

## Supplementary Figure S1

Recorded and simulated EMG spike-rate profiles for different spike-amplitude classes, corresponding to conditioned NM responses of different amplitude for subjects RB2 and 3.

Panels A-F: EMG data. Each trace is a mean of 3 EMG firing rate profiles for spike amplitudes partitioned into 5 classes. An individual profile was calculated every 50ms as the firing rate of the spikes in a given amplitude class in a surrounding 50ms bin. In each panel, CS onset is at time 0, and US onset is denoted by a dotted vertical line. Gaussian curves were fitted to traces (dashed lines).

Panels G-L: Model EMG results. Model results are generated for ten model trials with peak input currents  $I_0$  ranging from zero to 4 nA. The small, medium and large responses are the second, fourth and ninth model trials respectively. All other simulated conditions are as for the data traces. Note that because the Gaussian fits (dashed lines) well approximate the model results (solid lines) the two curves almost overlay.

## Supplementary Figure S2

Parameters of Gaussian fits to recorded and simulated EMG spike-rate profiles as functions of spike amplitude for subjects RB2 and 3.

Panels A-F: EMG data analysis. Data points correspond to the mean (panels A, D), width (panels B & E) and peak firing rate (panels C & F) of the Gaussian fits in panels A-F of Fig. 6 for each spike-amplitude class, plotted against the central value of spike-amplitude for that class. Dashed lines join data points from trials with similar values of conditioned response amplitude (results averaged over three trial batches). US onset is denoted by the dotted horizontal line on panels A & D. The best fit line and  $r^2$  value (where  $r$  is the correlation coefficient) are shown on panels B & E. The best fit exponential and its  $r^2$  value are shown on panels C & F. The ratio of peak firing rates  $h_k/h_1$  is used in Fig. 7C to show the dependence of peak class-firing rate on spike amplitude independently of the peak total-firing rate.

Panels G-L: Model EMG results. Results generated similarly to the EMG data, for the simulated EMG results in panels G-L of Fig. 6.

All fits shown here were significant ( $p < 0.01$ , calculated as described in METHODS).

### Supplementary Figure S3

Recorded and simulated change in class spike rate with total-spike rate for subjects RB2 and 3.

Panels A & D: Class spike rate plotted against total-spike rate sampled at 50 ms intervals. For each spike amplitude class, this relation is approximately linear (linear fits denoted by the solid lines; data by the points).

Panels B & E: Base firing rates (total-spike rate where a class spike rate becomes non-zero) plotted against the central spike amplitude for each of the spike amplitude classes in panels A & D. The solid line is the best linear fit to this data that passes through zero base firing rate when the spike amplitude equals the EMG threshold  $\theta_0$ .

Panels C & F: The gradients of the best-fits in panels A & D plotted against the central spike amplitude for each spike amplitude class. Hyperbolas (see equation

**Error! Reference source not found.**) were found to give good fits to these data.

Panels G-L: Model EMG results. The analysis of the simulated EMG records is the same as that for the EMG data in panels A-F.

Data fits shown in central and right-hand columns were significant ( $p < 0.05$ , calculated as described in METHODS).