Supplemental Text and Figures

Supplemental Figure S1.

(A) Drivable multi-electrode array designed for BF recording. Electrode bundles were ensheathed inside stainless steel cannulae and deployed by microdrives. Right, electrode lowering to the BF during surgery. **(B)** An example single unit showing its spike waveforms (average amplitude 137μV), the ISI distribution and all waveforms from the same channel projected into a 3D PCA space. The red dashed line in the ISI histogram indicated 1.5 msec. **(C)** The distribution of spike amplitude (peak-to-peak) of all 210 single units recorded in the Go/Nogo task (from Supplemental Figure S2). The mean and median amplitude were 209 μV and 177μV, respectively. **(D)** The state space map of a recording session using LFPs from the BF. Points within the three main clusters were labeled as the three major states, while points in between clusters were labeled as state transitions.

Supplemental Figure S2

(A) A reproduction of Figure 2B showing BF population bursting responses to cues in the Go/Nogo task. Only neurons with bursting responses to all three cues were plotted (n=105). **(B)** Responses of the remaining BF neurons (n=105), plotted the same way as in **A**. Notice that, while neurons were classified based on their bursting responses to all three cues, BF neurons in **A** shared similar baseline firing rates (2-8 Hz) before cue onsets. However, the baseline firing rates for neurons in **B** were more variable.

Supplemental Figure S3

(A1-A3) Distributions of the onset latency for excitatory (red, pointed up) and inhibitory (blue, pointed down) responses for all BF neurons, plotted separately for each cue in the Go/Nogo task. Most BF responses were short latency excitatory responses. Gray shaded area indicated responses defined as bursting responses. Similar plots aligned at the first delivery of sucrose and quinine in each trial **(B1-B2)** and for the first unreinforced lick in each trial **(C)**. Notice that BF neurons do not show bursting responses to the unreinforced lick.

Supplemental Figure S4

(A) BF bursting responses to T_S(Go) and T_Q(Nogo), as shown in Figure 2B, plotted on a larger time window ([-1, 1] sec). Note that the sustained response in some neurons

persisted for up to 1 sec, up until right before licking. In comparison, the latency for Go response was on average 1-1.1 sec (Figure 1B). **(B)** Response of salience-encoding BF neurons to T_Q while rats incorrectly made Go responses. Notice that, despite similar initial bursting response, the sustained response during T_Q(Go) are generally intermediate between T_S(Go) and T_Q(Nogo) trials.

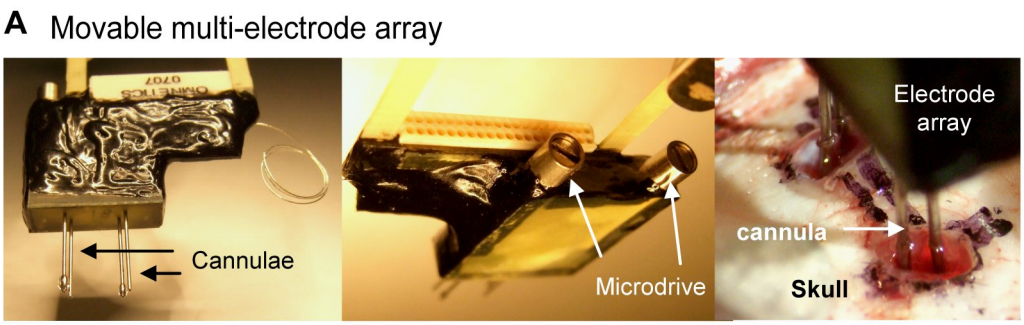
Supplemental Figure S5

BF responses to novel cues during the first 10 trials rats encountered a novel cue from the novel-T group **(A)** and novel-L group **(B)**. The lack of bursting response suggests that BF neurons may not encode the salience associated with novelty.

