Supplemental Experimental Procedures

Animal keeping

Freshly moulted adult cockroaches were selected from a breeding colony. The animals were kept at 23-25^{o}C under a reversed 12 h night/12 h day photoperiod regime to reverse circadian rhythms so as to maximize behavioural activity during normal working hours. They were provided with dried cat food and water *ad libitum*. Animal care was done in accordance with institutional guidelines.

Experimental apparatus.

Behavioural trials on cockroaches were performed in a circular arena 45cm in diameter with 15cm high walls in a darkened room under far-red (>675 nm) illumination provided by an array of LEDs. Wind stimuli were delivered from 15mm above the arena floor through a 25mm diameter pipe presented at 45^{o} to the horizontal, using a wind stimulus machine driven by a loudspeaker cone described in previous work [13]. Peak wind velocity of the stimuli was approximately 0.28 m s^{-1} as measured using a miniature hot-wire anemometer. All trials were captured on video at 50 frames s^{-1} using a monochrome CCD camera (Sony AVC-D7CE) and VCR (Panasonic 999). Both wind angle and ETs were computed by analyzing video stills of the escape trials using a custom analysis program (HeadAngle, Kappa Software, Brighton). The potential maximum error in the angle measurement, due to pixel size, was ± 0.6°. Wind angle-body turn data from previous work [Fig. 5 and 6 in Camhi and Tom [6] and Figs. 5A and 6A in Comer and Dowd [10]] were digitized on original figures (x-y plots of wind angle *vs*. body turn) using Scion Image.

Wind-angle distributions

Two series of experiments were carried out in order to compare the distribution of high numbers of escape trajectories of individual cockroaches with that of the whole colony. In the first experiment, we obtained a relatively high number of escape runs per individual in five cockroaches (*n*=93, 93, 89, 81, 75, respectively) over a wide range of wind angles. The distribution of wind angles was uniform for each animal (χ^2 test; P>0.05, P >0.1, P >0.25, P >0.25, P >0.75, respectively; d.f =8 in all cases) and not different among the five animals (χ^2 =15.7; d.f.=28; P>0.95). A second series of experiments was run by stimulating each cockroach only once, using a total of 86 individuals (singletons). The distribution of wind angles in singletons was uniform (χ^2 =9.44, P>0.25; d.f.=8). Previous work analysed here (Fig 4A and 4B) shows non-uniform distributions of wind angle (for Fig. 4A, χ^2=21.40; d.f.=8; P<0.025; for Fig. 4B, χ^2=73.17; d.f.=8; P<0.001).

Additional Statistics

Since U^2 tests are applied to the whole 360° range, an additional test of uniformity applied to the angular range within which most ETs occur was carried out. For each data set, the range was chosen as the smallest arc which contains 99% of the data. This corresponded to the following ranges: 80 to 200° (singletons), 60 to 220° (5i data set), -80° to 200° (data from Fig. 4A), and -10° to 270° (data from Fig. 4B). Uniformity was tested using χ^2 tests with 10° bins.

Curves based on mixtures of multiple Gaussian distributions, with the constraints of the same standard deviation and equal peak spacing, were fitted to unbinned ET data using the maximum-likelihood method [*mle* program: Darryl Holman, University of Washington, Seattle [1]. The program evaluated possible mixtures of from one to 10 Gaussian curves (of equal width and spacing) and the best-fitting curve was chosen as that with the highest corrected Akaike Information Criterion (AICc), which balances a maximization of the likelihood against the minimization of the number of parameters, thus avoiding overfitting [2,3]. The Akaike weight is directly derived from the AICc and gives the probability of that chosen model being the correct one compared to the alternatives. This approach does not rule out the possibility that more complex mixtures with Gaussians of variable width and spacing could more accurately describe the data; however, such models have many more parameters and are thus likely to have lower AICcs. These best-fit distributions were tested against binned experimental data using the χ^2 test. Finally, peaks in each multimodal distribution were defined as those that contribute at least 5% to the best-fit curve.

Supplemental References:

1. Holman, D.J. (2003). mle: A programming language for building likelihood models. Version 2.1. Volume 1. Users Manual. and Volume 2, Reference Manual. *http://faculty.washington.edu/~djholman/mle*.

2. Akaike, H. (1974). A new look at the statistical model identification. IEEE Transactions on Automatic Control *AC-19*, 716723.

3. Hurvich, C.M., and Tsai, C.L. (1989). Regression and time series model selection in small samples. Biometrika *78*, 499509.