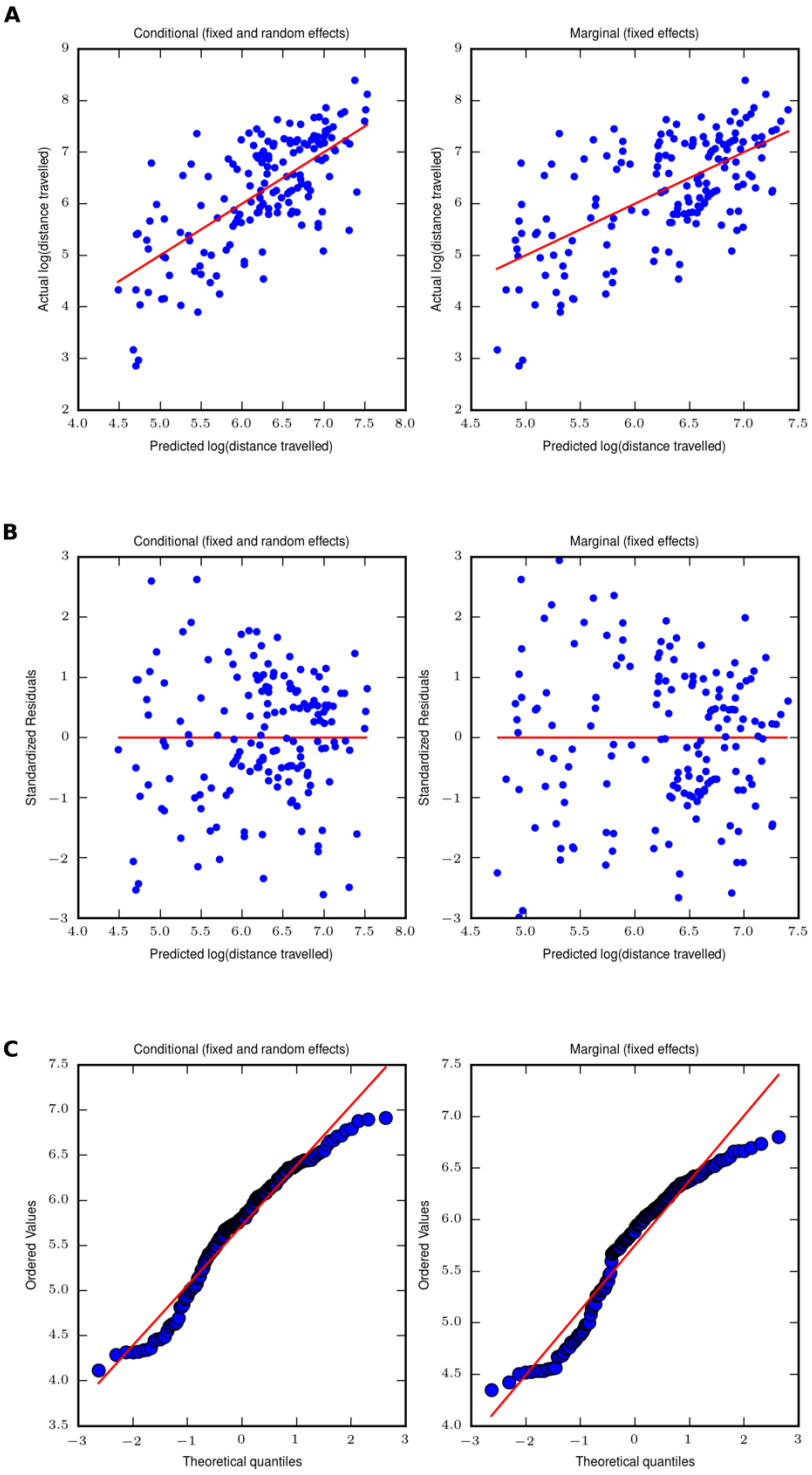


Fig. S1. Goodness-of-fit figures for the mixed effects linear model given in Table 1. (A) Actual vs. predicted taking into account (left) both fixed and random effects, or (right) just fixed effects. (B) Standardized residuals vs. predicted values, and (C) Q-Q plot.

