

Record: 1**Title:**

Brainy Bird.

Authors:

Smith,Carolynn "K-Lynn" L.¹

Zielinski, Sarah L.²

Source:

Scientific American. Feb2014, Vol. 310 Issue 2, p60-65. 6p. 4 Color Photographs.

Section:

ANIMAL BEHAVIOR

Brainy Bird**Chickens are smart, and they understand their world, which raises troubling questions about how they are treated on factory farms**

IN THE ANIMAL KINGDOM, SOME CREATURES ARE SMARTER THAN OTHERS. BIRDS, IN PARTICULAR, exhibit many remarkable skills once thought to be restricted to humans: Magpies recognize their reflection in a mirror. New Caledonian crows construct tools and learn these skills from their elders. African grey parrots can count, categorize objects by color and shape, and learn to understand human words. And a sulfur-crested cockatoo named Snowball can dance to a beat.

Few people think about the chicken as intelligent, however. In recent years, though, scientists have learned that this bird can be deceptive and cunning, that it possesses communication skills on par with those of some primates and that it uses sophisticated signals to convey its intentions. When making decisions, the chicken takes into account its own prior experience and knowledge surrounding the situation. It can solve complex problems and empathizes with individuals that are in danger.

These new insights into the chicken mind hint that certain complex cognitive abilities traditionally attributed to primates alone may be more widespread in the animal kingdom than previously thought. The findings also have ethical implications for how society treats farmed chickens: recognizing that chickens have these cognitive traits compels moral consideration of the conditions they endure as a result of production systems designed to make chicken meat and eggs as widely available and cheap as possible.

[CHATTY CHICKENS](#)

IT HAS TAKEN RESEARCHERS almost a century to figure out what is going on in the brains of chickens. The first inklings emerged from studies conducted in the 1920s, when Norwegian biologist Thorleif Schjelderup-Ebbe established that the birds have a dominance system, which he named the "pecking order" after noting that chickens will enforce their leadership by administering a sharp peck of the beak to underlings whenever they get ideas above their station.

The next major breakthrough in understanding the chicken mind came several decades later. The late Nicholas and Elsie Collias, both at the University of California, Los Angeles, categorized the birds' calls and determined that chickens have a repertoire of about 24 different sounds, many of which seem to be specific to certain events. For example, when faced with a threat from above, such as a hungry eagle, the birds crouch and emit a very quiet, high-pitched "eeee." The clucking sound that most people associate with chickens is actually one they use when encountering a ground predator. The discovery of food elicits an excited series of "dock dock" sounds from males, especially when a judgmental female could be listening.

These early findings suggested that more happens in the chicken's walnut-size brain than one might think. The vocalizations appeared to encode specific information intended to evoke a particular response from onlookers. Yet connecting these sounds and movements with their true meaning proved difficult until the development, in the 1990s, of technology that allowed researchers to test their hypotheses more rigorously. It was then that the late Chris Evans of Macquarie University in Sydney, Australia, and others began to use digital audio-recording devices and high-resolution televisions to test the function of chickens' array of sounds under controlled conditions. In essence, they created a virtual reality for the birds, surrounding a test cage with TVs that allowed them to change what a chicken encountered -- a companion, a competitor, a predator -- and to record how it responded to a variety of situations. A test chicken might see a simulated hawk flying overhead, or a fox running toward it from the side, or a rooster making a series of dock-dock sounds.

This virtual reality led to a truly astonishing revelation: the sounds or movements an individual chicken makes convey specific information, and other chickens understand it. A chicken need not see an aerial predator, for instance, to behave as if one was there; it needs only to hear the warning call from another bird. The chickens' calls are "functionally referential," as behaviorists would say -- meaning that they refer to specific objects and events broadly in the way that words used by people do. In a chicken hearing the calls, the sounds appear to create a mental picture of that particular object, prompting the bird to respond accordingly -- whether to flee a predator or approach a food source.

The virtual world also revealed that individual chickens tailor their messages for their audience. A rooster that sees a threat overhead, for example, would make an alarm call if he knows a female is nearby, but he would remain silent in the presence of a rival male. Females are equally selective, only sending up an alarm when they have chicks.

