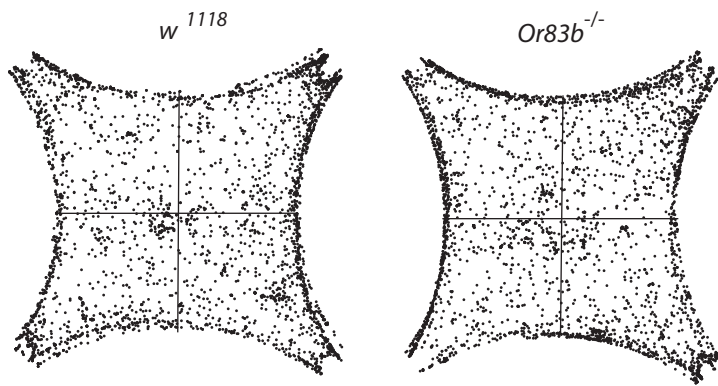
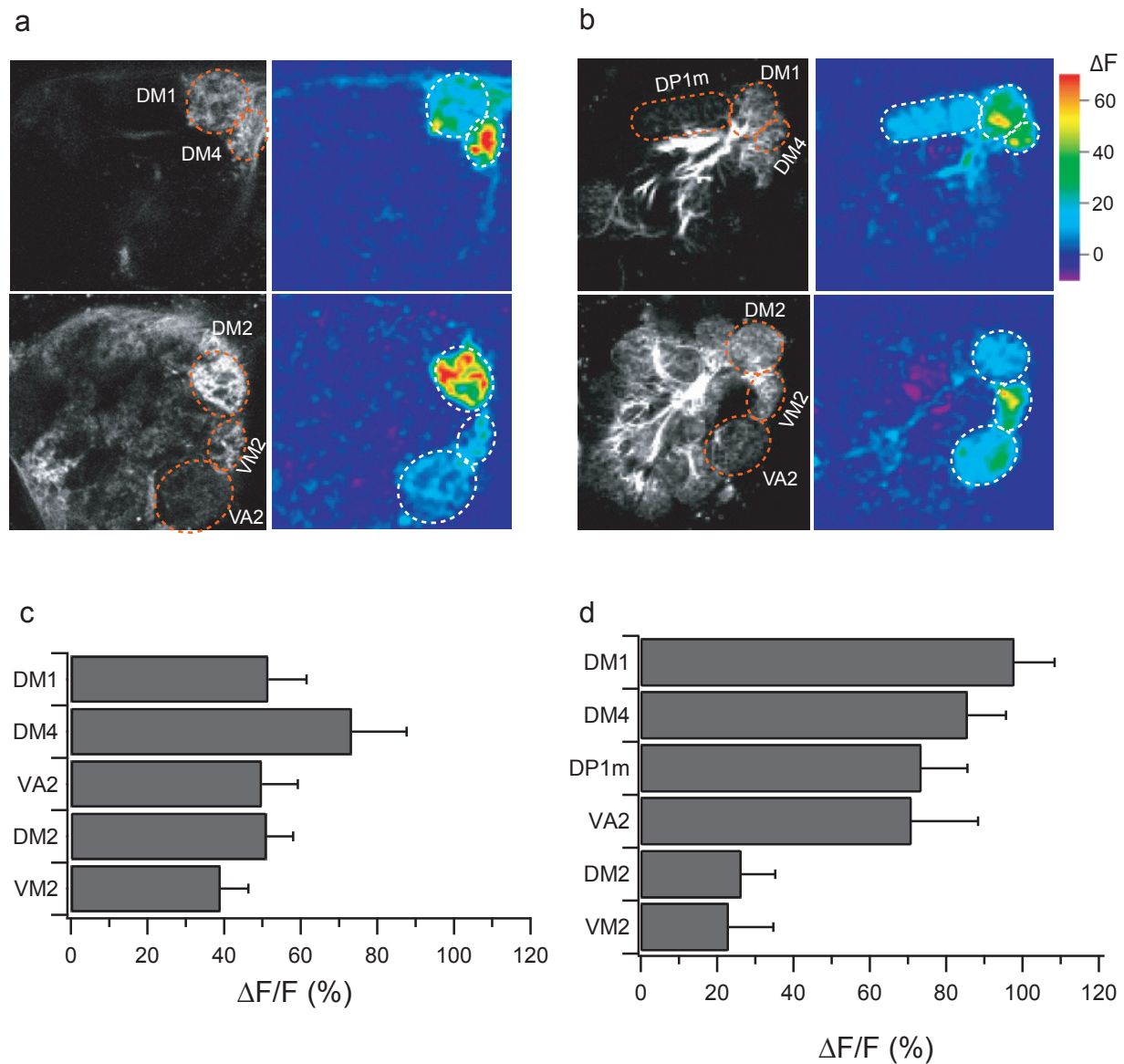


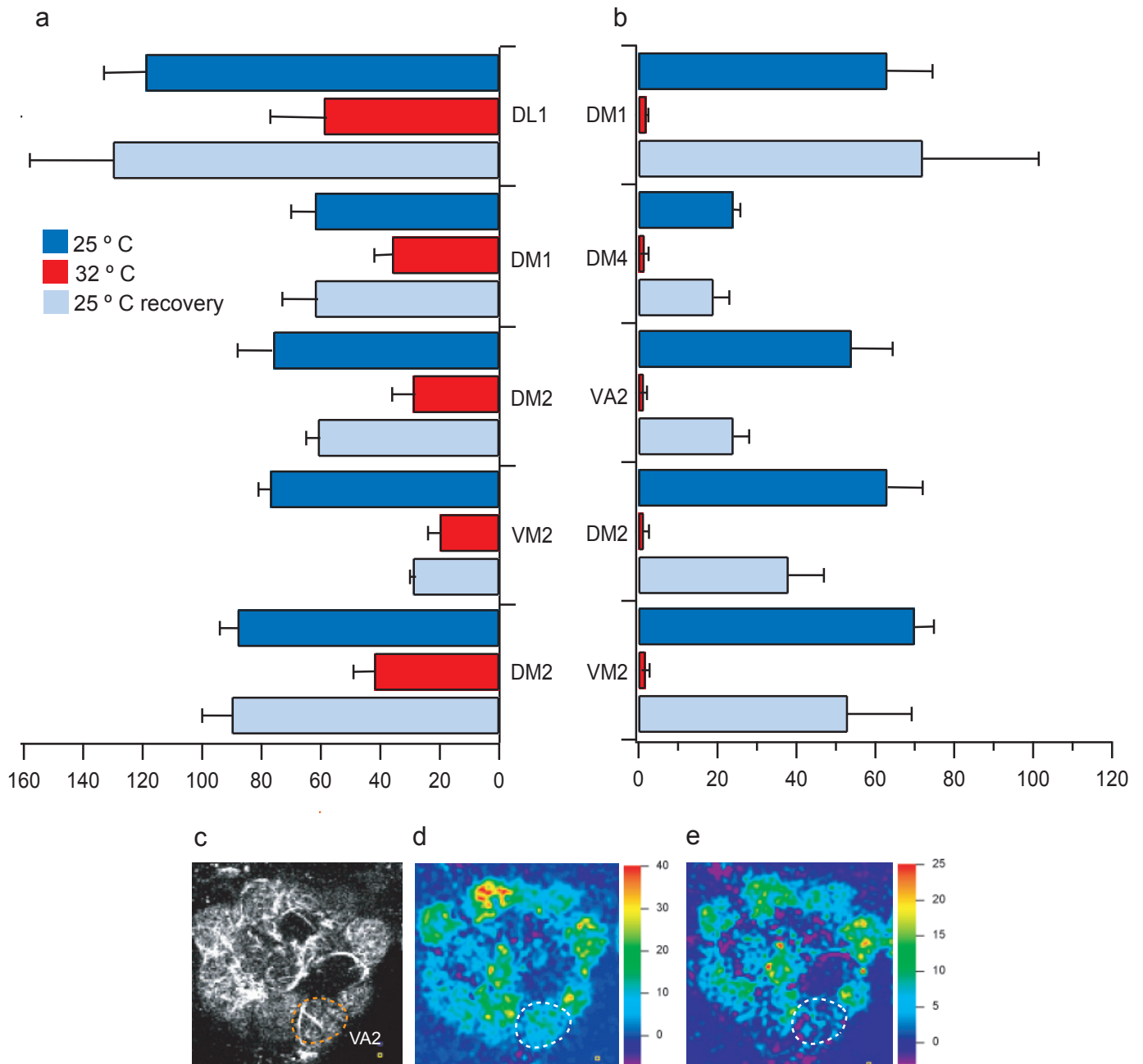
**Figure S1 | Tracks of individual flies. a**, 10  $w^{1118}$  flies, with performance indices listed below. 3 ppm vinegar was delivered to the upper left quadrant. **b**, Behavioral response of 10  $Or83b^{-/-}$  flies to 3 ppm vinegar.



