Figure S1 (linked to Fig. 1)

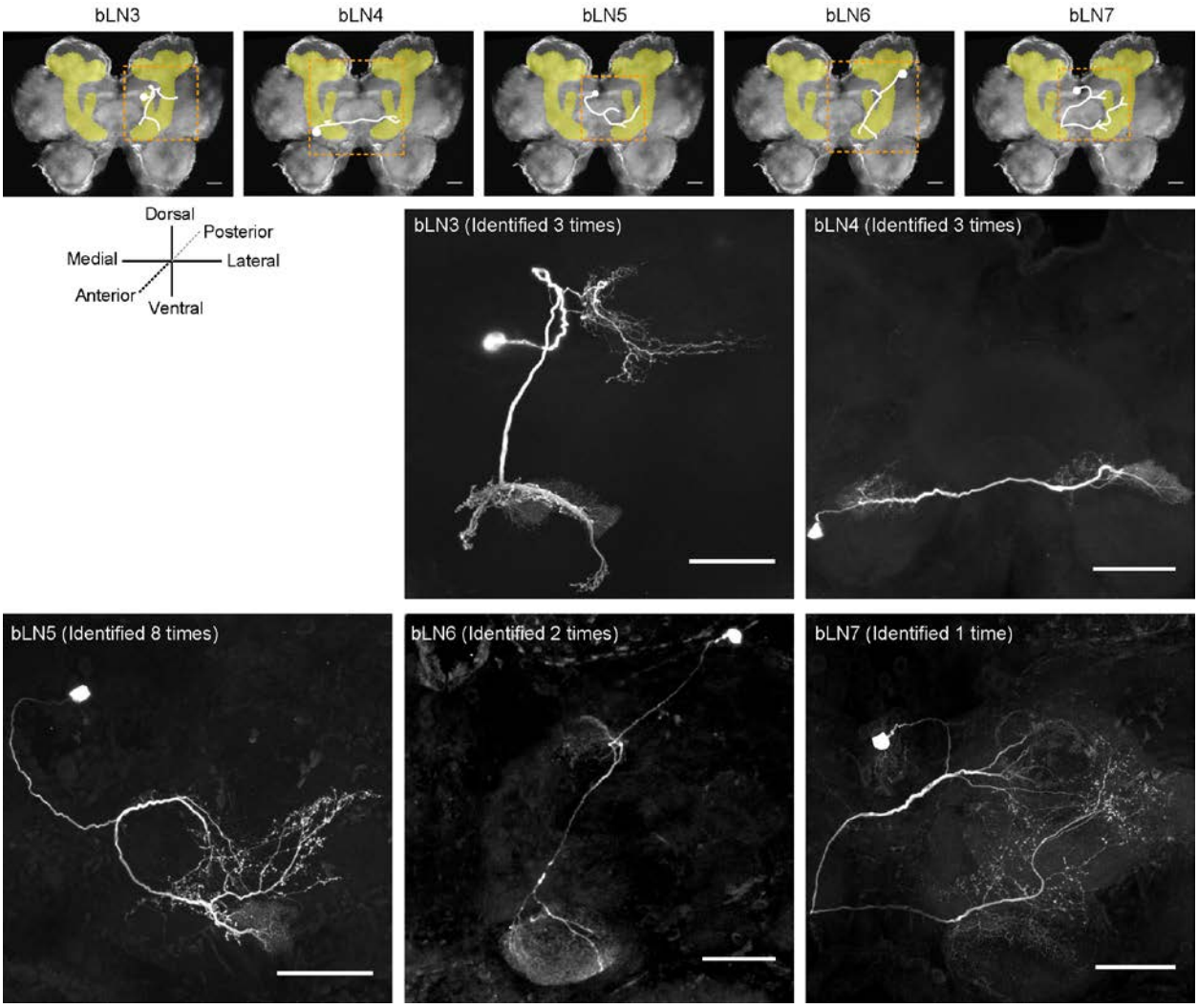

Figure S1. Organization of the β-lobe of the mushroom body**.** We identified 7 morphological classes of bLNs with intracellular staining; bLN1 and bLN2 are shown in **Fig. 1c**. Examples of the other 5 morphological classes, and the frequency with which they were identified, are shown here. Top row: legend shows the location of the stained area within the brain (orange square) containing each neuron (outlined in white); approximate position of the mushroom body is shaded in yellow for reference. Scale bars: 100 µm in all panels. The morphological classification was based on visual inspection of the positions of somata and major branches, and was unambiguous because these features were nearly identical within each class (see **Fig. 1c**) but very different between classes in different animals. This classification, although not essential for the conclusions of this study, is convenient for describing the neurons and provides a useful reference for future work. bLN1 has soma in the anterior-medial protocerebrum and neurites in the β-lobe, pedunculus and the lateral horn. bLN2 has soma in the lateral protocerebrum and neurites in the α-lobe, β-lobe, pedunculus and calyx. bLN3 has

