Supplemental Figure 1

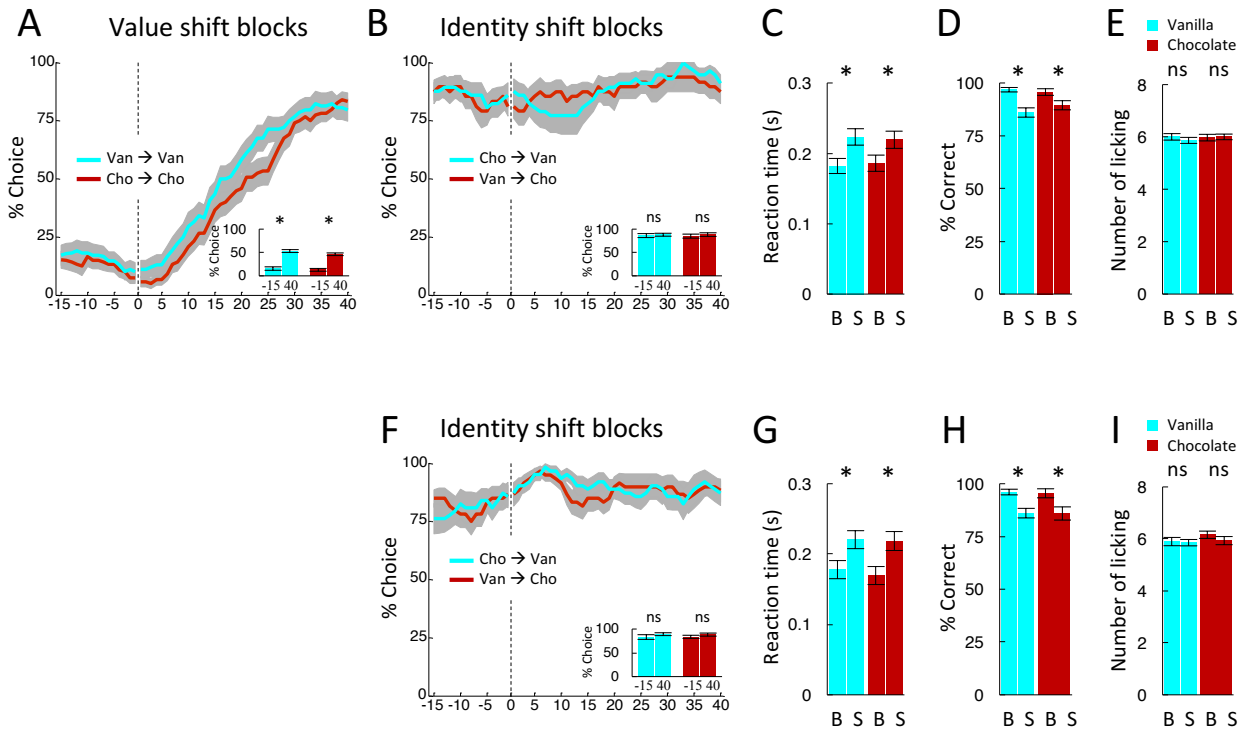

Figure S1, related to Figure 2: Comparison of value-based behavior when there was no fluctuation in any measured behavior at either well in the initial trials after a shift in reward number or flavor versus blocks in which at least one of the behavioral measures changed. (A-B) Choice rates in last 15 trials before and first 40 trials after a switch in reward number (A) or flavor (B) in blocks where behaviors fluctuated in the initial trials of the block. Y-axes indicate percent choice of side designated as big reward after block switch. Inset bar graphs show average choice rates in the last 15 before and first 40 trials after the switch. **(C)** Reaction times, **(D)** percentage correct, and **(E)** licking in the first 500ms after the 1st drop of reward on the last 10 forced-choice trials in response to big and small amounts of each flavor in the same blocks. **(F-I)** Choice rates, reaction times, percentage correct, and licking plotted as in B-E, but from blocks in which there was no fluctuation in any behavioral measures in the initial trials after a shift. Note there were not a sufficient number of number shift blocks that met criteria to plot free choice behavior effectively, so it is not shown. However a comparison of the data in B-E and F-G by ANOVA as in the the main text but with the added factor of block type (change, no change) revealed no main effects nor any interactions with block type ($F's < 0.73$, $p's > 0.39$). B, big; S, small. Error bars, S.E.M.

