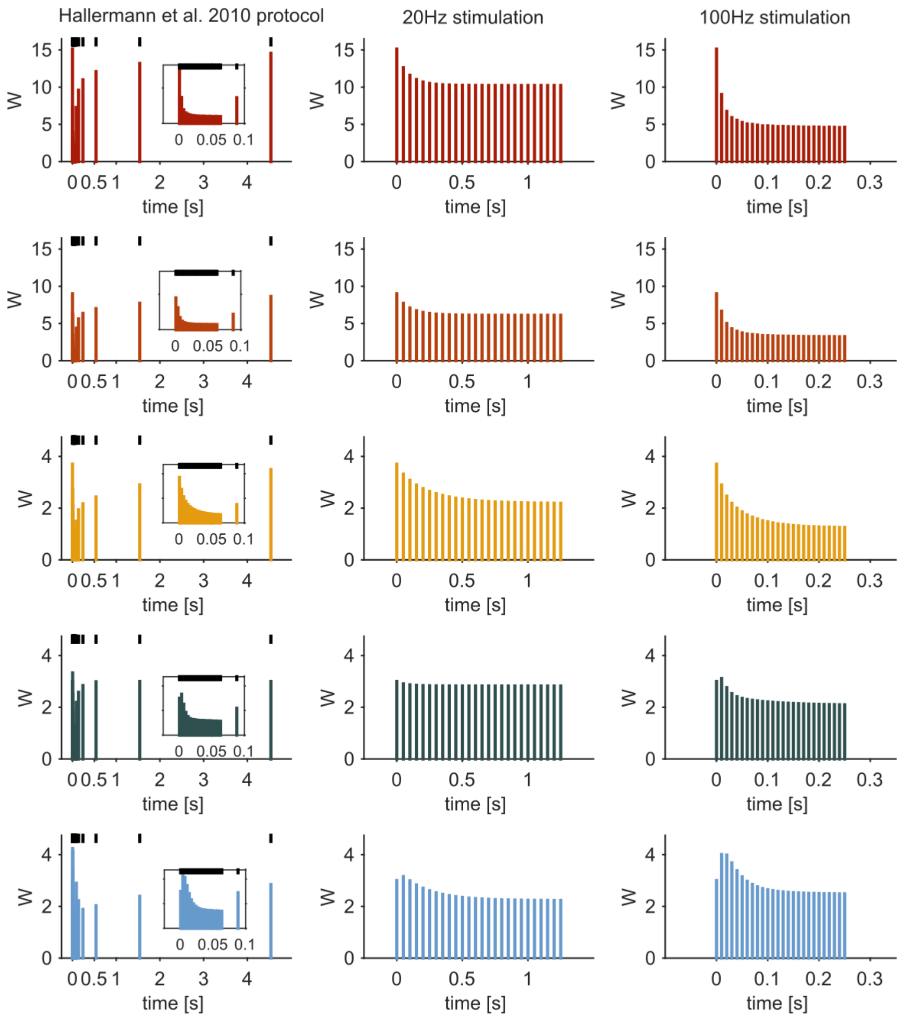
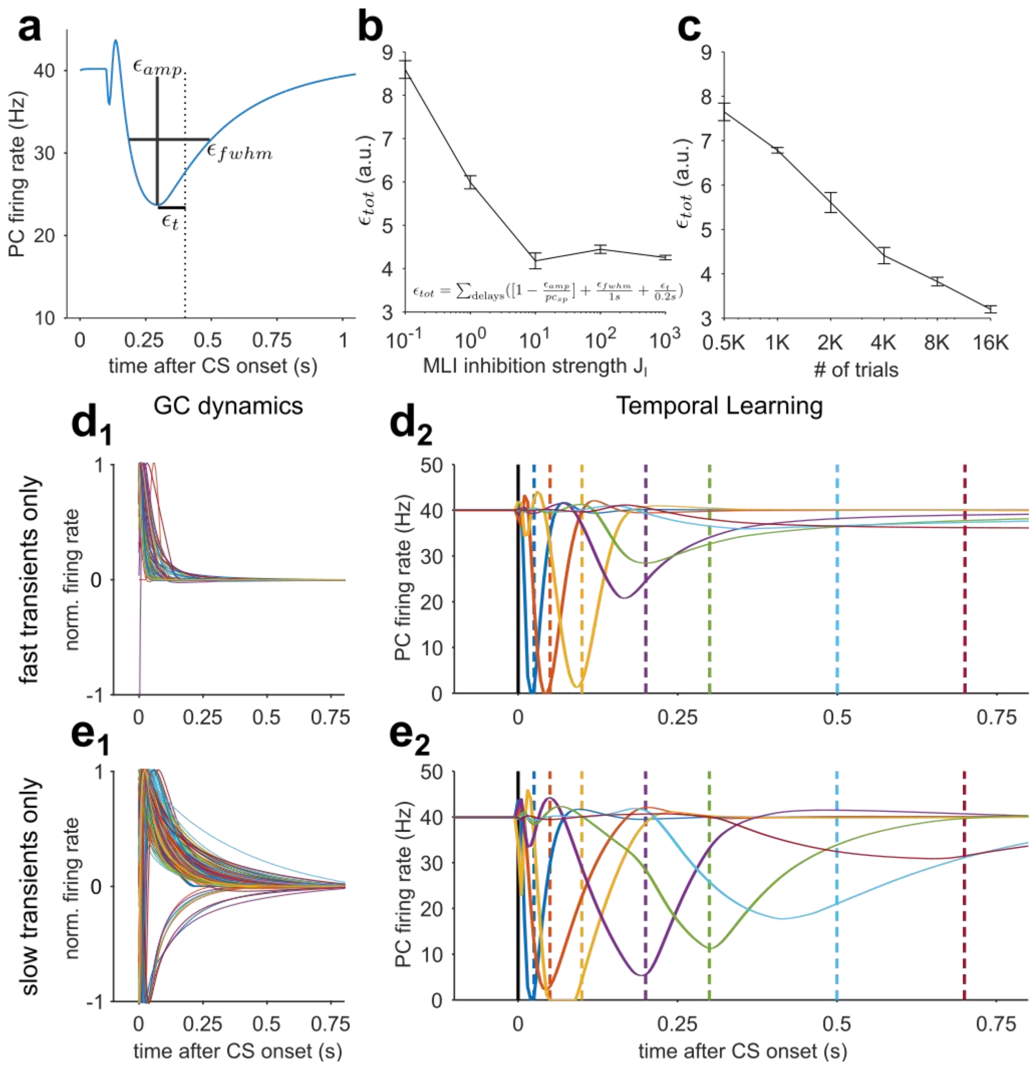
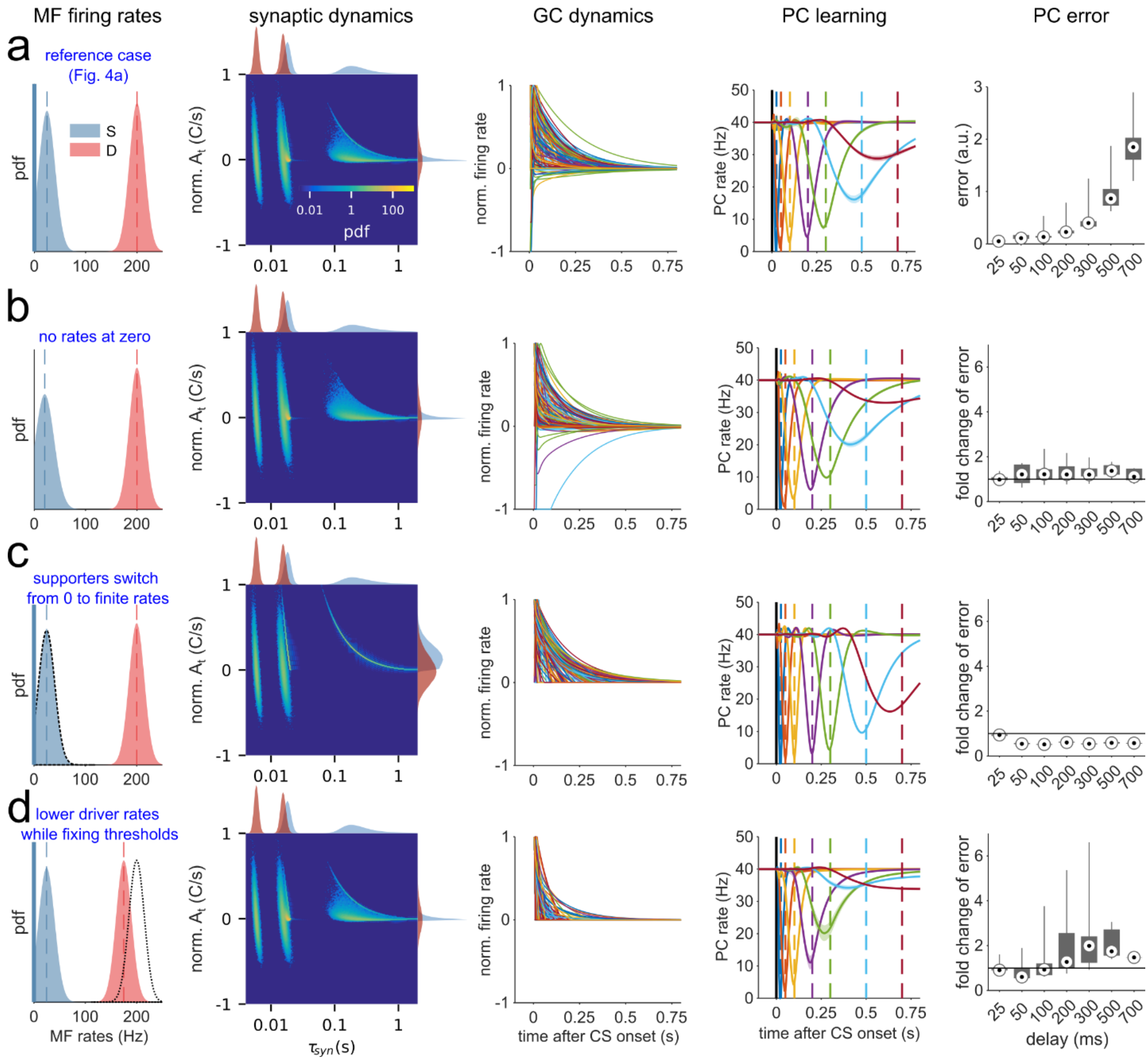
Supplementary Figures



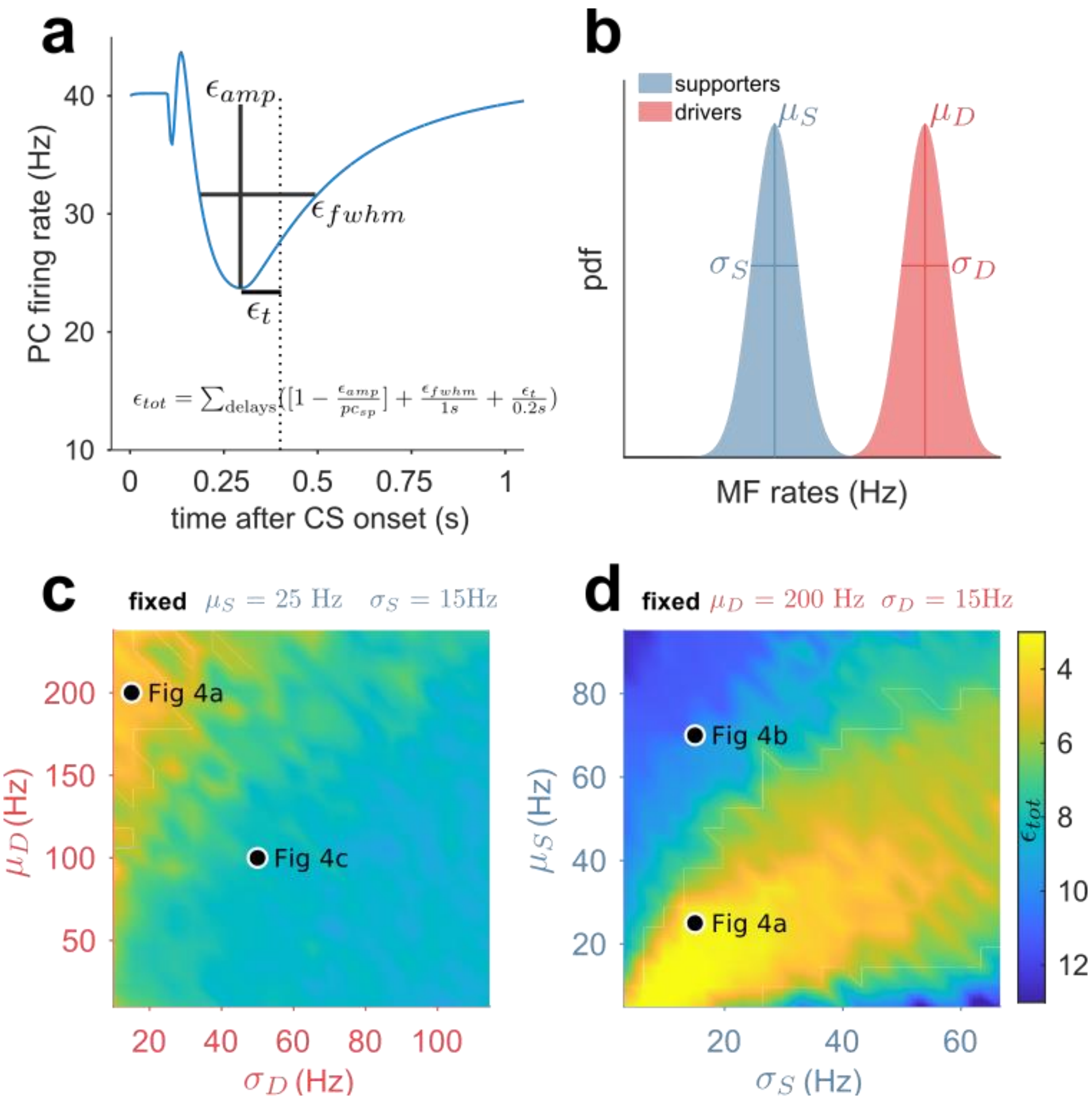
Supplementary Figure 1 *Behavior of model synapses subjected to different stimulation protocols. Each row represents one of the five synapse types from* ***Fig. 1****. First column: average synaptic weight in response to 300 Hz train followed by increasing intervals ranging from 25 ms to 5 s as in ref.