soma in the posterior-medial protocerebrum and neurites in the β-lobe and around the pedunculus. bLN4 has soma located in the anterior-ventral protocerebrum; neurites ipsilateral to the soma are posterior to the β-lobe while distal neurites innervate the contralateral β-lobe. bLN5 has soma in the dorsal-medial protocerebrum and its neurites innervate the β-lobe and regions near the α-lobe. bLN6 soma is located in the dorsal-anterior-lateral protocerebrum and its neurites innervate the tips of the α-lobe and the β-lobe. bLN7 soma is located on the anterior-medial surface of the brain and its neurites branch in the β-lobe and around the α-lobe.

Figure S2 (linked to Fig. 1)

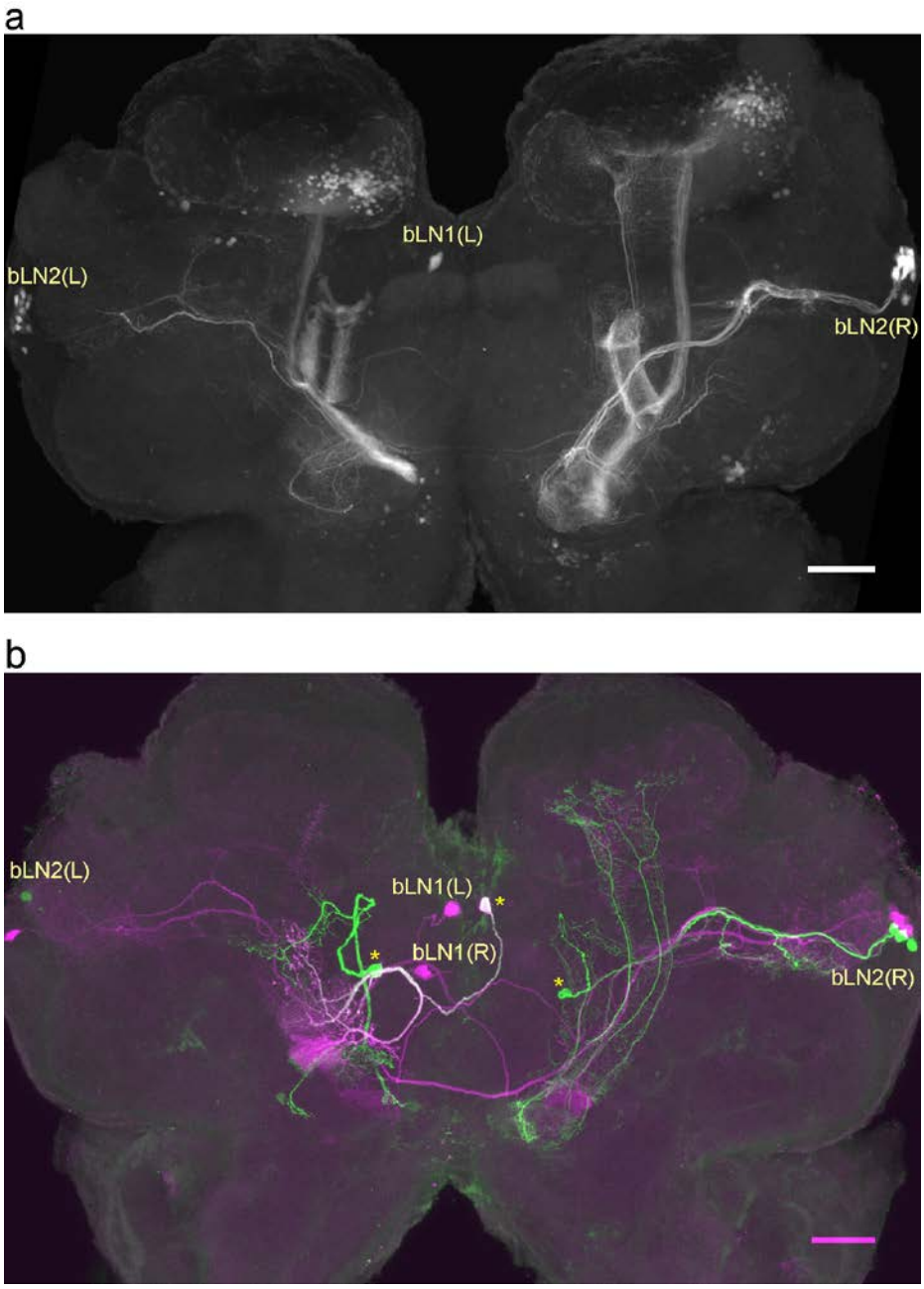

