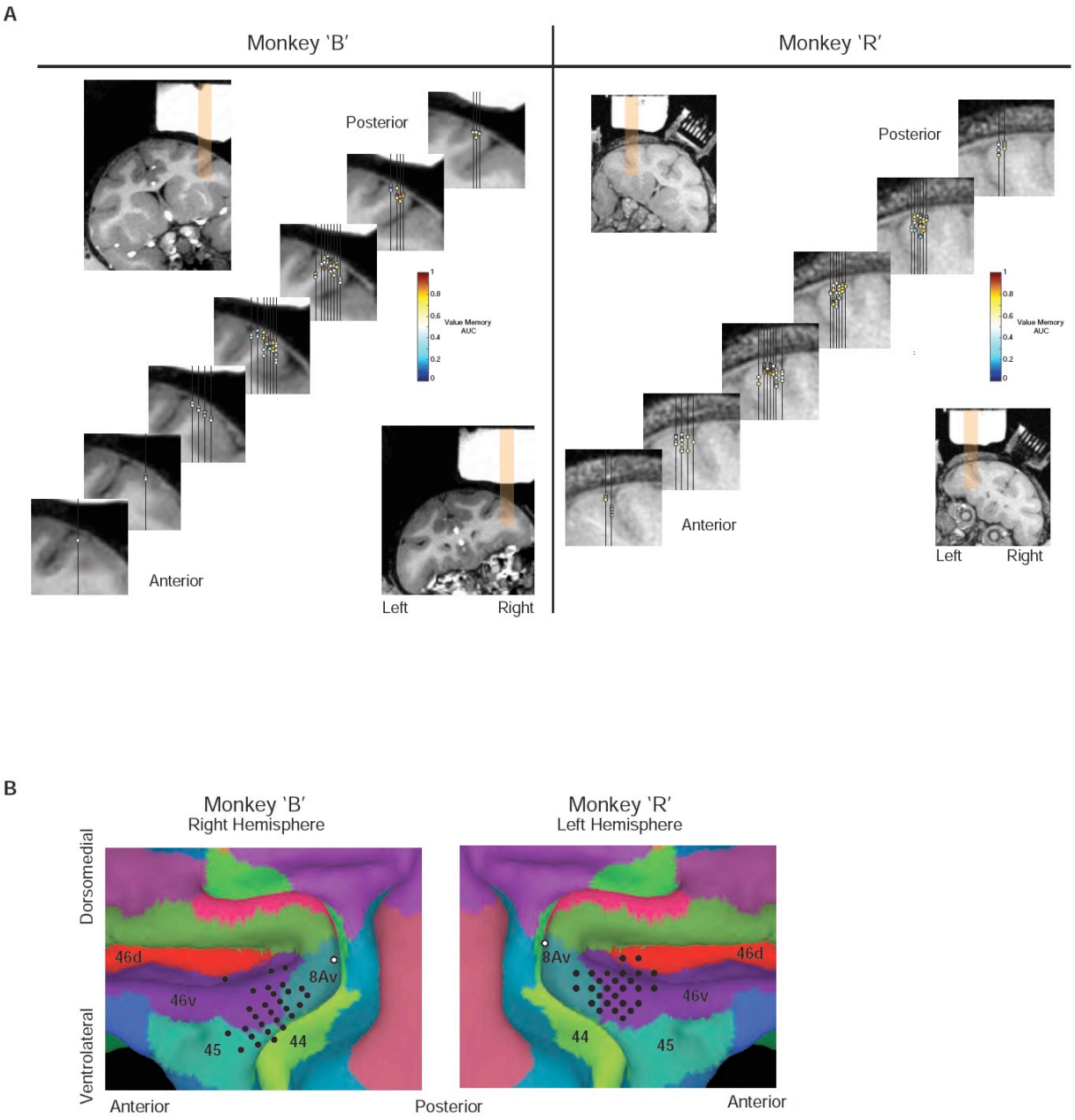

Figure S1. Reconstruction of recorded neuron locations in the vlPFC of both monkeys. Related to Figure 1. (A) For each monkey, the most posterior and anterior recording locations are shown in coronal sections with PFC recording chamber visible in upper left and lower right corners. (shaded area shows the mediolateral extent of recording). Intended electrode tracks (black lines) and reconstructed location of recorded neurons are shown in the MRI focused on the recorded region from most posterior to most anterior in 1mm apart sections. The recorded locations are color coded by the value AUC. (B) Anatomical regions covered by electrode penetrations (black dots) in both monkeys are shown on the surface of a standard brain (see STAR Methods). The white dot is the location identified as frontal-eye field by recording saccadic responses and low-threshold stimulation (<50μA) for evoking saccade. The color patches on the surface of the brain mark the anatomical regions in the standard atlas (Saleem and Logothetis, 2012) [S1,S2]

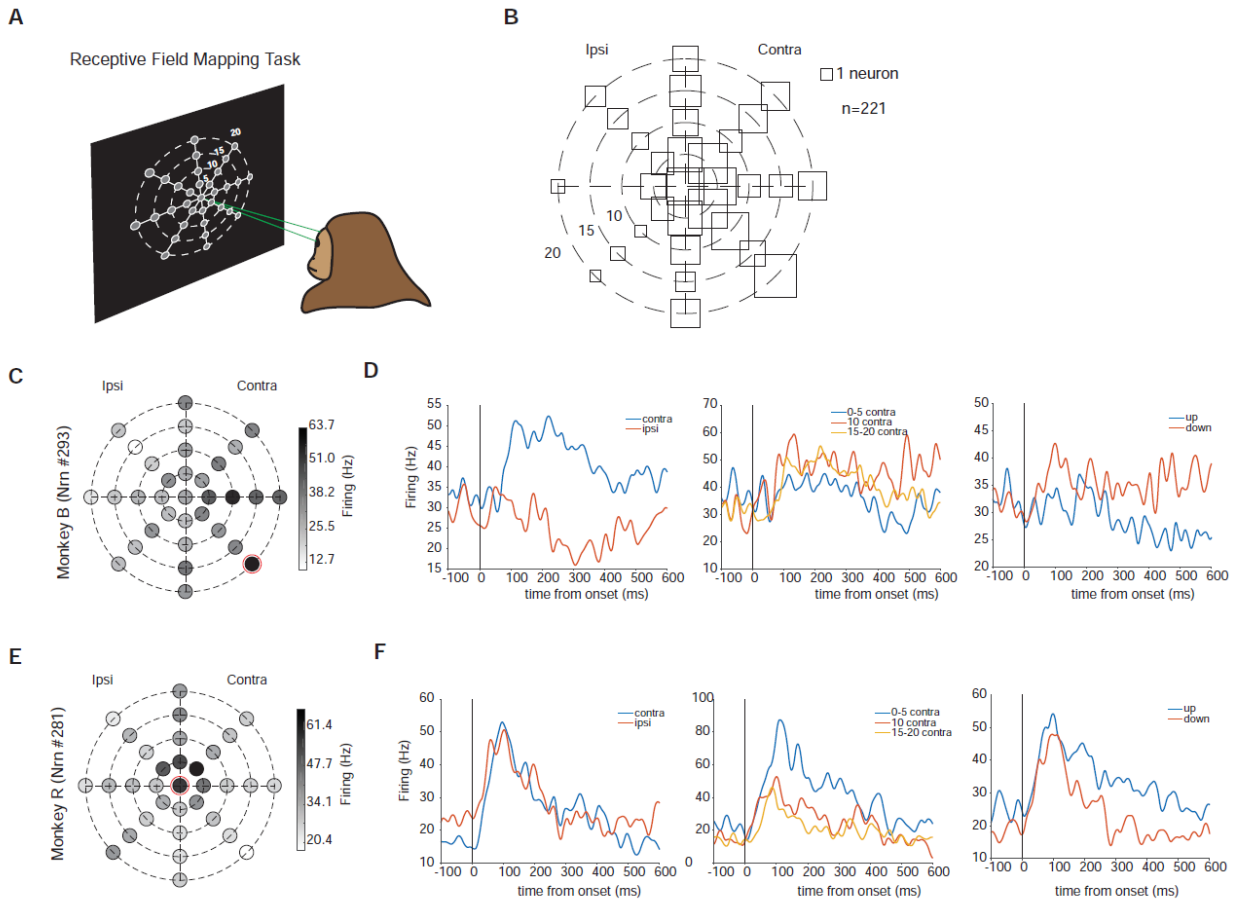

Figure S2. Receptive field mapping of PFC neurons. Related to Figure 1. (A) Animals fixated centrally while neutral familiar fractals were flashed in 33 locations including the center and 8 radial directions at 4 eccentricities. (B) The size of squares in each location indicates the number of neurons with maximum visual response in that location. (C) The visual response of the example neuron shown in Figure 3A-left across various retinal locations averaged 50-350ms after object onset. Darker colors indicate higher firing. Orange circle indicates location tested in passive viewing for value memory. (D) The average response across all contra- and ipsi-lateral locations (left), across different eccentricities in the contra-lateral side (middle) and across three upward vs three down ward directions (right) for neuron in C. (E-F) Same format as C-D for the example neuron shown in Figure S4-right.

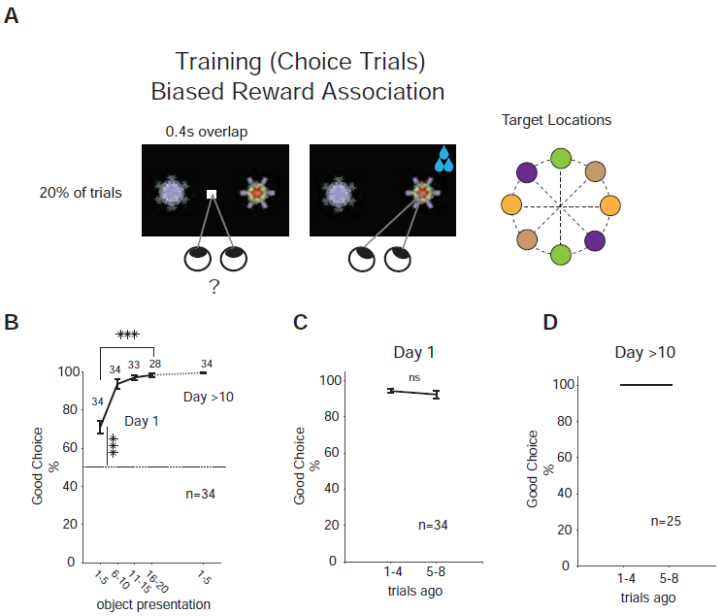

Figure S3. Behavioral learning and retention of object values across trials during value training. Related to Figure 2. (A) Monkeys first fixated centrally and after the instruction (fixation off) made a choice between two objects by making a saccade and holding gaze to one of them and then receiving the corresponding reward (high or low for good and bad objects, respectively). Objects were shown in diametrically opposed positions around fixation in one of the 8 radial locations between 10°-15° eccentricities. (B) Good object choice rate across reward training trials in the first day and after >10 days of training ($F_{4,158}$=44, P<10^{-19},1st day 1-5 trial choice t_{33}=21 P<10^{-20}, 1st day 1-5 vs 16-20 trial t_{27}=7.4 P<10^{-7}). (C) Good object choice rate for objects not seen 1-4 vs 5-8 trials ago during reward training in the first day of training (t_{33}=0.8, P=0.4). (D) Same as B but after >10 days of training (choice was 100% without variability in these sessions. Out of the 34 sessions in >10 day training, 9 sessions happened not to have choice trials where both good and bad objects were not seen 1-4 trials ago or 5-8 trials ago and therefore could not be used in C. This did not happen for first day data because sessions more trials in the first day).

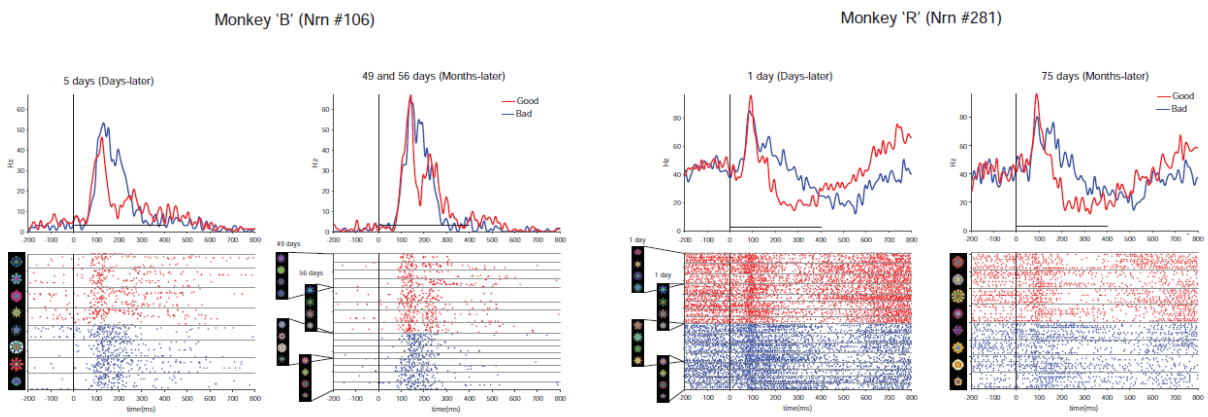

Figure S4. Example bad-preferring neurons. Related to Figure 3. Same format as Figure 3A but for bad-preferring neurons across memory periods. For neurons #106 in months period and neuron #281 in days period 16 objects (8 good and 8 bad from two sets) were used that are shown to the left of the rasters. In this case the number of days in memory is noted separately above each set of eight fractals.