*[38]*. Inset: zoom on 300 Hz train. Second and third column: average synaptic weight in response to trains of 26 stimuli at 20 Hz and 100 Hz, respectively, similar to ref.*[39]



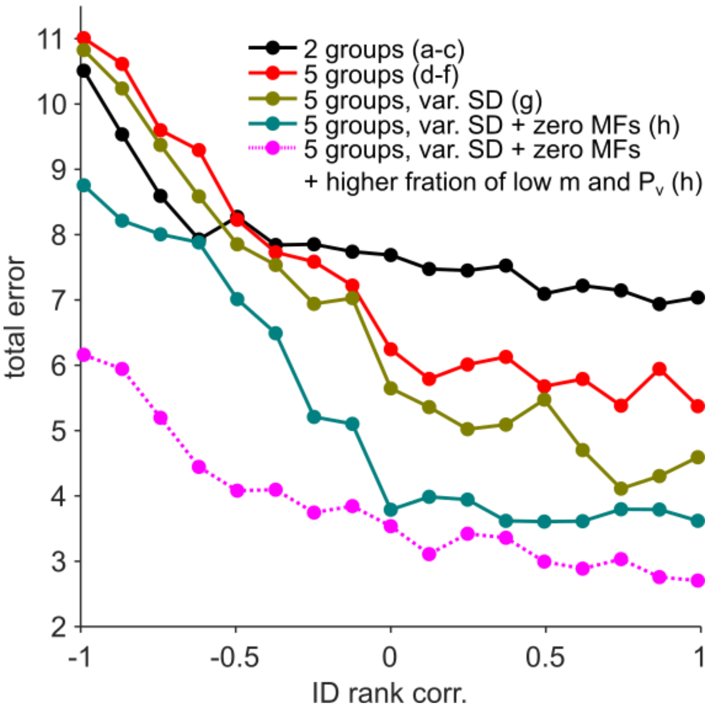
Supplementary Figure 2 (a) *Definition of error components used to assess learning performance.* ***(b)*** *Learning error as a function of MLI-PC inhibition strength. The total error is computed from the individual components according to the formula shown. Black line represents the average over 20 realizations of the network in* ***Fig.2****. Error bars are SEM.* ***(c)*** *Same as* ***b*** *for learning error as a function of number of learning iterations.* ***(d$_1$)*** *As in* ***Fig.2e****, but without GCs whose transients decayed to 10% of their peak values in more than 150 ms.* ***(d$_2$)*** *Learning performance when using the temporal basis from panel* ***d$_1$****.* ***(e$_1$)*** *As in* ***Fig.2e****, but without GCs whose transients decayed to 10% of their peak values in less than 150 ms.* ***(e$_2$)*** *Learning performance when using the temporal basis from panel* ***e$_1$****.* Note that learning of short delays was not completely abolished because our manipulations did not affect the rising phases of the GC transients.