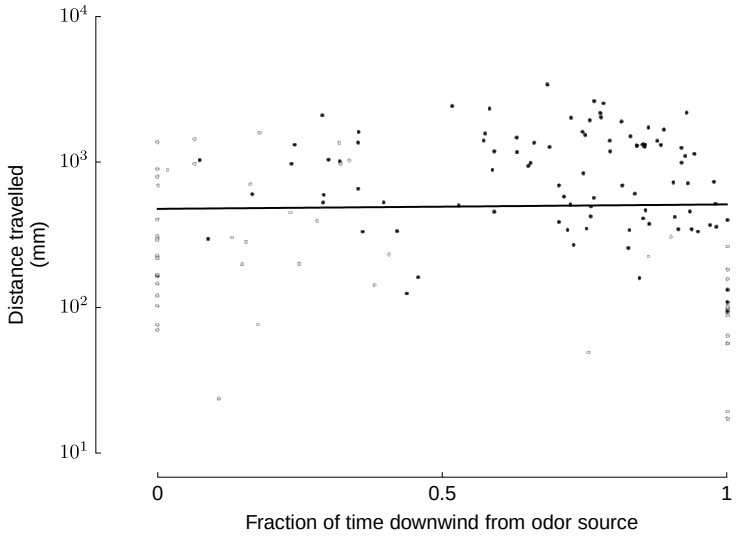


Fig. S2 Distance travelled is not correlated with the fraction of time flies spend in the ±45° wedge downwind of the odor source (slope=0.07, p=0.79, R^2=0.00048). To calculate the fraction of time flies spent downwind from the odor source I calculated the angle relative to downwind for each frame, as in Fig. 3G-H, and calculated the fraction of frames for which the absolute value of the angle was less 45°. Dark and light points correspond to flies that approached the odor source, and those that did not, respectively, as in Fig. 2D.

