PLOS Science Wednesday: Hi! I'm Corina Logan here to talk about my research on animal cognition, specifically how birds are able to adapt their behaviors to different situations — AMA!

PLOSScienceWednesday [1] and r/Science AMAs[1]

[1]Affiliation not available

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Abstract

Hi Reddit, My name is Corina Logan and I am a Leverhulme Early Career Research Fellow at the University of Cambridge. I study behavioral flexibility in birds: their ability to adapt their behavior to changing circumstances. I recently published a study titled "Modifications to the Aesop's Fable paradigm change performances in New Caledonian crows" in PLOS ONE. My colleagues and I set out to understand how New Caledonian crows solve novel foraging problems involving a clear tube that is partially filled with water and contains a floating food reward. Dropping objects into the water to raise the water level and bring the food within reach solves the problem. We found that crows can discriminate between water volumes: they dropped more objects into the narrower tube rather than the wider tube when the initial water levels were the same in both tubes, and they switched their preference later when the wide tube became the functional option. Also, one crow appeared to inhibit attention to causal cues to learn to associate the color of one tube with receiving food in its adjacent tube. I will be available to answer your questions at 1pm ET (10am PT, 6pm GMT) so Ask me Anything! And don't forget to follow me (and the birds!) on Twitter @LoganCorina.

the WINNOWER

REDDIT

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PLOSSCIENCEWEDNESDAY R/SCIENCE

ABSTRACT

Hi Reddit,
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In this age of funding cuts and applied science, how hard is it to get funding for bird behavior research? Can you get funded for basic research, or do you have to add 'spin' about its relevance to human neurology to get funding?

Frogophile
It's pretty difficult. Many senior researchers who have long-term and extremely valuable field sites studying behavior in birds and mammals are on the brink of shutting down because the National Science Foundation (NSF) in the US is giving less and less money to less people. I tend to pitch grant proposals focused on basic research without an applied angle, but with some kind of relevance with regard to what it might tell us about humans in a comparative sense. I just spent a few years in academia in the US after doing my PhD in Europe (and now I have returned to Europe) and I would say it is more difficult to get research funding for animal behavior/cognition in the US primarily because there are less opportunities to apply for at the federal and state level. It's basically NSF and NIH and my work doesn't fit NIH so that leaves only one pot of money to apply for. In Europe, there are many funding agencies to apply to, which increases one's chance of success. I keep getting rejected from the NSF and when I get the reviews back, it looks like they wanted me to have already done the project I am proposing so it is a safe bet. In Europe, there is a wider range of funding agencies and some prefer to fund risky projects. I'm glad I'm in Europe right now so I have a better chance of getting funding to keep my bird research going.

What sparked your interest in this field ? Also what is the most creative/intelligent thing you've seen a bird do?

justanotherepic

I've always thought that humans didn't give other species enough credit for their intelligence (and that we over-credit ourselves with this trait!), so when I was applying for PhD programs and ended up with the opportunity to work in Nicky Clayton's lab I jumped at the chance. Her creativity in designing experiments unlocked the field of comparative cognition in the 1990s, especially for cognitive abilities like future planning and episodic-like memory. Spending 3 years in her lab immersed in comparative cognition got me hooked!

I had seen lots of videos of New Caledonian crows using tools, but when I went to New Caledonia to study the crows and ran an experiment involving tool use, the first time I saw a crow actually pick up a stick from the table, insert it into the box and get the food out I was absolutely amazed. I had a permanent smile on my face for the rest of the day. It was the first trial and the bird just went about its business as if this was normal, even though it was a new apparatus and I provided an unnatural stick. These birds are so amazing and I am very lucky to have had the chance to experience them first hand.

Large social groups and complex social systems have previously been associated with large brain size and enhanced cognitive capacity. In your experience, is this something that you agree with in New Caledonian crows and if not, why? On a similar note - have you looked at whether an individual can solve floating water problems after observing another successfully solving the problem? And do you notice consistent behavioural variation in individual crows ability/speed to solve problems?

heurippa

Some mammalian studies report that group size correlates with relative brain size (corrected for body size), however other studies do not show such a correlation. It doesn't hold up in birds because most bird species are monogamous (whereas most mammals are not, see Lukas & Clutton-Brock 2013 Science), which makes for one high quality social bond that may select for more complex cognition, which Emery and colleagues refer to as "relationship intelligence" (see Emery et al. Phil. Trans. R. Soc. B (2007) 362, 489–505). The New Caledonain crows are monogamous and their offspring live with the parents for a pretty long time for a bird (around a year or so). I agree with Emery and colleagues that needing to maintain a long-term relationship with a mate, as well as care for offspring for an extended period, and negotiate territorial relationships with neighbors could select for enhanced cognitive abilities.