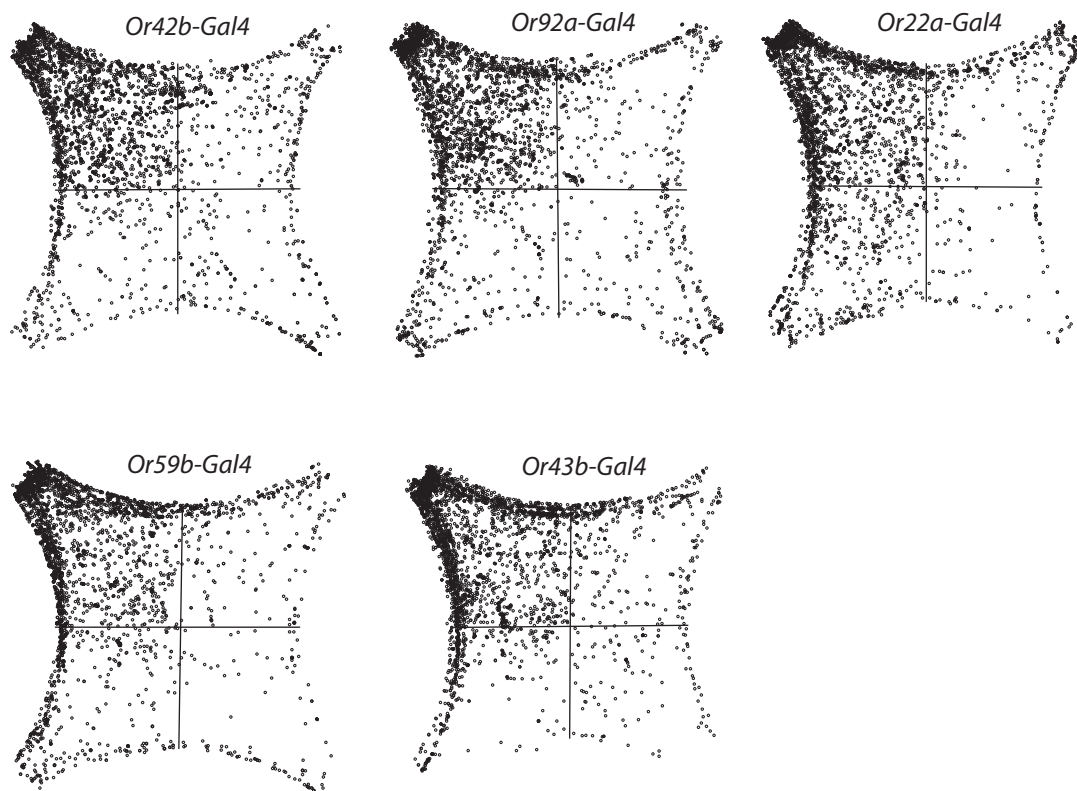
**Figure S2 | Density plots of 20  $w^{1118}$  and  $Or83b^{-/-}$  flies in an odor-free arena.**



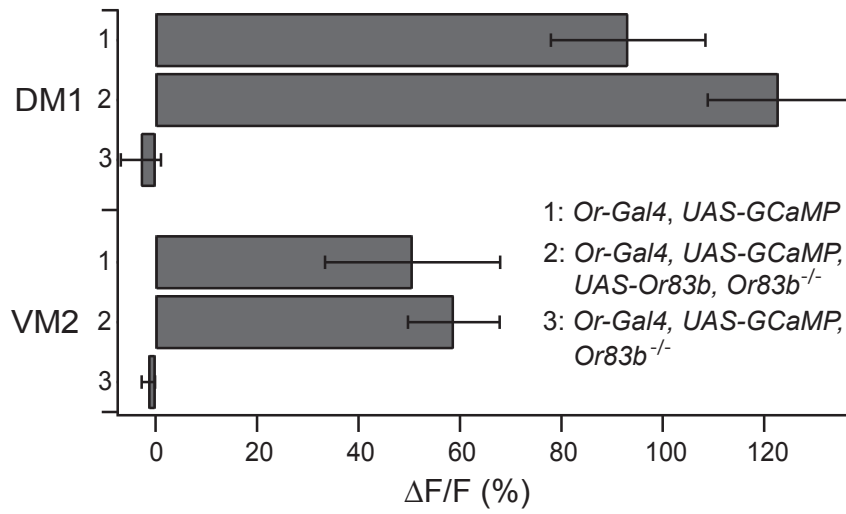
**Figure S3 | Vinegar activates a similar pattern of glomeruli when G-CaMP is expressed in ORNs or PNs.** **a**, Response to 3 ppm vinegar in a fly bearing the *Or83b-Gal4* and *UAS-GCaMP* transgenes. Note that the DP1m glomerulus is not labeled by the *Or83b-Gal4* line. **b**, Response to the same stimulus in a fly bearing the *GHI46-Gal4* and *UAS-GCaMP* transgenes. **c**, Average responses in ORN axons from four samples. **d**, Average PN response, n=10.



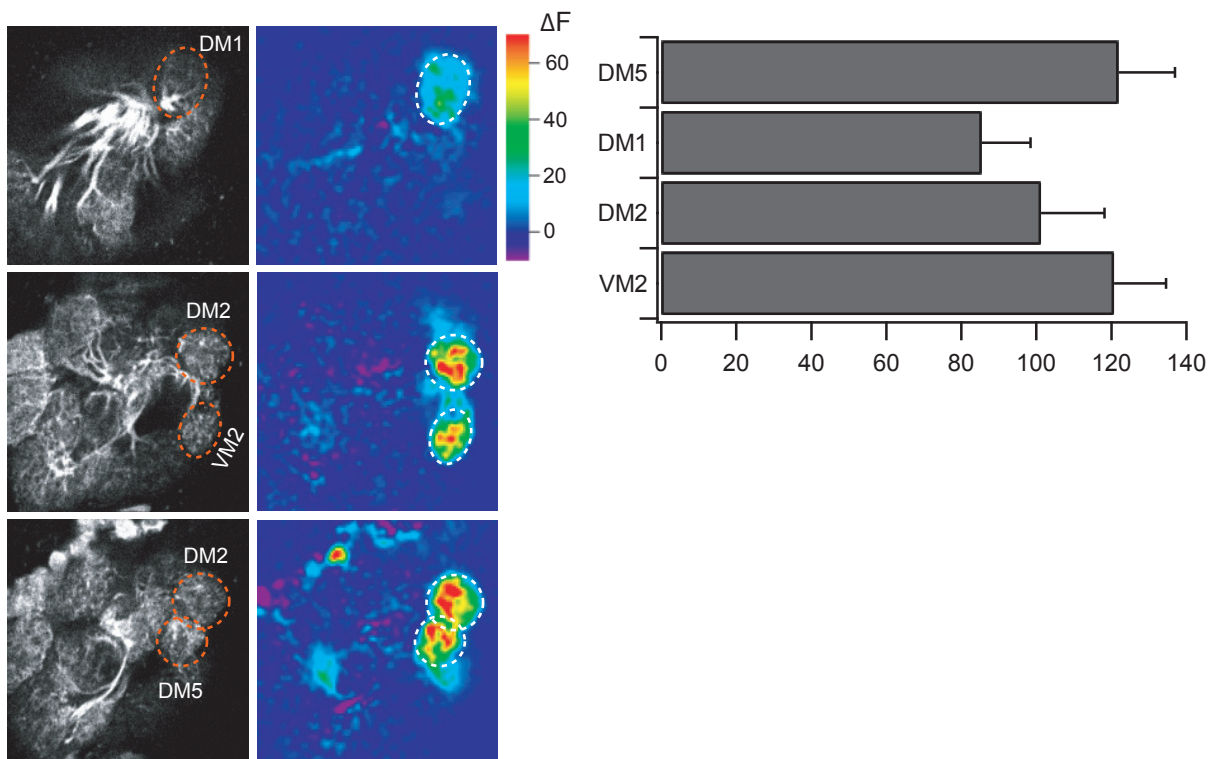
**Figure S4 | *Shibire<sup>ts</sup>* blocks PN activation at 32° C when expressed in ORNs.