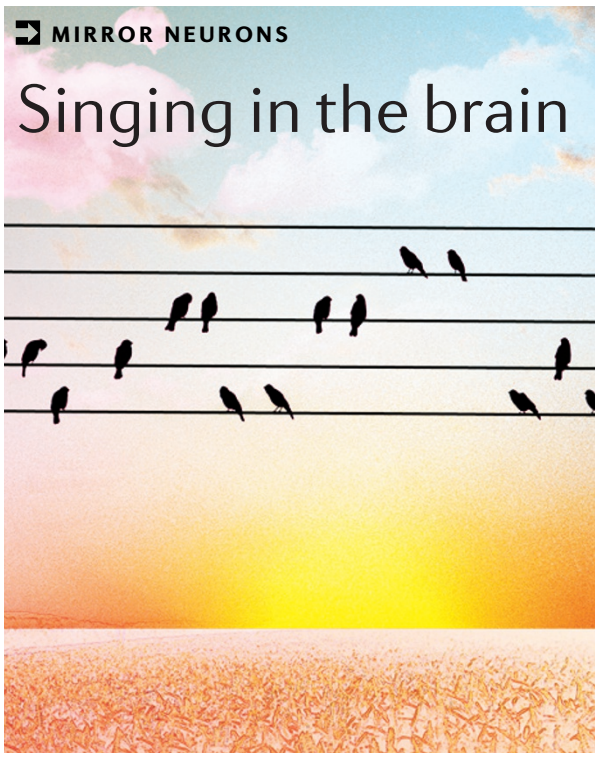

Song birds communicate by singing and learn their songs through imitation. Since their discovery in the monkey brain, it has been suggested that mirror neurons mediate the mimicking of behaviour in primates and perhaps also underlie empathy and language acquisition in humans. Prather *et al.* now show that mirror-like neurons also exist in birds and are involved in song learning.

The authors recorded the activity of individual neurons in the high vocal centre (HVC) — a brain area that is required for learning and producing songs — of swamp sparrows. When they played recordings of a bird's own songs, they found that a large proportion of HVC neurons that project to the avian basal ganglia, HVC_x neurons, became active. Interestingly, individual HVC_x neurons responded to only one of the songs in the bird's repertoire — the neuron's primary song. Moreover, these neurons fired at a specific time after the onset of the primary-song sequence.

Next the authors showed that HVC_x neurons were also active when the bird was singing, and each neuron responded most robustly when the bird sang the neuron's primary song. Moreover, the timing of the firing activity was the same as that which was induced by playing a recording of the song. In other words, HVC_x neurons respond to particular songs both when the bird sings them and when it hears them.

Interestingly, when a bird heard a song and started singing the same song in response, HVC_x neurons stopped responding to the auditory stimulus and instead showed only singing-related activity. This suggests that the activity of HVC_x neurons during singing might be due to corollary discharge (a 'copy' of the motor signal that might be used to adjust for changes in sensory input that result from the motor action) rather than to auditory feedback from the bird's own song. Moreover, it shows that the cells have the capacity to switch rapidly from an auditory state to a singing-related 'motor' state. Similar results were found in HVC_x neurons from Bengalese finches, indicating that the auditory and motor-state activities of HVC_x neurons might reflect a general mechanism by which songbirds learn vocal communication.

In nature, songbirds respond to conspecifics' songs. Although HVC_x neurons did not respond when randomly chosen recordings from other swamp sparrows were played, they did show activation in response to songs from other birds that contained note sequences that were similar to those in the neurons' primary songs.

These findings show that there is a remarkable resemblance between HVC_x 'auditory-motor' neurons in birds and 'visual-motor' mirror neurons in the frontoparietal cortex in monkeys, which respond when a monkey performs an action or sees that same action being performed. It has been suggested that in humans mirror neurons might have a role in language acquisition, and the findings of Prather *et al.* provide the first evidence that learned communication, at least in birds, might indeed involve the activation of mirror-like neurons.

Leonie Welberg

ORIGINAL RESEARCH PAPER Prather, J. F., Peters, S., Nowicki, S. & Mooney, R. Precise auditory–vocal mirroring in neurons for learned vocal communication. *Nature* **451**, 305–310 (2008)