Taken together, these findings suggested the sounds did not simply reflect a bird's internal state, such as "frightened" or "hungry." Instead the chickens interpreted the significance of events and responded not

by simple reflex but with well-thought-out actions. Chickens, it seems, think before they act -- a trait more typically associated with large-brained mammals than with birds.

BY HOOK OR BY CROOK

THE REFERENTIAL CALLS showed that chickens are more cognitively sophisticated than they have been given credit for. The research also raised an intriguing question: If these birds have the ability to communicate information about environmental events, might they also withhold that news or even broadcast misinformation when they stand to benefit from such deceitful behavior? Further insights have come from studies of other forms of chicken signaling.

Scientists have known since the 1940s that the birds perform complex visual displays in connection with the discovery of food. The most prominent of these displays is a series of actions collectively called tidbitting, in which an alpha rooster twitches his head rapidly from side to side and bobs it up and down, picking up and dropping food over and over again to signal to a female that he has found something tasty. This performance is the main way he lures a mate. Scientists thought the subordinate males, for their part, focus on keeping a low profile, so as to avoid attracting negative attention from the alpha. Yet some observations of chickens in their social groups hinted that the pecking order of the birds might not be quite as orderly as researchers initially thought. In fact, mounting evidence indicated that chickens could be devious bastards.

Human observers initially missed this underlying drama because interactions between members of the flock are short and often secretive; the birds prefer to hide in the tall grass and among the bushes. At the same time, it is just not possible for a single person to monitor all the chickens at the same time. To minimize those difficulties, one of us (Smith) came up with a solution she called "Chicken Big Brother."

Smith and her colleagues wired the outdoor aviaries at Macquarie University--large outdoor spaces with lots of vegetation, surrounded by nets on all sides -- with multiple high-definition cameras and an array of microphones to catch every move and sound the birds made. They then analyzed the resulting recordings.

As expected, the alpha in any group would crow to show he was the master of the territory. He would perform the tidbitting display to attract the ladies. And he would make alarm calls to warn the flock of danger from above.

It was the subordinates that provided the twist. The team expected that these males should keep to themselves, to avoid the harassment of being chased, pecked and spurred by the alpha if they dared to make a play for his girl. Yet the cameras and microphones revealed a more complex story. These lesser males employed surreptitious tactics in a way previously thought impossible for the birds: they performed only the visual part of tidbitting -- making the head motions without making the dock-dock sound -- thus creating a new signal that could quietly attract a mate while sidestepping the wrath of the alpha rooster.

The fact that the subordinate males modify the tidbitting signal in this way to secretly seduce the hens demonstrated a behavioral flexibility that shocked researchers. But they had yet to plumb the full depths of the birds' deviousness.

To examine the animals' behavior more closely, they added more technology to their tool kit. The chickens' vocalizations were often so subtle that Smith and the other researchers were unable to catch them, even with the extensive camera-and-microphone setup. They needed a way to record every call as it was made and heard by each of the individual chickens.

Ideally, they would outfit the chickens with little backpacks carrying lightweight wireless microphones similar to those reporters wear when working out in the field. But where to find the right materials for those packs? Bras, Smith thought, could do the trick. She began a hunt for old ones with easy-to-latch hooks and preferably colored black so they would not stand out against the feathers. Smith cut off the hooks and adjustable straps and attached these parts to the microphone to create a harness. Once strapped to a bird's waist, the jury-rigged apparatus -- affectionately dubbed Chicken Big Brother 2.0 -- would record what the chicken said and heard.

Smith was particularly keen to take a closer look at how the animals respond to danger. The previous research showing that males would sometimes call out when they saw an aerial predator, such as a hawk, was puzzling because making those squeals would place the rooster at greater risk of getting noticed and attacked himself. Scientists had assumed that the male's need to protect his mate and offspring was so critical that making the call was worth the risk. Yet Smith wondered if other factors influence the calling behavior.

It turns out they do. Using Chicken Big Brother 2.0 to eavesdrop on even the quietest communications revealed that males sometimes made calls for selfish reasons. The birds monitored the danger to themselves and their rivals and were more likely to call if they could both minimize their own risk and increase a rival's. A male calls more often if he is safe under a bush and his rival is out in the open, at risk of being picked off by a swooping predator. If the rooster is lucky, he will protect his girl, and another guy will suffer the consequences.

