

Experiment 1: Absolute conditioning

Acquisition

Table S1. Repeated measures MANOVA for the effect of olfactory, visual and bimodal signals on performance of bees in an absolute conditioning task.

Comparison	Trial	Treatment	Trial x Treatment
<i>Odour: 1-Hex, Colour: Green, Bimodal: Green/1-Hex</i>			
Green vs. 1-Hex vs. (Green/1-Hex)	$F_{7,58} = 18.88$ $P < 0.0001$	$F_{2,64} = 6.96$ $P = 0.002$	$F_{14,116} = 1.55$ $P = 0.103$
1-Hex vs. (Green/1-Hex)	$F_{7,38} = 18.37$ $P < 0.0001$	$F_{1,44} = 1.57$ $P = 0.217$	$F_{7,38} = 0.77$ $P = 0.618$
Green vs. (Green/1-Hex)	$F_{7,37} = 11.47$ $P < 0.0001$	$F_{1,43} = 14.01$ $P = 0.0005$	$F_{7,37} = 2.92$ $P = 0.016$
Green vs. 1-Hex	$F_{7,35} = 8.87$ $P < 0.0001$	$F_{1,41} = 5.91$ $P = 0.0195$	$F_{7,35} = 1.29$ $P = 0.282$
<i>Odour: 1-Hex, Colour: Blue, Bimodal: Blue/1-Hex</i>			
Blue vs. 1-Hex vs. (Blue/1-Hex)	$F_{7,58} = 29.82$ $P < 0.0001$	$F_{2,64} = 4.18$ $P = 0.0197$	$F_{14,116} = 1.62$ $P = 0.082$
1-Hex vs. (Blue/1-Hex)	$F_{7,38} = 23.76$ $P < 0.0001$	$F_{1,44} = 5.36$ $P = 0.253$	$F_{7,38} = 2.00$ $P = 0.081$
Blue vs. (Blue/1-Hex)	$F_{7,37} = 22.52$ $P < 0.0001$	$F_{1,43} = 7.52$ $P = 0.009$	$F_{7,37} = 2.15$ $P = 0.062$
Blue vs. 1-Hex	$F_{7,35} = 13.07$ $P < 0.0001$	$F_{1,41} = 0.16$ $P = 0.70$	$F_{7,35} = 0.368$ $P = 0.915$
<i>Odour: Lin, Colour: Green, Bimodal: Green/Lin</i>			
Green vs. Lin vs. (Green/Lin)	$F_{7,57} = 14.81$ $P < 0.0001$	$F_{2,63} = 6.20$ $P = 0.004$	$F_{14,114} = 1.88$ $P = 0.036$
Lin vs. (Green/Lin)	$F_{7,37} = 12.99$ $P < 0.0001$	$F_{1,43} = 0.60$ $P = 0.442$	$F_{7,37} = 0.93$ $P = 0.493$
Green vs. (Green/Lin)	$F_{7,38} = 9.71$ $P < 0.0001$	$F_{1,44} = 13.03$ $P = 0.0008$	$F_{7,38} = 3.27$ $P = 0.008$
Green vs. Lin	$F_{7,33} = 7.00$ $P < 0.0001$	$F_{1,39} = 6.20$ $P = 0.017$	$F_{7,33} = 1.39$ $P = 0.24$
<i>Odour: Lin, Colour: Blue, Bimodal: Blue/Lin</i>			
Blue vs. Lin vs. (Blue/Lin)	$F_{7,55} = 16.6$ $P < 0.0001$	$F_{2,61} = 0.62$ $P = 0.54$	$F_{14,110} = 1.40$ $P = 0.163$

Retention

Table S2. Comparison of retention after 24 h for bees receiving an olfactory, a visual and a bimodal signal in an absolute conditioning protocol. Hypothetical population assumes that the bees that were not available would have a chance of conditioned PER of 50%.

