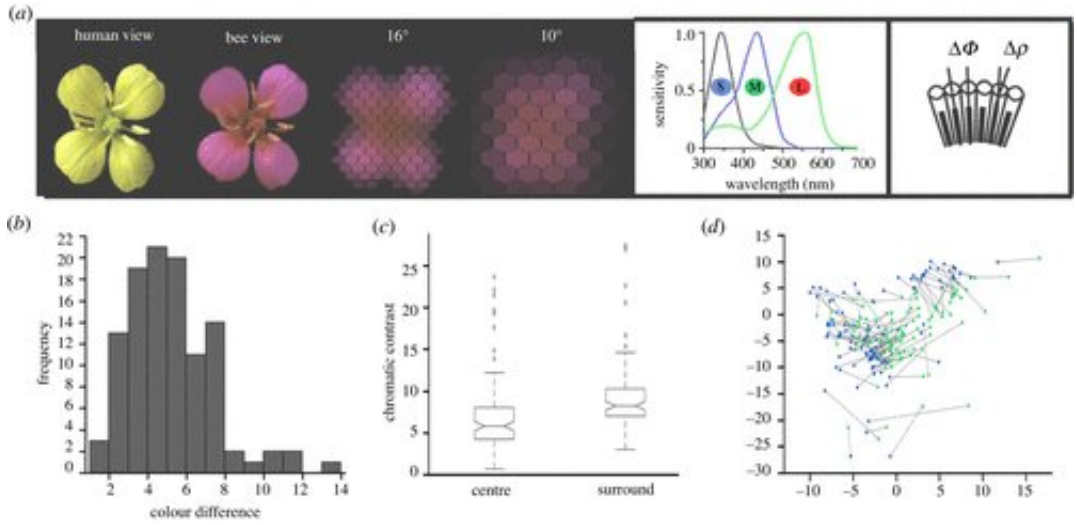
Bees use patterns, not just colors, to find flowers

September 6 2022



Variations of color in the centre–surround patterns of natural flowers. (a) A flower image at full resolution (human and bee receptor view) and as seen through the honeybee eye when the flower subtends visual angles of 16° and 10°. These angular sizes are close to the thresholds of spatial resolution of the chromatic and achromatic visual system in honeybees. Each hexagon indicates an ommatidium. The middle panel shows the spectral sensitivity curves for the three photoreceptor types of the honeybee eye (S, short-wavelength; M, middle-wavelength; L, long-wavelength receptor; sometimes also termed UV, blue and green receptors) [1]). (b) Distances between the color loci of the center and the surround in flower patterns were well above the discrimination threshold [34]. (c) Chromatic contrasts of the center and surround of flower patterns against an average foliage background. (d) Color loci of the center (green dots) and surround (blue dots) in a flower pattern in the honeybee color space (receptor-noise limited (RNL) model [34,35) relative to the locus of an average foliage background 00). Credit: *Philosophical Transactions of the Royal Society B:*

Biological Sciences (2022). DOI: 10.1098/rstb.2021.0284

Honeybees rely heavily on flower patterns—not just colors—when searching for food, new research shows.

A team led by the University of Exeter tested bee behavior and built bee's-eye-view simulations to work out how they see flowers.

Honeybees have low-resolution vision (about 100 times lower than human vision), so they can only see a flower's pattern clearly when they are within few centimeters. However, the new study shows that bees can very effectively distinguish between different flowers by using a combination of color and pattern.

In a series of tests, bees rarely ignored pattern—suggesting color alone does not lead them to flowers. This may help to explain why some colors that are visible to bees are rarely produced by flowers in nature.

"We analyzed a large amount of data on plants and bee behavior," said Professor Natalie Hempel de Ibarra, from Exeter's Center for Research in Animal Behavior.

"By training and testing bees using artificial patterns of shape and color, we found they relied flexibly on their ability to see both of these elements.

"Showing how insects see color and learn color patterns is important to understand how pollinators may, or may not, create evolutionary 'pressures' on the colors and patterns that flowers have evolved.

"Our findings suggest that flowers don't need to evolve too many

different petal colors, because they can use patterns to diversify their displays so bees can tell them apart from other flowers."

One consistent feature identified in the study is that the outside edges of flowers usually contrast strongly with the plant's foliage—while the center of the flower does not have such a strong contrast with the foliage color.

This could help bees quickly identify color differences and navigate to flowers.

While flowers may be beautiful to humans, Professor Hempel de Ibarra stressed that understanding more about bees—and the threats they face—meant we need to see the world "through the eyes of a bee and the mind of a bee."

The paper is published in a special issue of the journal *Philosophical Transactions of the Royal Society B*. The journal issue is entitled "Understanding color vision: molecular, physiological, neuronal and behavioral studies in Arthropods" and is edited by Professor Hempel de Ibarra, alongside Dr. Ayse Yilmaz and Professor Almut Kelber, both from Lund University,

It highlights the latest advances in research that unravel the diversity of color-vision systems found in invertebrates, demonstrating many interesting adaptations to their different life styles and to their diurnal and nocturnal habitats.

More information: Natalie Hempel de Ibarra et al, The role of colour patterns for the recognition of flowers by bees, *Philosophical Transactions of the Royal Society B: Biological Sciences* (2022). DOI: 10.1098/rstb.2021.0284

Provided by University of Exeter