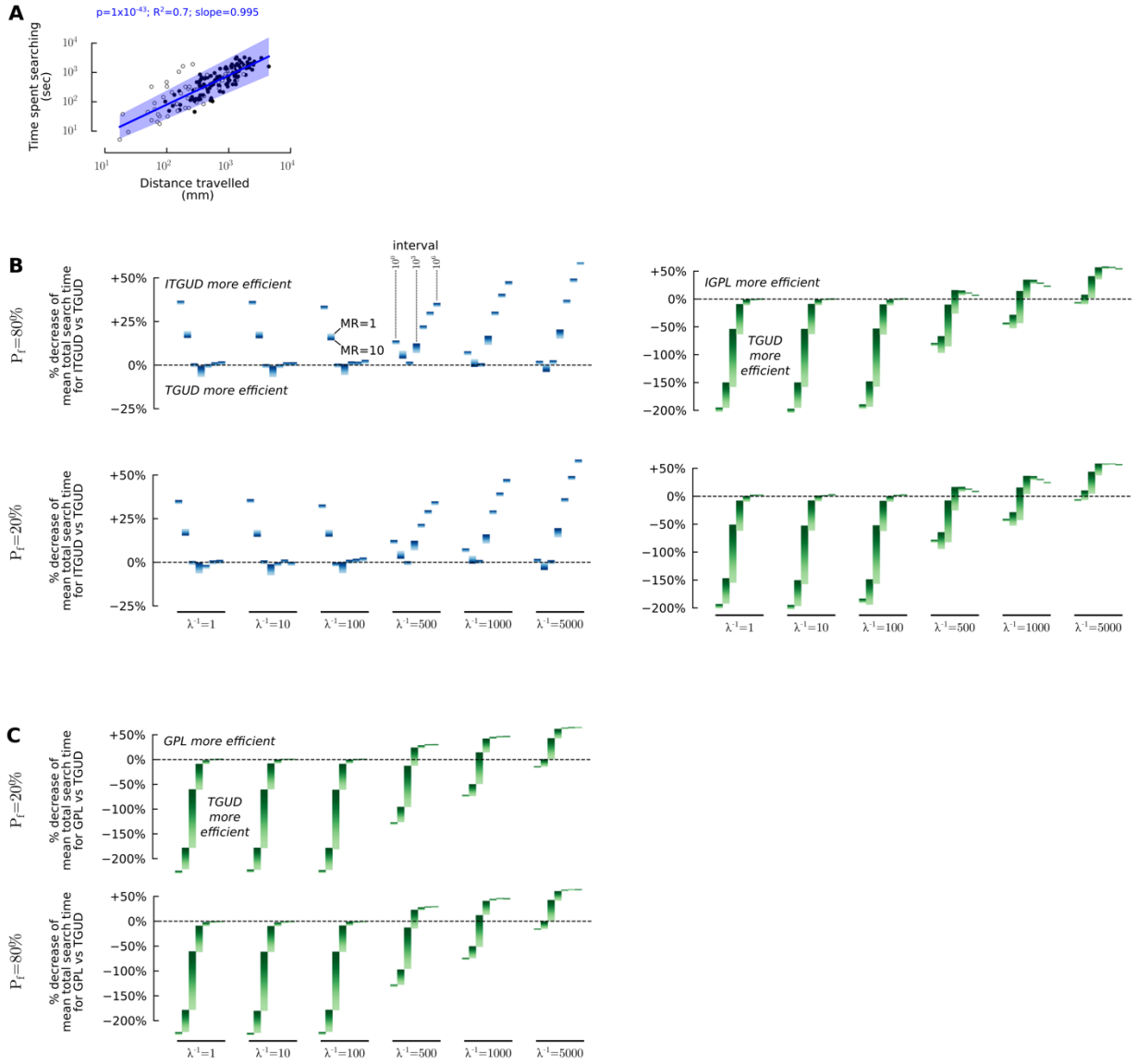


Fig. S3. Additional agent-based stimulation scenarios are consistent with those shown in Figure 4. (A) Correlation between the time flies spent searching on their patch visits and distance travelled. (B) Top row: repeated from Fig. 4. Bottom row: same as top row but for P_f=20%. (C) Same as Fig. 4F, but comparing GPL and TGUD strategies.

