

New Insight Into How Bees See

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Faces can dramatically change appearance when seen from different viewpoints, since the relationship between elements like nose and eyes change depending upon viewing angle. Bees solve this difficult visual problem by averaging previously learnt views. Credit: Monash University

New research from Monash University bee researcher Adrian Dyer could lead to improved artificial intelligence systems and computer programs for facial recognition.

Dr Dyer is one of Australia's leading bee experts and his latest research shows that honeybees can learn to recognise human faces even when seen from different viewpoints.

Dr Dyer said the research could be applied in the areas of new technology, particularly the development of imaging systems.

"What we have shown is that the bee brain, which contains less than 1 million neurons, is actually very good at learning to master complex

tasks. Computer and imaging technology programmers who are working on solving complex visual recognition tasks using minimal hardware resources will find this research useful," Dr Dyer said.

"Most current artificial intelligence (AI) recognition systems perform poorly at reliably recognising faces from different viewpoints. However the bees have shown they can recognise novel views of rotated faces using a mechanism of interpolating or image averaging previously learnt views."

The findings show that despite the highly constrained neural resources of the insects (their brains are 0.01 per cent the size of the human brain) their ability has evolved so that they're able to process complex visual recognition tasks.

The researchers individually trained different groups of free flying bees with a sugar reward for making correct choices, or alternatively the bees were punished with a bitter tasting solution for incorrect choices. Faces were presented on a vertical screen and bees slowly learnt to fly to the correct target faces. Over the course of a day a bee brain learned a complex task, and then when tested in non-rewarded tests (to totally excluded cues like olfaction) only bees that had experience multiple views (e.g. faces at both 0° and 60°) were able to solve a novel rotational angle of 30° .

Dr Dyer said the discovery helps to answer a fundamental question about how brains solve complex image rotational problems by either image averaging or mentally rotating previously learnt views.

"Bee brains clearly use image interpolation to solve the problem. In other words, bees that had learnt what a particular face looked like from two different viewpoints could then recognise a novel view of this target face. However, bees that had only learnt a single view could not

recognise novel views," Dr Dyer said.

The study, performed over two years in Australia and Germany by Dr Dyer with the support of the US Air Force Office of Scientific Research (AFOSR), and Dr Quoc Vuong from Newcastle University UK, was published in the prestigious science journal *PLoS ONE*.

"The relationships between different components of the object often dramatically change when viewed from different angles but it is amazing to find the bees' brains have evolved clever mechanisms for problem solving which may help develop improved models for AI face recognition systems," Dr Dyer said.

The original manuscript is available free of charge from PLoS ONE: www.plosone.org .

Source: Monash University

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