Supplemental Figure S6

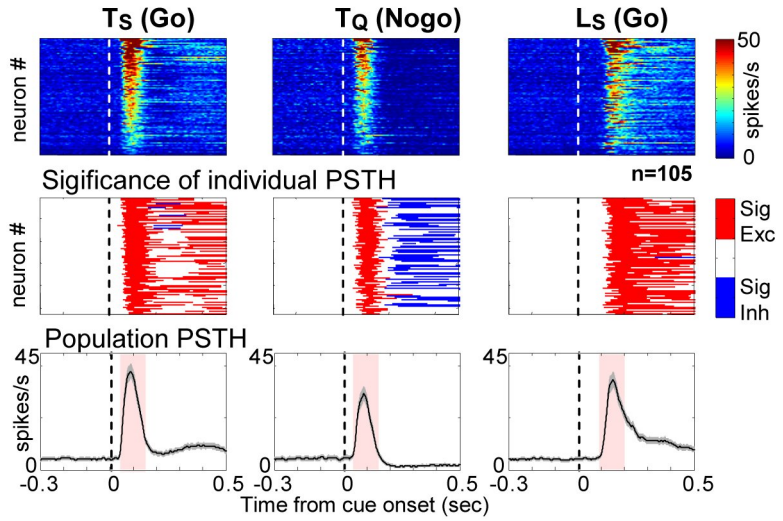
Response of putative ACh BF neurons to motivationally salient stimuli in the Go/Nogo task. **(A)** Average firing rate of individual BF neurons during WK and SWS. Among 143 BF neurons recorded in the Go/Nogo task that also contained at least 10 min SWS recording, 8 BF neurons were classified as putative ACh neurons (blue) based on at least 2-fold increase of firing rate during WK compared to SWS (Lee et al, J Neurosci, 2005, 25:4365-69). None of these eight neurons overlaps with salience-encoding BF neurons (red). Black open circles indicated neurons not classified in either group. **(B)-(D)** Response properties of three putative ACh neurons (indicated by arrows in **A**) to cues and reinforcement. PSTHs were color-coded based on cue and reinforcement identities. Statistical significance for all PSTHs were indicted by color-lines above (excitatory) and below (inhibitory). Notice that the significance for reinforcement responses were calculated differently here than those in Figure 5. In order to illustrate significant firing rate modulations before contacting reinforcement (such as in **B** and **C**), the calculation of significance started 1 sec before reinforcement (while in Figure 5, calculation started at the time of reinforcement delivery). Overall, response properties of putative ACh neurons were heterogeneous. Some showed delayed excitatory responses to cues, turning to inhibitory responses prior to contacting reinforcement **(B)**. Some showed mixed bursting and delayed excitatory responses to cues **(C)**. Several other showed little, if any, response to cues and reinforcement **(D)**. Given the small sample size and without independent means of verifying their neurochemical identity (such as juxtacellular recording and labeling), we are unable to draw a conclusion on how ACh BF neurons behave in the Go/Nogo task.