I did expose some New Caledonian crows who did not know how to drop stones down a tube to a knowledgable demonstrator to see if the naive individual would learn (it would save me so much training time!), but it wasn't successful after a few sessions so I stopped trying. Berenika Mioduszewska at the Max Planck Institute for Ornithology explored this in New Caledonian crows in a systematic way. I think she will publish the results soon so keep an eye on her website to see when the research is released (http://www.orn.mpg.de/409970/employee_page?employee_id=26348). I conducted a social learning experiment (not involving a water tube) on the crows to see how they learn about new foraging problems (http://link.springer.com/article/10.3758/s13420-015-0194-x#page-1). They do learn from others, but they don't imitate actions. Given these results, it makes sense that it is difficult to learn to drop stones down tubes using social information when they would need to copy a demonstrator's actions to solve the task.

Anecdotally, there are definitely individual differences in how birds approach a task and interact with it. Some fly straight to the testing table and slam through the experiments quickly, while others seem to walk around a bit and have a look before making decisions. Some are picky about when they feel like participating, and others want to participate all the time (it was difficult to keep 007 and Kitty out of the

testing room). In terms of the results in the PLOS ONE paper, Buster seemed to arrive at the correct choice early and then stick with it. Lady also leaned in this direction. It may be because they were the only adults (perhaps more life experience makes you smarter?), but the sample size was too small for me to run analyses to find out.

Thanks Dr. Logan for sharing your work with us!

So often we hear headlines that make very broad sweeping statements and then when you inspect closely the results and context are actually very narrow. Can you explain the process and philosophy of translating from results of a controlled and specific behavioral experiment to general and slippery concepts like cognition and intelligence?

Relatedly, what do you wish the media would get right about your research or field or stop saying?

Thanks!

Jobediah
You're welcome! It's a pleasure to be here!

The scientific method is actually a great way of placing results in context, if used properly. At the risk of sounding too basic, I'll reiterate it here: hypotheses are generated in advance and experiments are then designed to test the hypothesis. The hypothesis sets the stage for the predicted outcomes by placing the results in a broader context, so that when the results are obtained, what they mean makes sense. There are usually interesting side results or unexpected results that serve as a starting point for future hypotheses/experiments (note that these "interesting side results" usually happen because the bird did the one thing that would mess up your experiment because you didn't realize it could be solved that way…). In terms of interpreting cognitive results specifically, comparative cognition is a tricky field because we usually use behavior to make inferences about cognition without actually looking at brain activity. It's better to err on the conservative side and not over-interpret results, however there is a lot of pressure to publish in high impact journals, which usually want results that are of broad interest. Hence the general trend to over-interpret results.

I agree that complex cognition and intelligence are difficult to study - neither have very solid definitions and without these how can we compare anything? I'm working on a paper related to this topic with two philosophers of science, Irina Mikhalevich and Russell Powell, where we are defining cognition, complex cognition, and behavioral flexibility. Philosophers have very different training from biologists/psychologists and I am so impressed by their way of building arguments. I'm excited to share more about this paper when it is done (working on it now so hopefully we can submit it soon!).

I wish the media would lose interest in comparing everything with humans. Findings about non-human cognition are interesting in and of themselves for reasons related to the life history of the species under study.

These are some incredible results! This behavior reminds me of a Corvid study where Blue Jays were, unintentionally, found to dip their cage paper in their water and use the wet material to reach out of the cage, to where food *had been*, and dab up food crumbs. This level of understanding of the world astounds me. Their ability to grasp time in a seemingly (knowing they will be rewarded once completing a series of complex tasks, even in the case of no clear human-made reward), really seems to suggest human or at least ape level cognition. My question: What is your definition of human level of sentience, if unique, what makes it unique? If having the same kind of body with thumbs and consonants, would corvids be in a similar position? How might you rate Corvid vs Sea Mammal vs Human consciousness or is this something that cannot be linearly measured, in your opinion? Thank you for taking your time to

address the Reddit community r/science is very grateful!

joshuaseckler
Thanks! These are some incredible birds! And you are welcome! I'm glad to be here :)

I hadn't heard of the blue jay crumb collecting behavior you mentioned. Could you point me in the direction of the authors/publication? Yes, the corvids have been called "feathered apes" by Nicky Clayton and Nathan Emery because they perform similarly on tests as chimpanzees and other great apes. In fact, the best evidence we have so far of a non-human possessing theory of mind (the ability to put yourself in someone else's shoes) comes from Western scrub-jays (work by Nicky Clayton and colleagues).

