Cowbirds' Secret Identity Is Unlocked By A Vocal Password

Cowbirds have a big problem: because they are raised by foster parents of different species, they are faced with an identity crisis. But they deal with this by relying on a vocal password to unlock their inner secret identity and to trigger learning of who they really are

Adult male brown-headed cowbird (Molothrus ater). (Credit: Kelly Colgan Agar / CC-BY-SA 2.0)KELLY COLGAN AGAR VIA A CREATIVE COMMONS LICENSE

The behavioral and neural mechanisms for how songbirds learn their songs resembles the process that humans use to learn speech. This learning process starts by recognizing and learning appropriate songs from one's own species. For this reason, songbirds are widely studied as model systems for understanding the fundamentals of human social recognition and learning. But some songbirds learn differently: some bird species rely on other species to raise their chicks, which means these foster chicks are faced with an identity crisis that affects every aspect of their lives. Yet, these foster chicks are able to overcome this crisis and learn to recognize others of their own species.

Cowbirds as avian changelings

When a baby bird first hatches, it generally "imprints" on the first moving creature that it sees, and thereafter, it recognizes that individual as its parent. Imprinting is important as the chick matures because it provides the bird with a sense of identity; young birds tend to hang around with others of the same species and adult birds seek mates that resemble their parents. A bird that imprints on the wrong species suffers an identity crisis that interferes with nearly every aspect of its life, often preventing reproduction and creating a social misfit.

But cowbirds are not like other birds. Instead of building a nest and raising their own chicks, cowbirds adopted a different sort of lifestyle: they are brood parasites. Female cowbirds sneak their eggs into the nests of other bird species and leave them for these other birds to foster-parent. When it comes to different avian reproductive strategies, brood parasitism is very unusual: just 1% of all bird species are known to rely upon it.

Eastern Phoebe (Sayornis phoebe) nest with one speckled Brown-headed Cowbird (Molothrus ater) egg in it. (Credit: Galawebdesign / Creative Commons Attribution 3.0 Unported license.)GALAWEBDESIGN VIA A CREATIVE COMMONS LICENSE

The chatter call is the cowbird's vocal password that unlocks their secret identity

Brood parasitism raises fundamental questions, such as: how do cowbird chicks avoid mis-imprinting on their foster parents? How does a cowbird *know* it's a cowbird despite being fostered by birds of different species?

These are some of the questions that have long inspired behavioral ecologist and ornithologist, Mark Hauber, a professor in the psychology department at Hunter College and the Interim Vice Provost for Research at The City University of New York (CUNY).

The ability to recognize members of one's own species (also known as conspecifics) is the critical foundation upon which most social interactions are constructed for humans as well as many animals. Recognizing conspecifics is either inherent or learned during early development (or both).

An earlier study in brown-headed cowbirds, *Molothrus ater*, conducted by Professor Hauber when he was a graduate student, proposed that a young parasite recognizes conspecifics when it encounters a particular species-specific signal or "password" -- a vocalization, behavior, or some other characteristic -- that triggers detailed learning of the password-giver's unique traits (ref).

Brown-headed cowbirds are especially interesting because they do not specialize on parasitizing just one or a few bird species. Rather, they are known to parasitize more than 220 different species of North American birds. Thus, the young cowbirds are exposed to a vast diversity of foster parents and to an array of distinct social cues and vocalizations that they potentially could mis-imprint upon.

Professor Hauber's previous study found that adults, fledglings and even nestlings as young as six days old respond strongly and preferentially to the brown-headed cowbird chatter call, and this call may act as a "vocal password" that triggers species recognition (ref).

"After our discovery of the password as a behavioral mechanism in parasitic cowbirds over 15 years ago as a graduate student, it is rewarding for me to be working on an NSF [National Science Foundation] grant to identify the neural basis of this behavior as a professor," said Professor Hauber.

Professor Hauber's "password hypothesis" proposes that young brood parasites first recognize a particular signal, which acts as a password that identifies conspecifics, and the parasites learn other species-specific characters only after encountering that password. One of the important features of the password hypothesis is that the password must be innate and familiar to the animal from a very early age. This suggests that encountering the password triggers specific neural responses early in development -- neural responses can actually be seen and measured.

Hearing the chatter call triggers rapid production of an important protein in the brain

Behavioral correlates point to the chatter call as the likely password in cowbirds because it is frequently produced by females and occasionally by males; it is produced throughout the breeding season when young cowbirds are hatching and fledging; and it has no regional dialects despite the cowbirds' large geographic range, indicating this call is innate, not learned. Young cowbirds have a strong bias towards the chatter call, suggesting this may trigger social recognition before song learning can occur. Also consistent with this timeline: cowbirds delay memorizing their own species-specific song (see video) until their second year, practicing it with a poor imitation, and only start singing a good quality rendition in their third year (ref). This

contrasts sharply with the song-learning habits of other songbird species, who learn their songs from their fathers when they are fledglings.

This study revealed that the cowbirds' brains change after the birds hear the chatter call by rapidly increasing production of a protein known as ZENK. This protein is ephemeral; it is produced in neurons after exposure to a new stimuli, but disappears only a few hours later, and it is not produced again if the same stimuli is encountered. The production of ZENK occurs in the neurons in the auditory forebrain, which are regions in the songbird brain that respond to learned vocalizations, such as songs, and also to specific unlearned calls.

Interestingly, young cowbirds can still be tricked into mis-imprinting on their foster parents: if they do not locate and socialize with flocks of other cowbirds from an early age onwards, they will mis-imprint on their foster parents. This can be seen by increased levels of ZENK in the auditory forebrain when the foster parents sings their own species-specific songs.

"Our study reveals a neural basis for this password as well as a neural signature of misimprinting in young brood parasites that have prolonged exposure to host species songs," said lead author of the study, Kathleen Lynch, Assistant Professor of Biology at Hofstra University, in a press release.

Brood parasites' learning process has evolved to be quite different from that of most other songbirds. By learning more about the molecular mechanisms occurring in the brain that underly song learning in these birds, we can better understand how brood parasitism arose and evolved, and clarify the neural mechanisms for song learning in birds. Cowbirds provide fundamental information about the molecular mechanisms occurring in the brain for guiding how social recognition and learning actually occurs in birds as well as in other organisms -- such as people.

Source:

Kathleen S. Lynch, Annmarie Gaglio, Elizabeth Tyler, Joseph Coculo, Matthew I.M. Louder, and Mark E. Hauber (2017). **A neural basis for password-based species recognition in an avian brood parasite**, *Journal of Experimental Biology*, published online on 18 April 2017 ahead of print | doi:10.1242/jeb.158600

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