Supplemental:

Table S1 – Credibility intervals (Highest Density Intervals – HDIs) on the difference in means between animals with only a left or right antenna (used to form Figure 3). A negative credibility interval (the lower (HDI-lo) and upper (HDI-up) bounds are both negative) indicates that first group in the comparison is smaller than the second group, whereas a positive credibility interval (HDI-lo and HDI-up are both positive) indicates first group is larger than the second. A credibility interval that contains zero indicates the groups are the same. In this case, we compared left to right, and all groups are equal for all track parameters. Significant differences are highlighted.

	4 cm		2 cm		1 cm	
	HDI-low	HDI-up	HDI-low	HDI-up	HDI-low	HDI-up
Time to Source (s)	-12.9	10.9	-33.8	36.6	-112	106
Walking Speed (cm/s)	-4.83	4.68	-4.55	4.25	-18.47	6.75
Track Width (cm)	-2.00	1.81	-1.57	1.23	-5.63	4.50
Walking Distance (cm)	-248	200	-390	371	-1450	780
Linearity	-0.22	0.20	-0.11	0.22	-0.097	0.26
No. Stops	-6.52	6.68	-11.4	27.7	-82.8	75.7
Stop Duration (s)	-0.065	0.13	-0.039	0.11	-0.13	0.17
Total Stop Time (s)	-1.53	1.76	-2.52	7.58	-17.8	17.7
No. Backtracks	-4.16	4.31	-7.77	6.98	-21.8	16.3
No. Left Turns	-6.99	5.78	-9.84	15.8	-31.7	15.2
No. Right Turns	-9.18	6.16	-11.2	14.5	-28.7	7.32
Interturn Duration	-0.22	0.61	-0.50	1.05	-1.12	3.52
Mag. Body Angle (°)	-15.9	21.9	-20.1	12.2	-29.6	18.5
Body Angle (°)	-10.2	8.75	-11.7	6.12	-23.5	17.2
Angular Velocity (°/s)	-7.72	24.4	-0.67	27.32	-40.4	40.1
Angular Acceleration (°/s^2)	-5.65	5.44	-4.92	1.79	-9.24	5.79

Table S2 – Credibility intervals on the difference in means between animals with two antennae vs one antenna (used to form figure 4). See table S1 for information on how to interpret HDIs. Significant differences are highlighted.

	4 cm		2 cm		1 cm	
	HDI-low	HDI-up	HDI-low	HDI-up	HDI-low	HDI-up
Time to Source (s)	-17.9	-6.28	-40.8	-11.7	-62.6	-15.9
Walking Speed (cm/s)	1.27	9.56	3.34	10.9	4.82	11.9
Track Width (cm)	-3.31	-0.84	-3.09	-0.59	-3.18	-0.25
Walking Distance (cm)	-252	-79.9	-500.	-82.9	-761	142
Linearity	0.12	0.42	0.021	0.37	-4.59E-5	0.20
No. Stops	-8.44	-1.35	-29.9	-11.1	-32.0	-0.17
Stop Duration (s)	-0.12	-0.01	-0.12	-0.01	-0.12	0.0058
Total Stop Time (s)	-1.86	-0.21	-6.08	-1.30	-4.66	-0.24
No. Backtracks	-5.13	-1.35	-10.8	-2.13	-17.0	1.73
No. Left Turns	-7.71	-2.16	-15.0	2.95	-18.2	11.8
No. Right Turns	-7.93	-1.79	-16.0	-2.34	-16.5	8.84
Interturn Duration	-0.39	0.44	-1.05	-0.23	-1.96	-0.13
Mag. Body Angle (°)	-35.8	-8.63	-31.1	-0.17	-20.6	6.27
Body Angle (°)	-4.90	8.94	-8.89	2.45	-12.0	2.14
Angular Velocity (°/s)	-12.9	13.1	-5.14	16.3	-14.9	12.7
Angular Acceleration (°/s^2)	-9.38	0.82	-3.97	3.30	-3.27	3.20

Table S3 – Credibility intervals on the difference in means between animals with different length antennae, by treatment (used to form Figure 6). See Table S1 for information on how to interpret HDIs. Significant differences are highlighted.

