

'Taking out the bins': lessons from our Hymenopteran cousins

As a child of divorced and remarried parents, there has been no shortage of familial disagreements in our households. One of the biggest causes of arguments is who does the chores? Divorce changes humans' views of family but the insect world also has different types of family and I think that my metaphorical essay will make both issues slightly simpler to understand! This article can help children like me win those arguments - using as evidence, the family structures of particular insects (hymenopterans) and kin selection theory, to help rationalise this common problem. It might also unpick some of the complexities of hymenopteran societies within social insect biology which is an important contributor to other aspects of sociobiology.

First things first: the differences between humans and insects. Humans are diploid, which means that men and women have two full sets of chromosomes (23 pairs to be exact). Hymenopterans, one of the largest orders of insects, which includes the highly social group of ants, bees and wasps, are haplodiploid. If we use the example of the ant, it means that whilst female ants have the usual two full sets of chromosomes, male ants have only one set. This is called "haplodiploidy" and is one of the most important things to understand about ant (and all other hymenopteran) genetics.

Daughter ants - like their mothers - are diploid, coming from fertilised eggs and a 50:50 mix of their mother and father, inheriting equal numbers of chromosomes from both parents. But male ants are trickier (as they are in all species!), they are only descended from their mothers as they come from unfertilised eggs. This means they will develop with half the chromosomes (haploid). So all ant offspring are 50% related to their mothers, but sisters are related to each other even more, by 75% while they are only related by 25% to their brothers. And somewhat tragically, male ants have no fathers.

This is important, because of kin selection theory, which hypothesises that an individual is more likely to help a family member than a stranger, as it brings them benefits since their DNA is at least partially passed on. For example, your grandparents take you out to tea, it is in part because they like you, but also because *you are family*. They are unlikely to take a stranger out...why spend their money on them? But 'blood is thicker than water' and it's in their interest to ensure their children and grandchildren are looked after, and

survive, otherwise the family would die out.

So back to chores. In a “traditional” monogamous family unit, ant sisters help raise each other’s young, as well as their mother’s young; think of it as helping change their nappies. And the female ants are more closely related to their sisters’ sons (as only the queen ant can mate, the majority of ants lay unfertilised eggs that can only develop into sons) than their real brothers - 37.5% as opposed to 25% genetic relatedness. So they are most likely to help their sisters, then their sisters’ sons, and very unlikely to help their brothers as they are far less related. So in this case, you are likely to help your sister unload the dishwasher, and her son, but very unwilling to help your brother! So now I can tell my parents the reason I don’t help my brother is genetic and be sure to win the argument!

Ancestrally, hymenopterans are monogamous, a queen ant will only mate with one male. Monogamy is particularly useful for males in societies, as they can be certain that any offspring are their own. But further down their evolutionary line, some insect females start to discover the benefits of mating with more than one male as the males, desperate to mate, will give her all sorts of bribes to encourage her to select them. Honey bees are good examples of this behaviour.

So, what happens if you have a promiscuous mother? Well, the relatedness between sisters drop further, to 25% (the same as a brother). So this means you will help both your half sisters, and your real brothers equally - and less than you would help your real sister.

Now some insects take promiscuity to even greater levels where colonies have multiple queens and mating males. In this example, it is impossible to know who your full siblings are so you feel no sibling attachment to any of them. In this type of hymenopteran society, females actually kill the eggs their sisters lay, as they now compete for resources (the TV/milk in the fridge) with their own offspring. So whilst I wouldn't go so far as to suggest step-siblings should harm each other, it explains why they are less likely to help each other. Its all in the genes!

Here is a helpful flowchart showing you whether or not you should do chores at home:



