Songs of love

Researchers explore why and how birds sing • By Diane Cornell

The peaceful cooing sounds emanating from Mei-Fang Cheng's laboratory can make Newark's Smith Hall seem a tranquil oasis. As the delicate soft-gray African ring doves mate and lay their eggs, the birds sing their simple, but distinctive, two-note song.

For 28 years, Cheng has been studying these beautiful birds, exploring how their gentle coos relate to their courtship rituals. Before she began her work, common wisdom was that the vocalizations of the male bird triggered egg-laying. But actually, it is the female's own cooing that stimulates her to lay an egg, says Cheng, a psychology professor on the Newark Campus. . . .

To prove that it was the female's own singing that triggers the release of hormones, Cheng conducted an experiment that rendered the female birds unable to coo. When the female bird was then paired with a male bird that cooed as usual, nothing happened. It was only when the female heard recordings of her own voice that she produced an egg.

Cheng says the male ring dove still has an important role in the process-- he provides a powerful stimulus for the female to call-- but it is hearing her own coo that causes follicles in her ovaries to grow and burst and release an egg.

In her latest experiments, Cheng has been able to show exactly which neurons firing in the area of the brain known as the hypothalamus lead to these hormonal changes.

To pinpoint those neurons, she and her postdoctoral fellow first devised a test using blook samples from the pituitary gland to measure directly and instantaneously when levels of luteinizing hormone had risen in a bird. This hormone stimulates the follicle to grow, eventually triggering ovulation. Previously it could take days to ascertain such endocrine changes.

"No one before had been able to prove that neurons in the hypothalamus of the bird's brain fire in response to acoustic stimulation, sending a chemical messenger to another part of the brain-- the pituitary gland. The pituitary gland, in turn, triggers an endocrine response, causing the bird's ovarian follicles to mature and culminate in releasing eggs," Cheng explains.

This was an especially important discovery since the hypothalamus is prominently involved in the functions of the autonomic, or involuntary, nervous system and is not known to have anything to do with the portion of the brain that normally responds to auditory cues. . . .

Cheng advises caution when applying the results of research on physiological mechanisms in animals to explain human behavior… "Each species has its own adaptive niche. You cannot draw something from one study and blindly apply it to humans," she says…."What we are establishing is a bank of knowledge that eventually, as a whole, will contribute to our understanding of ourselves," she emphasizes.

Cheng, whose research team includes two graduate students and one postdoctoral fellow, has also been studying how social interaction amongthe birds aids in recovery from brain damage. For this study, she pairs a brain-damaged male ring dove with a normal female ring dove. Surprisingly, a male that has a female companion recuperates better than one held in isolation. "When alone, there is a certain part of their behavior that will never be recovered," Cheng notes. Her study, which is funded by the National Institute of Neurological Disorders, is trying to determine why the companyof another bird seems to promote healing.

One possibility, Cheng says, is that the pairing encourages the brain to produce new neurons, a process called neurogenesis. The idea of neurons regenerating is new, since it was thought that in birds, as in humans, the brain's ability to produce neurons stopped just after birth. Yet, for these ring doves, social stimulation seems to aid a regenerative ability. Cheng is now working to find exactly how this stimulation contributes to neuron growth, with hopes that her research may have implications for humans recovering from brain trauma.

Unlike the gentle, quiet doves, starlings are raucous, rather unattractive birds, emitting streams of long, elaborate vocalizations during courtship. "Starlings are great mimics. They are very talented birds. You can even train them to imitate human speech," observes MarthaLeah Chaiken, assistant professor of psychology on the Newark campus. Chaiken has studied these birds since 1979, when she was a graduate student working with psychology Professor Colin Beer.

Chaiken often collaborates with Cheng on various projects. But she has focused primarily on starlings, because her main interest is in song learning. "Some birds, like the doves, seem to hatch out of the egg knowing what sounds to produce, but songbirds like starlings have to learn their songs by imitation," she points out. "This is an unusual situation — so far as we know, the only other animals that need to learn their communication signals are whales and humans." The birds sing primarily to attract mates, but they even break into song when completely isolated.

Chaiken says she "fusses" over her birds, feeding them treats such as chopped eggs and vegetables. Part of it is practical, because' birds that are upset or sick stop singing. But, she emphasizes, "I am really concerned about their welfare. When we must keep birds in isolation for an experiment, 1 give them mirrors and baths to play with to prevent boredom. And when I collect birds from the nest, I always leave two so the parents won't be too upset and because one by itself would get too cold."

The birds used in her experiments breed in nest boxes on the New Brunswick campus. Chaiken's research examines what kinds of experiences the starlings need in order to produce their songs and what predispositions enable them to learn so successfully. One striking aspect of starlings is that they do not seem to have a critical period for song learning. Most birds, explains Chaiken, have a peak learning period of about one month when they are very young. "Many neurobiologists are interested in comparing those critical-period birds with open-ended learners, such as the starling, to find out what happens in the brain to turn off the ability to learn new songs," says Chaiken. "This is an exciting opportunity to explore the physiological basis of learning."

Chaiken's postdoctoral work at Rockefeller University with Peter Marler and Jorg Böhner was the first conclusive demonstration of open-ended learning by a bird.

To show that starlings do, indeed, learn throughout their lives, Chaiken isolated birds and controlled the sounds they heard for periods of up to two years. During this time, she exposed the birds to different sounds and periodically recorded their singing. She found that in starlings, a song or sound the bird hears very early in life can turn up in that bird's song months later. In one example, a song one bird learned when he was a few months old turned up in his singing for the first time when he was 18 months old.

It was originally thought that birds learned to sing by listening to an adult of the same species. But when Chaiken raised two male birds together in isolation, they were able to produce some "pretty good" songs, despite not having a model. Indeed, birds placed together, even without an older bird to mimic, produced much better songs than those raised in isolation or those that heard only recorded song. It seems that to produce song, starlings need stimulation from other birds, she says. She is now trying to identify what aspect of this stimulation is important.

Simply placing an older bird with a younger bird does not necessarily mean that the younger bird will learn his songs well. (Chaiken uses mostly male birds because they sing more than females.) So what, she wonders, makes a good tutor or a good pupil? "Is there something about the relationship that will predict who will learn a lot?" she asks.

"If the tutor is aggressive will the young bird learn more? If they tend to synchronize their behavior, like eating or bathing together, is that predictive?"

Chaiken is now measuring characteristics of good and bad tutors. She will then mix up the pairings; placing bad tutors with good pupils and vice versa, to see just which one in the pairings is responsible for good learning.

In her own teaching, Chaiken uses her lab experience often. "The issue of innate versus learned behavior runs through psychology," she says. "1 often use my work with birds when I teach. It's a great example of how innate predispositions can guide learning. This is also very relevant to discussions about language development."

Indeed, her research, which is funded by the National Institute of Mental Health and the Whitehall Foundation, may eventually shed light on how humans learn to talk. She notes that birds go through a babbling stage just as infants do. Starlings, like humans, also need to hear themselves in order to produce clear sounds. Understanding how and when birds learn songs and knowing the parts of the brain involved in this learning may help us to understand more about our own ability to communicate.

Rutgers Focus . October 24, 1997