Towards automated conditioning of honeybees in complex tasks

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Learning is a fundamental process by which animals acquire and store relevant information about their environment, and it has been the subject of many studies. During learning, however, the nervous system does much more than attaching an informative value to a stimulus. Indeed, many of the modifications that occur during learning are intended to optimize the detection of the stimulus itself, so that it stands out amid the surrounding background. The aim of my work is to dissociate between these two consequences of learning. To do so, honeybees will be trained in a contextual learning task, in which the same stimulus (for example an odour) has a different meaning depending on the context in which it is presented (e.g. the colour of the arena). With its ability to learn complex associations despite the reduced size of its brain, the honeybee is an ideal model organism for this project. I will present a new, automated Y-maze apparatus (yAPIS) in which bees can be robustly trained in visual and olfactory paradigms. Bees trained differentially to blue and green LEDs correctly avoid the shocked colour after a single conditioning trial, and exhibit a long lasting (24h) and specific memory of the association after as little as two trials. Further testing reveals that this memory trace is mostly aversive, since the safe colour is not preferred over a novel one. Bees trained exclusively with odours also perform well, but they tend to generalize the association to all odours after 24h, a phenomenon that was recently also described in fruit flies. I will also present preliminary results for the full contextual learning task, which we are now implementing.