Supplemental Figure Legends

Supplemental Fig. 1. Panel of ten odorant categories used for odor stimulation experiments. Each odorant category consisted of five different components (①-⑤).

Supplemental Fig. 2. E-I (ipsi-excitation, contra-suppression) type ipsi-nasal neurons. A subset of AON neurons showed excitatory responses to ipsi-OE stimulation and suppressive responses to contra-OE stimulation. Shown are raster representations of the spike responses (middle) and peristimulus time histograms (bottom) of an E-I (ipsi-excitation, contra-suppression) type AON neuron. The ascending and descending phases of the trace in the respiration monitor (Resp.) indicate inspiration and expiration, respectively. Ipsi-OE stimulation, left, red bar; contra-OE stimulation, right, blue bar. F.R., firing rate.

Supplemental Fig. 3. Peak of respiration phase-locked spike responses induced *via* the ipsi-pathway precedes that induced *via* the contra-pathway. **(A)** Comparison of peak latency of respiration phase-locked spike responses induced by contra-nasal odor stimulation (Y axis, one respiration cycle) with that induced by ipsi-nasal odor stimulation (X-axis, one respiration cycle). Each dot represents an individual AON

neuron. The averaged peak latency of the spike responses to contra-nasal odor stimulation was significantly longer than that of the spike responses to ipsi-nasal odor stimulation (n=8 cells, wilcoxon t-test, $p < 0.05$). **(B)** The averaged peak latency of the resumed respiration phase-locked discharges after ipsi-nostril obstruction (Y-axis, one respiration cycle) was significantly longer than that of respiration phase-locked activity before nostril obstruction (X-axis, one respiration cycle) (n=17 cells, wilcoxon t-test, $p < 0.01$).

Supplemental Fig. 4. The averaged magnitude of responses to ipsi-nasal odor stimulation exceeds that for contra-nasal odor stimulation. Each closed circle indicates the averaged magnitude of ipsi-OE- (left) and contra-OE-induced (right) responses in an individual binasal neuron. Open circles indicate the averaged response magnitude among 31 ipsi-OE-induced responses (left, mean $\pm$ SD, 7.8 ± 1.1) or contra-OE-induced responses (right, 4.7 ± 0.8) (31 binasal neurons, paired t-test, $p < 0.01$).