Supplemental Figure 2

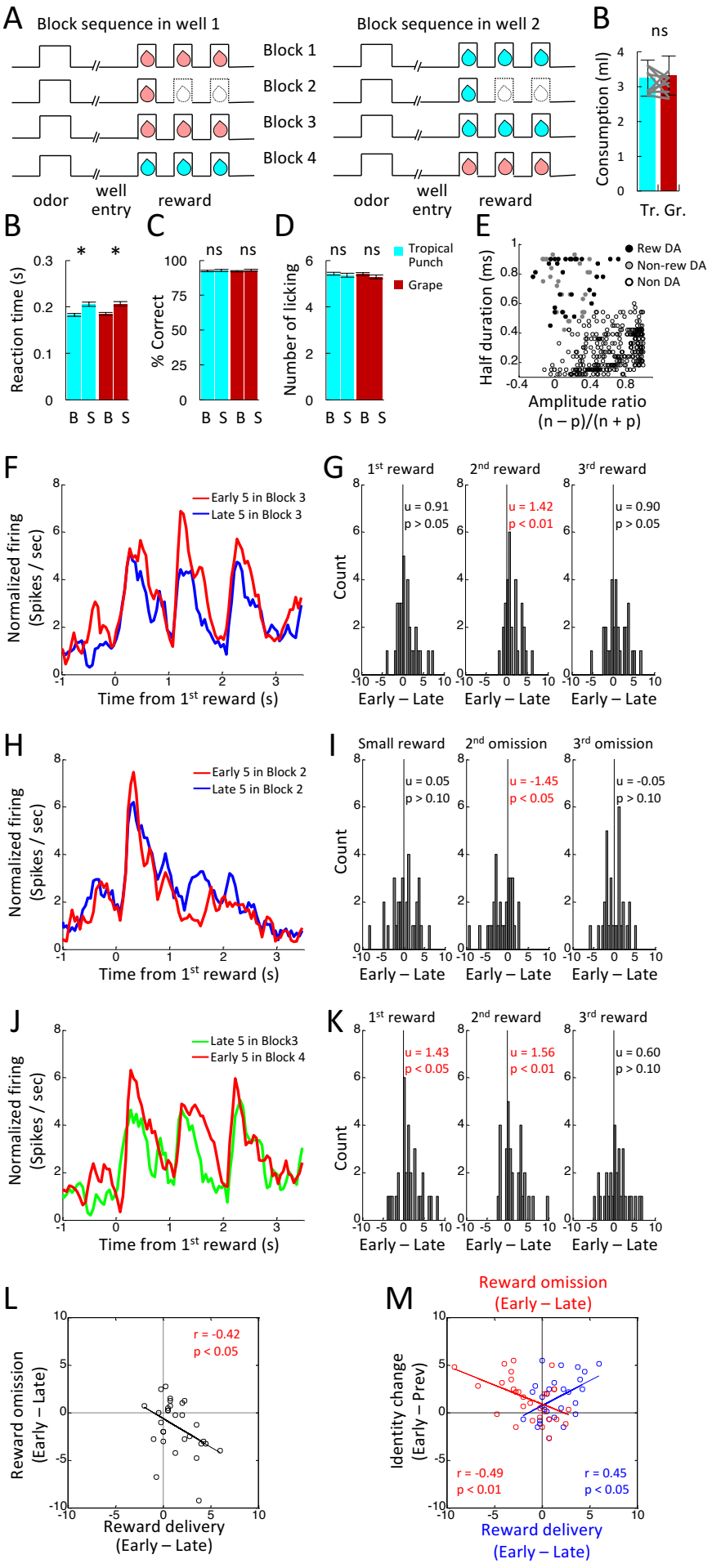

Figure S2, related to Figures 3-4: Value and identity prediction error signaling by reward-responsive putative dopamine neurons (n = 30) recorded in an alternative task in which rewards available in each block were of the same size. Neurons were identified and data analyzed as in main text. **(A)** Task design was similar to the one in the main text except, 1) no choice trials were included, 2) on big trials, each bolus was 1 sec apart, 3) two different Kool-Aid solutions (15% sucrose + 0.15% tropical punch or grape flavors, wt/vol) were used as rewards instead of flavored milk solutions. **(B)** Bar-graph indicates the result of 2-min consumption tests conducted at the end of some sessions. Gray lines indicate data from individual rats. Tr, tropical punch: Gr, grape. **(C)** Reaction times on the last 10 trials in response to big and small amounts of each flavor. **(D)** Percentage correct on the last 10 trials in response to big and small amounts of each flavor. **(E)** Number of licks in 500 ms after 1st drop of reward on the last 10 trials in response to big and small amounts of each flavor. B, big; S, small. Error bars, S.E.M. (F) Result of cluster analysis based on the half time of the spike duration and the ratio comparing the amplitude of the first positive and negative waveform segments ((n – p) / (n + p)). Black, reward-responsive dopamine neurons (rew DA, n = 30); gray, reward-nonresponsive dopamine neurons (non-rew DA, n = 29); open circle, VTA neurons in other clusters, no clusters or more than one cluster (non DA, n = 325). **(F)** Average firing on first 5 (red) and last 5 (blue) trials after a shift in reward number from small to big reward. **(G)** Distributions of difference scores comparing firing to 1st (left), 2nd (middle) and 3rd drops (right) of the big reward