	Bilateral				Antennectomy			
	4 cm vs 2 cm		2 cm vs 1 cm		4 cm vs 2 cm		2 cm vs 1 cm	
	HDI-low	HDI-up	HDI-low	HDI-up	HDI-low	HDI-up	HDI-low	HDI-up
Time to Source (s)	-17.4	-0.72	-21.7	1.83	-43.2	-11.7	-48.2	6.10
Walking Speed (cm/s)	-2.68	7.05	-4.08	4.01	0.97	6.80	-2.23	4.32
Track Width (cm)	-2.32	0.43	-2.55	0.02	-1.80	0.37	-2.61	0.25
Walking Distance (cm)	-244	-10.7	-515	14.8	-491	-99.6	-693	71.0
Linearity	0.043	0.43	0.030	0.38	0.043	0.28	5.6E-05	0.15
No. Stops	-3.27	2.18	-5.44	2.20	-26.0	-5.63	-26.6	17.7
Stop Duration (s)	-0.062	0.039	-0.082	0.039	-0.071	0.036	-0.71	0.043
Total Stop Time (s)	-0.39	0.44	-0.60	0.25	-5.63	-0.72	-5.14	4.79
No. Backtracks	-5.20	-0.32	-10.4	-0.30	-10.4	-2.90	-16.4	1.09
No. Left Turns	-12.4	-0.89	-16.6	3.28	-15.4	-3.09	-17.2	4.64
No. Right Turns	-9.60	-0.24	-16.52	.54	-15.8	-3.75	-14.6	7.43
Interturn Duration	-0.033	0.78	-0.21	0.24	-0.63	0.17	-1.21	0.45
Mag. Body Angle (°)	-35.7	-1.79	-31.8	-0.58	-23.7	-0.59	-19.5	3.99
Body Angle (°)	-3.11	9.97	-4.34	7.54	-7.63	4.24	-6.99	6.67
Angular Velocity (°/s)	-8.68	18.0	-14.0	14.6	0.77	20.4	-16.6	3.75
Angular Acceleration (°/s^2)	-7.41	3.27	-5.25	3.16	-1.29	4.25	-3.05	1.56

Table S4 – Credibility intervals on the difference in means between animals with the same net antenna length, bilateral (B) vs antennectomy (A) (used to form Figure 7). See table S1 for information on how to interpret HDIs. Significant differences are highlighted.

	2 cm B vs 4 cm A		1 cm B vs 2 cm A	
	HDI-low	HDI-up	HDI-low	HDI-up
Time to Source (s)	-10.4	5.98	-10.4	5.98
Walking Speed (cm/s)	-0.61	6.95	4.03	10.42
Track Width (cm)	-2.48	0.26	-1.58	0.34
Walking Distance (cm)	-181	114	-326	380
Linearity	-0.15	0.21	-0.12	0.10
No. Stops	-7.59	-0.61	-27.4	-6.31
Stop Duration (s)	-0.11	0.01	-0.10	0.01
Total Stop Time (s)	-1.57	-0.17	-5.14	-0.86
No. Backtracks	-3.16	3.26	-6.12	6.46
No. Left Turns	-4.55	8.92	-8.58	15.6
No. Right Turns	-5.48	4.63	-9.51	10.8
Interturn Duration	-0.56	-0.08	-1.14	-0.39
Mag. Body Angle (°)	-19.6	12.6	-9.85	11.5
Body Angle (°)	-7.32	4.24	-10.9	1.28
Angular Velocity (°/s)	-15.9	5.72	-8.27	19.1
Angular Acceleration (°/s^2)	-5.75	2.17	-2.43	3.90

