Supplementary Materials

Living in a Trash Can: Turbulent Convective Flows Impair *Drosophila* Flight Performance

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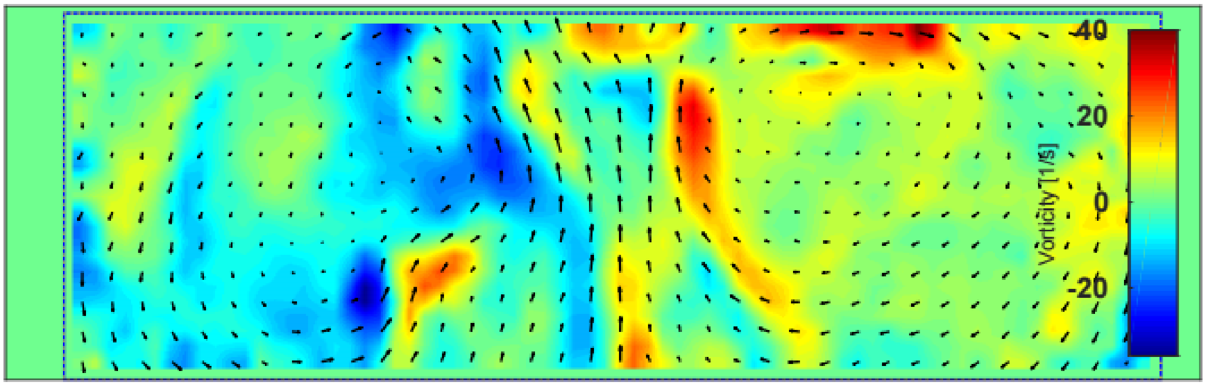

Figure SA. Vorticity field resulting from Rayleigh-Bénard convection in the flight chamber.

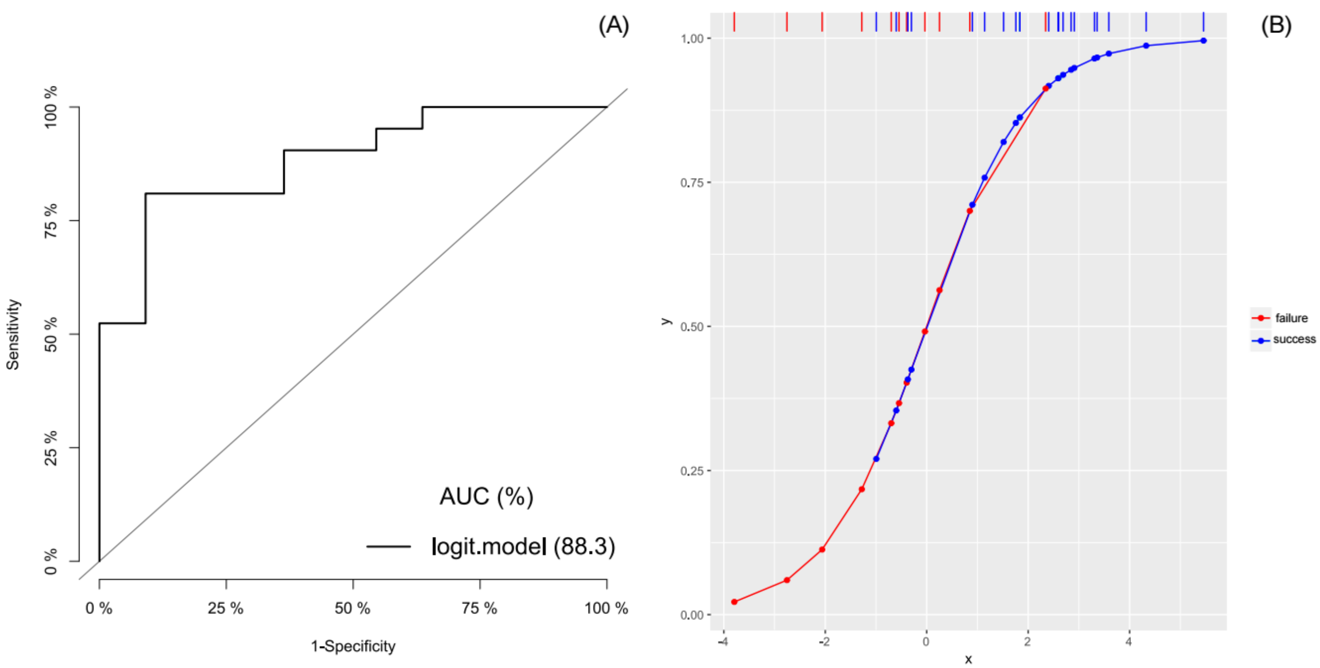

Figure SB. ROC plot (a) and S-curve plot (b) showing the predictions of success *versus* failure derived from the binary logistic regression model including body length, wing area, sex, and mean flight speed in still-air as predictors.