Figure S2. Mass fills in the β-lobes of the mushroom body. **(a)** Mass dye-fills into the β-lobes in both hemispheres, performed with blunt electrodes, show at least 12-15 bLN2s on each side, and only 1 bLN1 (left). Several KCs were also stained. L, left; R, right. **(b)** Mass fill in a different animal using sharp electrodes and two dyes shows several classes of bLNs. Multiple bLN2s and only 1 bLN1 were stained on each side. Asterisks indicate neurons from bLN classes other than bLN1 and bLN2. Some cells were partially filled. Mass-fills were obtained more than 5 times. Scale bars: 100 µm.

Figure S3 (linked to Fig. 1)

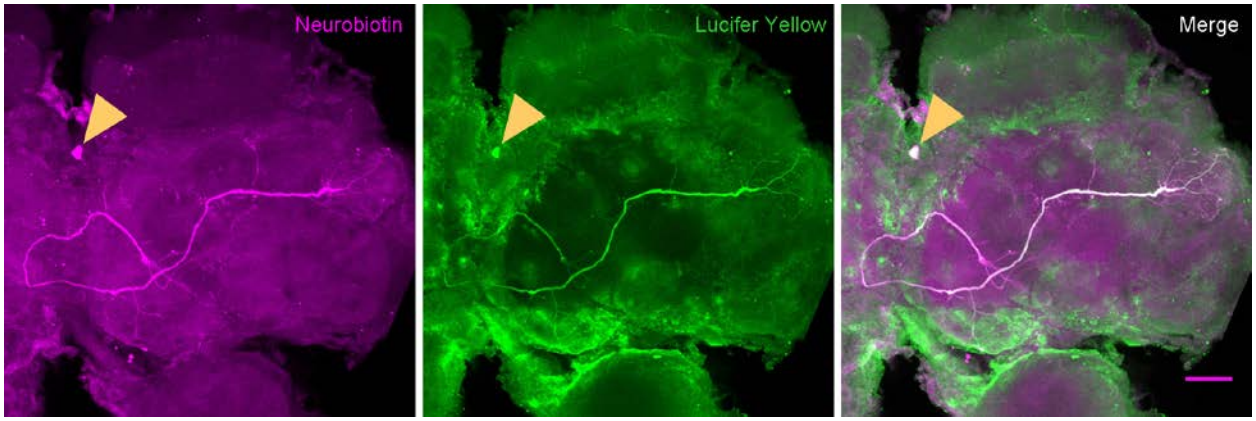

Figure S3. Intracellular staining of bLN1 in the same brain hemisphere twice, using two different dyes (Neurobiotin and Lucifer Yellow), revealed the same cell; arrowhead shows soma. This observation was repeated in another animal (not shown). Scale bar: 100 µm.

Figure S4 (linked to Fig. 3)

