Prof. Dr. Michael Boppré
Albert-Ludwigs-Universität
Professur für Forstzoologie
und Entomologie
D-79085 FREIBURG i.Br.
boppre@fzi.uni-freiburg.de

December 5th, 2016

On a current publication on wasp imitation

Wasp mimicry differently explained

A yellow-black insect at the coffee table – "help, a wasp!" But often it is just an innocent hoverfly, unable to sting. It is hard for us to separate these very similar looking insects.

Already at school we have heard that many hoverflies (and other insects) imitate wasps in order to be protected from predators (e.g., birds); these antagonists – so the textbook wisdom goes – learn from painful experience of stinging wasps, after which they avoid similar-looking hoverflies as well as the wasps. Such deception is quite common in the animal world and is called "Batesian mimicry", after the naturalist who proposed the idea, Henry Walter Bates (1825–1892). Also, different species of wasps look alike: a bird (reptile, amphibian) learns to recognise one of several similar-looking species as harmful and all others become equally protected from it. This is termed "Müllerian mimicry" in honour of 'Fritz' Müller (1821/1822–1897). "Müllerian resemblance" would be the more correct term because – in contrast to Batesian mimicry – this is not a case of cheating but one of similarity ("signal standardisation") for mutual benefit. For wasps and their many mimics both Batesian as well as Müllerian mimics often coexist – a local community of such species is called a "mimicry ring".

Thus for more than 150 years "wasp mimicry" seems to have had a good explanation – even though in most cases the mimicry hypotheses have not yet been explicitly supported with empirical evidence, they are, at least, very plausible. Similarity to wasps (as with many other cases of Batesian mimicry) often is not really 'perfect' – there are, in fact, more and less accurate mimics. In theory, this question also seems to be answered – several additional hypotheses have been proposed to explain how "imperfect mimicry" can work well.

Studying biodiversity in the Neotropics, Prof. Dr. Michael Boppré of the Albert-Ludwigs-University in Freiburg, Germany, encountered day-active moths (and other insects) which imitate wasps virtually perfectly: they have a wasp waist and a yellow-black pattern, their wings are transparent and even (as in wasps) folded, their antennae appear just like wasp antennae. In particular when flying, models and mimics are very hard to distinguish, even for trained eyes.

Who is who? A stinging wasp and two harmless day-active moths

Boppré asked himself how such 'perfect' similarity can develop when imperfectness seems sufficient for confusion. Who or what could generate selection that would lead to the evolution of greatest possible accuracy? Boppré's surprisingly simple answer: wasps! Wasps are predators and hunt insects as food for their larvae. Could the mimics, by looking just like wasps, protect themselves not (only) from learning birds and other vertebrate predators but also from attacks by their models, the wasps? By imitating their own enemies could they be mixed-up by the wasps, which innately do not attack their own nest-mates or conspecifics? Instead of signalling to birds that they are wasps (as assumed so far), it seems plausible that very precise similarity is sufficient to cause wasps, when foraging, to react to such mimics as if they were other wasps.

If this hypothesis is correct, then the similarity among many species of wasps can also be explained without invoking Müllerian mimicry: wasps from their own nest (sisters) during hunting flights are not discriminated from wasps coming from other nests, or other similar-looking wasp species, and are thus not attacked. (From a human point of view the wasps are being in a way ‘tricked’, but wasps do not separate species but see individuals – and the similar-looking individuals of other wasp species are equally unprofitable because of their stings.) Non-defended wasp mimics cheat wasps by looking like them, and are likewise not attacked. In the terminology of "adaptive resemblance" the hypothesis belongs in the "masquerade" category. It receives support by certain black wasp species that are perfectly imitated by other moths. Further, the probability that a wasp mimic meets a wasp is in many habitats probably much higher than being confronted by a learning vertebrate antagonist.

Boppré and co-authors (Prof. Dr. Dick Vane-Wright of the Natural History Museum, London, and Prof. Dr. Wolfgang Wickler of the Max-Planck-Institut für Ornithologie, Seewiesen, Germany) reported the new hypothesis in the journal "Ecology and Evolution" (http://onlinelibrary.wiley.com/doi/10.1002/ece3.2586/full), where it is discussed at length and in a wider context. There they underline that the new hypothesis is not an alternative to the traditional explanation, but an amendment or an addition; it will likely depend within a given community and its qualitative and quantitative composition, how strong the selection effected by learning predators is, in comparison to the selection brought about by wasps themselves.

Further studies are needed to find out if the doubts on the existence of wasp mimicry rings, which have been voiced as the result of various previous findings, are dispelled by the new hypothesis or not. Also, many gaps in knowledge are now apparent, and the need for new natural history studies is strongly underlined.

The new explanation at first glance might appear as a tiny detail – but the idea has wide-reaching consequences. The hypotheses, established for more than 150 years and directly relevant to Charles Darwin's theory of evolution, go with additional assumptions, e.g. that Batesian mimicry can only work if – at least temporarily – models outstrip mimics by numbers; only then the probability for learning by bad experience is given. The advantage of imitation (protection) goes with a disadvantage (lower abundance). Imitating wasps which innately do not attack mimics would not appear to entail this cost.