Erratum

Antennae are the key for courting wasps

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There was an error published in *J. Exp. Biol.* 211(15), ii.

The published title was ‘Antennae are key for courting fruitflies’.

This should have read ‘Antennae are key for courting wasps’.

We apologise to our readers for this error.

Inside JEB is a twice monthly feature, which highlights the key developments in the *Journal of Experimental Biology*. Written by science journalists, the short reports give the inside view of the science in JEB.

Inside JEB

QUEEN WASP STINGS LESS ROUSING THAN WORKERS'

Every wasp knows its place in society: queens lay eggs; workers toil. But what happens when a nest is under attack? Claudia Bruschini explains that as soon as a guard wasp stings an attacker, the venom releases an alarm-signalling odour picked up by the workers before they swarm to the colony's defence. But queens can't rely on protection from their workers in the days soon after establishing a nest. Only when her first eggs have hatched at the end of May can the queen turn to her nest mates for help. Which made Bruschini and her colleagues, Rita Cervo, Ilaria Protti and Stefano Turillazzi from the Università degli Studi di Firenze, Italy, wonder whether the queen's sting could convey the same wasp-rousing messages that workers' stings send (p. 2442).

First they had to choose a species of social wasp to answer the question for them. Bruschini explains that paper wasps (*Polistes dominulus*) are ideal; they construct simple open nest structures, which are perfect for studying the insects' comings and goings. Having settled on their wasp of choice, Bruschini and her colleagues headed into the Tuscan hills where the wasps like to build their nests in old tombs. Mounting an early morning raid on a cemetery in a near-by mountain village, the team collected wasp nests before the day warmed and the wasps became active.

Back in the lab, the team measured the size of worker and queen wasp venom sacs, and found that they were essentially the same size. But when they compared the venom sac sizes relative to the insects' body sizes, 'the workers' venom reservoirs were much bigger,' says Bruschini. The workers invest significantly more in venom production than the egg-laying queens.

Next the team analysed the alarm signalling volatile compounds in the queens' and workers' stings. 'This took a long time,' Bruschini admits. Carefully collecting minute drops of venom from individual venom sacs, the team analysed the volatile compounds with mass spectrometry and successfully identified 20 volatile components of the more than 40 found in both venoms. The team could see that the stings were similar: they shared many of the same compounds, but there were higher levels of spiroacetyls in the worker venom and an acetamide in the queens'. How would the wasps react to both stings?

Bruschini, Cervo and Protti headed back into the countryside to a field where they had set up attractive shelters for the queens to nest in. Knowing that the wasps only reacted to alarm signals coupled with a visual stimulus, the team rigged up a black neoprene disc in front of the nest for the wasps to focus their attack on. Then they set the disc oscillating, released a drop of venom behind the nest and waited to see how the insects responded.

As soon as the queen's venom was released, the workers mobilised but limited their aggression to flying towards the bobbing disc. However, it was a different matter when the workers' venom was released. The workers mounted a full-scale attack, landing on the disc and even stinging it. While queen's venom was sufficient to stimulate the early stages of an attack sequence, only the volatile components of the workers' venom provoked a full-on assault.

Despite their similarities, the two venoms are sending different messages, and Bruschini is keen to find out which venom components mobilise an attack.

10.1242/jeb.022426

Bruschini, C., Cervo, R., Protti, I. and Turillazzi, S. (2008). Caste differences in venom volatiles and their effect on alarm behaviour in the paper wasp *Polistes dominulus* (Christ). *J. Exp. Biol.* **211**, 2442-2449.

BLACKCAPS EVICT IMPOSTORS WITH WRONG UV APPEARANCE

It's not always easy spotting the cuckoo in the nest. But if you don't, you pay a high price raising someone else's chick. How hosts distinguish impostor eggs from their own has long puzzled scientists. The problem remained largely unsolved while looking at it through our own eyes. It was only when people started thinking from the birds' perspective that they began to understand how hosts recognise a cuckoo egg in the nest. Marcel Honza from the Academy of Sciences of the Czech Republic explains that birds see UV wavelengths that are well outside our own visual range. Knowing that many bird eggs

reflect UV wavelengths, Honza wondered whether altering the reflected UV spectrum of an egg would affect a bird's ability to recognise it as foreign and reject it. Would a blackcap recognise and evict an impostor egg if the reflected UV spectrum were different from the wavelengths reflected by the bird's own clutch? Teaming up with Lenka Polačiková, Honza headed into a near-by forest to test blackcap responses to impostor eggs (p. 2519).

