LEARNING

# Dabbling in babbling

A baby's babbling might seem to be meaningless, but it is actually an important step in the acquisition of language: such 'exploratory' motor behaviours, coupled with the sensory feedback that they evoke, help infants to learn to control the muscles that are required to produce adult behaviours such as speech. Although the importance of babbling is well-established, the underlying neural circuits were unknown. Fee and colleagues now report that specialized neural circuits distinct from those that produce adult vocalizations might underlie babbling.

Like human infants, juvenile zebra finches require a period of babbling, termed subsong, in order to learn to produce adult vocalizations (song); they therefore provide an excellent model in which to study motor learning. By lesioning specific brain areas and examining the effects of their loss, the authors investigated the neural circuitry that drives subsong production.

In adult songbirds, the forebrain nucleus HVC (high vocal centre) is known to drive song production through its projections to nucleus RA (robust nucleus of the arcopallium) and brainstem motor nuclei. HVC was therefore a natural starting point for this study. However, bilateral lesions to HVC or to its connections to RA in juvenile birds had little effect on subsong production or the acoustic characteristics of the sounds produced. Surprisingly, bilateral HVC lesions caused adult birds to produce subsong-like vocalizations instead of their normal songs.

If HVC is not required for subsong production, then which brain regions are involved? The authors demonstrated that RA is vital for subsong production, as lesioning this region abolished song production in birds of all ages. RA receives afferent input from both HVC and LMAN (lateral magnocellular nucleus of the nidopallium), a region that supports learning but is not required for adult song production. The authors showed that lesioning LMAN abolished subsong production in juvenile birds, confirming that this area provides the afferent input to RA that is necessary for subsong production.

To further investigate the role of LMAN, the authors obtained electrophysiological recordings from individual LMAN neurons during subsong production in live birds. In 20 out of the 31 neurons examined, they observed an increase in firing just before the onset or offset of an individual 'syllable' (an acoustic 'unit' of song), indicating that these neurons provide premotor drive to the motor circuit that controls vocal production.

These findings suggest that, contrary to some models of sensorimotor learning, early exploratory vocal behaviour is driven by circuits that are distinct from those that drive adult vocal behaviour. How the control of vocal behaviour is transferred from LMAN to HVC during development remains an open question. Furthermore, it will be interesting to investigate whether this principle applies to the development of other motor behaviours that are learned through such exploratory strategies.

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**ORIGINAL RESEARCH PAPER** Aronov, D., Andalman, A. S. & Fee, M. S. A specialized forebrain circuit for vocal babbling in the juvenile songbird. *Science* **320**, 630–634 (2008)