Taking care of our children seems like the most natural reflex. For humans and many other animals, so it is. The cuddling, feeding, diaper changing, baseball-throwing-lessons, and pushes to study for college entrance exams comes so automatically, that some might be surprised to reflect that these barely conscious behaviors have genetic underpinnings. Put another way, we do not do them because we want to. We do them because we are made that way.

While human social interactions are of near-bewildering complexity (and a long way from being satisfactorily understood) simpler models exist which could lay the foundation for a better understanding of sociality.

Consider the curious example of the burying beetle (Nicrophorus vespilloides). This type of carrion beetle bury the carcasses of small animals, such as mice or birds, as food for their larvae. Both males and females will care for young.

Now, a group of biologists centered at the University of Georgia has made a start at picking apart the mechanism for this behavior. To start, they have analyzed the genome and methylome of N. vespilloides, presenting their work in a recent issue of Genome Biology and Evolution.

To date, honey bees, ants, termites, and other eusocial insects (hailing primarily from Hymenoptera) have been front and center of most studies of sociality in insects. The information collected by Chris Cunningham, Allen Moore and their colleagues (2015) may help change that.

"This might be a better model for vertebrate behaviors [than honey bees]," explains Cunningham. While behavioral changes in Hymenopterans tend to be tied to developmental changes, parenting behavior in burying beetles seems to have an on-off switch.

"If you took one of the burying beetles and you put a larvae in front of it, it would eat it, which is bad parenting," says Moore in the understatement of the year. "So something switches in them to make them a parent."

The way to prime the beetles for parenting is simple. "Give the beetles a dead mouse," Moore continues, "and 48 hours later they'll parent anything you put in front of them" – even larvae of different species – “they’re not particular.”

The beetles lay eggs beside the dead carcass (after hatching the larva crawl into it). The parents protect the carcass against decay by laying down chemicals to stem fungal and microbial growth. Once hatched, larvae wave their limbs at the adults (presumably to catch their attention) and the beetles feed them by regurgitating food into their mouths.

“You really have the insect equivalent of a bird, but parental care lasts for about two or three days, which is about my attention span, so it’s much better than a bird,” says Moore with a laugh.

A few days later, put a larva in front of those same beetles, and they will make a snack out of it.

What is changed in this time? Obviously not their genome. Could it perhaps be the methylome? Methylation is a well-known way to make epigenetic changes of the genome that last only as long as they are needed.

Prior to the team’s sequencing of N. vespilloides, only one other beetle’s genome had been sequenced and published (Tribolium castaneum) and it seemed to lack methylation. Thus, it had been assumed that methylation was not present in beetles at all.

"That’s quite a thing to say because there are over a million beetles and only one had been looked at," says Cunningham. Still, when the team did find evidence for methylation it was an enjoyable surprise.

This was also a key point of intrigue for Rebecca Kilner, a professor of Evolutionary Biology at the University of Cambridge. "DNA methylation might therefore be a common genomic feature of social insects because it facilitates the transition between behavioral castes (or task specialization) which these insects have in common.”

Evaluating how the beetles are using methylation is the next clear step says Cunningham. “I’m now trying to see if they use it in the way honeybees do, to regulate gene expression.” But he says the fact that the switch in beetle behavior is not developmentally coupled makes it especially fascinating for him.
Moore says his ultimate goal is to find the genes responsible for social interaction. “What makes an organism socially compatible?” he wonders. After all, most organisms in the world do not like being around others. “Put two of them together they either run away or they fight. So, what is it that leads to social tolerance? Or if you put a larva in front of a beetle, why should it take care of it instead of eating it?”

He even wonders if the genes involved in this are common across all social organisms, beetles, bees, birds, and humans included.

By laying out this organism’s genome and methylome, his lab is paving the way for many more investigations. In particular, researchers can start asking how cues generate varied gene expression and how that, in turn, leads to the wide panoply of behaviors that determine how we conduct ourselves, how we approach mates and how we keep our children alive.

**Literature Cited**

Cunningham, et al. (2015). The Genome and Methylome of a Beetle with Complex Social Behavior, *Nicrophorus vespilloides* (Coleoptera: Silphidae). *Genome Biol Evol.* 7:3383–3396.

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