

IN THEIR WORDS

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Do bees distinguish colours?

ADRIAN HORRIDGE delves into the enlightening research world of bee vision.

Humans have long believed that the colours of flowers have evolved to attract bees.

But my recent experiments show that bees actually distinguish shapes and patterns by basing their decisions on seeing edges with green receptors and shades of blue with blue receptors.

Back in 1912, Carl von Hess, professor of ophthalmology at the University of München, Germany, concluded in his book on the physiology of animal vision bees do not distinguish between colours in the way humans enjoy. His sources were few but reliable.

Karl von Frisch, a young assistant in zoology at the same university, set to work to demonstrate that bees distinguish flower shapes and colours from all shades of grey, which is a test of defects in human colour vision.

In 1914, von Frisch demonstrated his trained bees at a large scientific congress in Freiburg.

However, he ignored some experiments that failed.

The bees had learned nothing when trained to go to mid-grey or green versus a palette of all shades of grey.

In response, von Hess showed bees learned when rewarded on blue squares on a blue and yellow checkerboard but they learned nothing (except to avoid blue) when rewarded on yellow squares.

Neither repeated the experiments of the other; neither understood their own data.

Von Hess died in 1923. Von Frisch won by default, became a dominant force in German zoology and later shared a Nobel Prize for his work on bees.

And that's where I come in.

A suitable retirement research topic

In 1992, I decided a summer school for bees provided a suitable topic for retirement research.

It required only bees, sugar, a simple Perspex box, paper patterns and some thought.

Progress was slow but, in 2009, ANU Press published my book, *What does the honeybee see?*

It showed that when bees distinguish shapes or patterns, they actually use simple features like oriented edges, radial spokes, the locations of centres of a black area and a few other cues.

However, they only use two or three of these at a time and only for the task in hand.

After five more years of bee training on warm, sunny Canberra days, four papers containing 50 experiments on bees' vision of colour revealed an unexpected but simple mechanism.

Bees do not distinguish colours like we do.

They detect whether a local area like a flower is more or less blue than the background foliage.

Flying on the right course

Bee vision research was going almost entirely in the wrong direction for a century.

They locate and measure the amount of vertical edge with the green receptor channels as they scan the local scene.

As they cross an edge, receptors of green light respond with a modulation, a brief electrical response propagated to the next layer of nerve cells.

Bees distinguish shapes and patterns by remembering a position and the amount of blue, relative to the strongest green edge.

Colour and pattern are inseparable because they share the same detectors.

The results relate to robot vision and the understanding of the behaviour of bees and, perhaps, all insects.

Bee vision research was going almost entirely in the wrong direction for a century.

Now it's flying on the right course.

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