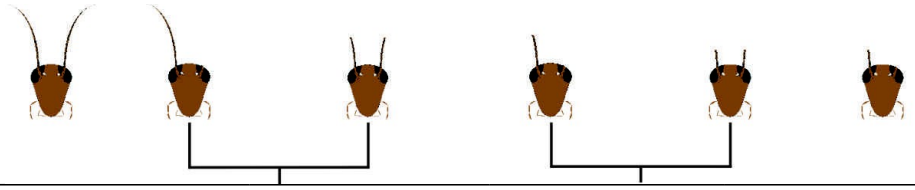
Table S5 – Grand means ±S.D. of parameters measured from the trajectories of *P.americana* males with antennae of different lengths as they walked upwind in plumes of female pheromone. Means across rows with no letters or symbols in common are significantly different according to a one-way ANOVA ($P \leq 0.05$) followed by a Tukeys-Kramer multiple comparison test (JMP ver. 11.1.1). Roman letters indicate significant groups in the ANOVA length comparisons, Greek letters (α, β, and γ) indicate significant groups in the length comparisons in the Bayesian hierarchical model.

	4 cm	2 cm	1 cm
Time to Source (s)	$17.0 \pm 13.3^{b\alpha}$	$45.0 \pm 44.7^{a\beta}$	$52.9 \pm 42.5^{a\gamma}$
Walking Speed (cm/s)	$20.6 \pm 6.9^{a\alpha}$	$17.4 \pm 6.81^{b\beta}$	$18.4 \pm 6.05^{ab\beta}$
Track Width (cm)	$4.49 \pm 2.32^{b\alpha}$	$5.29 \pm 2.17^{ab\alpha\beta}$	$6.13 \pm 1.86^{a\beta}$
Walking Distance (cm)	$318 \pm 247^{b\alpha}$	$707 \pm 797^{a\beta}$	$914 \pm 808^{a\gamma}$
Linearity	$0.52 \pm 0.27^{a\alpha}$	$0.34 \pm 0.2^{b\beta}$	$0.22 \pm 0.18^{b\gamma}$
No. Stops	$7.84 \pm 7.58^{b\alpha}$	$17.9 \pm 20.6^{a\beta}$	$19.2 \pm 25.6^{a\alpha\beta}$
Stop Duration (s)	$0.14 \pm 0.13^{\alpha}$	$0.14 \pm 0.09^{\alpha}$	$0.15 \pm 0.09^{\alpha}$
Total Stop Time (s)	$1.50 \pm 2.25^{b\alpha}$	$3.75 \pm 5.28^{a\alpha}$	$3.79 \pm 5.89^{a\alpha}$
No. Backtracks	$3.29 \pm 4.48^{b\alpha}$	$10.5 \pm 12.4^{a\beta}$	$15.2 \pm 13.0^{a\gamma}$
No. Left Turns	$7.63 \pm 7.90^{b\alpha}$	$21.3 \pm 27.3^{a\beta}$	$25.6 \pm 23.2^{a\beta}$
No. Right Turns	$8.04 \pm 9.33^{b\alpha}$	$21.2 \pm 24.5^{a\beta}$	$26.7 \pm 27.8^{a\gamma}$
Interturn Duration	$1.40 \pm 1.05^{\alpha}$	$1.27 \pm 0.85^{\alpha}$	$1.46 \pm 2.00^{\alpha}$
Mag. Body Angle (°)	$44.4 \pm 24.7^{b\alpha}$	$58.3 \pm 24.2^{a\beta}$	$68.1 \pm 17.1^{a\gamma}$
Body Angle (°)	$1.60 \pm 11.5^{\alpha}$	$1.36 \pm 9.84^{\alpha}$	$-0.69 \pm 9.20^{\alpha}$
Angular Velocity (°/s)	$5.36 \pm 20.3^{\alpha}$	$-3.33 \pm 17.7^{\alpha}$	$-0.09 \pm 19.1^{\alpha}$
Angular Acceleration (°/s^2)	$-0.27 \pm 8.27^{\alpha}$	$-0.39 \pm 5.37^{\alpha}$	$0.57 \pm 4.5^{\alpha}$

Table S6 - Grand means ± S.D. of parameters measured from the trajectories of *P.americana* males with 1 and 2 antennae as they walked upwind in plumes of female pheromone. * is given in the 2 antennae column if there was a significant difference between groups by number of antennae in the ANOVA and † is given to denote a significant difference between 1 and 2 antennae individuals in the Bayesian Hierarchical model.