Supplemental Figure S1

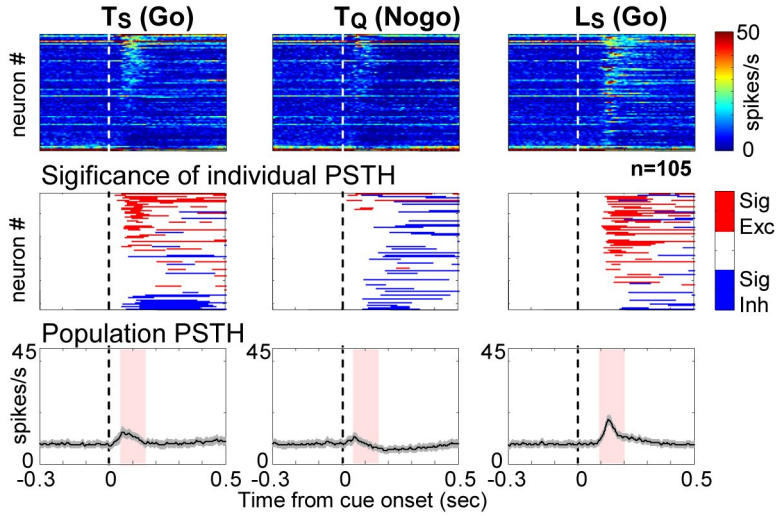


Supplemental Figure S2

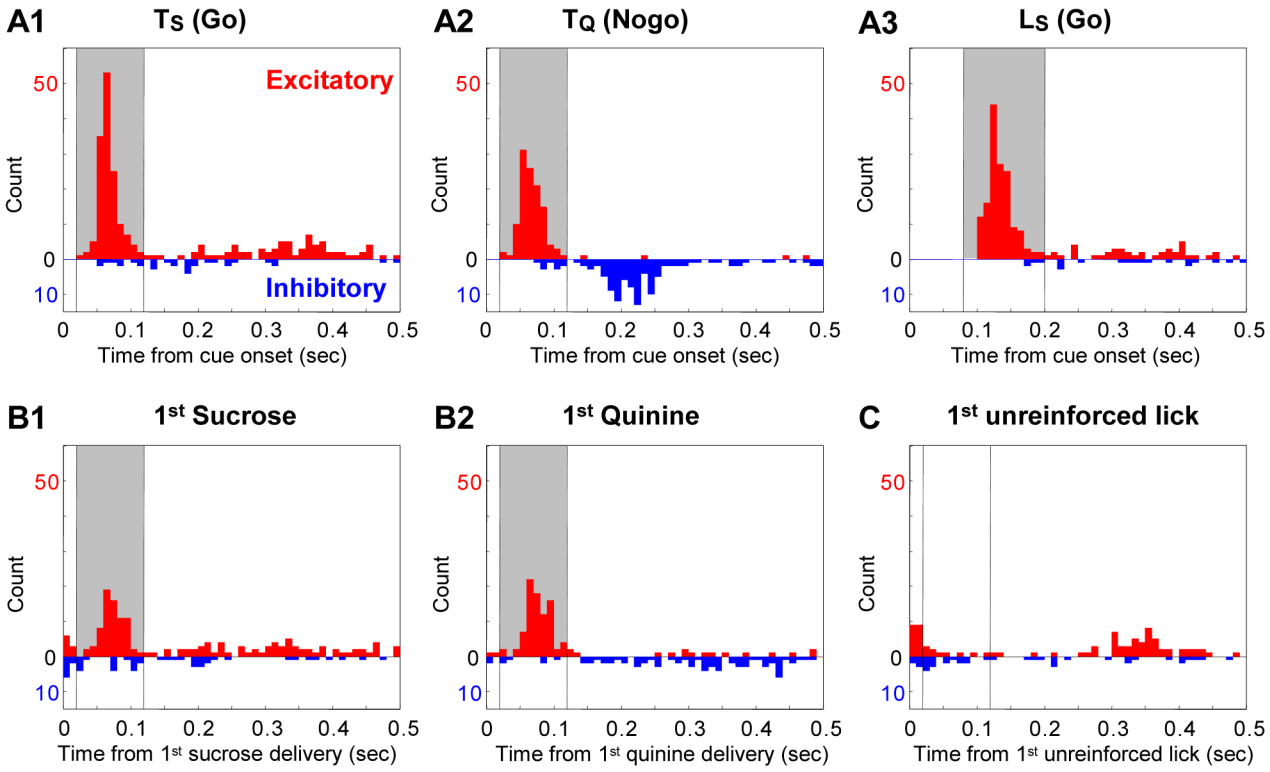
A BF neurons with bursting responses to all three cues (Figure 2B)