I don't have a definition of sentience or consciousness, but I don't think humans are as unique in terms of cognition as we think we are. One reason is because we like to claim that humans are better than non-humans at ability X when X has not been measured in humans and non-humans in the same way or it hasn't even been measured in humans yet so how can we compare at all? For example, last year I wrote an opinion piece on progress in the field of mental time travel: the ability to imagine yourself in the past (episodic memory) and future (http://journal.frontiersin.org/article/10.3389/fpsyg.2014.00305/full). I set out to scour the human literature to find the brain regions that are associated with imagination in humans so I could then suggest that we explore those areas in non-humans on the same tasks, but it turns out that we don't know what brain regions are responsible for imagination (specifically with regard to episodic memory and future planning). I was shocked because I had taken for granted that we knew enough about humans to actually make comparisons with other species. There is some exciting new research showing that rats do imagine themselves with regard to mental time travel (I discuss it in the opinion piece) and I think I just heard about something similar coming out on humans, so progress is being made, but assumptions still dominate.

I don't think I can compare corvids with sea mammals with humans because they are adapted to very different ways of living. If species across these taxa are given the same tasks it would be difficult to determine whether their failures or successes on cognitive tasks was related to their life history differences, which may have resulted in their understanding (or not) the question the task is asking. Making tasks ecologically relevant to each species being tested is crucial for understanding their cognitive abilities, but it makes it difficult to compare species when testing each on their own apparatus. These are the kinds of issues comparative cognition scientists deal with all of the time and, for myself, sometimes I choose an apparatus that is a bit ecologically irrelevant for the sake of comparison, and sometimes I try to tailor the apparatus to what I think the species can do based on what I observe them doing in the wild. It generally depends on the question I am interested in.

Hello Dr Logan!

I'd like to ask your opinion on the recent research regarding the relationship between innovation, cognition and motor diversity. Recent work by Griffin et al. has suggested that motor diversity may act as a significant predictor of foraging innovation, and that the relationship between cognition and innovation may not be as clear as originally thought. How has your own work shaped your thinking on this issue?

Thanks for doing this AMA!

Ratmonger
No problem! It's fun to experience interacting with people in a forum setting!

Your question is so directly relevant to a paper I have in review that I can't directly answer it based on my results until it comes out (I'll post news of its release on twitter if you are interested @LoganCorina). But I can say that based on a literature review I include in the paper, every study that

has directly tested behavioral flexibility in species that differ in relative brain size and/or innovation frequency using the same tests has at least one result that goes against the prediction that these three factors are positively correlated. It appears that we don't actually know what innovation frequency measures - it doesn't measure behavioral flexibility, which is what it was originally thought to be a proxy of.

Now I need to say that innovation frequency is different from innovativeness. Innovation frequency counts the number of novel foraging techniques used and novel food types eaten per species based on anecdotal reports in the literature, and was developed to facilitate broad, cross-species comparisons by serving as a proxy for behavioral flexibility and complex cognition (via relative brain size). Innovativeness, like what Griffin and colleagues study, is measured experimentally in individuals, as are the other factors it is being compared with (e.g., neophobia, problem solving, etc.), which allows one to make broader conclusions based on direct data from the ground up. The research on innovativeness is giving us an idea of the mechanisms underlying this behavior, and motor diversity certainly seems like it plays a role. I am looking forward to exploring this with my grackles!

Has the behavior, language, and social interactions of the same species of crow been compared across separated areas? What I'm curious about is whether we know how much of their behavior is learned from the previous generation, and how much is instinctual, and if it is learned, whether there are different crow 'cultures' across the same species, in different areas of the world.

