Current Biology, Volume *31*

Supplemental Information

Drosophila re-zero their path integrator at the center of a fictive food patch

Amir H. Behbahani, Emily H. Palmer, Román A. Corfas, and Michael H. Dickinson

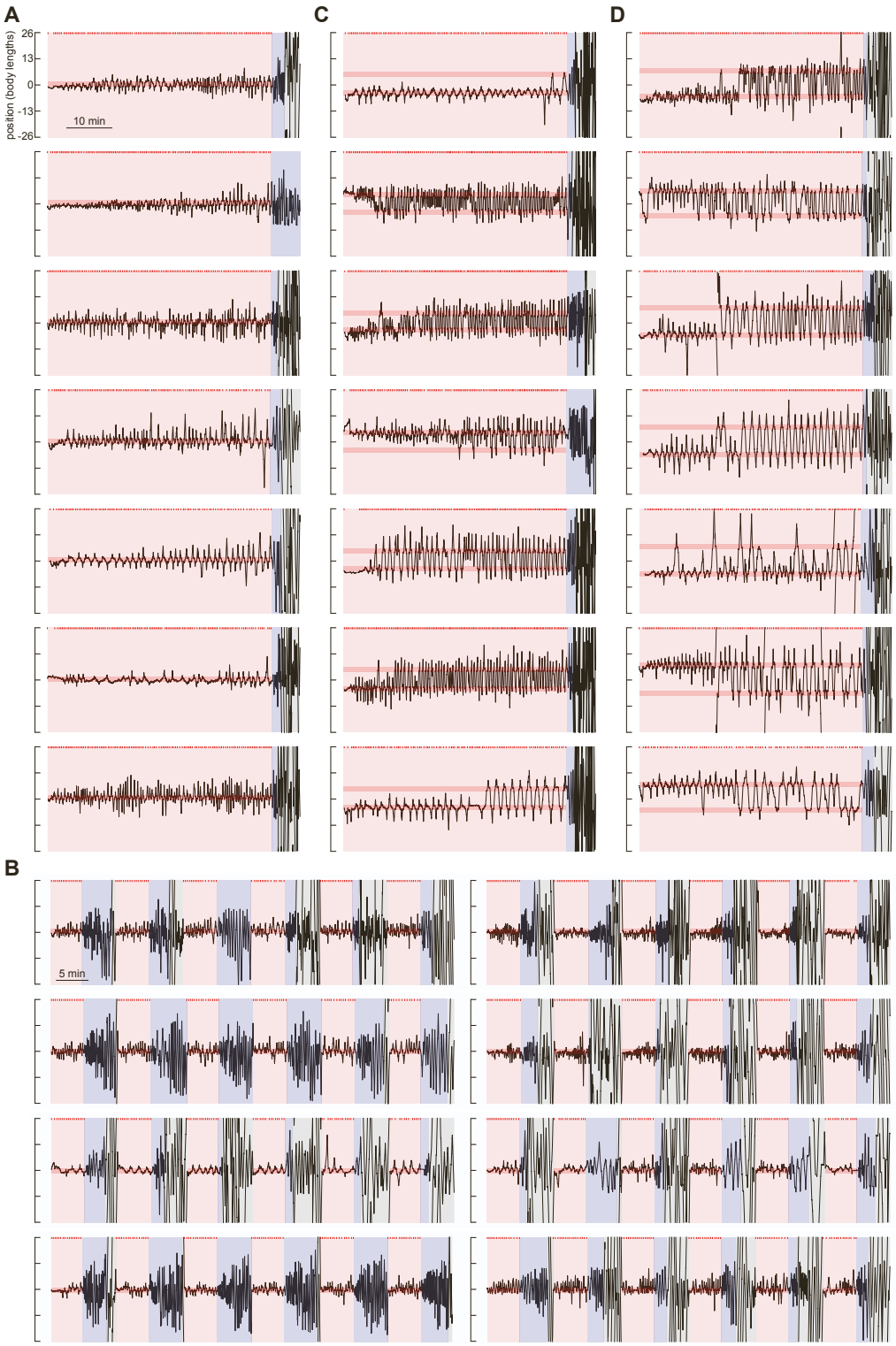

Figure S1. Sample trajectories of local search around one or two fictive food sites, related to Figures 1 and 4.

(A) Seven representative example trajectories for the AP and post-AP from single food 40-min AP experiments. Plotting conventions are the same as Figure 1B.

(B) Eight representative example trajectories for the AP and post-AP from single food trial-based experiments. Plotting conventions are the same as Figure 1C.