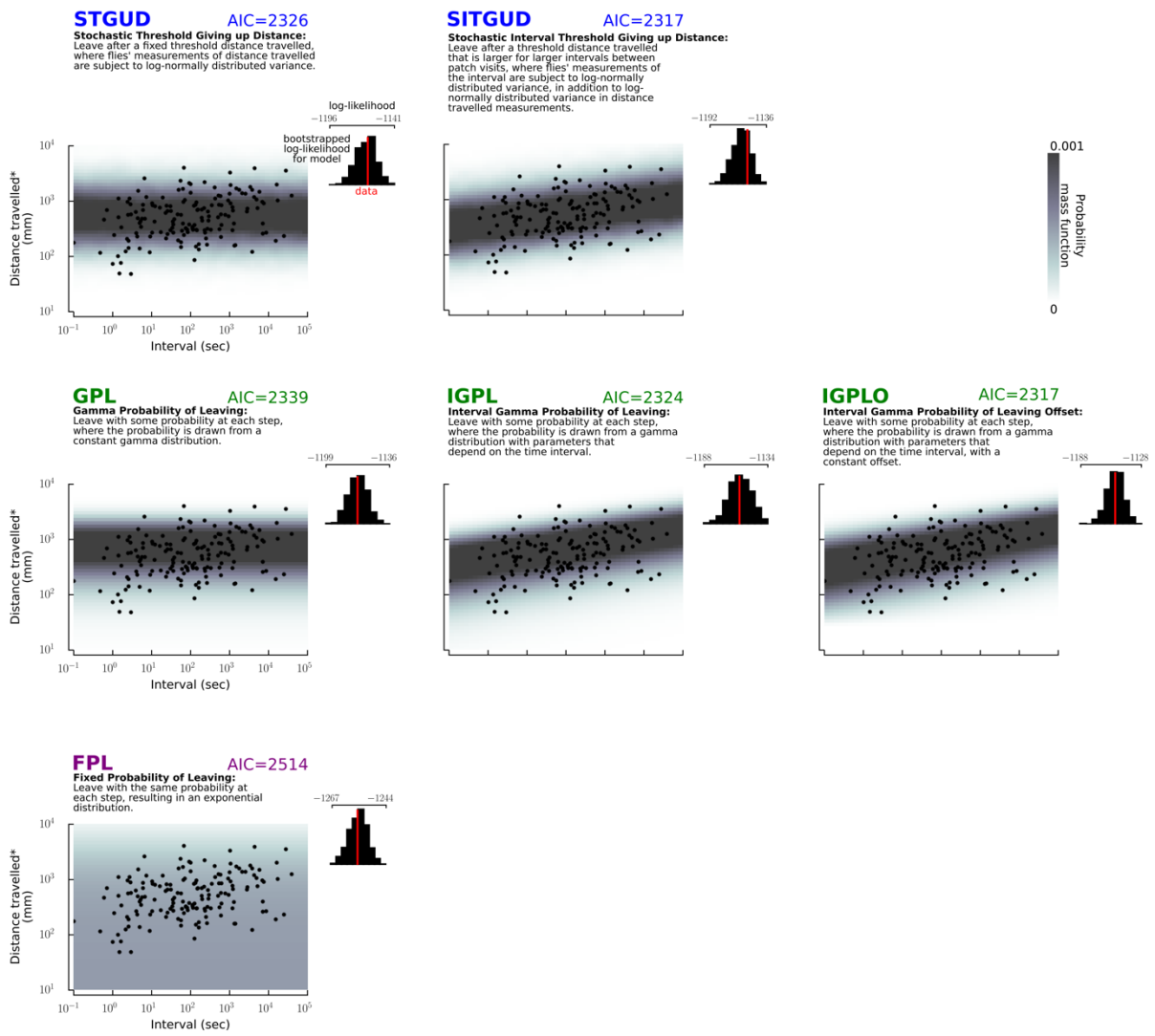
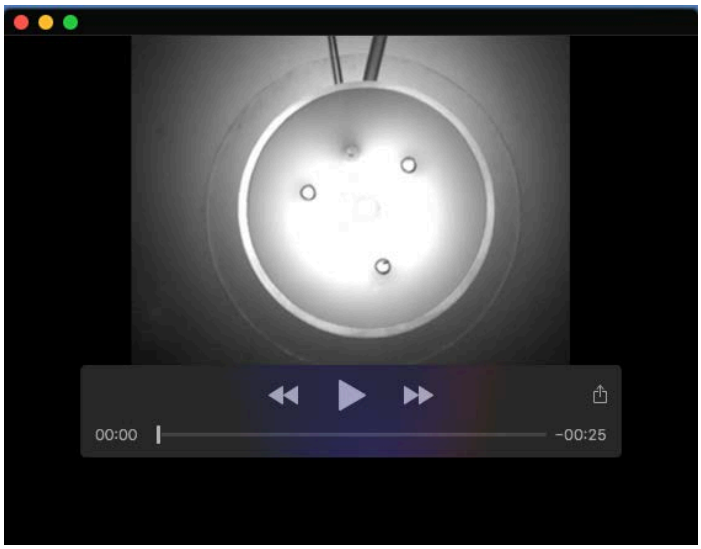
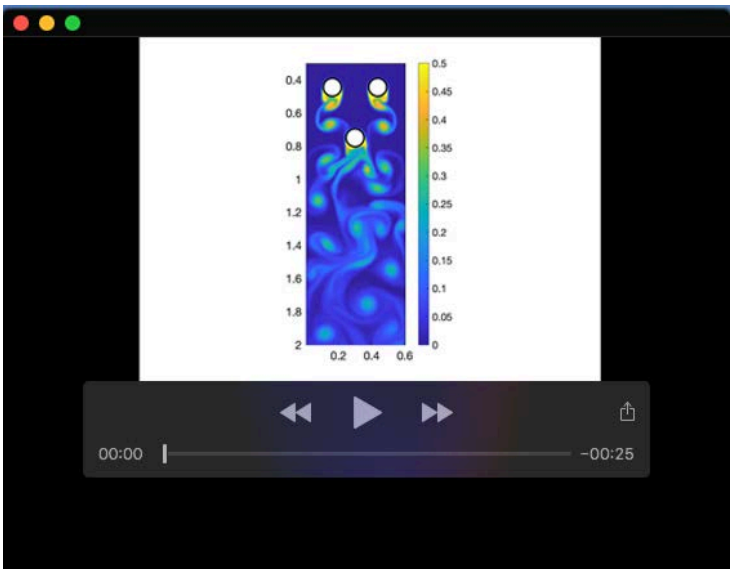