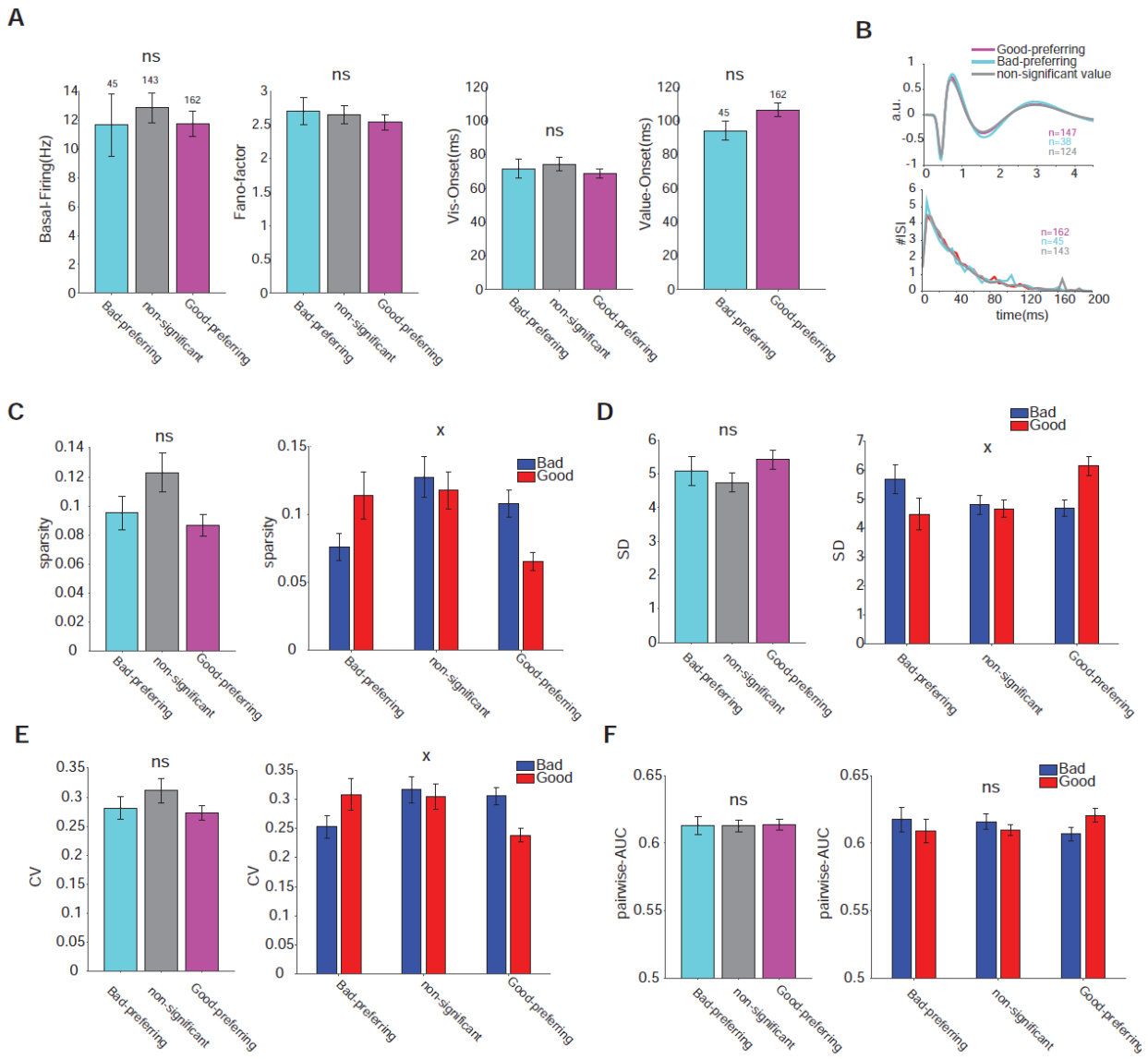

Figure S5. Good-preferring and bad-preferring neurons are not distinguishable based on various physiological measures. Related to Figure 4. (A) Baseline firing ($F_{2,347}$=1.6 P=0.18), Fano-factor ($F_{2,347}$=0.34 P=0.7), visual response onset ($F_{2,347}$=0.23 P=0.79) and value differentiation onset (t_{201}=1.7 P=0.08) for good- and bad-preferring neurons as well as other non-significant value neurons (neuron type). (B) The spike shape and inter-spike interval (ISI) distribution of good-, bad-preferring and non-significant neurons. Spike shape was recorded for 309 out of 350 recorded neurons. (C) Object selectivity measured by sparsity (left: $F_{2,347}$=1.7, P=0.17, right: object type $F_{1,692}$=0.16, P=0.68, neuron type $F_{2,692}$=2.89, P=0.06, interaction $F_{2,692}$=3.12, P=0.04) (D) variability (standard deviation) of object responses (left: $F_{2,347}$=1.5, P=0.22, right: object type $F_{1,694}$=0.01, P=0.9, neuron type $F_{2,694}$=2.44, P=0.08, interaction $F_{2,694}$=5.78, P=0.003) (E) coefficient of variation (CV) (left: $F_{2,347}$=1.5, P=0.22, right: object type $F_{1,694}$=0.17, P=0.7, neuron type $F_{2,694}$=2.5, P=0.08, interaction $F_{2,694}$=3.17, P=0.04) and (F) pairwise AUC (left: $F_{2,347}$=0.01, P=0.9, right: object type $F_{1,692}$=0.002, P=0.96, neuron type $F_{2,692}$=0.01, P=0.98, interaction $F_{2,692}$=2.3, P=0.09) for good-, bad-preferring and non-significant neurons. In C-F metrics were calculated within good and bad objects and averaged across categories in the left plot or shown separately for good and bad objects in the right plot (x: significant interaction of object type that is good or bad and neuron type).

