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Bat Talk

Do bats possess language?

Robert Locke

Mexican free-tailed bats, researchers find, have a rich repertoire of distinct and complex calls that play a major role in social interactions. Now scientists are finding something much more surprising: strong hints that at least some of those calls are composed of specific “phrases” – sounds that can be mixed and matched to convey very different meanings. If confirmed by subsequent studies, that would come stunningly close to what we call language.

“What is becoming apparent here is that the way bats use [their communication signals] is very sophisticated and may have rules to guide it,” said neurophysiologist George Pollak of the University of Texas at Austin.

“Those rules may involve syntax and grammar. If you combine those signals in certain ways, the meaning changes according to how they are combined. That starts to approach language, albeit in a very primitive, rudimentary way.”

“Now,” Pollak said, “we have to prove it. I’m not positive yet, but I’m assembling a whole group of people to try to prove this.”

The next step: trying to talk to the bats.

First hints

The new research has been presented at several international scientific meetings, and “people are just floored by this,” said Pollak, who has studied how bats handle auditory signals for some 30 years. “I was just amazed when we first recorded these signals at Barbara’s [Bat Barn].”

Barbara French handles countless information queries as BCI’s Science Officer, but after hours, she rescues and rehabilitates bats at her home and has maintained a colony of rescued Mexican free-tailed bats (*Tadarida brasiliensis*) at the Bat Barn for a decade. She’s been studying the social communication of free-tailed bats since about 1995, working for much of that time with fellow rehabilitator Amanda Lollar of Bat World Sanctuary in Mineral Wells, Texas (BATS Summer 2000).

Echolocation calls that bats make while hunting have been well documented, but previous behavior-related vocalization studies have seldom investigated individual interactions. French and Lollar, building on their long (initially informal) observations, began to discover patterns in bat calls. By systematically monitoring calls within their social contexts, they eventually found that many specific calls were associated with very specific behaviors – both by the calling bat and by others in the vicinity.

The two veteran rehabilitators had an important advantage in their research: Each maintains a captive colony of 50 to 75 rescued bats that, for various reasons, cannot be released into the wild. After often-extended medical care and hand feeding, they get to know their bats,



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learning to identify each one and to recognize personality differences.

And, of course, they hear bats chattering continually. In wild colonies, individual calls are buried under the wild cacophony of millions of Mexican free tails, which is what most researchers observe. French and Lollar's more manageable numbers let them home in on the calls and responses of individual bats.

What they find suggests a rather complex social order, with vocalizations that bats use to locate, greet, argue and play with one another and to express irritation, anticipation and affection. Over the years, they have "translated" about two dozen vocalizations, linking each one to a specific behavior ("What Bats Talk About," page 4). Bats at both captive colonies use similar calls.

The noisy Bat Barn

A colony of Mexican free tails seems like a noisy place filled with raging hormones, nervous conversation and boys and girls trying to figure out where everybody fits into this little society.

Consider this extended conversation from French's free tails:

Dillon, a male, stands at the entrance of his fabric roosting pouch, flaps his wings wildly and declares, "Bzzzzzzz bzzzzzz, nee nee, nee nee, rrrrrrrrrrr." Blossom pokes her head out of another pouch and looks his way. She creeps slowly towards him. On the other side of the cage, Guanito notes her movement and calls out from his own roosting pouch, "Bzzzzzzz, bzzzzzz, bzzzzzz, nee nee, nee nee, nee nee." Dillon calls again and Blossom stops, listening to the boys as they compete for her attention.

Blossom eventually scampers towards Dillon as she responds with a quiet "ta, ta, ta." She crouches against the cage and lowers her ears in a submissive gesture as he pounces. Extending his elbows so that his body raises up higher than usual, Dillon pushes his face into her shoulders. "De de de, de de de," he says as he takes a position of dominance over her. Blossom scampers into his pouch and joins three other females already inside.

Dillon follows Blossom inside. "Zzzzzzzzzzz, zzzzzzzzz, zzzzzzz," he buzzes as he pushes his face against the females, herding them around until they form a tight cluster in one corner of the pouch. Scrunching down, he rubs a gland on his throat around the entrance to his roosting pouch. Adding a drop of urine to the mixture, he creates his own unique "perfume." He sings a quiet little song – "Chee chee chee chip, chee chee chee chip" – while he marks the pouch.

"The bats in our little captive colonies chatter frequently," French said. "By recording and analyzing these distinctive calls and their behavioral context, we have learned a great deal about the way these bats use vocalizations and about their social order."

Daily life in these colonies features wide-ranging "conversations." Bats greet one another by rubbing faces and making a chittering sound. They jump towards one another, in what looks to be a form of play, with an exaggerated chittering. As they kick and squabble over roosting spots, they express their displeasure through irritation buzzes.

An outside threat typically produces a loud alarm call, often followed by an escape cry as bats scamper away from the roost. Our bats respond to non-threatening intrusions from outside the colony with a soft questioning call. They beg for food with food-solicitation

clicks and buzzes.

Pregnant females that face problems during delivery emit distress calls. Mother bats produce sharp, rapid-fire clicks – directive calls – when looking for their pups. Hungry babies use isolation calls to get mom’s attention. As the pups mature, they flap their tiny wings and make fluttery pre-flight calls before they actually make their first flight.