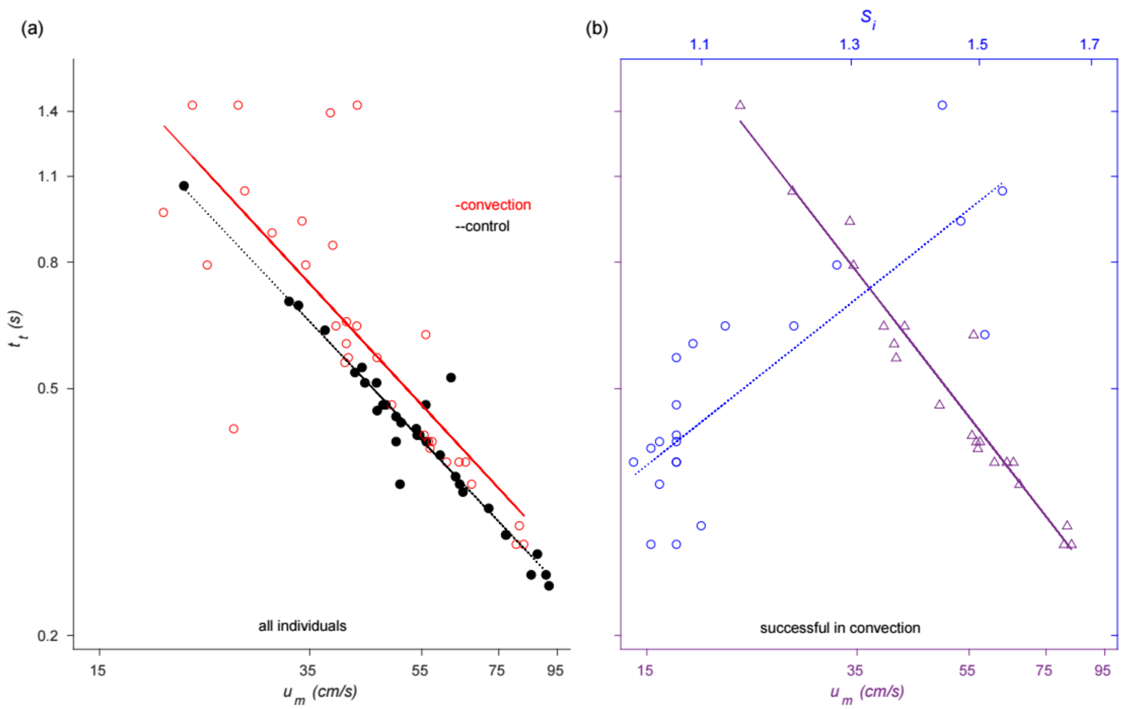

Figure SC. Regression plots of total travel time as a function of mean flight speed and path sinuosity. (a) Log-log plot showing linear regression of travel time as a function of average flight speed for all individuals (N=32) in still air (control, filled circles) and convection conditions (open circles). (still air: $F_{2,30}$=88, R^2 = 0.74, p < 0.001; convection: $F_{2,30}$=31, R^2 = 0.5, p < 0.001). (B) Log-log plot showing linear regression of total travel time as a function of mean flight speed (purple) and path sinuosity (blue) for successful flies (N=21) in convection conditions. ($F_{2,18}$=63 R^2 = 0.86, p < 0.001; u_m p <0.001, *Si* p< 0.001).