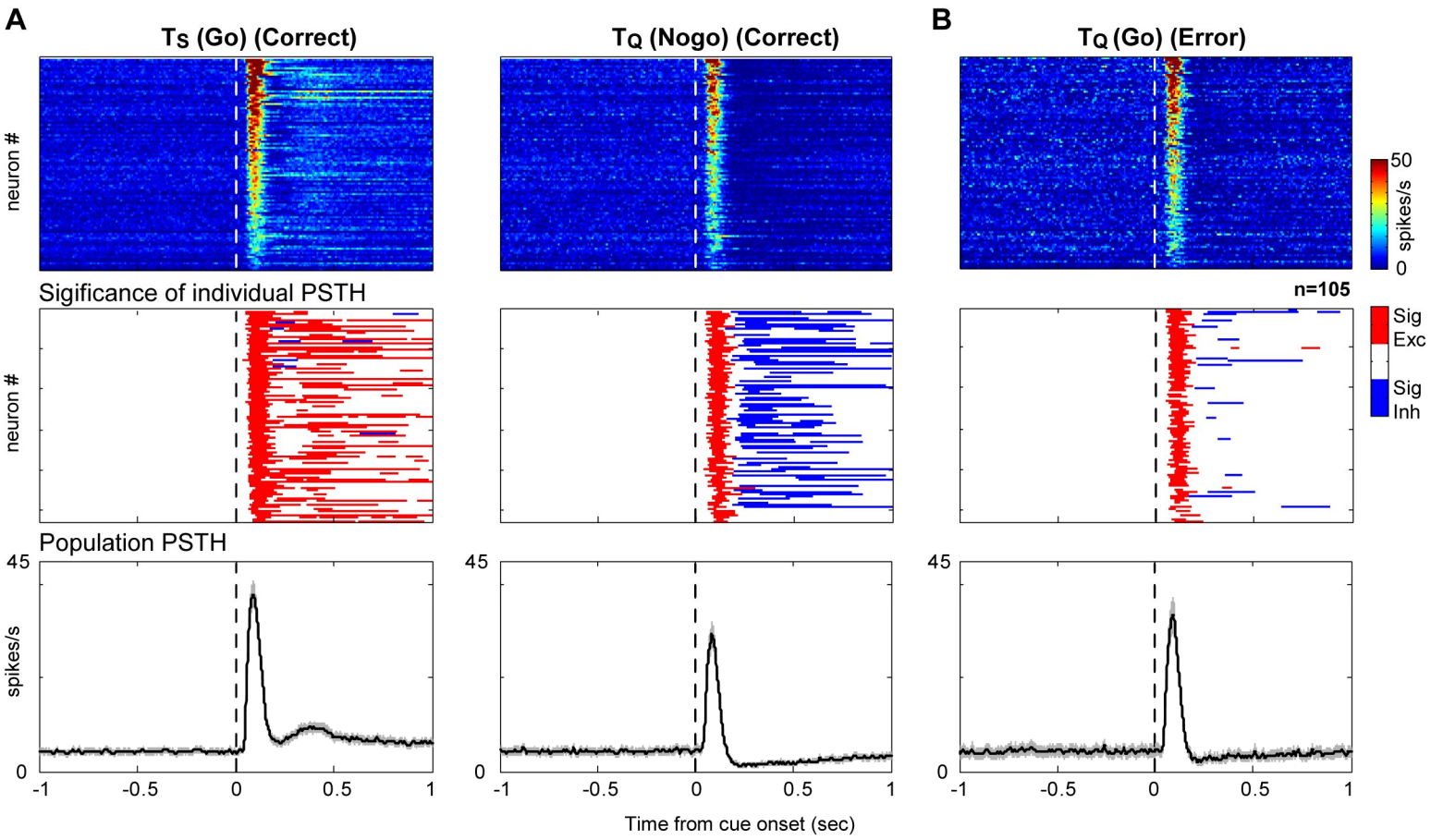
B The remaining BF neurons



Supplemental Figure S3

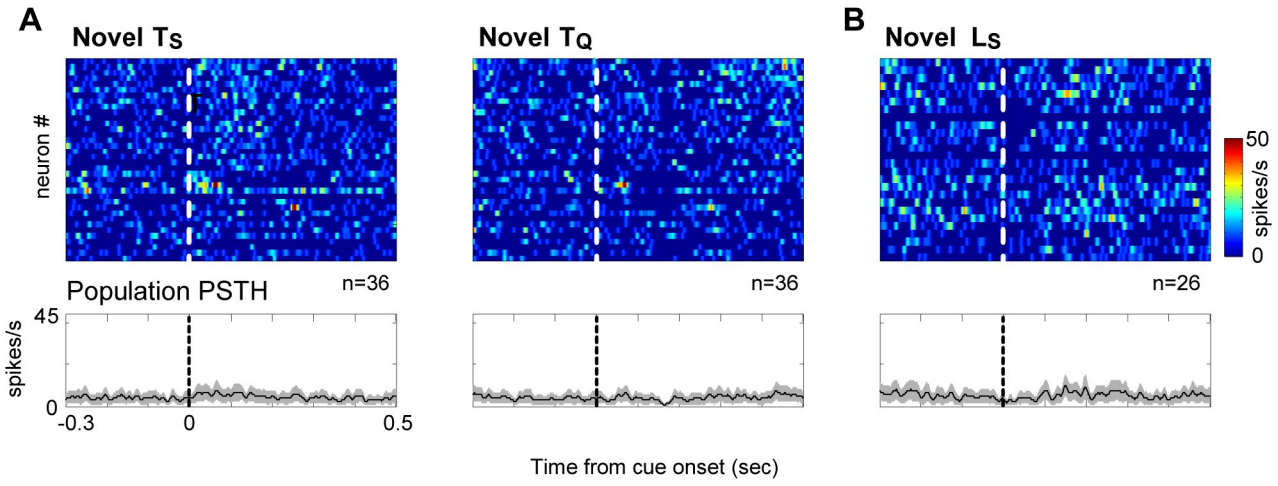


Supplemental Figure S4



Supplemental Figure S5

Response to novel cues in the first 10 trials



Supplemental Figure S6