

Electronic Supplementary Materials (ESM)

Table S1. Learned colour preferences of bumblebees after absolute conditioning to various colour patterns, differing in spatial arrangement of blue and/or yellow colour segments. Bees were trained to collect sucrose from the centre of their rewarded training pattern, and after ten trials were tested for a learned colour preference during three-minute tests with unrewarded bicoloured patterns. A colour preference is evinced by a significant difference in time spent searching one colour-half versus the other: ‘search time’ is the total time the bee spent visually exploring the test pattern within a distance of 5cm, excluding time spent landed/walking on the target.

Rewarded training pattern	N	Test pattern	Mean time (s) searching each colour \pm S.E.		Paired test	Colour preference
			Blue half	Yellow half		
Yellow	10	Blue/Yellow	6.5 \pm 1.2	31.5 \pm 7.51	Z=-2.803, p=0.005	Yellow
		Yellow/Blue	8.4 \pm 2.17	18.2 \pm 3.53	t ₉ =-3.83, p=0.004	Yellow
Blue	10	Blue/Yellow	25.0 \pm 4.99	3.9 \pm 0.81	t ₉ =4.9, p=0.001	Blue
		Yellow/Blue	28.0 \pm 2.68	9.1 \pm 1.46	Z=-2.803, p=0.005	Blue
Blue/Yellow	11	90	7.6 \pm 1.32	18.8 \pm 2.01	Z=-2.803, p=0.005	Yellow
		270	6.9 \pm 1.56	16.3 \pm 2.89	t ₉ =-5.41, p<0.001	Yellow
		180	9.5 \pm 2.13	17.8 \pm 3.9	Z=-2.09, p=0.037	Yellow
Yellow/Blue	12	90	20.1 \pm 3.23	7.1 \pm 1.18	t ₁₁ =4.91, p<0.001	Blue
		270	21.3 \pm 2.95	8.3 \pm 1.42	t ₁₁ =6.97, p<0.001	Blue
		180	19.2 \pm 4.83	8.4 \pm 1.31	Z=-2.28, p=0.023	Blue
3Y:1B	10	90	17.3 \pm 3.53	19.6 \pm 3.75	t ₈ =-1.07, p>0.05	No
		Blue/Yellow	9.1 \pm 2.35	14.4 \pm 2.81	t ₉ =-1.84, p>0.05	No
		Yellow/Blue	8.6 \pm 7.74	18.6 \pm 11.74	Z=-1.78, p>0.05	No
1B:3Y	10	90	7.2 \pm 1.66	20.2 \pm 2.66	t ₉ =-8.71, p<0.001	Yellow
		Blue/Yellow	4.53 \pm 0.99	15.42 \pm 3.29	t ₉ =-4.52, p=0.001	Yellow
		Yellow/Blue	6.6 \pm 1.6	15.0 \pm 2.32	t ₉ =-6.5, p<0.001	Yellow
3B:1Y	10	90	17.8 \pm 3.92	9.5 \pm 2.35	t ₉ =3.07, p=0.013	Blue
		Blue/Yellow	21.7 \pm 3.47	5.6 \pm 1.56	Z=-2.83, p=0.005	Blue
		Yellow/Blue	14.1 \pm 4.44	9.3 \pm 1.78	t ₈ =1.46, p>0.05	No
1Y:3B	10	90	11.7 \pm 2.39	4.8 \pm 1.31	t ₉ =4.51, p=0.001	Blue
		Blue/Yellow	9.8 \pm 2.68	8.8 \pm 2.44	Z=-0.05, p>0.05	No
		Yellow/Blue	18.0 \pm 2.76	4.7 \pm 0.61	t ₉ =5.64, p<0.001	Blue

N = number of bees in each treatment.

Test pattern numbers refer to the degree of rotation of the training stimulus.

Paired tests give the results from t-tests when data met assumptions of normality, and Wilcoxon tests if assumptions were violated.