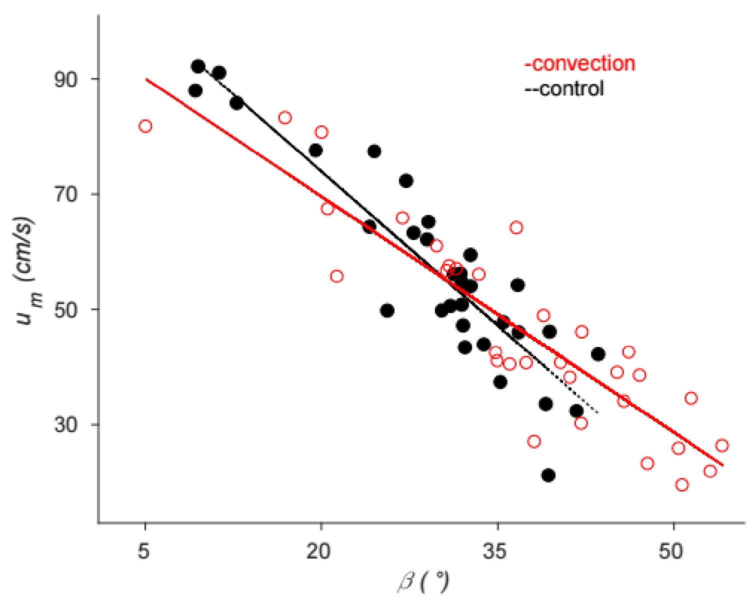

Figure SD. Linear regression of mean flight speed as a function of body pitch angle for all individuals (N=32) in still air (black, filled) and convection (red, open). (still air: $F_{2,30}$=148, R^2 = 0.83, p < 0.001; convection: $F_{2,30}$=126, R^2 = 0.8, p < 0.001).

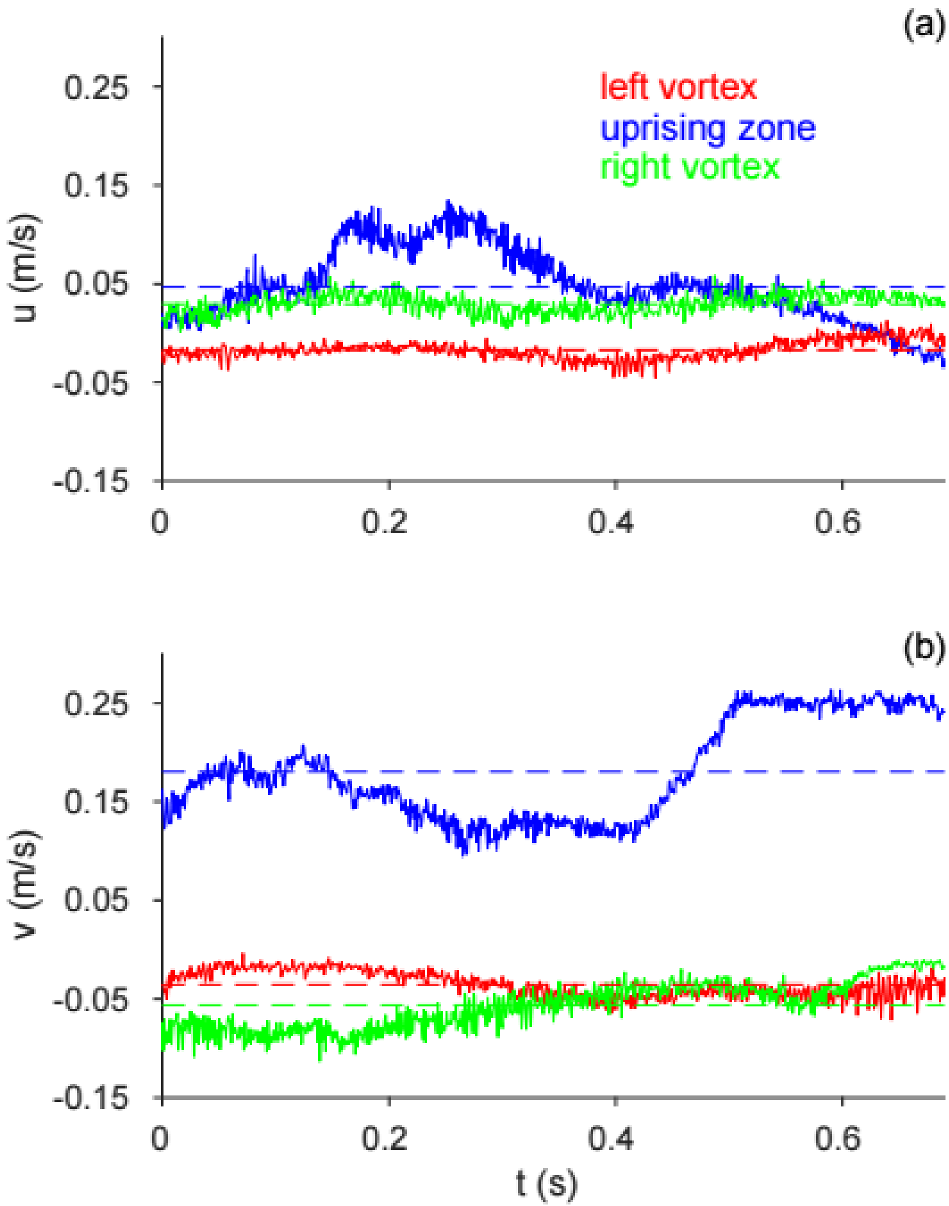

Figure SE. Time series of horizontal (u) and vertical (v) flow speed in the left vortex zone (red), uprising zone (blue) and right vortex zone (green). Sampled points are represented in Figure 1 as asterisks, respectively. Average values are shown by broken color lines.

