Talking With Birds: The Fascinating World of Avian Intelligence

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Can birds be as intelligent as chimpanzees or dolphins? Can they communicate and use language like a child would? Can they even outsmart undergraduate students? A line of research started more than 40 years ago continues to reveal new findings about parrots' intelligence and even their ability to use English speech to communicate with humans.

Irene Pepperberg, an APS Fellow and adjunct research professor at Boston University, pioneered the study of bird cognition back in the 70s and still studies the cognitive and communicative abilities of grey parrots, comparing their abilities with those of great apes, dolphins, and young children. In this conversation with APS's Ludmila Nunes, she speaks about research on parrots' cognitive abilities, their conservation and preservation in the wild, and much more.

Listen to a related podcast episode in which APS Charter Member Janet Jones, author of the book *Horse Brain, Human Brain,* shares unique insights into how the brains of horses and their human riders can work in tandem.

Unedited Transcript

[00:00:14.310] – Ludmila Nunes

Can birds be as intelligent as chimpanzees or dolphins? Can they communicate and use language like a child would? A line of research started more than years ago has been showing that parrots are intelligent animals and can use English speech to communicate with humans. This is under the cortex. I am Ludmila Nunes with the Association for Psychological Science Today. I have with me APS member and fellow Irene Pepperberg. Dr. Pepperberg is an advanced research professor at Boston University. She pioneered the study of bird cognition back in the still, studies the cognitive and communicative abilities of gray parrots, comparing their abilities with those of gray tapes, other mammals like dolphins, and young children. Dr. Pepperberg is also the founder of the Alex Foundation, named after the first gray parrot she studied in 1977. The Alex Foundation has the goal to support research that expands the knowledge about the cognitive abilities of parrots and the use of these findings to encourage the responsible ownership of parrots conservation and preservation of parrots in the wild, and veterinary research into the psychological diseases and care of parrots. Irene, thank you for joining me today. Welcome to under the cortex.

[00:01:41.290] – Irene Pepperberg

It's my pleasure to be here.

[00:01:44.010] – Ludmila Nunes

So before we start talking about your fascinating research, I'm curious about your trajectory. Your undergraduate and graduate training is in chemistry. I mean, you hold a PhD in chemical physics from Harvard. How did you end up studying bird cognition?

[00:02:00.390] – Irene Pepperberg

Well, it's a very long story, but the short version is that while I was doing my doctorate, I was very frustrated at the way the research was going. Computers that time were the size of big rooms. It took me seven years to do what? At that point, I thought, oh, it would only take maybe seven weeks as computers got better. And of course, now it's probably seven nanoseconds with the computers we have today. But it was very frustrating research. I didn't see a future in it. And it was also an incredibly sexist field. We were actually told at Harvard that there was no way they were ever going to hire a woman faculty member because we weren't good enough. And I'm thinking, you're giving us PhDs, and yet we're not good enough to serve in your department. There's something really wrong here. And I had had a budgie as a child, and I used to play with them, but the critical intersection was the Nova programs. They started 1974, basically in the middle of my doctorate, and they had programs on chimpanzee, communication with humans via sign language and computer chips, work with dolphins who were understanding human sign languages, and a critical one on Why do birds Sing?

[00:03:17.020] – Irene Pepperberg

Showing that birds learn their song and learn to communicate. And I put that all together, and I said to myself, well, why aren't these people working with parrots? They learn English speech. So I went over

to the Museum of comparative Zoology at Harvard tried to convince them to let me switch into their program, because that would have been the most sensible one. And they were very sweet, and they said, look, we can't do that, but take whatever courses you want. Just don't make us grade your papers. All right? Finish your doctorate. It's a union card. And the psychology department said the same thing. Just basically, if you want to sit in on some courses, we don't have a problem. You're a registered student at Harvard. Just don't make us grade your papers. And that was the time when people were first beginning to understand how children acquired language. So it was a great time to start spending time on this kind of work. And I would spend 40 hours a week finishing my doctorate and 40 hours a week doing all this reading and attending seminars and preparing myself for what I knew was going to be a different career.

