Introduction

Given the small size of their brain, honeybees have astonishing cognitive capacities, comparable in many respects to vertebrates [1,2]. Much of this is based on their remarkable visual learning and discrimination abilities that extend beyond learning simple colours, shapes or patterns.

Indeed, honeybees can discriminate landscape scenes, types of flowers, and even human faces, suggesting that they have a highly developed capacity for processing complex visual information. Here, we investigated whether this capacity extends to complex images that humans distinguish on the basis or artistic style: Impressionist paintings by Monet and Cubist paintings by Picasso.

Methods

Assay: Using a simple choice assay, we trained free-flying honeybees into a tunnel, at the end of which they encountered photographic prints (7 x 9.5 cm) of a Monet and a Picasso painting (Fig. 1). Underneath the paintings were holes through which the bees could enter into chambers behind the paintings, one of which contained a feeder with sugar.

Training: For each experiment, two groups of 25 individually marked bees were trained separately to discriminate between pairs of Monet and Picasso paintings. One group was trained to Monet rewarded, the other to Picasso rewarded. Training was conducted in blocks of 20 min with the rewarded image presented on the right and then on the left side for 10 min each. Painting pairs were presented in multiple blocks over several days, with bees first trained to a single painting pair, and then to five paintings pairs in a row (Fig. 2 above), and then presented with novel unrewarded paintings (Fig. 2 below) interspersed by training blocks with familiar paintings.

Analysis: Only the first choices of each bee with the rewarded image presented on the left and the right side per block were used for analysis. Results for all bees of a group were pooled for a block, and the mean percentage of correct choices for each block (or set of blocks) analyzed using ANOVA and Fisher post-hoc tests.

Results

Honeybees learnt to discriminate between a Monet and Picasso painting (Fig. 3a), and were able to discriminate at least five painting pairs at the same time (Fig. 3b). They easily transferred their discrimination ability to grey scale (Fig. 3d left), demonstrating that colour was not used for discrimination. To some extent, honeybees could generalize knowledge about the visual structure that differentiates Monet from Picasso paintings to new images they had never encountered before (Fig. 3c), in particular when the novel paintings were presented in grey scale (Fig. 3d right). This suggests that honeybees are able to discriminate art by extracting the characteristic visual information inherent in a painting style [3].

Conclusions

Our study suggests that honeybees discriminate Monet and Picasso paintings by extracting and learning the characteristic visual information inherent in each painting style.

Our study also suggests that discrimination of artistic styles is not a higher cognitive function unique to humans, but simply due to the capacity of animals to extract and categorize the underlying visual characteristics, such as structural regularities, of complex images.

References