

Why Evolution Is True

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Sex versus sociality: cooperative breeding in birds

A new paper in *Nature* on bird reproduction ends with this provocative quote from E. O. Wilson's *Sociobiology*: "sex is an antisocial force in evolution." What does that mean? In the case of cooperatively breeding birds, the subject of the report by Charlie Cornwallis et al., it means that the cooperation between parents and their offspring is endangered if the parents have too much sex.

Cooperative breeding is the phenomenon whereby offspring help their parents have more offspring. In birds, the young will hang around at the nest and, rather than reproduce themselves, help their parents raise the next brood. The classic example is the Florida scrub jay (*Aphelocoma coerulescens*), but it's estimated to occur in about 10% of all bird species.

It would seem to defy evolutionary sense to sacrifice your own reproduction to help your parents, but it may not. After all, a young bird is related by exactly as much to its own offspring as to the brothers and sisters that it could help its parents to raise: in both cases there is sharing of 50% of one's genes. Any gene, then that promotes this behavior—*do not reproduce yourself but help your parents raise more brothers and sisters*—won't necessarily be at a disadvantage. Indeed, if there's a problem with you being able to reproduce personally, such as your having to first learn the ropes about how to tend broods, or your inability to gain a breeding territory since the area is full of other birds, the evolutionary balance may be tipped in favor of your deferring reproduction while you stay at home for a while, but still passing on your genes by helping mom and dad.

Cooperative breeding is a case of *kin selection*: animals exercising "altruism" (deferral or absence of reproduction) towards close relatives as a way of passing on their own genes. Kin selection is also the classic explanation for another very famous case of cooperative breeding: the sterile workers in social insects like ants and bees. In this case, because males are haploid, if the queen mates only once it may be genetically advantageous for a worker to produce more sisters, with whom she shares three-quarters of her genes, than to produce her own offspring, with whom she shares only half of her genes. This genetic explanation for sterile workers is controversial, but I won't go into that now.

Now the kin-selection explanation for cooperative breeding in birds (and social insects) breaks down if the female parent is "promiscuous", that is, mates more than once. If, after producing you, your mother then mates with a male who is not your own father, then your relatedness to her offspring drops from 50% to 25%. In that case you'd share more genes with your own offspring than with your potential brothers and sisters, and so it's not such a good idea, evolutionarily speaking, to defer your own reproduction and help mom and dad. The evolution of cooperative breeding, then, is hindered if females are promiscuous, and you'd expect to see that phenomenon less often in promiscuous than in monogamous species.

That leads to the paper of Cornwallis et al., which is based on this prediction. The authors analyzed 267 bird species for which there was information about cooperative breeding, promiscuity of females, and their position in the phylogenetic tree of birds. There's a lot of new information about promiscuity (or "extra-pair fertilization"—EPF) from DNA-based or other genetic evidence. It shows that birds are committing adultery all over the place: roughly *three-quarters* of bird species that *appear* monogamous because they breed in pairs ("social monogamy") are actually promiscuous to some degree.

Correlating the data on cooperative breeding with that on promiscuity (and controlling the whole lot with the phylogeny), Cornwallis et al. showed the following:

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- The level of promiscuity (that is, the number of broods containing at least “illegal” chick) was much lower in cooperatively breeding (about 12%) than in non cooperatively breeding species (about 24%).
- There was a significant negative relationship among species between levels of promiscuity and percentage of nests having cooperative breeders. In other words, those species that had very promiscuous females showed virtually no nests with cooperative breeding.

These might be taken as verifications of the prediction, but there’s a problem with that. Suppose that cooperative breeders formed a fairly closely related group, and the non-cooperative breeders another closely related group. Then the data points from the different species would not be independent: if promiscuity had evolved only once, on the branch separating these species, and likewise cooperative breeding (on the nonpromiscuous branch), your correlation among species would reflect only this single evolutionary branching. But Cornwallis wanted to see if there was a *recurrent evolutionary pattern* of cooperative breeding being associated with evolutionary decreases of promiscuity (and the converse). So they looked at the data using the evolutionary tree, which tells you about when these events took place. Doing this, they found that

- There was still a very strong negative correlation between the evolution of cooperative breeding and the evolution of promiscuity.
- Looking at those species that had evolved cooperative breeding from non-cooperative ancestors, those ancestors were less promiscuous than the non-cooperative ancestors of non-cooperative descendants. In other words, if you’re a non-cooperative species, you’re more likely to evolve cooperative breeding if you’re not too promiscuous.
- There was some suggestion (though it wasn’t statistically significant) that, if you look at cooperative ancestors, those that produced non-cooperative descendants were more promiscuous than those that produced only non-cooperative descendants.