(C) Seven representative example trajectories for the AP and post-AP from two-food 40-min AP experiments. The two food zones are spaced 9 body lengths (BL) apart. Plotting conventions are the same as Figures 1B and 4A.

(D) Seven representative example trajectories for the AP and post-AP from two-food 40-min AP experiments. The two food zones are spaced 13 body lengths (BL) apart. Plotting conventions are the same as Figures 1B and 4A.

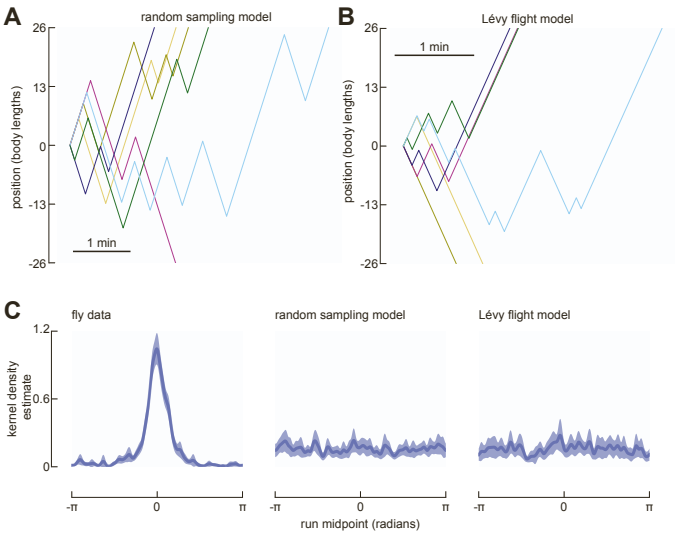

Figure S2. Memory-less models cannot recapitulate *Drosophila* local search, related to Figure 1.

(A) Six representative example trajectories from simulations for which run lengths were randomly drawn from the distribution of run lengths in Figure 1J (excluding the departure runs). Trajectories begin at the 0 position and are terminated when the simulated fly reaches 26 body lengths from the point of origin.

(B) As in (A) from simulations for which run lengths were drawn from a Lévy distribution fit to the distribution of run lengths in Figure 1J (excluding the departure runs).

(C) Normalized kernel density estimate (KDE) of the wrapped run midpoint in the post-AP period for fly data (re-plotted from the right panel in Figure 1M), random sampling model (n = 300), and Lévy flight model (n = 300).