[00:04:26.910] – Ludmila Nunes

What is also very interesting to me is that you chose birds. At the time, it was thought that birds were not as intelligent as other animals, let alone able to learn and communicate.

[00:04:41.070] – Irene Pepperberg

And that was a problem at the time. In the 70s, people had no idea about the complexity of the avian brain. It wasn't until 2005 that the papers started coming out about the fact that there was actually a corticallike area in the avian brain that didn't look anything like a human cortex, but function that way. That was in 2005. This is now 1970, 70, 75 or so. But I have had these young little budgies as a child that talked to me, that communicated with me in very simple, basic ways. And when you looked at the bird song literature, birds would learn 20 songs. They used these songs in different contexts to express different types of needs. So it seemed to me that there was a basis on which to develop this work. There were also studies coming out of a research program in Otto Curler's lab. Kerler had studied all sorts of amazing numerical competence in corvids and parrots, and also Deetmar had begun to establish some kind of twoway communication system with a great parrot. He had developed a system called the model rival, or Mr, training technique, which was a way of socially demonstrating to the birds the types of vocalizations that wanted it to learn.

[00:06:10.800] – Irene Pepperberg

And he had gotten a great parrot to communicate with him. It was a simple sort of a stimulus response at that point, but he could ask the bird, what's your name? And the bird would respond, things like that. And this suggested to me that what I wanted to do was completely possible.

[00:06:29.130] – Ludmila Nunes

So you actually use this type of training when you first studying the gray parrots, right?

[00:06:35.880] – Irene Pepperberg

That's right. We adapted this model rival technique, and it's really quite simple. Essentially, you have the bird on a perch, you take a toy that it really wants to play with. So it's sitting on the perch and you have this toy. You have a student who is the model for the bird's behavior and its rival for the attention of the principal trainer, who initially is myself. You show the bird that by labeling this object, they can get a toy. So I would show it to the student. I'd say, what's this? And she say, for example, key. I say,

that's right, it's a key. And she takes the key and she starts playing with it the way the bird would play with it, scratching under her chin and going, Key. And I'm saying, that's right, it's a key. And I give a little sentence frames. You've got the key. It's a beautiful key, it's a hard key. You can play with the key all the time. She's playing with it. And the bird is practically falling off the perch because it wants the subject. So we exchanged roles of model, rival and trainers. So the bird saw that one person was not only the questioner and the other person the respondent, but that it was an interactive process.

[00:07:41.010] – Irene Pepperberg

So now she would show me the object and let me respond and I could get the key and play with it. And sometimes we would make mistakes. That was also another difference from toad's procedure, so that the bird could see that not any weird noise caused transfer of the object. So I show it to her and she got rack. And I go, no, you're wrong, and I take it away and then I give her another chance. And the bird would process all that and then we'd show it to the bird. Now, in order for a parrot to produce sounds, it has to learn how to control its syrinx, which is its sound box. That's sort of equivalent to our larynx, but it's at the base of its trachea instead of at the top of its trachea like ours. So it has to learn to control its syrings, the trachea itself, which doesn't change very much, but it turns out is important, producing the first format of English speech. It does have a larynx, and it's Gladys. Those are basically holes that open and close to control its beak opening and closing, like our mouth opening and closing, the tongue going back and forth and up and down, just like ours.

[00:08:45.060] – Irene Pepperberg

So think about all the differences in your mouth when you go e versus A. The bird has to learn how to do the same thing. So when you show the bird something like the key and say, what's this? It's not going to say key right away, but it might say something like E, which is easy to produce, and you reward that. And then over time, you can shape up the sound, which is more difficult to produce. So it's a complicated process, but over the course of the years, alex learned about 100 different labels or so. He learned labels for 30 different objects, for seven colors and five shapes, for numbers up to eight. For phrases like I want X and want to go Y or X and Y, appropriate object location labels. He learned concepts of same, indifferent, not simply identity versus non identity, but same and different. Where he could tell you which attributes of two objects were same and which were different for the same objects, he understood concepts of bigger and smaller. And we trained him in these ways so that he could communicate with us in a very basic way. I don't think at any level could you call it language, because he could never do what you and I were doing, but he could communicate his needs and his wants.