This strategy is known as risk compensation, and it is yet another skill that chickens have in common with humans. Many of us will take on more risk if we perceive a mitigating factor. People will drive faster when wearing a seat belt, for example, or when in a car equipped with antilock brakes. Male chickens will likewise take more risks if they feel more secure.

[MOTHER HEN](#)

THE CHICKEN'S LIST of cognitive skills continues to grow with each scientific discovery. Giorgio Vallortigara of the University of Trento in Italy has shown that young chicks have the ability to distinguish numbers and use geometry. Given a half-completed triangle, for example, chicks can identify what the shape should look like with all its parts. And research published in 2011 by Joanne Edgar of the University of Bristol in England and her colleagues revealed a softer side of these sometimes Machiavellian birds, demonstrating that they are capable of feeling empathy.

In Edgar's experiment, mother hens watched as their chicks received a harmless puff of air that ruffled their downy plumage. The chicks perceived the puff as a threat and showed classic signs of stress, including increased heart rate and lowered eye temperature. Intriguingly, their mothers also became upset simply by observing their chicks' reaction. They showed the same signs of stress the chicks exhibited even though the hens themselves did not receive the puff of air and the chicks were in no obvious danger. The hens also made more clucking calls to their chicks. These findings indicate that chickens can take the perspective of other birds -- an ability previously seen in only a handful of species, including ravens, squirrels and, of course, humans.

The fact that the common chicken, which is not closely related to other bird species known for their braininess, has such advanced cognition suggests something interesting about the origin of intelligence. Perhaps it is rather more common in the animal kingdom than researchers have thought, emerging whenever social conditions favor it as opposed to being a rare, difficult-to-evolve trait.

For its part, the chicken presumably inherited its cognitive prowess from its wild ancestor, the red junglefowl, which lives in the forests of southern and Southeast Asia. There the ancestral chicken society consisted of long-term, semistable groups of four to 13 individuals of varying ages. A dominant male and a dominant female headed each group, and as in many other societies, those in charge got what they wanted, whether it be food, space or sex, mostly by keeping their subordinates in line. Males spent much of their time strutting their stuff for the females and providing them with food; females carefully observed the males, judging them on their actions and remembering what each had done in the past; they shunned the ones that were deceptive or nasty. A rooster's reputation was important to his long-term success with the hens, and competition for the females was fierce.

Competition within the flock was not the only source of pressure on the birds' mental capacity. They also faced a range of threats from outside the flock -- including predators such as foxes and hawks -- each of which necessitated a different escape strategy. These conditions forced the fowl to develop clever strategies for dealing with one another and the dangers around them, as well as ways to communicate about all these situations. Those characteristics are still present in the domestic chicken.

That such a litany of abilities belongs to animals that humans eat by the billions naturally raises questions about how they are treated. Birds that would typically live in small flocks in the wild can be penned in with up to 50,000 others. A potential 10-year life span is shortened to a mere six weeks for chickens raised for meat. They are killed so young because these birds have been genetically selected for such fast growth that allowing them to become any older would subject them to heart disease, osteoporosis and broken bones. Egg layers fare little better, living only 18 months in a space about the size of a sheet of printer paper.

The chicken's flexibility and adaptability, derived from its social red junglefowl ancestor, may have been part of its undoing, letting the birds survive even under the unnatural and intense conditions in which humans now raise them. This type of farming will likely continue as long as most people are unconcerned about where their food comes from and unaware of chickens' remarkable nature.

Consumers have begun to effect change, however. In Europe and some U.S. states, such as California, new laws are being passed that require improved housing conditions for egg-laying chickens, largely driven by buyer demand for better animal welfare, as well as healthier food. In Australia, producers now actually highlight the positive conditions under which they raise their animals, competing for a growing population of ethical consumers. Yet there is still more to be done. The conditions under which meat chickens are raised have largely gone unscrutinized.

Researchers have just begun to elucidate the true nature of chicken intelligence, but one thing is already certain: these birds are hardly the "dumb clucks" people once thought them to be.

