

Mortal combat is the rational choice for wasps

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Males of an unusual group of wasps fight to the death over females, even if they've already mated or are competing with their own brothers, a new study shows. The behaviour was seen in parasitoid wasps, which lay their eggs inside living animals.

The only thing that affects these parasitoids' belligerent ways is how many combatants need to be fought. It seems that when it comes to violent conflict, they have a simple script and stick to it - fight whenever you can.

Most animals don't engage in this kind of mortal combat, because no matter how valuable the resource they're fighting over - usually food or the chance to mate - it's generally not worth risking their lives for.

But males of the parasitoid wasp *Melittobia* engage in exceptionally vicious battles that often end in dismemberment and decapitation. How can this be a sensible risk to take in the great struggle to survive long enough to mate? The answer seems to lie in the unusual situation they find themselves in when looking for mates.



Parasitoid wasp laying eggs in a caterpillar.

'What they are fighting over is incredibly valuable to them, and it makes sense to risk everything to get it.'

Dr Tabitha Innocent

A team of researchers decided to investigate what affects the likelihood of deadly violence in this particular parasitoid family. They put males in enclosed environments and tracked how much they fought after emerging as adults. They varied three factors that theory predicts might influence their violent tendencies - how related the potential combatants were, the absolute number of males available to fight, and the relative value of the mating opportunity being fought over.

Parasitoid wasps lay their eggs inside developing offspring of other insects like caterpillars. These luckless individuals then play host to the brood of larvae growing within them, which eventually emerge to start the cycle again.

Male *Melittobia* wasps develop into adults before females, and are relatively few in number - sometimes as little as five per cent of a brood. They have ferocious scythe-like mandibles and immediately set about each other, puncturing bodies, amputating limbs and even chopping off heads. Losers are killed and even winners often walk away badly wounded.



Male parasitoid wasps fighting

The males are blind and flightless, so they can't get away from the host they are born in, and this turns out to be crucial. 'Because of these wasps' unusual biology, what's at stake in these contests is a male's only chance to mate - its entire lifetime opportunity to reproduce,' says Dr Tabitha Innocent, who led the research while a PhD student at the University of Edinburgh. 'The males emerge first and begin fighting; the male (or males) that make it through this gladiatorial process get to mate with all the females in the local area. So what they are fighting over is incredibly valuable to them, and it makes sense to risk everything to get it.'

The scientists manipulated the value of the mating opportunity being fought over by letting some males mate before the fighting began, reasoning that for a male that has already mated many times, the chance to do so again will be relatively less valuable than it would be for a male that's never mated. The male that's already mated might therefore be less willing to fight for the chance to do so again.

But they found that only the number of opponents makes any difference; the more males in an area, the more lethal fighting goes on. The insects don't seem to be able to recognise their kin, and they still fight just as often and ferociously even with their brothers - opportunities to mate are so scarce that they're always worth risking everything for.

'These males don't seem to carry out any assessment of the costs of fighting,' Innocent says. 'It seems that they have such a small window of time in which to mate, and the number of potential females to mate with is so limited, that it's always worth fighting, even if they're unlikely to win.' She says this supports earlier work by the same group, which showed the wasps' eagerness to fight isn't affected by their opponent's size, even though this affects their chance of winning considerably.

The research helps illuminate the theory of fighting in animals more generally. 'There is massive variation in the extent of violence when males compete in different species of animal,' Innocent explains. 'If the resource being fought over is limited in space and time, you're more likely to get fatal fighting - this is exactly what we see in the parasitoid wasps.'

According to evolutionary theory, what matters is the resource's current value compared to its future value. In animals where costly conflict is limited such as deer, a chance to mate now is valuable, but not as valuable as the total of all future mating opportunities. Stags can always hope to find other females or to mate another year, so it's not worth risking their lives for any particular female. But for these wasps the future value of mating opportunities is very low - males have to mate quickly with as many females as possible, or they'll miss their only chance.

Innocent says the wasps are at the extreme end of the spectrum stretching from extreme violence to peaceful resolution, but understanding their behaviour will provide insights into more typical cases. 'Looking at extremes of conflict and

cooperation really helps us understand how these behaviours evolve,' she observes. 'Fatal fighting is rare, but competition for mates is common across animal species. This research improves our understanding of why this competition varies and what influences how violent these fights become.'

The research is published in *Behavioral Ecology*.

Tabitha M Innocent, Stuart A West, Jennifer L Sanderson, Nita Hyrkkänen and Sarah E Reece. Lethal combat over limited resources: testing the importance of competitors and kin. *Behavioural Ecology*, doi: 10.1093/beheco/arq209

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