in the first 5 versus last 5 trials in a number shift block. **(H)** Average firing on first 5 (red) and last 5 (blue) trials after a shift in reward number from big to small reward. **(I)** Distributions of difference scores comparing firing to the single drop of the small reward (left), and omissions of 2nd (middle) and 3rd drops (right) of the big reward in the first 5 versus last 5 trials in a number shift block. **(J)** Average firing on last 5 before (Green) and first 5 (blue) trials after a shift in reward identity. **(K)** Distributions of difference scores comparing firing to 1st (left), 2nd (middle) and 3rd drops (right) of the big reward in the last 5 versus first 5 trials before and after identity shift. **(L)** Correlation between differences scores representing changes in firing to delivery and omission of the 2nd drop of the big reward in a number shift block. **(M)** Correlation between changes in firing to shifts in reward identity, and changes in firing to delivery (blue dots) or omission (red dots) of the 2nd drop of the big reward in number shift.

Supplemental Figure 3

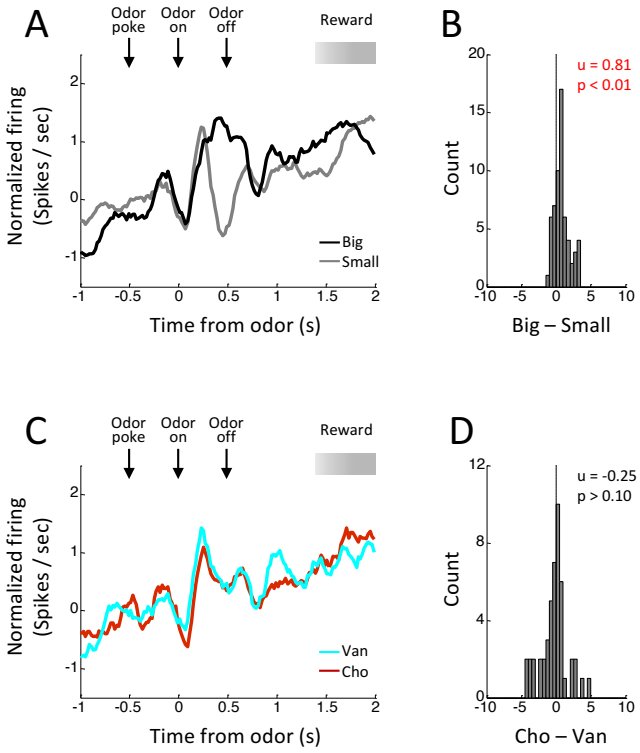

Figure S3, related to Figure 5: Changes in activity of reward-responsive dopamine neurons to cues paired with different value and identity. **(A)** Average firing to cues paired with big (black) or small reward (gray) on last 10 trials. **(B)** Distribution of difference scores comparing firing between high-(Big) and low-valued (Small) cues on last 10 trials. **(C)** Average firing to cues paired with chocolate- (Cho) or vanilla (Van) flavored milk on last 10 trials. **(D)** Distribution of difference scores comparing firing between cues paired with chocolate- and vanilla-flavored milk on last 10 trials. The numbers in upper right indicate results of Wilcoxon signed-rank test (p) and the average difference score (u).