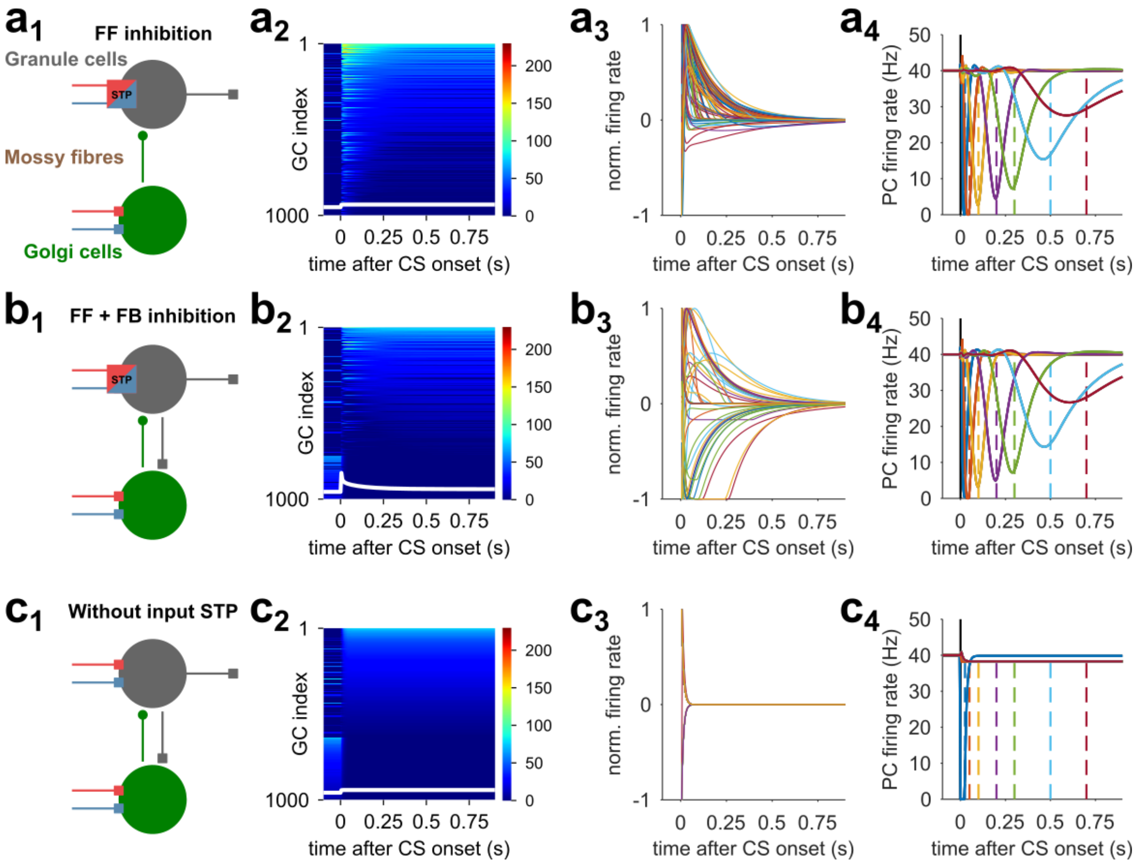
Supplementary Figure 3 *Additional examples of MF rate distributions and their impact on learning.* ***(a)*** *Same as* ***Fig. 4a*** *(i.e. reference case, see legend of* ***Fig. 4*** *for details).* ***(b)*** *Without zero firing rates.* ***(c)*** *Simulations in which all supporter inputs are set to zero before the CS and switch to finite firing rates during the CS.* ***(d)*** *Simulations in which GC thresholds are set as in* ***a*** *(blue and dashed firing rate distributions), but eyelid conditioning is carried out with lower driver inputs (blue and red firing rate distributions).*



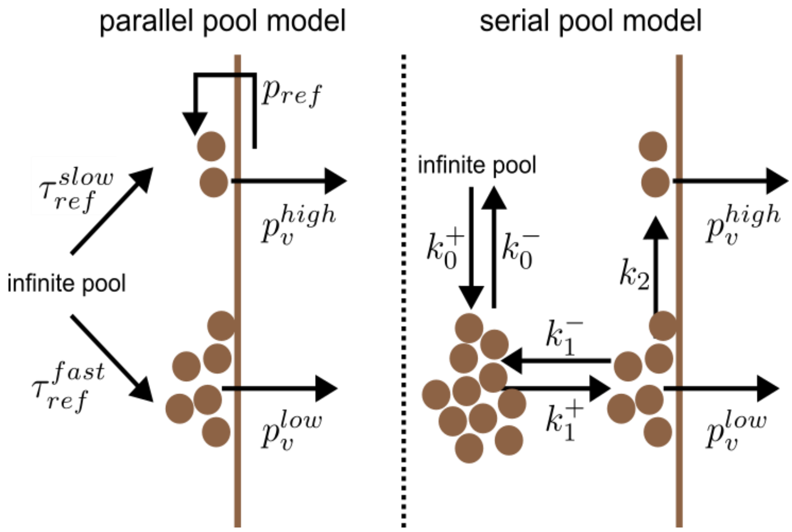
Supplementary Figure 4 *Scan of MF firing rate parameters show distinct roles for driver and supporter inputs.* ***(a)*** *Definition of error components used to assess learning performance. The total error is computed from the individual components according to the formula shown.* ***(b)*** *Definition of the MF firing rate parameters. μ_D, μ_S and σ_D, σ_S denote means and standard deviations of the MF firing rate distributions of drivers (red) and supporters (blue) respectively.* ***(c)*** *Scan over driver parameters while keeping supporter parameters fixed.