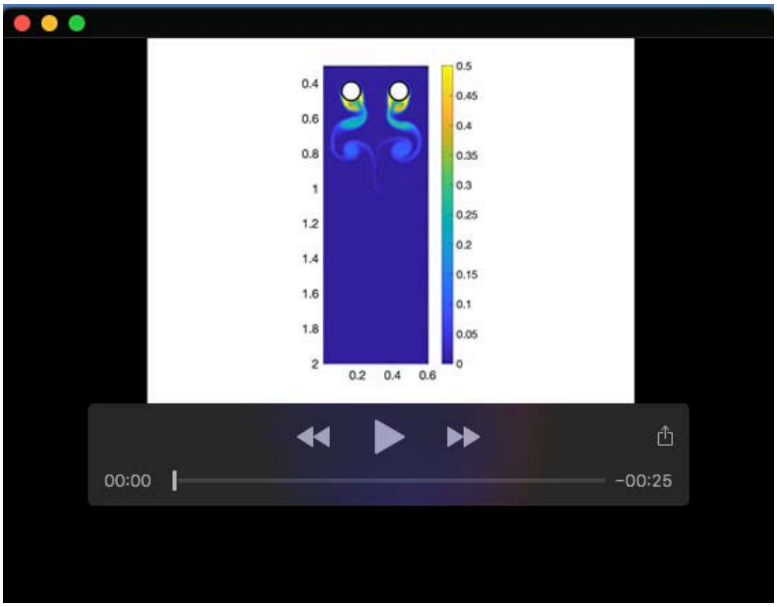
Fig. S4. The IGPL and ITGUD strategies offer the best explanatory power of the models considered. Additional decision making strategies supplementary to Figure 4 are shown here, including variations on the deterministic TGUD and ITGUD models that account for the possibility that flies' measurements of distance travelled and time interval elapsed might be subject to log-normally distributed noise (see Methods for mathematical descriptions). For each model, parameters were chosen to maximize the log-likelihood, goodness-of-fit for each model is shown in the insets. The goodness-of-fit figures compare the log-likelihood given the data (red) to a bootstrapped distribution (black) of log-likelihood values derived from simulations of the models themselves. The explanatory power of each model is given by the AIC values. Although the SITGUD model has a better AIC compared to the IGPL model, a slight modification of the IGPL that includes a subtle offset (see Methods) results in a similar AIC value. This offset effectively sets a lower bound threshold on the distance travelled.



Movie 1. Movie of a representative search bout by a fly on one of the platforms, played back at 20x real time.



Movie 2. Movie of a 2D computational fluid dynamics simulation of relative odor concentration (color) as a function of space and time for the 3-cylinder arrangement equivalent to the wind tunnel experiments.



Movie 3. Movie of a 2D computational fluid dynamics simulation of relative odor concentration (color) as a function of space and time for a 2-cylinder arrangement.