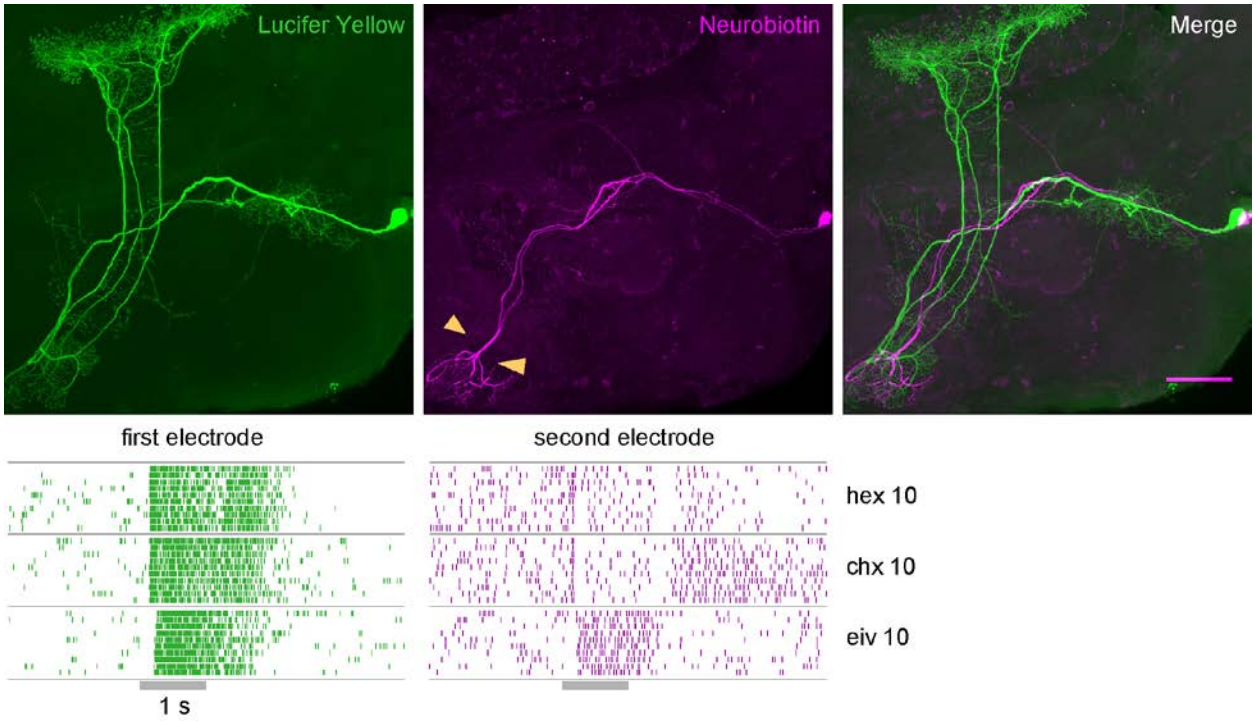

Figure S4. Odor-evoked temporal patterns are different for different cell-odor combinations. Two bLNs, recorded in the same brain separately using electrodes containing Lucifer Yellow and Neurobiotin, respectively, responded to a panel of 3 odors with different temporal patterns. Fills from both dyes revealed bLN2 morphology, evident from the unique location of bLN2 somata (see **Fig. S2**), and the characteristic shape of neurites connecting somata with dendrites in the β-lobe. Note that Neurobiotin stained two bLN2s, and the neurites (arrowheads) that go along the pedunculus toward the calyx were not fully stained. Scale bar: 100 µm.

Figure S5 (linked to Fig. 5)

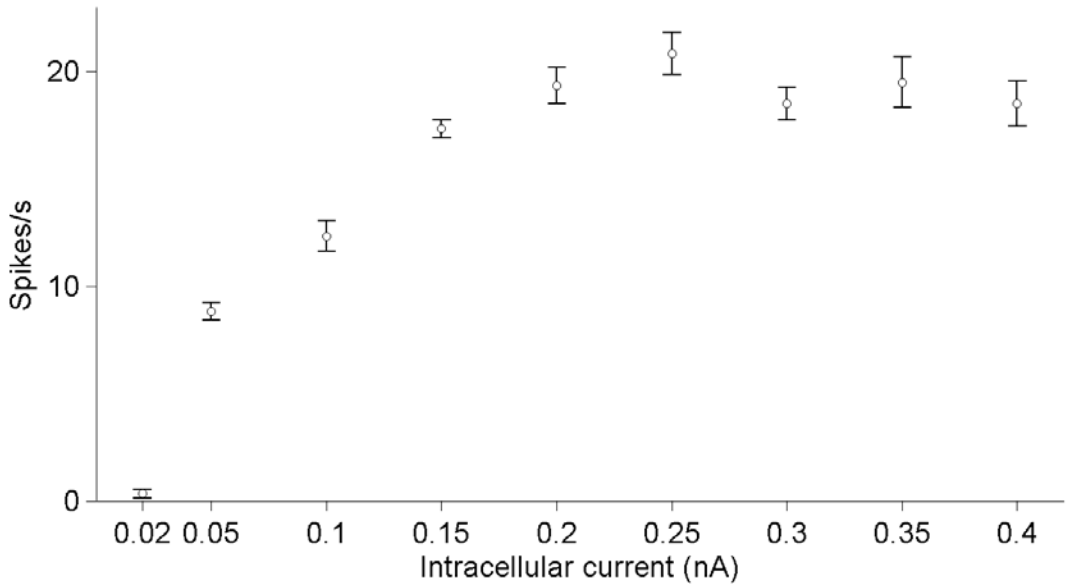

Figure S5. Firing rate of KCs saturates at ~20 spikes/s when driven by intracellular current injections. A KC was monitored using a sharp intracellular electrode. We injected step current pulses (duration 1 s) of different amplitudes through the same electrode, and counted the number of spikes elicited in the 1-s interval. Error bars show SEM over 6 trials for each current amplitude.