ScienceWatch – Eavesdropping Eggs

"Paying attention to cues from the outside is important to survival." – J. C. Noguera

It's a tough world out there, especially for the young. The mortality rate in the first year of life is about 60%. Eggs and nestlings are especially vulnerable so zebra finch (*Taeniopygia guttata*) and superb fairy wren (*Malurus cyaneus*) parents warn their unhatched embryos about the environment to better prepare them to survive and reproduce (see http://hras.org/sw/swnovdec2016.htm).

Alberto Velando, evolutionary ecologist at the University of Vigo, Spain, and others have studied survival strategies in a colony of yellow-legged gulls (*Larus michahellis*) nesting on a Spanish island. The colony has a history of intermittent predation by invasive minks (*Neovison vison*). In response to a predator the parents fly off the nest and emit alarm calls to lure it away. In 2018 the researchers found that mothers exposed to predators *before* egg-laying could enhance the survival behavior of their offspring. Chicks from exposed mothers crouched faster when they heard alarm calls.

Now Velando and Jose C. Noguera show that the developing embryos can influence survival strategies even among themselves. In the July 22, 2019 issue of *Nature Ecology & Evolution*, they demonstrate that embryos exposed to alarm calls warn their sibling embryos by vibrating their eggs.

Nesting gulls lay three eggs over a period of a week and earlier findings indicated the middle embryo would be more responsive than its siblings. So the researchers collected the second egg from 90 nests. They created 30 clutches of three eggs each, which they kept in temperature controlled incubators. For half the clutches (exposed) the same two eggs were moved to another incubator and exposed to alarm calls for three minutes, four times a day, for the seven days before hatching. The third egg in the clutch was kept in silence. They manipulated the other clutches (unexposed) the same way, but the two eggs were simply moved back and forth to a soundproof incubator with no alarm call exposure. Excluding the brief exposure times, all the eggs in each clutch were in constant contact.

Thus the researchers created two sets of gull clutches. Exposed clutches had two embryos that were "warned" of possible predators, while the third was naïve. Conversely, all three embryos were naïve in unexposed clutches.

In the exposed clutches the "warned" embryos exhibited a host of physical and physiological changes, all of which were mirrored in the naïve third embryo. Eggs exposed to alarm calls showed higher vibration rates caused by increased embryo movements, which was soon mimicked by the naïve embryo, and just prior to hatching all three did less vocalizing. Embryos in the unexposed clutches did not show these behavioral changes.

"Warned" and naïve chicks from the exposed clutches were all quicker to crouch in response to an alarm call as compared to those from unexposed clutches. They also exhibited higher levels of the stress hormone corticosterone and by five days post hatching had fewer mitochondria for energy production and were smaller. Their DNA showed epigenetic changes as well.

According to Noguera and Velando, although embryos may share information while still in the egg by vocalizing, that only begins three days before hatching. In contrast, eggs begin vibrating 10 days pre-hatching. This warns younger clutch mates whose sense of hearing is not yet developed and reduces the risk of predation for the entire brood. "Even before hatching embryos can use different sources of information—for example, those coming from their parents but also from their siblings—to prepare themselves for the future," said Noguera.

Although chicks that develop a defense strategy suffer a growth penalty due to higher levels of stress hormone, they can better survive an extremely hazardous period and so are more likely to reproduce.

In nature, making babies is all that matters.

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