* ***(d)*** *Scan over supporter parameters while keeping driver parameters fixed. In* ***c*** *and* ***d*** *the total learning error is color coded and parameter configurations corresponding to rows in* ***Fig. 4*** *are indicated by black dots.*



Supplementary Figure 5 *Average total error over seven delay intervals for varying rank-correlation between the m category and the* p_v *category for all scenarios shown in* ***Fig. 5****.*



Supplementary Figure 6** Eyelid learning is not significantly affected by simple GoC feedback.* ***(**a1*****)*** *Scheme of CC input layer with GoC inhibition that acts in a purely feed-forward manner. This configuration is functionally identical to the reduced model used in the main text.* ***(*****a2, a3*****)*** *GC temporal basis (as in* ***Fig. 2c****). White line in* **a2** *indicates GoC activity.* ***(*****a4*****)*** *PC eyelid response learning.* ***(*****b1-4*****)*** *Same as row* ***a****, but with GC-GoC feedback connections.* ***(*****c1-4*****)*** *Same as row* ***b****, but without MF-GC STP.*



Supplementary Figure 7 *Scheme comparing the parallel pool model used here with the serial pool model from ref.*[38]*. The symbols k_0^+, k_0^-, k_1^+, k_1^- and k_2 are rate constants described in ref.*[38].