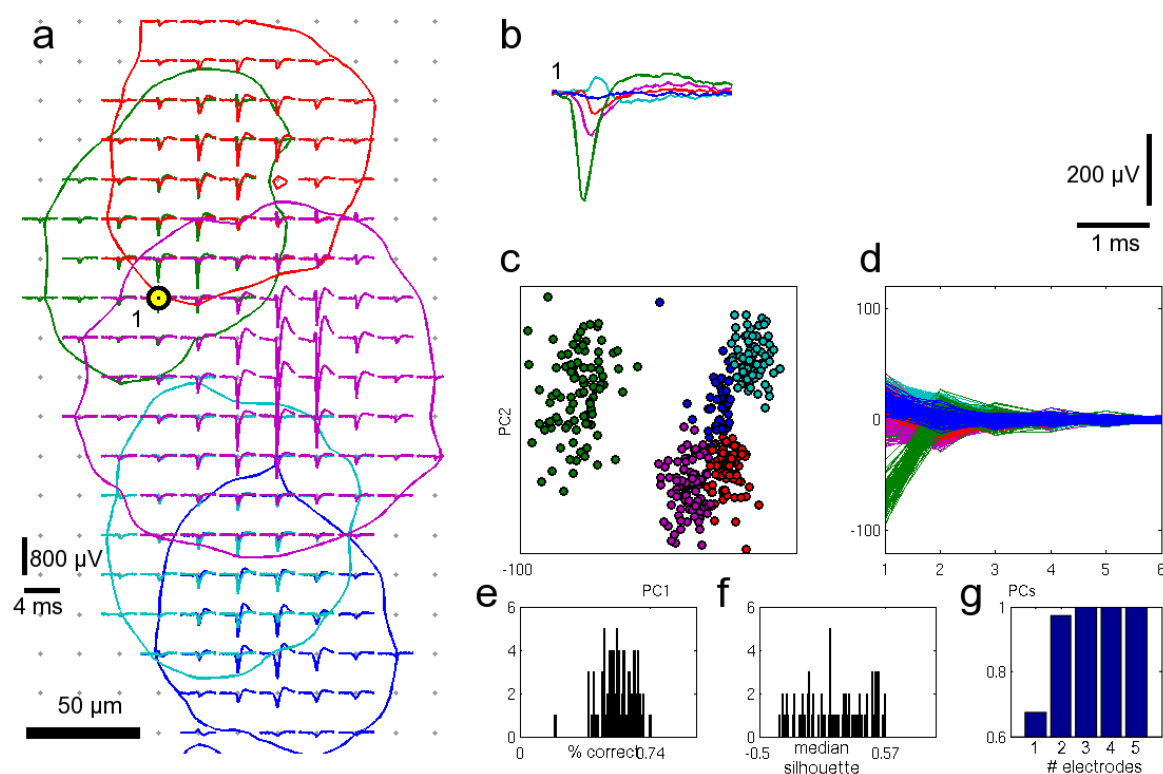


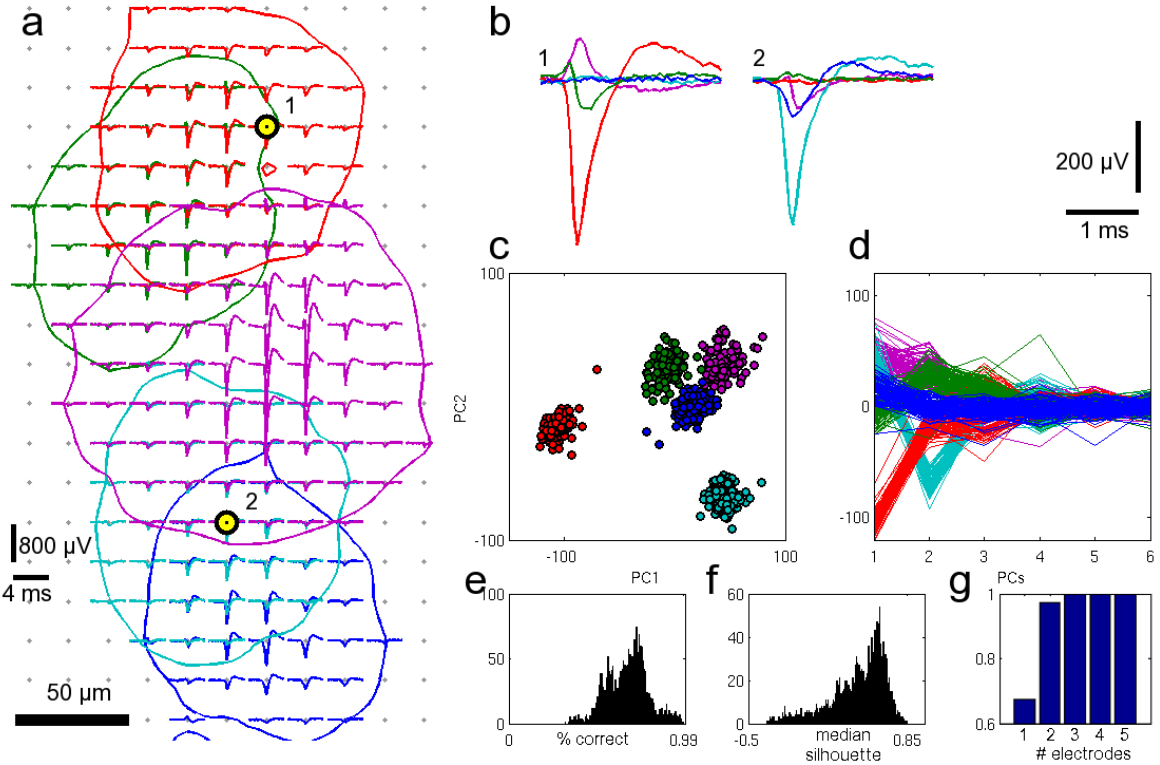
Supplementary Figure SF1_a – SF1_e

The electrical activity of five neurons has been identified and spike-sorted with 209 electrodes. Subsequently, the performances of all combinations of selecting 1 out of 209 (SF1_a), 2 out of 209 (SF1_b), 3 out of 209 (SF1_c), 4 out of 209 (SF1_d) and 5 out of 209 (SF1_e) electrodes were analyzed in terms of correctly classified APs. Refer to the text for a detailed discussion of the process. It can be seen that, while 3 electrodes are sufficient to correctly classify all APs, using more electrodes improves segregation of clusters in the PC space. Furthermore, as one would intuitively guess, the electrodes exhibiting the largest peak signal for the respective neuron become selected when searching for the 5 optimally placed electrodes, which indicates a correctly working selection process. (a) Spike-triggered averages of five identified neurons with overlapping electrical footprints. For each neuron, a circle is drawn, where the amplitude of the respective electrical signal exceeds a threshold of 4.5 standard deviations of the noise level. Black-yellow circles indicate the three electrodes yielding best sorting performance. (b) Spike-triggered average waveforms recorded with the three electrodes marked in (a). (c) Principal component (PC) projection of 500 AP waveforms recorded with the three electrodes marked in (a). The PC projection is used for clustering. (d) First six PCs. Color values in all subfigures correspond to the same neurons. (e) Distribution of performances for all 1.45 million tested electrode combinations. A considerable fraction of configurations yields more than 95% correct classifications. (f) Distribution of the medians of the silhouette coefficients for all 1.45 million tested electrode combinations for clustered waveforms as in (c). (g) Comparison of the best achievable spike-sorting performances for different numbers of electrodes. With just one electrode, only about 65% of all APs can be correctly classified. With three electrodes and more, the performance saturates at 100%, thus three electrodes chosen at the correct spots are sufficient to reliably record from these five neurons.