But instead of testing the birds' reactions to real cuckoo eggs, the team found abandoned blackcap eggs, introducing them as impostors to blackcap clutches. Having identified nests with well-established clutches, the team coated some impostor eggs in UV blocker, to alter their UV appearance, and others in Vaseline, which didn't alter the egg's UV reflectivity, before planting the impostors in their new nest. Then the team kept their fingers crossed, hoping that the nests weren't washed out by a heavy downpour or raided by a hungry predator, as they waited 5 days to see if the parents rejected the interlopers.

Of the 16 eggs coated in Vaseline, 11 of the impostors were accepted by the nesting parents, while five were rejected; most of the interloper blackcap eggs were visually indistinguishable from the nesting parents' own eggs and were accepted as belonging to the brood. However, it was a different matter for the birds sitting on UV-block-coated impostors. Seventeen brooding parents evicted the strange looking egg, pecking at the shell until they had made a large enough hole to stick their beak in and carry it away. Only 11 blackcaps accepted the interloper with its altered appearance.

The UV appearance of the eggs was very important in enabling the blackcaps to recognise the new eggs as impostors. The blackcaps rejected far more eggs when Polačiková and Honza covered them in UV block. By altering the eggs' UV reflectivity the team had made them stand out from the crowd.

Honza admits that he was surprised that the UV reflectivity had such a significant effect on the blackcap's ability to reject an impostor. Having found that an interloper's UV appearance is key to its acceptance in a clutch, Honza is keen to see whether cuckoos try to outsmart their victims by choosing clutches that closely match their own eggs' UV reflectivity.

10.1242/jeb.022418

Honza, M. and Polačiková, L. (2008). Experimental reduction of ultraviolet wavelengths reflected from parasitic eggs affects rejection behaviour in the blackcap *Sylvia atricapilla*. *J. Exp. Biol.* **211**, 2519-2523.

ANTENNAE ARE KEY FOR COURTING FRUITFLIES

Courtship can be a complex ritual, and when parasitic wasps get together, they stroke each other's antennae; which made Ferdinando Bin from the University of Perugia, Italy, wonder whether the males' antennae were more than simply sensory organs. Were they communicating vital sex signals? Having discovered in 1986 that some parasitic wasp males carry glands on their antennae, Bin wondered whether they might be crucial for successful courting. But it took another 20 years before Bin and his team identified the best species to test out his theory: *Trichopria drosophilae*. Teaming up with Bin, Marzia Rosi and Nunzio Isidoro, Roberto Romani played cupid for pairs of *T. drosophilae* to see how courtship progressed when he had tampered with their antennae (p. 2486).

But first the team had to figure out a way to cover up the minute glands on the insect's antennae. Romani admits that when Isidoro came up with the idea of covering the gland in glue he was sceptical. 'I thought the wasps would push it off with their legs,' he admits. But after carefully anaesthetising the insects and gently applying a dab of glue to the antennomere housing the gland, the males soon recovered and were raring to go.

Isolating courting couples with exposed antennae glands, Romani filmed the insects as they slowly stroked each other's antennae, mating successfully in 40 s. But it was a different matter when he paired a male with glued antennae with an expectant female. After 2 min of enthusiastic antennae rubbing, the female had had enough and threw the frustrated male off. Undeterred the male attempted courting again, but to no avail. The females failed to become receptive to the male's advances. 'She wasn't picking up a signal,' says Romani 'so she decided that he was either no good, or the wrong species.'

Next the team tested the secretions' effects by removing one of the male's and female's antennae to see if they needed to be rubbed together to get the message across. Leaving both partners with an antenna on the same side, the insects were able to rub the antennae together and mate. But when the male lost his right antenna and the female lost her left, they no longer came into contact and the courtship ritual ended in failure. Without access to secretions from the male's antenna glands, the females lost interest and were unable to court successfully.

