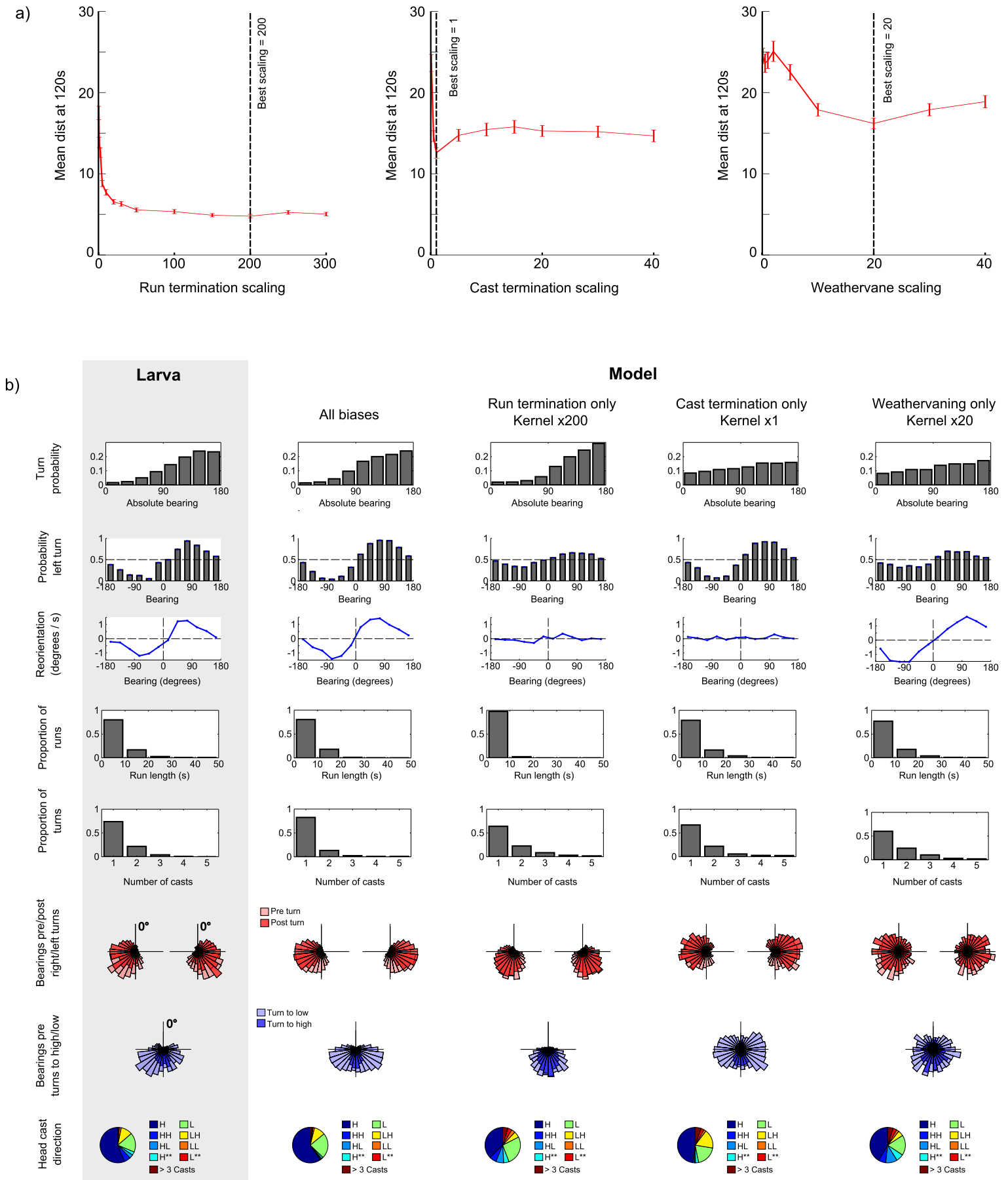**Supplementary figure 1**

Single mechanism performance with optimised kernel scaling. All results were obtained by collecting statistics from simulated larvae in the single odour source environment, as described for figures 2 and 3. **a)** Mean and standard error of distance to the odour peak after 120s for 200 larvae with only one behavioural bias, plotted against a range of kernel scaling values. We used these plots to determine the approximate kernel scaling which gave the closest clustering around the source for each behaviour bias; scaling = 200 for run termination, scaling = 1 for cast termination, and scaling = 20 for weathervaning. **b)** Low level behavioural statistics produced by each of the three 'single-bias' model variants when the kernel is scaled by the value determined in a). Behavioural statistics from the larva and the full model are included for comparison. Note that the 'single-mechanism' models fail to match the larva's statistics as well as the full model, both due to the lack of the other mechanisms (e.g. the 'run-termination only model' shows low bias in left turn probabilities due to the lack of cast-termination bias) and the excessive strength of the scaled bias (e.g. the 'run-termination only' model shows a higher rate of runs of length 0-10s due to high scaling of the run termination kernel).