Comparison	Hypothetical 50% PER for bees not tested at 24 h	Survivors only
<i>Odour: 1-Hex, Colour: Green, Bimodal: Green/1-Hex</i>		
Green vs. 1-Hex vs. (Green/1-Hex)	$Chi\text{-square}_{2,67} = 2.85$ $P = 0.24$	$Chi\text{-square}_{2,45} = 9.34$ $P = 0.009$
1-Hex vs. (Green/1-Hex)	—	$Chi\text{-square}_{1,33} = 4.55$ $P = 0.032$
Green vs. (Green/1-Hex)	—	$Chi\text{-square}_{1,29} = 7.50$ $P = 0.006$
Green vs. 1-Hex	—	$Chi\text{-square}_{1,28} = 1.147$ $P = 0.28$
<i>Odour: 1-Hex, Colour: Blue, Bimodal: Blue/1-Hex</i>		
Blue vs. 1-Hex vs. (Blue/1-Hex)	$Chi\text{-square}_{2,67} = 3.99$ $P = 0.1362$	$Chi\text{-square}_{2,43} = 8.00$ $P = 0.018$
1-Hex vs. (Blue/1-Hex)	—	$Chi\text{-square}_{1,32} = 6.58$ $P = 0.010$
Blue vs. (Blue/1-Hex)	—	$Chi\text{-square}_{1,27} = 4.18$ $P = 0.041$
Blue vs. 1-Hex	—	$Chi\text{-square}_{1,27} = 0.075$ $P = 0.78$
<i>Odour: Lin, Colour: Green, Bimodal: Green/Lin</i>		
Green vs. Lin vs. (Green/Lin)	$Chi\text{-square}_{2,66} = 4.25$ $P = 0.12$	$Chi\text{-square}_{2,44} = 12.35$ $P = 0.002$
Lin vs. (Green/Lin)	—	$Chi\text{-square}_{1,32} = 0.13$ $P = 0.72$
Green vs. (Green/Lin)	—	$Chi\text{-square}_{1,28} = 9.56$ $P = 0.002$
Green vs. Lin	—	$Chi\text{-square}_{1,28} = 11.32$ $P = 0.0008$
<i>Odour: Lin, Colour: Blue, Bimodal: Blue/Lin</i>		
Blue vs. Lin vs. (Blue/Lin)	$Chi\text{-square}_{2,64} = 5.82$ $P = 0.054$	$Chi\text{-square}_{2,40} = 7.01$ $P = 0.030$
Lin vs. (Blue/Lin)	—	$Chi\text{-square}_{1,29} = 0.04$ $P = 0.837$
Blue vs. (Blue/Lin)	—	$Chi\text{-square}_{1,24} = 5.91$ $P = 0.015$
Blue vs Lin	—	$Chi\text{-square}_{1,27} = 5.49$ $P = 0.019$

Experiment 2: Differential conditioning**Table S3.** Repeated measures MANOVA for the effect of reward on performance of bees in a differential conditioning task

Comparison	Trial	Treatment	Trial x Treatment
G+ vs B-	$F_{6,33} = 1.95$ $P = 0.102$	$F_{1,38} = 8.82$ $P = 0.005$	$F_{6,33} = 1.88$ $P = 0.11$
B+ vs. G-	$F_{6,34} = 4.47$ $P = 0.002$	$F_{1,39} = 20.90$ $P < 0.0001$	$F_{6,34} = 3.35$ $P = 0.010$
Lin+ vs. 1-Hex	$F_{6,38} = 6.75$ $P < 0.0001$	$F_{1,43} = 31.00$ $P < 0.0001$	$F_{6,38} = 6.75$ $P < 0.0001$
1-Hex+ vs. Lin-	$F_{6,33} = 8.18$ $P < 0.0001$	$F_{1,38} = 42.16$ $P < 0.0001$	$F_{6,33} = 7.12$ $P < 0.0001$
(GHex)+ vs. (BLin)-	$F_{6,27} = 3.73$ $P = 0.0079$	$F_{1,32} = 14.73$ $P = 0.0006$	$F_{6,27} = 3.73$ $P = 0.0079$
(BLin)+ vs. (GHex)-	$F_{6,36} = 10.23$ $P < 0.0001$	$F_{1,42} = 58.44$ $P < 0.0001$	$F_{6,37} = 10.29$ $P < 0.0001$
(BHex)+ vs. (GLin)-	$F_{6,37} = 17.80$ $P < 0.0001$	$F_{1,42} = 77.41$ $P < 0.0001$	$F_{6,37} = 15.76$ $P < 0.0001$
(GLin)+ vs. (BHex)-	$F_{6,39} = 18.08$ $P < 0.0001$	$F_{1,44} = 93.53$ $P < 0.0001$	$F_{6,39} = 18.08$ $P < 0.0001$

Table S4. Repeated measures MANOVA for the effect of olfactory, visual and bimodal signals on performance of bees in a differential conditioning task.