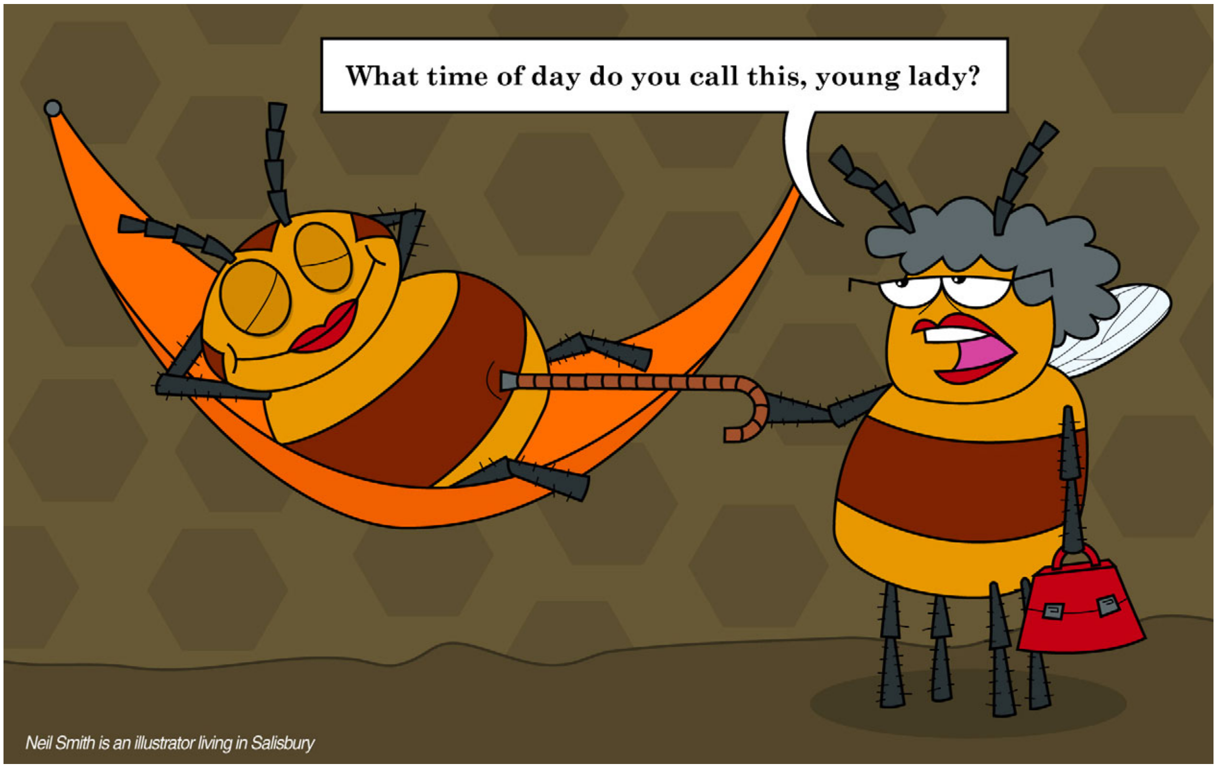
Finally, the team tested whether the glue itself had interfered with the amorous male's advances. But applying glue further along the male's antennae didn't deter the females.

Having found that the parasitic wasp antennae are more than sensory organs, and key to the male's courtship ritual, Bin and his colleagues are keen to know whether other insects rely on their antennae to the same extent for successful courtship.

10.1242/jeb.022400

Romani, R., Rosi, M. C., Isidoro, N. and Bin, F. (2008). The role of the antennae during courtship behaviour in the parasitic wasp *Trichopria drosophilae*. *J. Exp. Biol.* **211**, 2486-2491.

DO YOUNG BEES SLEEP?



Hives are busy places. Young bees scurry around 24/7 doing the chores, while older bees spend the day foraging and sleep at night. 'Their around-the-clock pattern of activity raises the question of whether young bees sleep as foragers do,' say Ada Eban-Rothschild and Guy Bloch. Working at the Hebrew University of Jerusalem, the pair filmed and monitored old and young bees' activities to see whether young bees sleep (p. 2408).

According to the team, they do and their sleep patterns were quite similar. The 3 day olds slept as deeply as elderly foragers, moving down through light and medium sleep until they reach deep sleep. But the way the youngsters moved between different sleep states was different from their elders. Instead of waking up immediately, like the foragers who move directly from deep sleep to consciousness, the youngsters sometimes dipped back down into deep sleep when it had looked as if they might be about to wake, and often moved back and forth between light, medium and deep sleep. Also, the youngsters were all over the place, compared with the foragers, during the day. Once foragers wake in the morning they remain active until sunset, but the youngsters only woke for several hours at a time before dozing off again.

Overall the youngsters slept as much as their elders and were as easy to wake when the lights went on, but the older bees had a well-defined sleep pattern that the youngsters lacked. So young bees do sleep, despite their 24 h lifestyle.

10.1242/jeb.022392

Eban-Rothschild, A. D. and Bloch, G. (2008). Differences in the sleep architecture of forager and young honeybees (*Apis mellifera*). *J. Exp. Biol.* **211**, 2408-2416.

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