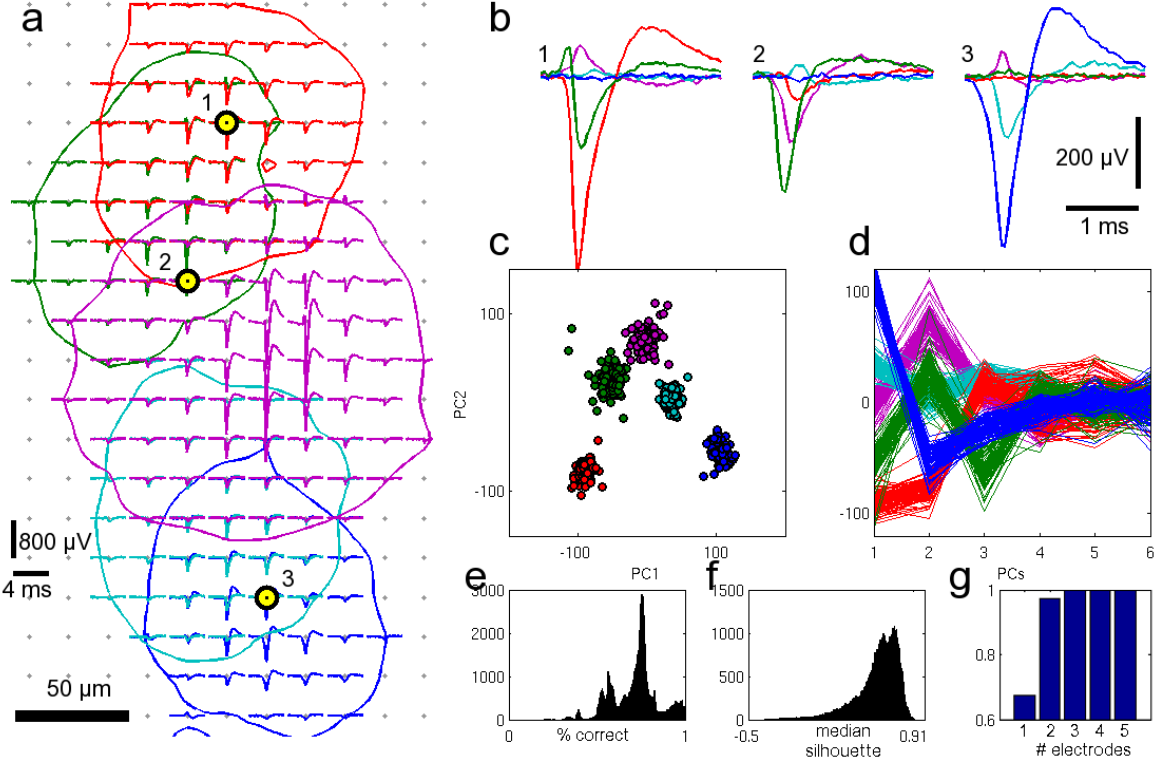
Supplementary Figure SF1_a



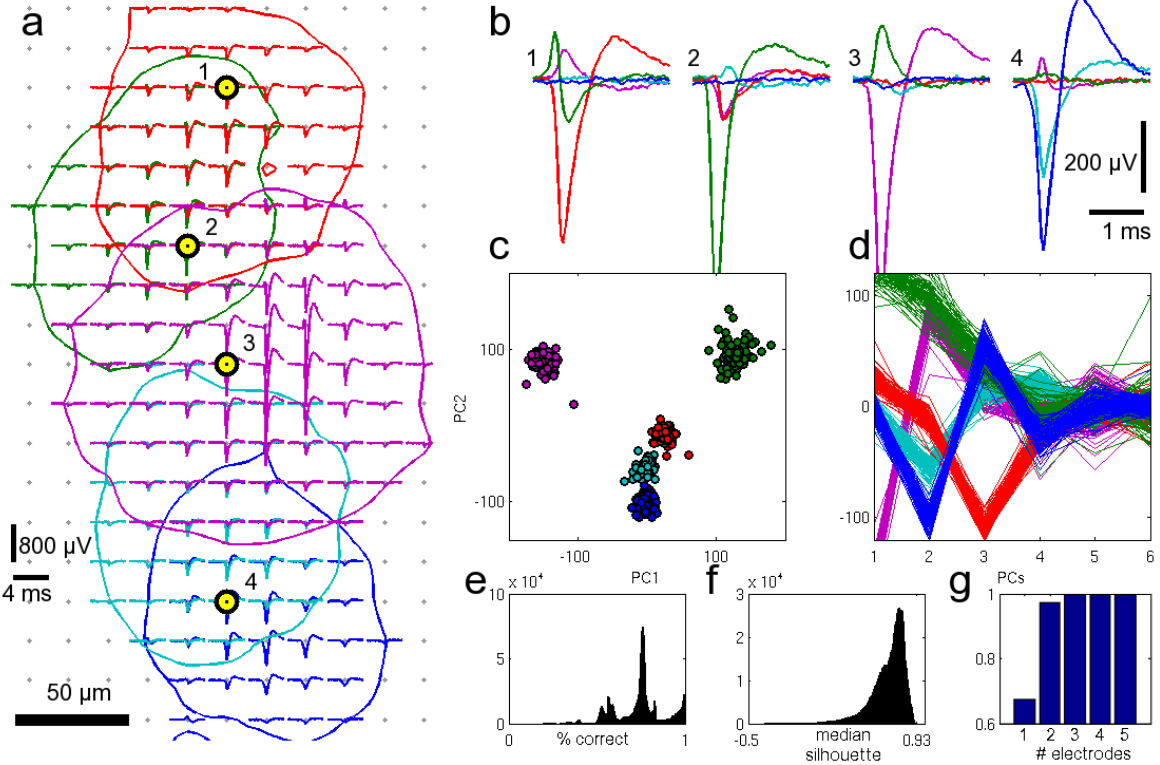
Supplementary Figure SF1_b



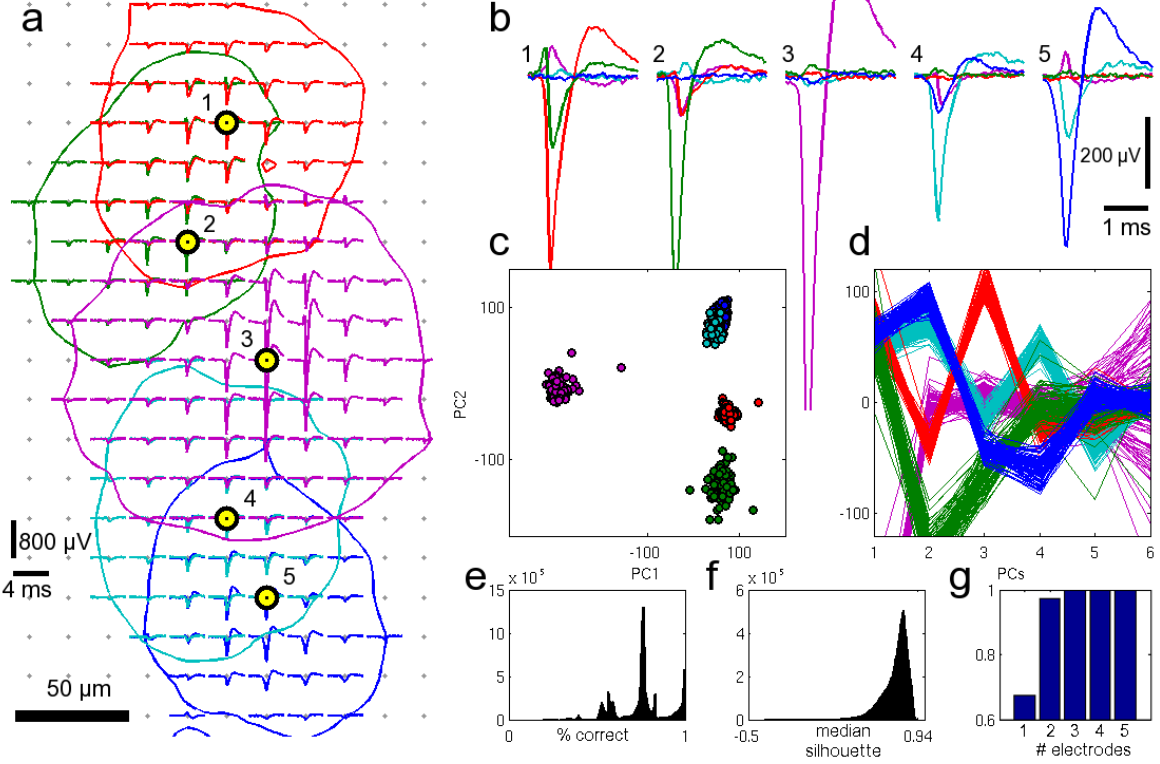
Supplementary Figure SF1_c



Supplementary Figure SF1_d

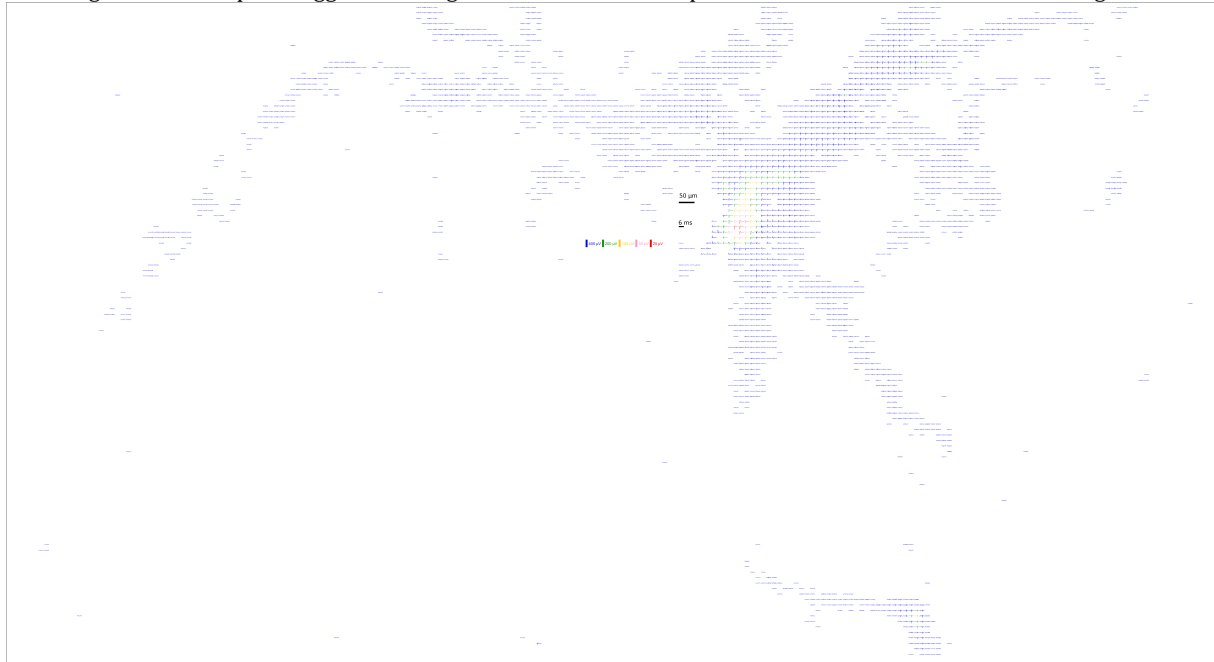


Supplementary Figure SF1_e



Supplementary Figure SF2

The image shows the spike-triggered averages of the electrical footprint of the same neuron as shown in Fig. 4.



Supplementary Movie SM1

The video shows the propagation of an AP through the axonal arbor of a single neuron as shown in Figure 4.

Supplementary Movie SM2

The video shows, for five different single neurons, the propagation of an AP through their axonal arbors.

Supplementary Movie SM3

The video shows the propagation of a stimulation-induced AP through a branching segment of an axon. To reduce noise and better reveal the AP, 300 trials have been averaged.