I've heard people saying crows can recognize faces, and some say they can then communicate about who is a threat to other crows. Is this true in that the second crow would have a chance of recognizing the threatening person just from the first crow's 'description' or is it only learned by having the first crow there to show, either through action or calls, that a person is trouble?

Shiladie
The New Caledonian crows are particularly interesting in terms of this question because it is hypothesized that they might have cumulative technological culture: they make and use tools and tool shapes vary across the island, which might indicate that the tool shapes themselves evolve as they are passed on from generation to generation. I set up an experiment to test how they learn about new problems to see if this hypothesis is plausible and the paper was just published last week: http://link.springer.com/article/10.3758/s13420-015-0194-x#page-1

John Marzluff at the University of Washington did the crow facial recognition study where baby crows in the nest saw their parents mob a person with the threatening mask and then a year later, after one of the babies had left the nest went off on its own, John approached it while wearing the threatening mask and the crow mobbed it. So the juvenile didn't learn from a description of the mask from the parents, but from having watched its parents mob the mask.

How unique are crow's cognitive abilities among other birds? I know there have been studies looking at language with some birds like African Greys, but how do the problem solving abilities of crows compare to other birds? And if crows are unique in their intelligence, what is it about them that led to their intelligence?

kerovon
Parrots are being tested by Alice Auerspeg and colleagues and they are finding these birds very capable of complex cognition. I think the reason we know more about the cognitive abilities of corvids and parrots is that these bird taxa have larger relative brain sizes than other bird taxa. Since there is a tendency to think that only large brained species are capable of complex cognition, if one wants to find complex cognition, the larger brained species are the ones that should give positive results so they are the ones that are tested. However, the few smaller brained species that have been tested in a

comparative cognition context often do really well (see Sabine Tebbich's research on Darwin's finches). Once we have more data on the smaller brained species, we will be better able to answer questions like this.

Have there been any comparative studies with humans performing the same task?

busterfixxitt
Thanks for answering the earlier question for me! There was a study by Cheke and colleagues that compared water tube performance on the same tests in Eurasian jays and children: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0040574.

Welcome to /r/science,

What questions would you like to answer about crow behavior that have come about because of your current research?

Thank you!

adenovato
Thanks for the welcome! It's my first time here :)

Working with the crows got me really interested in great-tailed grackle behavior. Grackles are an invasive, urban bird in the Americas and I set up a field site in Santa Barbara, California to study them (I was in the middle of setting it up when I went to New Caledonia to study the crows). Both species are behaviorally flexible, but the grackles have a much smaller brain for their body size. We usually think "intelligence" only occurs in large-brained species, so this got me wondering how the grackles are able to be so behaviorally flexible. What are the mechanisms of behavioral flexibility and what kinds of cognitive abilities are involved?

Thanks for doing this AMA and congrats on your fellowship!

I have some questions-

Does it seem likely to you that the independent but closely comparable evolution of something resembling the frontal lobes in higher mammals and corvids reflects a response to near identical environmental demands? Is it likely that the differences in anatomical organisation reflect any differences in environmental demands? Does the similarity in evolution of a frontal lobe indicate that this is the most efficient (or only plausible?) way of supporting higher cognitive abilities in your opinion?

On a related note, does it seem likely that similar neural mechanisms are solving cognitive problems in both corvids and higher mammals? Is this something you'd be interested in investigating at some point?

Thanks very much for any of these you get round to addressing!

TypeToken
Thank you for the congrats!

It looks like similar neural mechanisms are being used in birds (not just corvids) and mammals (not just "higher", which is an out of date term based on a ladder-like approach to evolution rather than each species being at the front of their own line of evolution) because of some recent research led by Erich Jarvis: http://www.sciencemag.org/content/346/6215/1256846.full, http://onlinelibrary.wiley.com/doi/10.1002/cne.23404/full. I think the environment plays a role in the

development of complex cognition and that this is related to neuroanatomy, however I need to be elusive about the details because this is a paper that is in preparation at the moment. Lots more to come on this front though so check for news on twitter (@LoganCorina) if you want to get updates. What is becoming clear though is that small brains that seemingly lack the neuroanatomy for complex cognition can perform well on cognitive tasks. See Chittka and Niven (Are bigger brains better? Current Biology 19, R995-R1008) for lots more on this. Right now is an exciting time because the more species we test that are not predicted to have complex cognition, the more entrenched ideas are overturned!