

Video Article

A new computer-controlled Skinner box to study free flying nectar gathering behavior in bees

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Abstract

The experimental study of nectar foraging behavior in free-flying bees requires the use of automated devices to control solution delivery and measure dependent variables associated with nectar gathering. We describe a new computer-controlled artificial flower. Our device is similar to a "Skinner box" and is different from other automatic flowers because it combines a unique set of characteristics¹⁻⁴. All the components are assembled together as an integrated USB device and the researcher can use the device in the laboratory or in the field. As solution distribution is contingent on visits, it does not accumulate between visits. As a consequence, the apparatus provides good control of a solution collected by honey bees. Another important characteristic of the device is the delivery of discrete amount – fixed or variable - of reinforcers under computer control. The complete automation of experimental protocols now opens the possibility to easily perform experiments in the laboratory or in the field while measuring a complete set of parameters related to individual behavior. Several scientific fields should benefit from our device. First, as shown with the data concerning pumping rate, the device could be used to measure physiological parameters. Secondly, the automatic flower offers interesting perspectives in the context of optimal foraging models. The experimental test of this kind of quantitative model requires known and controlled resource properties (for example patch depletion). As natural flower resources are generally unknown, it is often difficult to test these models in the field. Software controlled flowers open the door to unlimited number of protocols and reinforcement schedules are one example of such protocols. The fact that the device provide discrete amount of solution and a natural flower a continuous nectar flow does not constitute a limitation to ecological applications because a continuous flow can be approximated with a discrete set of values. Thirdly, the device can be used as a Skinner box for honey bees, thereby opening the way to new investigations into comparative studies of honey bee learning abilities⁵. Moreover, even though the apparatus was designed for honey bees it can easily accommodate larger or smaller bees including bumble bees. Finally, because the device not only provides measures of foraging behavior, but also controls access to a consumed solution, the device offers interesting perspectives in toxicology studies.

Disclosures

No conflicts of interest declared.