[MORE TO EXPLORE](#)

Tactical Multimodal Signalling in Birds: Facultative Variation in Signal Modality Reveals Sensitivity to Social Costs. Carolynn L. Smith, Alan Taylor and Christopher S. Evans in *Animal Behavior*, Vol. 82, No. 3, pages 521-527; September 1, 2011.

The Chicken Challenge: What Contemporary Studies of Fowl Mean for Science and Ethics. Carolynn L. Smith and Jane Johnson in *Between the Species*, Vol. 15, No. 1, pages 75-102; 2012.

[FROM OUR ARCHIVES](#)

Just How Smart Are Ravens? Bernd Heinrich and Thomas Bugnyar; April 2007.

[FINDINGS](#)

[The Virtual Chicken Experiments](#)

The knowledge that chickens will watch one another on television inspired one of us (Smith) and her colleagues to create a 3-D animated rooster using the same rendering technology employed in movies such as *Skyfall* and *Titanic*. This virtual rooster allowed the team to test the meaning of the birds' displays and their perceptions of one another. It also solved the age-old question of why roosters have wattles.

The wattle is that dangling flap of skin that hangs loosely from a rooster's beak. When a male performs his tidbitting display -- a series of head movements that he uses to tell potential mates that he has found food -- the wattle swings back and forth, even smacking him in the side of the head if he gets too enthusiastic.

Decades of research had failed to find any benefit to the male's having a wattle. Smith suspected that the flap of skin might make a male's tidbitting display more obvious and give him an edge in attracting the females, but she could not test her idea by cutting off the appendage and seeing how a female reacted. Instead she created an animated rooster that would tidbit on command for a live hen and then altered the flexibility and size of the wattle on her animated bird to test how the females would react.

The wattle, it turned out, acts like a red flag to the females, making it easier for a hen to spot the male who has the food. For the male, the ornament may cost him a bit in terms of his health because a bigger

wattle comes with more testosterone, which weakens the immune system, but the cost is worth it in the long run because it gets him the girls.

Sometimes the chickens' intelligence made studying them challenging. On multiple occasions a bird would subvert an experiment by answering a different question than the one the researcher was posing. In a test of the tidbitting display, Smith had created a setup in which a hen got a chance to watch a video of a male with food. To do so, the female had to wait behind a door that had been rigged with a remote-controlled servo stripped from a toy car. One hen that wore an orange band with the numbers 07 (and thus affectionately dubbed "007") was notorious for getting into trouble. While waiting for the researcher to open the door via remote control, 007 grew impatient and began examining the release mechanism closely, turning her head from side to side. After a few moments, she carefully plucked the wire that controlled the latch. The door opened, and 007 got what she wanted: to be close to the guy and his food. After that single trial, she would never wait again. Although the researchers changed the latch configuration several times, 007 was always able to solve the puzzle and escape before her turn.

-- C.L.S. and S.L.Z.

SCIENTIFIC AMERICAN ONLINE Watch a video of the virtual rooster at ScientificAmerican.com/feb2014/chickens

IN BRIEF

Mounting evidence indicates that the common chicken is much smarter than it has been given credit for.

The birds are cunning, devious and capable of empathy. And they have sophisticated communication skills.

That chickens are so brainy hints that such intelligence is more common in the animal kingdom than once thought.

This emerging picture of the chicken mind also has ethical implications for how society treats farmed birds.

PHOTO (COLOR): FACTORY-FARMED CHICKENS, such as these hens on a farm in Fleurus, Belgium, often live in extremely crowded conditions.

PHOTO (COLOR)

PHOTO (COLOR)

PHOTO (COLOR)

~~~~~

By Carolyn "K-Lynn" L. Smith and Sarah L. Zielinski

Carolynn "K-lynn" L. Smith is a research fellow at Macquarie University in Sydney, Australia. Her research investigates communication and cognition in animals ranging from giant cuttlefish to elephants. She is the joint recipient of a 2010 Australian Museum Eureka Prize.

Sarah L. Zielinski is a freelance science writer in Washington, D.C. Her work has appeared in Science, Science News and Smithsonian, among other publications.

---

Copyright of Scientific American is the property of Scientific American and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.