On the whole, these data provide pretty strong support for the idea that cooperative breeding is more likely to evolve when females mate with fewer males. This verifies the kin-selection prediction that cooperative behaviors are favored when you are more related to those you help. It’s a nice piece of work. I’m a bit worried about reconstructing the level of promiscuity in ancestors (something that’s derived from inferences based on living species), which is problematic if the characters change too often; and there’s a potentially confounding factor if the degree of promiscuity is related to the likelihood of forming new species (which is plausible). Nevertheless, the paper gives some intriguing data supporting social evolution via kin selection, and, apart from the evolution of paternal/maternal behavior itself, we don’t have a lot of that kind of data.

C. K. Cornwallis, S. A. West, K. E. Davis, and A. S. Griffin. 2010. [Promiscuity and the evolutionary transition to complex societies](#). *Nature* 466:969-972.

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This entry was written by [whyevolutionistrue](#) and posted on August 19, 2010 at 9:51 am and filed under [Articles](#), [animals](#), [evolution](#). Bookmark the [permalink](#). Follow any comments here with the [RSS feed](#) for this post. Post a comment or leave a [trackback](#): [Trackback URL](#).

22 Comments



Ken Pidcock

Posted August 19, 2010 at 11:07 am | [Permalink](#)

At the risk of appearing sycophantic, I have to say what a great pleasure it always is to witness Jerry Coyne's facility with explanation.

Reply



Torbjörn Larsson, OM

Posted August 19, 2010 at 1:26 pm | [Permalink](#)

If you say that it isn't beyond our ken, I have to agree!

[To not appear too sycophantic, I will throw in that, as a visually oriented person, I enjoy Myers' biology posts more, because he almost always chose a central image. But I can get with both styles.]

Reply



GM

Posted August 19, 2010 at 11:28 am | [Permalink](#)

I see that Dr. Coyne left out the authors association of "kin discrimination" and variation in relatedness between older siblings vs new broods. This relationship was indeed significant, but seemingly more suspect than assigning levels of ancestral promiscuity.

Reply



articulett

Posted August 19, 2010 at 10:27 pm | [Permalink](#)

I don't have access to the article. were more related siblings more cooperative? That is, did there seem to be some "recognition" of relatedness? I think that would be hard to measure, but it would be interesting to hone in on what they might be recognizing.

Reply



Marella

Posted August 20, 2010 at 12:52 am | [Permalink](#)

'Home in', not 'hone in'. Hone means sharpen, it is done to knives and other edges.

Reply



articulett

Posted August 20, 2010 at 3:43 am | [Permalink](#)

Yes, thanks for the correction.

Reply



Notagod

Posted August 20, 2010 at 10:26 am | [Permalink](#)

Marijuana hones the senses 😊

Reply



GM

Posted August 20, 2010 at 11:43 am | [Permalink](#)

As far as kin recognition, the authors contended that in species with high promiscuity and low promiscuity, that there would be little variation in relatedness between siblings and new broods. However, if there was a medium amount of promiscuity, that meant that new broods may share a bunch of full siblings or a bunch of half sibs or possibly non-sibs. The authors reasoned that in this middle ground there should be selection for individuals who can discriminate between highly related kin. The authors tested this with a quadratic relationship which was missing data points for a large range of relatedness values. If you want to access the paper, Stu West usually posts free PDF's of his papers on his website.

[Reply](#)



What a maroon

Posted August 19, 2010 at 2:46 pm | [Permalink](#)

"...it means that the cooperation between parents and their offspring is endangered if the parents have too much sex."

It sounds like the issue is not having too much sex, but rather having sex with too many partners. And furthermore, it's really only an issue if the mother has too many partners, not the father.

[Reply](#)



Torbjörn Larsson, OM

Posted August 19, 2010 at 4:03 pm | [Permalink](#)

Cheat, Play, Love?

[Reply](#)



Dave

Posted August 19, 2010 at 3:38 pm | [Permalink](#)

Nothing to do with this article, but Glenn Beck just called Charles Darwin the "Father of Racism." I'd love to hear Dr. Coyne respond to this lunatic. I now have a migraine.

