EMS1: Perception of contextual size illusions by honeybees in restricted and unrestricted viewing conditions

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Viewing angle:

During the learning phase, target sizes and thus viewing angle changed constantly while background size and viewing angle remained consistent as bees appeared to make decisions at similar distances. A number of studies have demonstrated that bees make decisions at approximately 5 – 7 cm from a rotating screen [1-4], and in a previous study on size rule learning using a rotating screen, the distance bees made decisions at appeared to be 6 cm [1] (thus this was the reason for the distance in the y-maze). In addition, Howard et al. (2017) demonstrates that free-flying unrestricted honeybees made decisions at approximately 4 – 6 cm regardless of the size of the stimulus when sizes ranges from 1 cm^2 to 64 cm^2 [5].

For this experiment, we did not measure the distance of bees at the time of decision-making, however, we can estimate the visual angle at which bees would need to be in order to keep the varied white square backgrounds at a constant visual angle during the transfer tests. For this purpose we assume a distance of 6 cm from the stimuli for decision-making as this has previously been determined for free-flying bees (and was the case for the restricted viewing conditions). In transfer test 1, the central target was 2.25 cm^2 with a visual angle of 21° at 6 cm. The large background size was 30.25 cm^2 with a visual angle of 137°. The small background was 6.25 cm^2 with a visual angle of 55°. If a bee were to alter its distance in order to have the visual angle of smaller white background match that of the larger white background at 6 cm, the bee would need to inspect the stimulus at a distance of 1.24 cm, which would then give the central target a visual angle of 84°. If a bee were to alter its distance in order to have the visual angle of the larger background match that of the smaller background at 6 cm, the bee would need to inspect the larger background stimulus at a distance of 29.04 cm, which would then give the central target a visual angle of 4° which is potentially below the minimum threshold for detection [6].

In transfer test 2, the central target of the larger target was 12.25 cm^2 with a visual angle of 91° at 6 cm. The background of this target was 36 cm^2 with a visual angle of 143°. The smaller central target was 9 cm^2 with a visual angle of 75°, while the background for this target was 12.25 cm^2 with a visual angle of 91°. If a bee were to alter its distance to have the visual angle of the smaller white square match the visual angle of the larger white square at a distance of 6 cm, bees would need to inspect the smaller background stimulus at a distance of 2.04 cm, giving the target a visual angle of 131°. If bees were to alter their distance to have the visual angle of the larger background match that of the smaller background at a distance of 6 cm, bees would need to inspect the larger background stimulus from a distance of 17.63 cm, giving the target a visual angle of 38°.

Given what is known about bee visual acuity and the distance at which honeybees make decisions on size in previous experiments, it is unlikely that bees would mediate their viewing distance from 6 cm to 1.24 cm, or 6 cm to 29.04 cm in transfer test 1. Similarly, it is also unlikely that bees in transfer test 2 would change their viewing distance between stimuli from 6 cm to 2.04 cm, or 6 cm to 17.63 cm. In addition, these drastic changes in viewing distance between stimuli during the unrestricted viewing phase of the experiment were not observed and bees appeared to make decisions from approximately the same distance for each choice.

References:

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