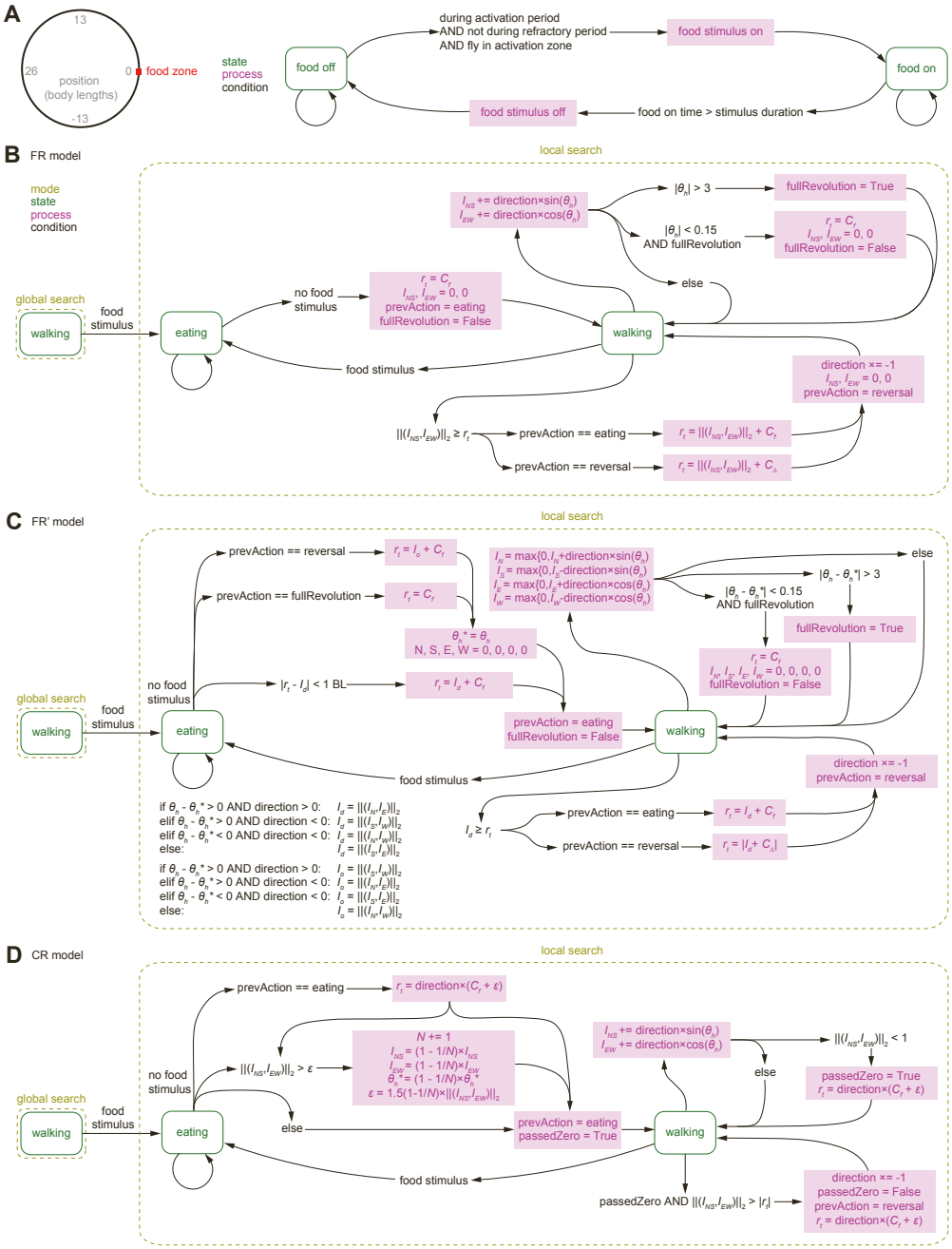

Figure S3. State-transition diagrams describing agent-based odometric integration models of *Drosophila* local search, related to Figure 3.

(A) Left: Schematic of the simulated environment. The example shown here is for a simulated environment with a single food zone. Right: State transition diagram for the simulated environment. The simulated environment is in either the food on or off state. Transitions between these states, via processes, are determined by the conditions at each timestep of the simulation. See methods for details.

(B-D) State transition diagrams for the FR model (B), FR' model (C), and CR model (D). The simulated fly can either be in an eating or walking state, within either a global or local search mode. Transitions between these states and modes, sometimes via processes, are determined by the conditions at each timestep of the simulation. (r_t = target run length, BL = body lengths, I = Integrator, N = North, S = South, E = East, W = West, θ_h = heading angle, prevAction = previous action, firstRev = first reversal). The variables C_f, C_Δ, $C_{\Delta,AP}$, and $C_{\Delta,post\text{-}AP}$, represent a value drawn from the corresponding distribution. See methods for details.

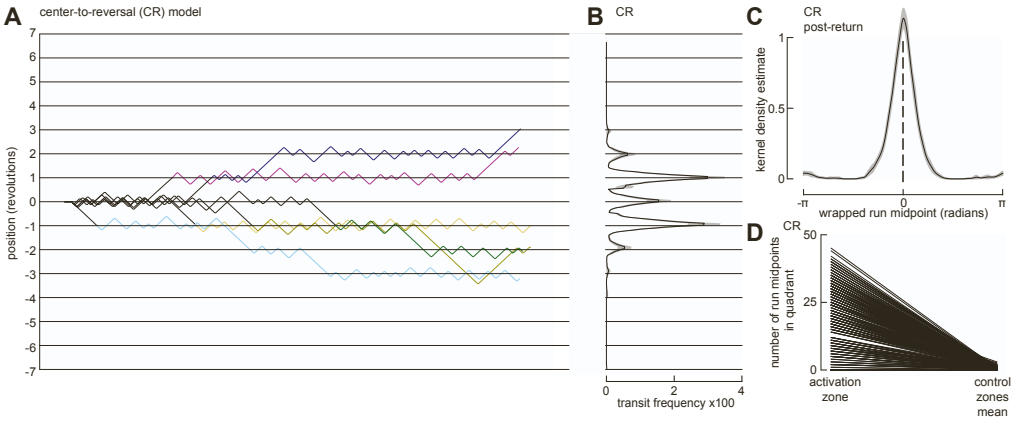

Figure S4. The CR model recapitulates fly re-initiation of local search at a former fictive food site after circling the arena, related to Figure 2.

(A) As in Figure 2B, for simulations using the CR model (n = 300).

(B) As in Figure 2E, for simulations using the CR model (n = 300).

(C) As in Figure 2F, for simulations using the CR model (n = 300).

(D) As in Figure 2G, for simulations using the CR model (n = 300).