	2 antennae	**1 antennae**
Time to Source (s)	25.9 ± 34.6*†	44.4 ± 39.4
Walking Speed (cm/s)	22.4 ± 6.48*†	16.0 ± 5.55
Track Width (cm)	4.28 ± 2.04*†	5.92 ± 2.14
Walking Distance (cm)	597 ± 896†	615 ± 456
Linearity	0.46 ± 0.30†	0.32 ± 0.24
No. Stops	6.83 ± 9.16*†	20.4 ± 22.4
Stop Duration (s)	0.11 ± 0.11†	0.16 ± 0.10
Total Stop Time (s)	1.18 ± 2.41*†	4.28 ± 5.50
No. Backtracks	7.52 ± 12.8†	9.89 ± 9.81
No. Left Turns	18.2 ± 29.0†	16.2 ± 14.1
No. Right Turns	18.0 ± 29.1†	17.0 ± 14.9
Interturn Duration	1.02 ± 0.83†	1.65 ± 1.50
Mag. Body Angle (°)	48.6 ± 25.8*†	60.7 ± 22.4
Body Angle (°)	-0.03 ± 9.87	1.75 ± 10.7
Angular Velocity (°/s)	1.87 ± 21.2	-0.05 ± 17.7
Angular Acceleration (°/s^2)	-1.42 ± 7.87	0.54 ± 4.94

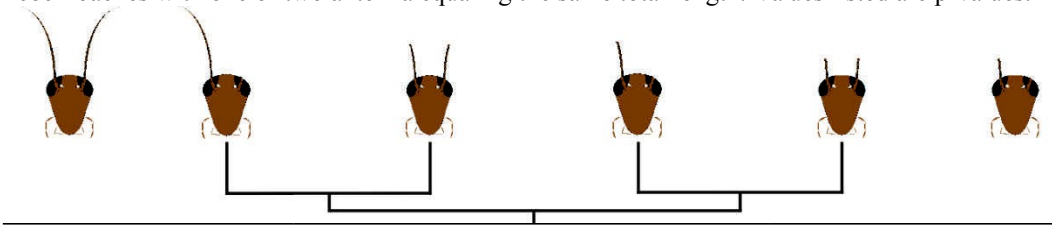
Table S7. Least squares contrast between the mean track parameters measured from cockroaches with one or two antenna but with equal total length of antenna. Values listed are p-values.



Track parameter	4cm uni- vs bi- contrast	2cm uni- vs bi- contrast	Effect of side w/ respect to length
Walking distance (cm)	0.07	0.36	No effect of "side" on distance walked. [Tracks of roaches w/ one longer antenna marginally shorter.]
Time to Source (sec)	0.44	0.1	No effect of "side" on time to source.
Walking speed (cm/s)	0.06	0.0001*	Symmetrical roaches walk faster.
Track width (cm)	0.05	0.30	No effect of "side" on track width. [Roaches w/ one long antenna generate wider tracks than symmetrical roaches.]
Linearity index	0.69	0.75	No effect of "side" on directness of track.
Mean # stops	0.35	0.001*	Roaches w/ only one short antenna stop more.
Stop duration (sec)	0.12	0.20	No effect of side on stop duration.
Total stops time (sec)	0.31	0.005	No effect of "side" on total time stopped. [Roaches w/ only one short antenna stop more.]
# of Backtracks	0.12	0.71	No effect of "side" on backtracking.
# of Left turns	0.02	0.27	No effect of "side" on # of left turns. [Fewer L turns with longer antenna.]
# of Right turns	0.07	0.23	No effect of "side" on # of right turns.
Inter-turn duration (sec)	0.13	0.03	No effect of "side" on inter-turn durations. [Shorter inter-turn dur. w/ two short antennae.]
X body angle (degrees)	0.58	0.80	No effect of "side" on body angle
Body angle	0.69	0.08	No effect of "side" on body angle
Angular velocity (degrees/sec)	0.37	0.41	No effect of "side" on angular velocity
Angular acceleration (deg./s/s)	0.31	0.63	No effect of "side" on angular acceleration

Significance was designated after a Bonferroni correction for multiple comparisons. For this design the post-correction probability level indicating a statistically significant difference is $p < 0.002$

Table S8. Least squares contrast of the effect of antennal length across all of the mean track parameters measured from cockroaches with one or two antenna equaling the same total length. Values listed are p-values.