“We think we have most of the basic calls,” French said, “but there may be calls that don’t have any sonic components. We wouldn’t hear those.”

Bat echolocation calls are largely ultrasonic – pitched beyond the frequency range of human hearing (roughly 20 to 20,000 hertz). Bats’ social chatter, however, spans a much broader range, from about 5 to 60,000 hertz, so only parts of it can be heard by human ears.

High tech arrives

The bat-language research moved to a new level about two years ago, after Gary McCracken, a leading bat biologist at the University of Tennessee and a member of BCI’s Scientific Advisory Board, became intrigued by French’s results. He described her work to Pollak, who promptly made the first of many visits to the Bat Barn.

“This was shocking to me,” Pollak said. “The closer we looked, the more complicated and rich it became – and the more interested we became.” He dispatched University of Texas graduate student Teh-Sheng Ma to begin analyzing and cataloging the calls.

Since so much of bat communication is ultrasonic, French and Ma had to use “homemade black boxes” full of high-tech electronics to record the calls. Flat-frequency microphones collected both sonic and ultrasonic signals. A custom amplifier and processor digitized and enhanced the signals, which were stored in a computer database under the name of the bat and the related behavior. Sonograms visually depicted even the smallest details of the sounds.

After analysis identified distinct and recognizable calls, French and Ma began filming the behavior associated with each call. Bats, however, refuse to accept direction: You can’t tell them where to stand, when to talk or what to say. Patience is the only solution. The researchers often had to wait, camera and microphone at the ready, night after night to catch a single call on a few seconds of film.

And even then, the free tails’ talkative nature often got in the way. Just as one bat finally made the particular call they had been waiting for, another would chime in and contaminate the recording.

Months later, French said, slow and systematic observations paid off as Ma began extracting as much acoustical detail as possible about the structure of each call. Individual components were teased out of complex calls.

Signature Syllables

Among several intriguing, early discoveries: The territorial call is essentially the same for all males in the colony, except that each male has a signature syllable – a sound that is unique and consistent to that male bat.

The call is used when another male intrudes on the territory claimed by a dominant male

and also in reply to the territorial calls of other male free tails. French said the call means something like: “This is my home. Back off or I’ll kick the #@&\$ out of you!” Then the bat signs his warning, presumably so other males will know exactly who they are dealing with.

Ma’s analysis of the territorial call led directly to the possibility of bat language.

The territorial call consists of a series of repeated phrases – chirps – that are often, but not always, followed by a series of buzz phrases. Each chirp comprises several repeats of a standard chirp syllable and concludes with the signature syllable of each male.

That same repeated multi-syllable phrase (chirp), including the signature syllable, forms the beginning of the courtship call, which males emit to attract the attention of females. The courtship call ends with a different phrase, the trill.

Thus, different combinations of three phrases produce strikingly different meanings. “Chirp ... chirp ... chirp ... buzz ... buzz” says: “Stay away or there’ll be trouble,” while “Chirp ... chirp ... chirp ... trill ... trill” is the free-tailed bat equivalent of: “You’re pretty cute. You wanta come over to my place?”

All that, Pollak says, may mean that they have some kind of grammar and syntax that gives meanings not to individual sounds but to the way those sounds are arranged in sentences of sorts.

The next big step will be to try talking to the bats to see how they respond. His team plans to collect phrases and calls, rearrange them and see if the bats respond in predictable, appropriate ways.

That bats might actually possess something approaching language would be an amazing discovery on its own. But the information could have much broader implications, especially for understanding how human language evolved and how we learn and process our uniquely rich linguistic abilities. That’s what draws Pollak into the research.

“Whether that [grammar and syntax] is unique to bats is something I tend to doubt,” he said. The raw genetic material for language might well reach far back on the evolutionary chain and be shared in small doses among many species.

The idea that basic grammatical rules are hardwired in the human brain, rather than learned anew with each generation, was once hotly controversial but is now mostly accepted. “It was always thought that these kinds of rules are unique to humans,” Pollak said. “It’s not clear now whether or not that’s actually true.”

Researchers like Pollak have learned to examine the living brain’s reaction to language. The main area of interest is a section of the midbrain called the inferior colliculus. This is a collection of neurons that integrate and process incoming auditory information.

In birds, Pollak said, researchers have found that specific neurons are activated only in response to the song of the bird’s own species and that seems to be “the way the bird learns to sing.”

In Mexican free-tails, those neu-rons are highly selective, with each responding to some species-specific signals but not to others. A territorial call, for example, activates one set of

neurons while others remain quiescent; a court-ship call lights up another collection of neurons.

“I’m trying to figure out how that circuitry works,” Pollak said. Unraveling the simpler bat brain’s use of language could shed considerable light on how humans handle language.

Countless questions remain, however, before bat talk becomes clear. How do bats learn their complex system of calls? Is it all genetic, as pups’ calls to their mothers almost certainly are? Do calls change over generations? Are new ones added to meet new needs? Are there dialects that differentiate the calls of Texas free tails from those of Arizona bats?

Those, Pollak agrees, are very tough questions. “You’ve got to tackle the easy questions first,” he said. So French, Pollak and his grad students will keep gathering at the Bat Barn to eavesdrop on the bats.

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