Instantaneous e-vector detection in the honeybee using an associative learning paradigm

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Honeybees'capability of learning certain e-vector orientations was examined by using a classical associative conditioning paradigm with the proboscis extension reflex (PER). An e-vector orientation as a conditioned stimulus (CS+) was associated with sugar water as an unconditioned stimulus (US), while another e-vector orientation (CS-) was not. Associative conditioning showed that the honeybees could discriminate CS+ from CS- after eight conditioning trials. Bees whose DRA alone was covered with a black paint could not learn CS+ whereas they could learned CS+ if the area of compound eye except for the DRA was covered. When the ultraviolet light (350 nm) was used for CS, bees could discriminate CS+ from CS- but not when the CS was blue (442 nm) or green (546 nm). By fixing their neck to stabilize their head through the experiments we examined whether a bee can discriminate two e-vectors without scanning the polarized light by turning its head, and found that it did discriminate between CS+ and CS-. This is the first evidence to show that the "instantaneous" method is used in the polarization vision system of the insect brain, which requires no active scanning of the sky.