Apimondia News

May 10th 2026

The Math Skills of Honey Bess

According to a new study, honey bees have numerical ability related to the concept of quantity, but they can do also simple operations. Here the interview to one of the researcher involved in this work.

By Matteo Giusti

A recent study, published in the scientific journal Proceedings of the Royal Society B, has highlighted some of the mathematical abilities of honey bees. These are basic skills, related to numerical cognition and the concept of quantity, but they are very important for understanding how these insects use their brains to perceive the environment.

Mirko Zanon, a researcher at the University of Trento in Italy, explains these findings and why they are innovative and significant for our knowledge of honey bee biology.

Dr. Zanon, what did you find?

“With this study, we showed that bees are actually able to process pure numerical information: in other words, they can pay attention to how many objects are present in a scene.

This is important because there has been a long debate in the field about whether animals really understand “number,” or whether they simply rely on other visual cues. For example, if a bee has to compare 2 flowers with 5 flowers, the larger group also usually takes up more space, has more color, or simply looks more visually striking. So, the bee might just choose the bigger or more noticeable group, rather than responding to the number itself.

In our work, we carefully reanalyzed the visual stimuli used in previous numerical experiments with bees. We showed that the bees’ choices are consistent with them evaluating the number of items, rather than relying on other features such as the overall size, shape, arrangement, or occupied space of the groups.”

Why is this innovative?

“This is an important contribution to the field because recent studies had questioned whether bees truly use numerical information. Instead, it had been suggested that, in many numerical experiments, bees may have simply relied on other visual cues when comparing groups containing different numbers of elements.

As a result, support for the idea that bees possess genuine numerical abilities had weakened in some areas of the field. Our work helps address this issue by showing that the bees’ behavior is more consistent with sensitivity to number itself, rather than to other visual properties of the stimuli as previously suggested.

In this way, our findings re-evaluate the idea that bees do in fact possess a basic form of numerical cognition, analogous to what it has been found in vertebrates.”

What kind of numerical cognition do honey bees have?

“The numerical cognition we are talking about here is a general ability that is shared across many animal species. This kind of “number sense” is thought to have evolved because it can provide important advantages for survival. For example, being able to identify the larger amount of food, avoid larger groups of predators, or choose the bigger social group can all be ecologically useful.

Importantly, we are not talking about mathematics or symbolic counting like humans use, but rather about simple numerical discrimination: the ability to distinguish between groups based on the number of items they contain.

In this context, bees show both relative and absolute numerical abilities. Relative discrimination means they can distinguish, for example, the smaller from the larger quantity. Absolute discrimination means they can learn to recognize and select a specific rewarded number of elements.”

Can honey bees count? If so, how?

“Considering what we discussed up to now, the word “count” usually refers to more advanced computations than the basic “number sense” we have been talking about. Importantly, the number sense we described is a direct and fast estimation of the number of items visualized, not necessitating a counting process.

However, there is interesting evidence that bees can perform simple counting-like operations.

In one study, bees were trained inside a Y-shaped maze where they first saw a group of shapes. The color of the shapes told the bees which rule to apply: blue meant “add one,” while yellow meant “subtract one.” After seeing the sample, the bees had to choose between two possible options. For example, if they saw 2 blue elements, the correct choice was 3 elements; if they saw 2 yellow elements, the correct choice was 1 element. After training, the bees learned to use color as a symbolic cue for simple addition or subtraction and could apply these rules even to new shapes and numbers they had never seen before. So, at least for these very simple forms of calculation, bees show counting-like abilities.

There is also some evidence that bees can use a simple form of counting in navigation by keeping track of how many landmarks they pass on the way to a food source. This is not full counting in an abstract sense, but a basic use of sequential number information linked to their route.”

Your research suggests that spatial frequency may not be essential for numerical cognition or spatial vision. Should we rethink how honey bees perceive distances, such as those they communicate through the waggle dance?

“The results suggest that some previously proposed low-level visual explanations (such as spatial frequency in the arrangement of items) are not sufficient to account for bees’ numerical behaviors. However, this does not directly affect models of distance perception: even if simple number-related processes could play some role in navigation, distance evaluation is known to rely on multiple factors, for example visual flow and landmark-based guidance.

Therefore, while our findings help refine how we interpret visual processing in numerical tasks, there is currently no strong reason to reconsider the core mechanisms underlying distance communication and their communication through the waggle dance.”

Reference: Zanon et al., 2026 - Stimuli that fit: a biology-aligned approach to numerical cognition research - Proceedings of the Royal Society B Volume 293, Issue 2069