[Reply](#)



Ken Pidcock

Posted August 19, 2010 at 5:17 pm | [Permalink](#)

Right era, wrong guy. He was probably thinking of Joseph Smith.

[Reply](#)



Notagod

Posted August 20, 2010 at 10:32 am | [Permalink](#)

Mormons: I don't know how anyone could think that mormons are racist, it was god what done it!

[Reply](#)



Insightful Ape

Posted August 19, 2010 at 6:06 pm | [Permalink](#)

I have to say I am suprised. Mormons are not supposed to have a problem with evolution. Apart from their theology, that is considered to be the only thing distinguishing them from

fundamentalist Protestants.

Reply



Notagod

Posted August 20, 2010 at 10:36 am | [Permalink](#)

Is the biology department still the bastard child at BeWhyYou?

Reply

5.



Insightful Ape

Posted August 19, 2010 at 6:03 pm | [Permalink](#)

Translation for sexual conservatives: don't have sex outside marriage, but ask your adult children to stay in your basement and help out as you have more babies.

Did I get that right, Ms Palin?

Reply

6.



Ysor

Posted August 20, 2010 at 9:45 am | [Permalink](#)

"After all, a young bird is related by exactly as much to its own offspring as to the brothers and sisters that it could help its parents to raise: in both cases there is sharing of 50% of one's genes."

Would someone please explain how siblings necessarily share 50% of their genes?

I can think of scenario where two siblings may not share any gene at all. Consider a case in which: for every gene of a diploid species, there are at least 4 alleles. The parent individuals have totally distinct, non-overlapping sets of alleles. For every gene, let's arbitrarily label those alleles as M1, M2, P1, and P2 (M for maternal, and P for paternal). It is possible for these parent individuals to have two offsprings which share 0% of their genes. For example, offspring1 will have all M1 and P1 alleles, and offspring2 will have all M2 and P2 alleles.

I know the scenario above is highly hypothetical. However, I could not spot any flaw in my reasoning. More importantly, I could not arrive at the 50% figure.

Reply



whyevolutionistrue

Posted August 20, 2010 at 10:18 am | [Permalink](#)

A good question. Yes, it is possible that offspring might share no genes, so your idea is correct. In practice, however, given a reasonable number of independently assorting chromosomes, and with some recombination, that chance is very very small. The main point, though, is that an allele coding for a certain behavior will be selected against the AVERAGE genetic background in which it finds itself, and that background is one in which 50% of the genes are shared with siblings.

Reply



astrokid.nj

Posted August 20, 2010 at 12:49 pm | [Permalink](#)

1) Thank you for asking this question. I was wondering the same, and not knowing much of biology, I started reading up wikipedia articles about genetics.. but didnt get very far. I need to grab some introductory book on

genetics someday.. I was thinking 'The Selfish Gene'?

2) By any chance, do we know if 'promiscuity' in birds is controlled by specific (i.e identified) genes?

3) As an aside, Why is there no brooding/subsequent child-feeding amongst reptiles? Is there some advance in bird eggs? I mean..birds have a "longer childhood" than reptiles (which are ready to face the world on their own right out of the egg).. what is it.. is there a larger brain?

Reply



astrokid.nj

Posted August 20, 2010 at 1:19 pm | [Permalink](#)

Re: 3.. Hmm.. Is it that the wing-muscles need development time?

Reply



Torbjörn Larsson, OM

Posted August 20, 2010 at 1:34 pm | [Permalink](#)

While we wait for the biologists, I see that Linnean class Reptilia contains Crocodylia, where you can see brooding behavior in the assistance sense. (Wikipedia on alligators, say: "The mother will defend the nest from predators and will assist the hatchlings to water. She will provide protection to the young for about a year if they remain in the area.")

The general behavior ability goes back to fishes, I think (ref cichlids, hiding broods in mouths et cetera).

Reply



Torbjörn Larsson, OM

Posted August 20, 2010 at 1:38 pm | [Permalink](#)

D'oh! "goes back to fishes" but modern ones.

So "expands cladistically out to fishes" perhaps.

Reply

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1. By [Mr. Topp and the Big Bad Blog](#) » [The morning coffee on sex](#) on August 22, 2010 at 11:11 pm

[...] excuse for the 30-year-old living in his parents' basement? Perhaps. Some birds exhibit cooperative breeding, in which the children remain in the nest to help the parents raise more [...]

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