Comparison	Trial	Treatment	Trial x Treatment
<i>Odour: 1-Hex, Colour: Green, Bimodal: Green/1-Hex</i>			
Green vs. 1-Hex vs. (Green/1-Hex)	$F_{6,47} = 10.83$ $P < 0.0001$	$F_{2,52} = 6.02$ $P = 0.0044$	$F_{12,94} = 1.11$ $P = 0.36$
1-Hex vs. (Green/1-Hex)	$F_{6,29} = 9.15$ $P < 0.0001$	$F_{1,34} = 3.22$ $P = 0.082$	$F_{6,29} = 0.80$ $P = 0.581$
Green vs. (Green/1-Hex)	$F_{6,28} = 4.03$ $P = 0.005$	$F_{1,33} = 1.92$ $P = 0.175$	$F_{6,28} = 0.65$ $P = 0.691$
Green vs. 1-Hex	$F_{6,32} = 8.53$ $P < 0.0001$	$F_{1,37} = 13.11$ $P = 0.001$	$F_{6,32} = 2.20$ $P = 0.068$
<i>Odour: 1-Hex, Colour: Blue, Bimodal: Blue/1-Hex</i>			
Blue vs. 1-Hex vs. (Blue/1-Hex)	$F_{6,54} = 25.79$ $P < 0.0001$	$F_{2,59} = 2.57$ $P = 0.09$	$F_{12,108} = 1.22$ $P = 0.28$
<i>Odour: Lin, Colour: Green, Bimodal: Green/Lin</i>			
Green vs. Lin vs. (Green/Lin)	$F_{6,54} = 16.73$ $P < 0.0001$	$F_{2,59} = 9.50$ $P = 0.0003$	$F_{12,108} = 2.20$ $P = 0.016$
Lin vs. (Green/Lin)	$F_{6,36} = 17.30$ $P < 0.0001$	$F_{1,41} = 4.02$ $P = 0.052$	$F_{6,36} = 1.38$ $P = 0.25$
Green vs. (Green/Lin)	$F_{6,34} = 12.37$ $P < 0.0001$	$F_{1,39} = 22.42$ $P < 0.0001$	$F_{6,34} = 3.94$ $P = 0.004$
Green vs. Lin	$F_{6,33} = 5.73$ $P = 0.0004$	$F_{1,38} = 5.02$ $P = 0.031$	$F_{6,33} = 2.29$ $P = 0.06$
<i>Odour: Lin, Colour: Blue, Bimodal: Blue/Lin</i>			
Blue vs. Lin vs. (Blue/Lin)	$F_{6,34} = 8.50$ $P < 0.0001$	$F_{1,39} = 0.03$ $P = 0.86$	$F_{6,34} = 0.87$ $P = 0.53$

Retention

Table S5. Comparison of retention after 24 h for bees receiving an olfactory, a visual and a bimodal signal in a differential conditioning protocol. Hypothetical population assumes that the bees that were not available would have a chance of conditioned PER of 50%.

Comparison	Hypothetical 50% PER at 24 h for bees not tested	Survivors at 24 h
<i>Odour: 1-Hex, Colour: Green, Bimodal: Green/1-Hex</i>		
Green vs. 1-Hex vs. (Green/1-Hex)	$Chi-square_{2,55} = 12.97$ $P = 0.002$	$Chi-square_{2,41} = 10.4$ $P = 0.006$
1-Hex vs. (Green/1-Hex)	$Chi-square_{1,36} = 12.96$ $P = 0.0003$	$Chi-square_{1,29} = 9.38$ $P = 0.002$
Green vs. (Green/1-Hex)	$Chi-square_{1,35} = 6.81$ $P = 0.009$	$Chi-square_{1,26} = 1.59$ $P = 0.21$
Green vs. 1-Hex	$Chi-square_{1,39} = 1.49$ $P = 0.221$	$Chi-square_{1,27} = 3.83$ $P = 0.050$
<i>Odour: 1-Hex, Colour: Blue, Bimodal: Blue/1-Hex</i>		
Blue vs. 1-Hex vs. (Blue/1-Hex)	$Chi-square_{2,62} = 1.034$ $P = 0.60$	$Chi-square_{2,46} = 3.39$ $P = 0.183$
<i>Odour: Lin, Colour: Green, Bimodal: Green/Lin</i>		
Green vs. Lin vs. (Green/Lin)	$Chi-square_{2,62} = 1.69$ $P = 0.43$	$Chi-square_{2,44} = 5.20$ $P = 0.074$
<i>Odour: Lin, Colour: Blue, Bimodal: Blue/Lin</i>		
Blue vs. Lin vs. (Blue/Lin)	$Chi-square_{2,62} = 1.80$ $P = 0.40$	$Chi-square_{2,52} = 3.87$ $P = 0.14$