Track parameter	4cm vs 2cm contrast	Effect of length regardless of symmetry
Walking distance (cm)	0.12	No effect of length regardless of symmetry on angular acceleration
Time to Source (sec)	0.002*	Significant effect of antennal length regardless of symmetry. [Cockroaches with longer antennae take less time to reach the source.]
Walking speed (cm/s)	0.10	No effect of length regardless of symmetry on angular acceleration
Track width (cm)	0.01	No effect of length regardless of symmetry on angular acceleration. [Roaches w/ one long antenna generate wider tracks than symmetrical roaches.]
Linearity index	0.0003*	Significant effect of antennal length regardless of symmetry. [Cockroaches with longer antennae generate a more direct track to the source.]
Mean # stops	0.002*	Significant effect of antennal length regardless of symmetry. [Cockroaches w/ only one short antenna stop more.]
Stop duration (sec)	0.43	No effect of side on stop duration.
Total stop time (sec)	0.005	No effect of "side" on total time stopped. [Roaches w/ only one short antenna stop more.]
# of Backtracks	0.021	No effect of "side" on backtracking.
# of Left turns	0.17	No effect of "side" on # of left turns.
# of Right turns	0.04	No effect of "side" on # of right turns.
Inter-turn duration (sec)	0.80	No effect of "side" on inter-turn durations. [Shorter inter-turn duration w/ two short antennae.]
Magnitude of body angle (degrees)	0.002*	Significant effect of antennal length regardless of symmetry. [Cockroaches with longer antennae steer more directly into the wind.]
Mean Body angle	0.96	No effect of length regardless of symmetry on angular acceleration
Angular velocity (degrees/sec)	0.20	No effect of length regardless of symmetry on angular acceleration
Angular acceleration (deg./s/s)	0.84	No effect of length regardless of symmetry on angular acceleration

Significance was designated after a Bonferroni correction for multiple comparisons. For this design the post-correction probability level indicating a statistically significant difference is $p < 0.003$.

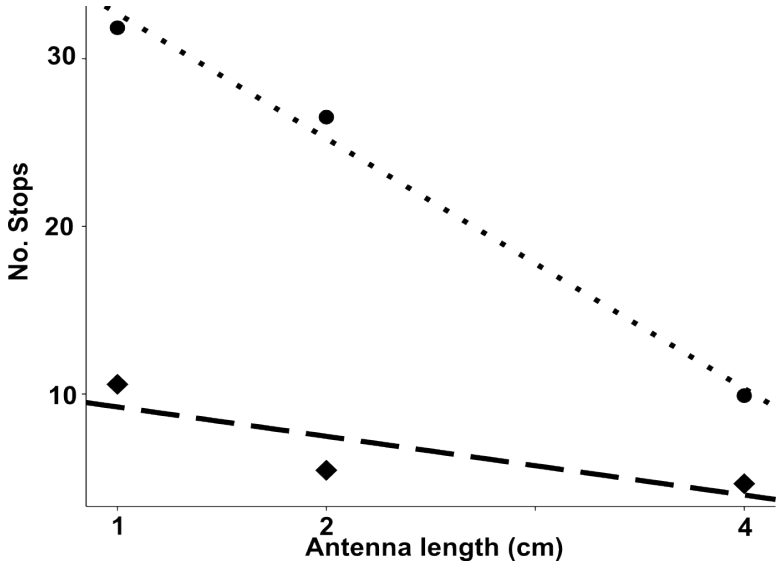


Figure S1 – Interaction of antenna length and number of antennae with the number of stops: length ($F_{2,2}$=7.31, p=0.001), side ($F_{1,1}$=28.0, p<0.001), length-side interaction ($F_{2,2}$=3.47, p=0.034). The dotted line and circles are for 1 antenna, and the dashed line and diamonds are for 2 antennae.