Supplemental Figure 4

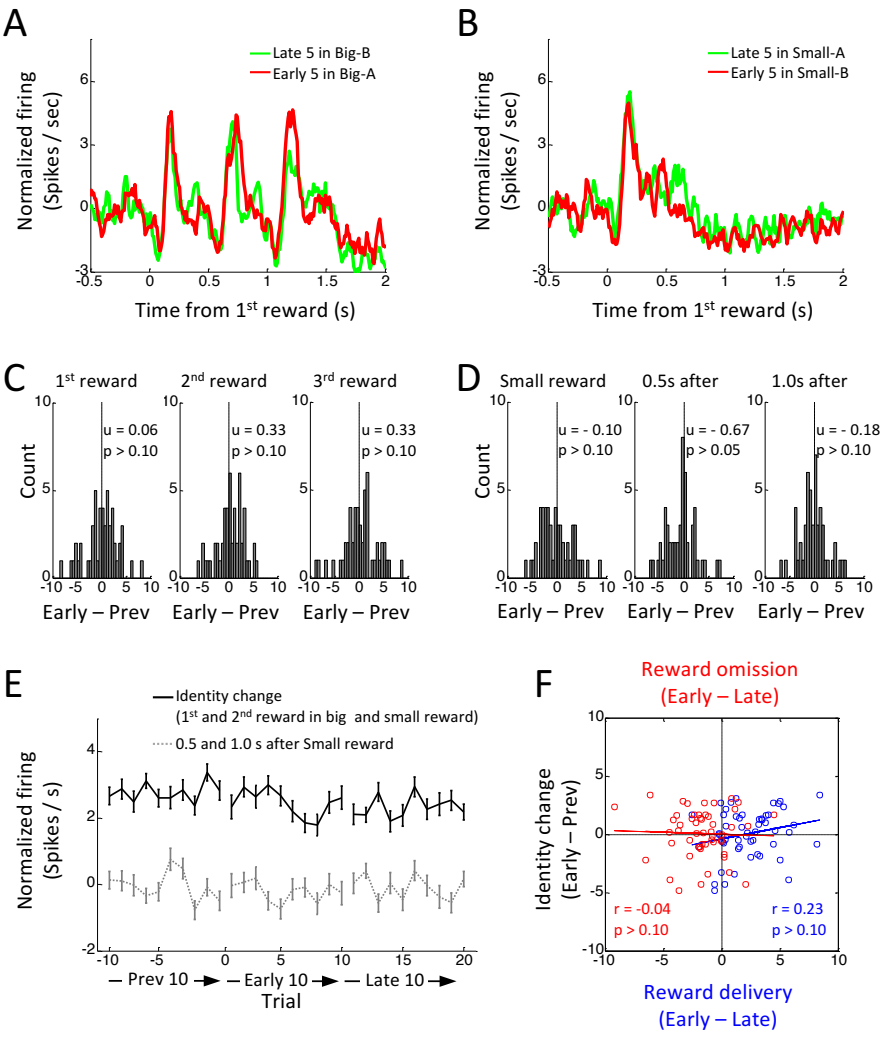

Figure S4, related to Figure 4: Changes in reward-evoked activity of reward-responsive dopamine neurons (n = 51) to changes in reward identity in blocks where rats showed no evidence of noticing the change in reward identity (see Fig S1 for behavior). (A – B) Average firing on last 5 trials before (green) and first 5 trials after (red) a shift in reward identity for the big (A) and small (B) rewards. Big-A, 3 drops of reward A; Big-B, 3 drops of reward B; Small-A, one drop of reward A; Small-B, one drop of reward B. **(C)** Distributions of difference scores comparing firing to 1st (left), 2nd (middle) and 3rd drops (right) of the big reward in the last 5 versus first 5 trials before and after identity shift. **(D)** Distributions of difference scores comparing firing to the single drop of the small reward (left), and omission of 2nd (middle) and 3rd drops (right) of the big reward in the last 5 versus first 5 small trials before and after an identity shift. Difference scores were computed from the average firing rate of each neuron. The numbers in each panel indicate results of Wilcoxon signed-rank test (p) and the average difference score (u). **(E)** Changes in average firing before and after reward identity shift. Black line indicates firing at the time of the 1st and 2nd drops of the big reward and the small reward. Gray dashed line indicates average firing 0.5 s and 1.0 s after small reward. Error bars, S.E.M. **(F)** Correlation between changes in firing to shifts in reward identity, shown here, and changes in firing to delivery (blue dots) or omission (red dots) of the 2nd drop of the big reward, shown in Fig 3.