

Bees' flight secrets revealed

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A honey bee robs a comb. Photo by Lynn Ketchum

Honeybees use a combination of what they feel and see to streamline their bodies and gain maximum 'fuel efficiency' during flight, a world first study has found.

Scientists at Australia's Vision Centre (VC) have found that bees use their antennae as well as their eyes to calculate the best position for swift [flight](#). The discovery could help in the development of robot aircraft, such as insect-like flying machines, say Mr Gavin Taylor and Professor Mandyam Srinivasan of The VC and The University of Queensland Brain Research Institute (UQ).

"Honeybees often have to travel very [long distances](#) with only a small amount of nectar, so they have to be as 'fuel-efficient' as possible," says

Prof. Srinivasan. "They achieve this by raising their abdomen to reduce drag so they can fly at high speeds while using less energy."

Previous research has found that honeybees use their eyes to sense the [airspeed](#) and move their abdomens accordingly, Mr Taylor says. "When we trick a honeybee into thinking that it's 'flying' forward by running background images past its eyes, the bee will move its body into a flying position despite being tethered.

"The faster we move the images, the higher it lifts its abdomen to prepare for rapid flight. However, if we blow wind directly at them without running any images, the bee raises its abdomen for only a little while. This means that they rely on their vision to regulate their flights."

Now, VC researchers have further unravelled the honeybee's flight secrets by adding airflow to the bee's environment. "We created a headwind and ran background images simultaneously," says Mr Taylor. "We found that when the fan is turned on, the bee raises its abdomen much higher than when the fan is switched off.

"This shows that while bees need to see to adjust their abdomens during flight, their streamlining response is also driven by airflow."

Prof. Srinivasan explains that the honeybee senses airflow with its antenna: "As soon as we immobilised the bee's antenna, its streamlining response was reduced as it relied only on its eyes.

"The bee uses its antenna to do many wonderful things – it tastes food with it, senses the vibration in the air when other bees dance, and now we know they also use it to regulate their flights by detecting wind speed."

Using information from several senses to control their flight is more

effective as it helps bees respond more quickly to changes in the environment, Mr Taylor says. "For instance, their antennae can detect a change in the airflow, such as sudden gusts of wind, allowing them to adjust their bodies and speed. This is something that their vision can't do as their eyes might not 'see' the wind."

"As we start to build more robot aircraft, such as 'robotbees' with tiny flapping wings, a better understanding of how these creatures fly takes us one step further towards perfecting these flying machines," says Prof. Srinivasan.

"For instance, we can place battery packs on small unmanned flying vehicles that mimic the bee's abdomen. The vehicle can streamline itself when performing long distance, cruising flights – or stabilise itself by letting the 'abdomen' droop when needed.

"These [bees](#) are living proof that it's possible to engineer airborne vehicles that are agile, navigationally competent, weigh less than 100 milligrams, and can fly around the world using the energy given by an ounce of honey."

The study "Vision and air flow combine to streamline flying [honeybees](#)" by Gavin J. Taylor, Tien Luu, David Ball and Mandyam V. Srinivasan has been published in *Scientific Reports*.

More information: www.nature.com/srep/2013/13091.../full/srep02614.html

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