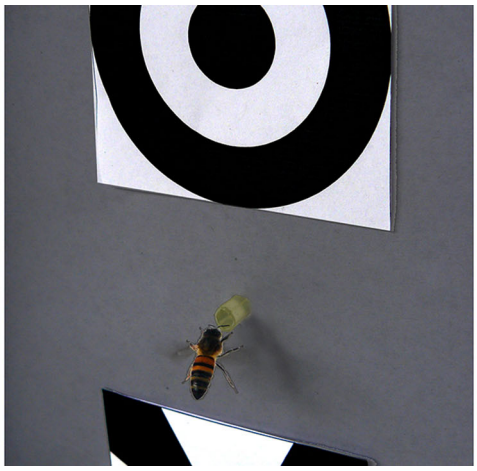
INSIDE JEB

Communal talents build hive versatility



A honeybee visits the syrup reward after correctly identifying the 'target' shaped image it has learned to recognise. Photo credit: Aurore Avarguès-Weber.

It takes all sorts to build a team, from creative problem solvers to focused strategists and coordinators, and collectively dwelling honeybees may also benefit from the individual strengths of their nest mates. 'Individuals with different abilities, some faster to learn, others slower but more accurate, may help a group to be more efficient to cope with a broad spectrum of problems encountered in nature,' says Martin Giurfa from the Université de Toulouse, France. In other words, communities of individuals with a range of aptitudes may be able to respond more flexibly to change. 'We wanted to study if a good "visual learner" is also a good "olfactory learner"', says Aurore Avarguès-Weber (Université de Toulouse), who worked with Giurfa and Ricarda Scheiner (University of Würzburg, Germany) to find out whether bees that are smart at one task are equally talented at others.

Together they set foraging honeybees three challenges to test their ability to learn. First, to find out whether the insects were able to learn more quickly after practice, Valerie Finke (Université de Toulouse) initially provided a group of 18 honeybees with a choice between two patterns – a mini archery target and a square of horizontal bars – training the bees to recognise one of the patterns by rewarding them with a sugary sip of syrup. Then, she tested how well the bee remembered the pattern it had learned, to distinguish the sharpest bees from the slowest learners. The following day, Finke provided the bees with two new patterns to learn and on the third day she presented the bees with a final pair of patterns. However, the bees did not pick up the task faster on the final day and, when Avarguès-Weber, Finke, Scheiner and David Baracchi (Université de Toulouse) compared the bees' learning abilities over the course of the experiment, the smarter bees consistently out-performed the weaker learners.

Second, having tested the abilities of the first group of bees to learn to recognise patterns, the team set a second group of bees another task, first testing how well the new insects learned to distinguish two patterns and then, a day later, training them to distinguish between two scents – orange (limonene) and a mushroomy odour (2-octanol). This time, some of the bees – which had been slower visual learners – picked up which scent to recognise more quickly, while others that learned to recognise the scent well struggled to learn to recognise one of the images. It seemed that the bees' abilities depended on which sense they were using when learning the task. Bees that were visually 'smart' weren't necessarily so bright when it came to distinguishing odours and vice versa.

Then, Finke turned up the pressure during the third task, to find out how well a final group of foragers could learn to recognise the relative position of two objects – either placed side-by-side or one above the other – in addition to the tried-and-tested pattern recognition task, 'to compare a higher-order form of problem solving, requiring a rule based on a relationship, with a simpler one', say Giurfa and Avarguès-Weber. And again, the bees' abilities ranged from very able to slower.

So, honeybee communities are much like human society, composed of individuals each with their own strengths. Just like some people pick up languages more easily but struggle with science, some honeybee whiz kids pick up certain tasks swiftly, but slower learners may make better decisions that compensate for their lack of speed. And even though the insects don't seem to learn faster with practice, hives are definitely stronger for the collective contributions of their communal talents.

10.1242/jeb.243698

Finke, V., Baracchi, D., Giurfa, M., Scheiner, R. and Avarguès-Weber, A. (2021). Evidence of cognitive specialization in an insect: proficiency is maintained across elemental and higher-order visual learning but not between sensory modalities in honeybees. *J. Exp. Biol.* **224**, jeb242470. doi:10.1242/jeb.242470

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