[00:10:03.270] – Irene Pepperberg

He could answer questions. So we could use this communication system to examine his cognitive processing. So he was kind of at the level of a toddler who was just basically learning to speak. But his intellectual capacity, we found out, was much greater than that and more. We found out these great parents are at the levels of about a six or seven year old child.

[00:10:25.300] – Ludmila Nunes

Do you want to talk more about that part?

[00:10:28.290] – Irene Pepperberg

Yes. So the thing is, not just with Alex, but now with Griffin and Athena, who are my parents that I'm working with now. We've done studies on number confidence. We've done studies on inference by exclusion, hijabian studies, not just simple things like object permanence, but on probabilistic learning and on liquid conservation. And on these types of tasks. The birds are at the level of about a six or seven year old child. We did a work on visual memory manipulation, and this is basically a shell game on steroids. You have four different colored woolen pompoms. You cover them with four little black cups. You rotate the cups around and you interchange them, you know, swapping them like a shell game. And only after you've done like, four swaps, you show them a different pompom. You say, okay, here's the yellow one. Where is the yellow one on this tray? Now, think about that. You've made all these different swaps. Griffin basically beat out Harvard undergraduates until it got to four cups and three swaps where he matched them, and he only fell below them. At four cups and four swaps, he beat out six to eight year old children completely.

[00:11:43.540] – Irene Pepperberg

They really only managed like, three cups and four swaps.

[00:11:47.970] – Ludmila Nunes

So this not only shows that these parrots are able of complex reasoning, of inferential deduction, and again reinforces the idea that they can separate attributes and understand, for example, the notion of color or.

[00:12:02.100] – Irene Pepperberg

Size, color, shape, material, things like that. Yes, Alex had concepts, and so does Griffin concepts of category. So they understand just not what is or is not green, but that's a green and three corner, which is our label for a triangle, represent different categories of shape and color. They have labels for material. So you can show them a particular object and say what color, what shape, what matter, what toy? And they can switch and answer all those questions. And that's part of executive function, being able to switch these kind of capacities. So these birds are very advanced for creatures that are separated from us by 300 million years of evolution and supposedly didn't have any cortical processing.

[00:12:51.810] – Ludmila Nunes

Does this research tell us anything about our own evolution and the way we evolved to communicate?

[00:13:00.570] – Irene Pepperberg

Well, it tells us that there are parallel types of evolutionary systems. Some people claim that because if you go back those 300 million years ago, you're developing the cortical areas from the same paleo region so that it's homologous rather than analogous evolution. I'm completely neutral on which way you want to argue this, but the point is there is this ability in their brains that allows them to learn all these different vocalizations. There are seven areas of the human brain that are responsible for learning vocalizations. There are seven parts of the avian brain. And those birds that do learn their vocalizations

that are responsible, they're not identical, but they're very similar. When you think about, again, being separated by 300 million years of evolution, that we can still see amazing parallels in the way these brain areas function. It tells us something about the fact that these are separate systems that still allow similar types of communication. Not identical, but similar types of communication.

[00:14:18.270] – Ludmila Nunes

And just to be very clear, this research is very different from what was being done with birds before. For example, associative learning where they would learn stimulus and the response the response they should give to a stimulus because of the entire process and methodology that you created. Correct?

[00:14:38.910] – Irene Pepperberg

Correct. So the point is that because of the way we trained our birds, they can extrapolate to novel situations and innovate. So, for example, when Alex was learning bigger and smaller, training him, what color bigger? What color is smaller? We transferred to all the different objects in the lab. We transferred to novel objects, and then we gave him two objects that were the same size. Now, he had never seen that before. He had learned the word none when we did the same different study. So if nothing was same and different between two objects, he learned to say none. But that was the only situation in which he had learned to use it. But the first time we showed him two objects that were the same size, and we asked him, what color bigger? He looks at me and he questioned actually, he said, what's name? Which was quite clever. And I said, well, you tell me what color is bigger, what color is smaller? And he said, none. So he transferred the concept from the absence of an attribute to the absence of a size differential, just like what.

[00:15:50.020] – Ludmila Nunes

A child would do learning the meaning behind the concept.

[00:15:55.310] – Irene Pepperberg

Right.

