

Wing flexibility enhances load-lifting capacity in bumblebees (w/ Video)

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A bumblebee with pieces of glitter stiffening its flexible vein joints. Credit: Andrew Mountcastle

(Phys.org) —New research published today in *Proceedings of the Royal Society B* demonstrates that the secret of bumblebees' capacity for lifting relatively heavy loads lies in the flexibility of their wings.

Harvard University scientists manipulated the wings of live insects to

investigate how wing deformations affected bumblebee aerodynamics. They found that wing flexibility enhances vertical force production, and thus how much weight bees can lift while in flight.

[Insect wings](#) are flexible structures that passively bend and twist during flight. Only recently has insect flight research explored the aerodynamic consequences of flexible wing deformations. However, results from robotic models have contradicted those of computational models on whether wing deformations enhance or diminish aerodynamic force production.

Dr Andrew Mountcastle and his colleagues addressed this question for the first time by manipulating the wings of live bees. They artificially stiffened the wings of [bumblebees](#) by applying a splint (in the form of a piece of glitter) to a flexible vein joint, and carrying out load-lifting tests. They found that wing stiffness decreased the amount of weight the bees could lift.

The bees with stiffened wings showed an 8.6 per cent reduction in maximum vertical force production. This cannot be accounted for by changes in wing kinematics, as flapping frequency and amplitude were unchanged. Thus the team concluded that wing flexibility affects aerodynamic force production in a natural behavioural context; locomotory traits with important ecological implications.

More information: Mountcastle, A. and Combes, S. [Wing flexibility enhances load-lifting capacity in bumblebees](#), *Proceedings of the Royal Society B*, 27 March 2013.

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