** PN responses to electrical stimulation of the antennal nerve were measured in flies with one type of ORNs silenced. **a**, Responses to electrical stimulation in non-silenced glomeruli, from the same preparations as in **(b)**, n=3. For example, DL1 in **(a)** was measured from the same preparation as DM1 in **(b)**. **b**, Responses to electrical stimulation in glomeruli where the corresponding ORNs express *shibire<sup>ts</sup>*, n=3. **c**. Pre-stimulation image. **d**. Permissive temperature response in a fly in which the Or92a ORNs are silenced. **e**. Response of the same fly at the non-permissive temperature. Flies contained the following transgenes: *GHI46-LexAGAD*, *LexAop-GCaMP-IRES-GCaMP*, *OrX-Gal4*, *UAS-shibire<sup>ts</sup>*. In general, GCaMP fluorescence decreased at 32° C, but for glomeruli where the ORNs were silenced, the response was virtually abolished. The olfactory nerve was stimulated with 16 pulses of 10 V at 1 ms duration and 100 Hz.



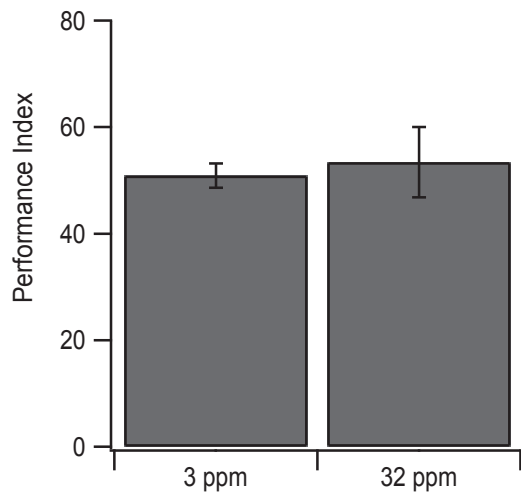
**Figure S5 | Or-Gal4 flies exhibit normal attraction.** Density plots of 20 flies each for the five Gal4 lines used in figure 2.



**Figure S6 | Expression of Or83b in individual ORNs in *Or83b* mutant flies restores the odorant response to wild-type levels.** Responses to 3 ppm vinegar in flies bearing the indicated transgenes.  $n \geq 3$ .



**Figure S7 | Ethyl butyrate activates four glomeruli. a,** Response to 7 ppm ethyl butyrate in a fly bearing the *GHI46-Gal4* and *UAS-GCaMP* transgenes. **b,** Average response to ethyl butyrate, n=4.



**Figure S8 | DM1 rescue flies are attracted to 32 ppm vinegar.** Behavior of *Or83b*<sup>-/-</sup> flies bearing the *Or42b-Gal4* and *UAS-Or83b* transgenes.