[00:15:57.210] – Ludmila Nunes

So this is all really interesting, fascinating work. But you also develop a personal relationship with these animals. It's different testing and working with parrots for many, many years versus just testing human subjects that come and go, they're not always the same. How do you describe your relationship with your parents?

[00:16:20.490] – Irene Pepperberg

Well, basically I treat them as my colleagues because we are working together to establish the intelligence of these birds. After Alex died, of course, that was such an emotional shock, and I realized that there was a much stronger relationship there. But even with Griffin and Athena, now, I still have to keep a professional distance and treat them like my colleagues, because I have to be exceptionally careful not to over interpret my data and not to want them to do so well that I think they're doing so

well. And just I have to be so careful to not do any queueing to go through the experimental design and make sure that everything is completely clean and clear and that there's nothing that they can read from my emotional behavior or any other type of behavior as to what's happening. So I really do have to, again, remove all the emotions when I sit down across from them on the experimental set up and treat them as my colleagues.

[00:17:35.610] – Ludmila Nunes

So do you want to tell us what are you working on right now?

[00:17:40.290] – Irene Pepperberg

We're doing a lot of studies right now on inference by exclusion, and that is the ability to figure out where something is by having information about where it's not. So the initial studies were done by people like David Premack with his aides. You have a barrier up, you show the animal you're hiding something in one of two cups. You remove the barrier, you show them this cup is empty, go find something. It's a two cup exclusion. But then I started working with Susan Carey at Harvard, and again, we had done some studies to try to make sure that the bird wasn't simply avoiding the cup from which something had been removed. So we did a study where we gave them like two pieces of chow and two jelly beans. And in this situation, they should always go to the jelly bean because one jelly bean is so much better than two pieces of chow. So we showed that they weren't just avoiding the cup from which something was removed. And we did some other studies to basically show that it was a little bit more complicated than just avoiding empty. But Susan Carey was looking at this and going like, well, if you look at this, think about it, you set up the barrier, you show them the two cups, and the treat could be in maybe A, maybe B.

[00:19:00.320] – Irene Pepperberg

You show them it's not in B. And we are assuming therefore, it's an A, but it could just maybe be an A. And you choose A because you have no other choice. So she and her graduate student developed a three cup and a four cup study. The three cup is sort of certainty. So I'll go to the four cup. So in the four cup, you put up the barrier. You have two sets of two cups. They're separated slightly, and you show the subject. You're putting something in one cup on the AB site, something on the other cup CD. They don't know whether it's A or B, C or D. You remove the barrier. So it's maybe A, maybe B, maybe C, maybe D. And then you show them, look, A is empty. So if they understand exclusion, they know that it's therefore B, because there's only one thing on that side. But if they don't understand exclusion, they're still thinking maybe B, maybe C, maybe D. And if you ask a tour two and a half year old child to choose to get the treat, they're random. They choose all sides equally, a three year old and a four year old.

[00:20:12.530] – Irene Pepperberg

They're better they're not at ceiling. Even a five year old isn't at ceiling. Griffin, when we did this with him, was close to ceiling. So some other people were arguing that maybe what you also have to do these are people in Australia, Sudendorf and his crew, maybe you have to do a study where you show them, for example, okay, there's something in A, and now you have to infer, okay, you have to take the stuff

out of A. But then to get the second treat. You have to remember to skip that whole side. Because you have to assume and you have to infer exclude the A and B. Even though you don't know anything about B. Because you only ship and showed A and choose C or D. And it turns out that monkeys are a chance with that only five year old children can really succeed on that. And Griffin also succeeded. We're just writing up that study now. A postdoc in my lab is looking at optical illusions with these birds, and she's looking now at the navan illusion, which is the idea of if you have, like, an H made up of little T's, okay?

[00:21:25.040] – Irene Pepperberg

And I ask you, what letter do you see? Do you say t or h? And the idea is, are you looking at local versus global effects? And that's what she's examining. Now, we're just beginning some work on some mirror studies, and we're, of course, continuing to work on teaching Athena, who's quite young compared to the other birds, more labels so we can do some exciting work with her.

