Social cues are key to vocal learning in birds and babies

July 26 2017, by Krishna Ramanujan

A juvenile (right) attends to the social cues of its parents. In the zebra finch, the female (left) and male (middle) raise their chicks together as a team. When developing their song, the chicks pay attention to social cues from both parents to guide their learning. Chicks that are less motivated to pay attention to these social cues develop lower-quality songs. Credit: Michael Goldstein

When a baby bird learns a song, is it simply mimicking and practicing its father's tune? Or do chicks learn by first putting out nonsensical sounds – akin to a human infant's babble – which they then build upon based on their parent's response?

A Cornell study, published July 19 in *Proceedings of the Royal Society B*, suggests that social feedback from other birds plays a crucial role in how baby birds – and human babies – learn to communicate.

The study informs how birds and babies learn to vocalize in socially appropriate ways, but it also has implications for children with autism who struggle to pick up social cues and learn to speak.

"For decades, across birds and babies and all vocal learners, there has been this idea that the mechanism was imitation – a baby passively listened and then it just absorbed those sounds and spat them back out, and we're finding that's not true in many of these animals," said Samantha Carouso Peck, a graduate student in the Behavioral Analysis of Beginning Years (BABY) Laboratory and co-lead author on the paper with former graduate student Nicole Baran, Ph.D. '15.

The BABY lab investigates the development and evolution of communication and social learning, and is one of the only labs in the world that actively compares vocal learning in human infants and songbirds.

"What seems to be true is that the baby does something and gets a response and then it is motivated to get more of that," added associate professor of psychology Michael Goldstein, a co-author on the paper and a co-director of the BABY lab.

This type of exchange can be seen in human babies who learn cause and effect by, for example, repeatedly dropping a spoon from a high chair,

prompting their parent to keep picking it up, Goldstein said.

In order to better understand how song learning develops in young birds, the researchers ran experiments with zebra finches, a widely used model organism for studying vocal learning. In the study, one set of newly hatched birds was given vasotocin, a hormone involved in social bonding, social motivation and related processes. Vasotocin is the avian analogue to human oxytocin, which has been simplistically referred to as the "love" hormone in popular culture.

Other baby birds were given a compound that blocked the receptor for vasotocin, while a third set of control birds received a saline solution.

"We really wanted to make sure all the birds had the exact same upbringing" and eliminate any confounding genetic issues that might play a role in rearing, Peck said.

The researchers separated the newly hatched males, since only the males sing, and made 10 nests. Each nest contained three baby male birds, one from each experimental condition, and a male foster parent who was genetically unrelated to each baby. As the young birds grew, the team conducted a battery of social-motivation and behavioral tasks, and they measured song learning.

While both the controls and the birds given vasotocin produced an adult song that closely matched their foster dad's song, the songs of birds with the vasotocin blocker were poorly matched, disjointed and truncated. The ability to learn an effective song is important, as birds use their songs to attract mates. Further experiments that examined sound qualities such as pitch and frequency of the birds' songs found that those given vasotocin learned song significantly better than the controls.

Furthermore, when all the birds grew to adulthood, the birds with

vasotocin were adept at reading social cues from females and their songs were attractive to females. In contrast, the ones given the vasotocin blocker had ineffective songs, were aggressive toward females and drove them away.

The findings provide the first evidence that these hormones – which belong to a class of hormones called nonapeptide hormones and exist in all vertebrates – are critical to the development of vocal learning.

"We decided to change their brains to either ramp up or ramp down social motivation. If social responses didn't matter, all these birds should learn the same way," which was not the case, Goldstein said.

The study has implications for treating autism in humans. Clinicians have been experimenting with administering oxytocin nasally into young autistic children to increase their social skills, Peck said. "We think this bird work can help shed light on the role of these hormones in social motivation. If we can identify the mechanisms and we can look at long-term outcomes, I think we could give some much-needed context for some of these autism studies," Goldstein said.

More information: Nicole M. Baran et al. Early life manipulations of vasopressin-family peptides alter vocal learning, *Proceedings of the Royal Society B: Biological Sciences* (2017). DOI: 10.1098/rspb.2017.1114

Provided by Cornell University