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Bee Bullies

What the impact of aggression on brain chemistry can tell us about social rank

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While a graduate student in zoology at UNH, Jacob Withee '16G studied the effects of aggression on the social behavior of *Ceratina calcurata*, commonly known as small carpenter bees.

Withee's work, which was recently published in the journal Integrative and Comparative Biology, adds valuable insight into the role of aggression in the development of dominance hierarchies and how brain chemistry can be the difference between winners and losers.

Withee recently spoke about what he's learned, his fascination

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with animal behavior and (very) bad bee puns.

COLSA: Let's begin with a summary of what you discovered in your research.

Jake Withee: To boil it way, way down, we found that aggression and dominant-subordinate interactions can have longer-term effects on behavior and thus hypothesize that aggression may be a huge driver of the transition to more complex social systems.

COLSA: Why is this research important?

Withee: Sociality is the basis for society — it's right there in the name! So, there's plenty of reason to be interested in how animals evolved to become social in the first place. And when we look at the most complex social systems on the planet, it becomes even more fascinating to ask how animals can evolve from simply being social at all to having a whole hierarchical system of castes and whatnot. It's one of the major evolutionary transitions of life on Earth, so it's worth understanding.

COLSA: Does this mean that a certain amount of aggression is necessary for more simple social systems to evolve?

Withee: Cooperation is still the most critical aspect of forming social relationships in the first place — if two individuals can't get along, they're not going to live together. It's the elaboration of those simple groups into more complex social systems which, we hypothesize, requires aggression. The standing theory is that cooperation is enough to explain this change, but we disagree,

and to those who have a problem with that, we have some bees to show you.

COLSA: Why did bees make a good subject?

Withee: If you want to study the evolution of sociality, you need a model organism that has interesting social behavior but that also has close relatives with a broad array of different types of social organization. This allows you to compare between related species and make some amount of inference about evolutionary changes in the past. The more closely related they are, the more recent their common ancestor.

Hymenopterans (ants, wasps, hornets and bees) have some of the most complex social behavior (eusociality – a reproductive queen with non-reproductive workers), but only bees really exemplify every single level of sociality, from totally solitary on upward. The particular species I studied, *Ceratina calcurata*, is cool particularly for studying the evolutionary origins of social behavior because it has a very simple form of social living, with precursors for something much more complex.

"I think that the biggest thing people ought to know about bees is that they really need our help, and that helping can be as simple as creating a little bit of habitat in your yard."

COLSA: While doing your research, did you learn anything that surprised you? If so, what?

Withee*: Most* of what I learned in my research surprised me. For example, did you know that bees can be *green*? But a lot of the biggest surprises came from the general background information I learned in the beginning: There are over 20,000 bee species in the world, 4,000 of which are in North America and at least 200 of which are in New Hampshire, and most bee species are solitary.

COLSA: What is one thing most people don't know about bees that they should?

Withee: I think that the biggest thing people ought to know about bees is that they really need our help, and that helping can be as simple as creating a little bit of habitat in your yard. I expanded on this in detail a couple of years ago, too. I basically never shut up about it.

Also, many people think that any talk of bees refers specifically to honeybees. Honeybees are not native to North America, and in a lot of ways, they harm the native species here. They are a domesticated species, but they largely act as an invasive species. Every campaign to "save the bees" suggests that honeybees are the ones we need to save, but they are generally doing fine and exclusively helping *them* puts the native population even *more* at risk.

COLSA: Let's change gears for a minute. Of these bee puns, which is your favorite? Beauty is in the eye of the bee-holder; bee puns really sting; to bee or not to bee; or we were always meant to bee?

Withee: Of those puns, I'll go with "Beauty is in the eye of the bee-holder." There is also a box of terrible bee puns in the lab in Spaulding, which we had to create to keep folks from saying them out loud all the time.

COLSA: Was bee-pun overuse ever cause for aggression inside the lab?

Withee: Well, Sean Lombard '17 hasn't shown his face in quite some time, so you tell me. OK, he graduated in May. But, still!

COLSA: Finally, what's next for this area of research?

Withee: I very much hope that others will use my results as a stepping-off point for further investigation, both into what genes

are involved in aggressive behavior and how these behaviors may have shaped social structures across evolutionary time. I'm excited to see where it goes.

Read more about Withee's research in an earlier article published in Behaviour. The full text is available on Sandra Rehan's bee lab website.

WRITTEN BY: Sarah Schaier | College of Life Sciences and Agriculture

PHOTOGRAPHER: Scott Ripley | Communications and Public Affairs | scott.ripley@unh.edu | 603-862-1855

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