Table S1: Morphology and flight kinematics of *Drosophila melanogaster* flying in still air and convection conditions. Data from flight trials is presented with all individuals grouped together (*N*=32), and with individuals separated into those that were successful in convection (*N*=21) and those that failed in convection (*N*=11). Data is also shown for the five individuals that completed still-air trials both before and after flying in convection (*N*=5). Variables are as follows: body length l_b, wing area S, travel time t_t, path sinuosity Si, mean flight speed u_m, travel time t_t, pitch angle β, flapping frequency n, and stroke amplitude Φ. Data shown are means ± one standard deviation.

group	treatment	N	l_b (mm)	S (mm²)	t_t (s)	Si	u_m (cm/s)	β (deg)	n (Hz)	Φ (deg)
all	still-air	32	1.6±0.2	1.1±0.2	0.4±0.2	1.03±0.02	57±17	30±9	233±22	135±20
	convection	32	1.6±0.2	1.1±0.2	0.7±0.4	1.60±1.07	46±18	37±12	246±24	127±15
success	still-air	21	1.7±0.2	1.2±0.2	0.4±0.1	1.02±0.01	62±17	27±10	236±21	140±18
	convection	21	1.7±0.2	1.2±0.2	0.6±0.3	1.17±0.17	53±17	33±12	249±27	126±16
failure	still-air	11	1.6±0.1	1.0±0.2	0.5±0.2	1.03±0.02	46±12	34±5	225±21	124±19
	convection	11	1.6±0.1	1.0±0.2	0.9±0.4	2.43±1.52	34±9	45±5	241±18	130±14
before	still-air	5	1.6±0.1	1.2±0.2	0.5±0.1	1.03±0.02	48±10	32±5	243±16	127±17
after	still-air	5	1.6±0.1	1.2±0.2	0.6±0.2	1.04±0.02	42±14	33±7	239±20	115±23

Table S2: Results of unpaired t-tests for differences in morphological and kinematic variables between female (*N*=25) and male (*N*=7) fruit flies. Variables are as follows: body length l_b, wing area S, travel time t_t, path sinuosity Si, mean flight speed u_m, travel time t_t, pitch angle β, flapping frequency n, and stroke amplitude Φ.

		still air						convection					
	l_b	t_t (s)	Si	u_m (cm/s)	β (deg)	n (Hz)	Φ (deg)	t_t (s)	Si	u_m (cm/s)	β (deg)	n (Hz)	Φ (deg)
statistic	0.36	1.67	0.64	-1.56	0.64	0.43	-1.58	1.84	0.24	-0.97	0.68	0.76	-0.12
df	15.47	14.42	7.99	8.79	7.42	12.05	14.42	20.80	9.80	11.18	10.21	25.45	14.47
p-value	0.72	0.12	0.54	0.15	0.54	0.68	0.14	0.08	0.82	0.35	0.51	0.46	0.90

Table S3: Results of paired t-tests for differences in flight performance between the first and second (post-convection) still-air trials performed on a subset of individuals (*N*=5). Variables are as follows: travel time t_t, path sinuosity Si, mean flight speed u_m, travel time t_t, pitch angle β, flapping frequency n, and stroke amplitude Φ.

	t_t (s)	Si	u_m (cm/s)	β (deg)	n (Hz)	Φ (deg)
statistic	-1.9	-1.1	0.96	-0.28	1.4	1.1
df	4	4	4	4	4	4
p-value	0.13	0.34	0.39	0.79	0.25	0.3

DataSet_and_Raw_Data.xlsx [First sheet shows the datasets used for statistical analysis. Other sheets show 3D digitized data from 32 individual fruit flies (7 males and 25 females) flying through still air (control I and II) and convection conditions. Point 1 (head), point 2 (abdomen tip), point 3 (wing base) and point 4 (wing tip) correspond to Cartesian coordinates XYZ in cm (see Figure 1). Software is described in: Hedrick, T. L. (2008). Software techniques for two- and three-dimensional kinematic measurements of biological and biomimetic systems. Bioinspir. Biomim. 3, 034001.]