[00:21:49.650] – Ludmila Nunes

It's fair to say that there is still a lot to learn about how parrots and birds in general are able to learn and communicate.

[00:22:01.290] – Irene Pepperberg

That's right. And again, we've also been doing some work on delayed gratification. And the interesting thing about this is that Griffin has understood the label weight in a way that young children would learn. Weight. Wait for your turn at a game, or wait for your dinner or something like that. He's never been trained as a command. So instead of using some of the other tasks that people have used for delayed gratification. We use the standard Michelle marshmallow test.

[00:22:34.830] – Ludmila Nunes

Which is if you give a child a marshmallow and ask them to wait to eat and then you leave the room. Those who tend to show. Restrain and not eat the marshmallow until later. Until they are authorized to do so. Or under the prospect of getting more than one marshmallow. Tend to perform better in certain areas later in their lives. That's the classic study.

[00:23:00.400] – Irene Pepperberg

And so we gave Griffin the study, would you wait for a better reward? And he waited for up to 15 minutes for a better reward. We then tested him, could he wait for more? And that he failed on, which was surprising. So we gave him a study using tokens instead of the actual nuts to see if taking out the hedonic reward and showing him a cool token, because each token is representing a nut and he succeeded on that. So we then just finished a study now transferring him to nuts, and we're just beginning to write that up and he did succeed on that. So this is telling us something about executive function in these birds and how it compares with that of young children. I think.

[00:23:53.000] – Ludmila Nunes

So at first the nuts were too tempting, but when they were able to learn that the tokens represent the nuts, they're okay, I can do this like I just did with tokens.

[00:24:03.160] – Irene Pepperberg

Right?

[00:24:03.910] – Ludmila Nunes

So I know you're very interested in wildlife conservation too. How do you think this whole line of research might help to protect parrots worldwide and maybe other animals?

[00:24:17.070] – Irene Pepperberg

Well, great, parrots in particular are now site is one endangered, which is the absolute highest level of endangerment you can imagine. And what we're trying to explain to people is their intelligence. And the reason for that is people like to conserve things that are similar to them. So as soon as you showed people that dolphins were smart mammals, they got very interested in dolphin free tuna. So the idea is by showing people that these birds are so smart, that they will also be sensitive to the deforestation and for the poaching, for the pet trade and help with conservation efforts. And I think that's really important because we have to understand about all the creatures with whom we share our world. And I hope this helps us to appreciate their abilities and to go on and not just think about parrots, but think about all the other animals in our lives and the other animals in the world that could be equally intelligent if somebody decided to study them. We also want responsible pet ownership. We want people to understand again how smart these birds are. You wouldn't take a four year old child and put it in a play pen with a couple of toys and a couple of snacks for 8 hours a day and leave it alone.

[00:25:41.510] – Irene Pepperberg

But you're doing that to your parent by putting it in the cage and going to work for 8 hours a day. Rather, if they're working at home and the bird can come out and sit on their shoulder for part of the day and have lunch with them and things like that. And then, yeah, maybe a parrot is a good companion animal. We want people to understand how their lifestyle affects the type of companion animal that they should be choosing. Exactly.

[00:26:12.270] – Ludmila Nunes

And do you think you also learned from your parents during this entire process?

[00:26:17.850] – Irene Pepperberg

Oh, I have learned patience because working with these birds is like working with the toddler, only they never grow up. They may have the intellectual ability of an older child, but their emotional level is stuck in the two year old stage and they want what they want when they want it. And they'll decide they don't want to work and just turn their backs and start preening. They'll throw all the experimental materials on the floor with their beak. Sometimes Alex's favorite game, and Griffin does this too, sometimes is to give us all the wrong answers and repeat all the wrong answers. And statistically, you know, they can't

be doing that unless they know the right answer. Because you can't give me twelve wrong answers in a row unless you're carefully avoiding the correct one.

[00:27:10.050] – Ludmila Nunes

Should be a chance. Yes, this is Ludmila Nunes with APS, and I've been speaking to Irene Pepperberg from Boston University and pioneer researcher on birth cognition.

[00:27:24.160] – Irene Pepperberg

Thank you so much for the interview and this has been really fun.

[00:27:27.930] – Ludmila Nunes

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