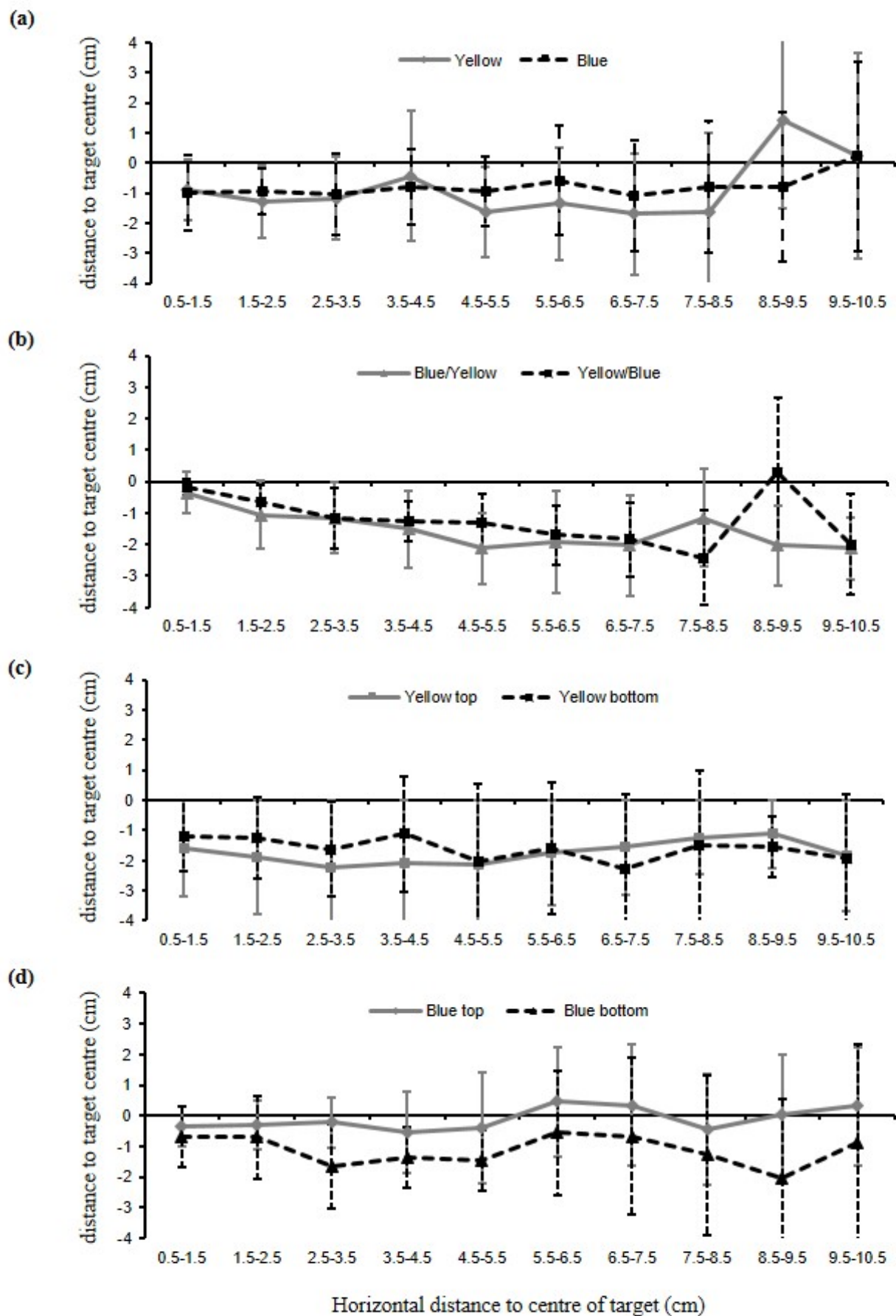


Figure S1. The mean approach height of bees trained to vertical colour patterns (8cm diameter) with a sucrose reward at the centre. Data shown are for the last rewarded training flight prior to tests. (a) Single-coloured blue or yellow discs (n=10 bees for both treatments); (b) bicolour discs with a central contrast line, with a blue top and yellow bottom (n=11), and vice versa (n=12); (c) bicolour patterns with an off-centre contrast line, with yellow in the top or bottom 6cm (n=10); (d) bicoloured patterns with an off-centre contrast line, with blue in the top or bottom 6cm (n=10). X-axis depicts horizontal distance and Y-axis vertical distance to the target plane. Error bars show standard deviation from the mean.