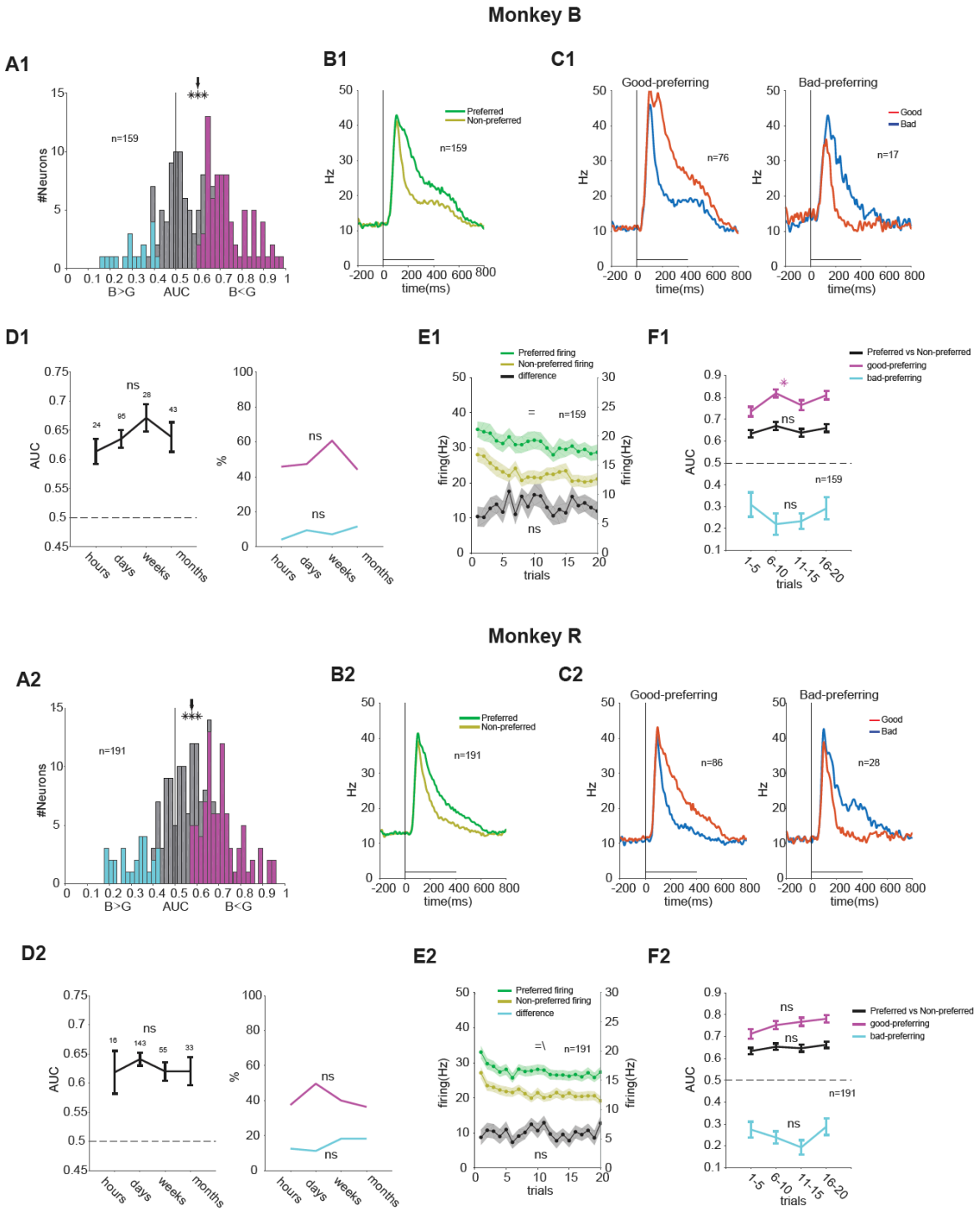

Figure S6. Value memory shown separately for each monkey. Related to Figure 4. Similar data as shown in Figure 4 but separately shown in both monkeys (A1-F1 for monkey B, A2-F2 for monkey R). (A1-2) Distribution of good vs bad discrimination (AUC) for all neurons collapsed across memory periods (average good vs bad AUC A1: 0.6 A2:0.57, $P<10^{-9}$). (B1-2) Average PFC firing to preferred vs non-preferred values (C1-2) Average firing of good- and bad-preferring neurons to good and bad objects collapsed across memory periods. (D-F 1-2) same as Figure 4D-F but separate for each monkey. (D1 left) preferred vs non-preferred AUC $F_{3,186}=0.73$, P=0.53. (D1 right) $\chi^2_3<2.1$, P>0.5. (E1) main effects of value $F_{1,6320}=120$, $P<10^{-27}$ [=] and of trials $F_{19,6320}=1.5$, P=0.07, interaction $F_{19,6320}=0.17$, P>0.9, firing

difference $F_{19,3160}$=0.58, P>0.9. (F1) preferred vs non-preferred AUC $F_{3,632}$=0.93, P=0.42, good-preferring AUC $F_{3,300}$=3.6, P=0.01 and bad-preferring AUC $F_{3,64}$=0.83, P=0.48. (D2 left) preferred vs non-preferred AUC $F_{3,243}$=0.51, P=0.67. (D2 right) χ_3^2<3.1, P>0.3. (E2) main effects of value $F_{1,7600}$=159, P<10^{-35} [=] and of trials $F_{19,7600}$=2.5, P<10^{-3} [\], interaction $F_{19,7600}$=0.2, P>0.9, firing difference $F_{19,3800}$=0.64, P=0.87. (F2) preferred vs non-preferred AUC $F_{3,632}$=0.69, P=0.55, good-preferring AUC $F_{3,340}$=2.3, P=0.07 and bad-preferring AUC $F_{3,108}$=1.5, P=0.2.

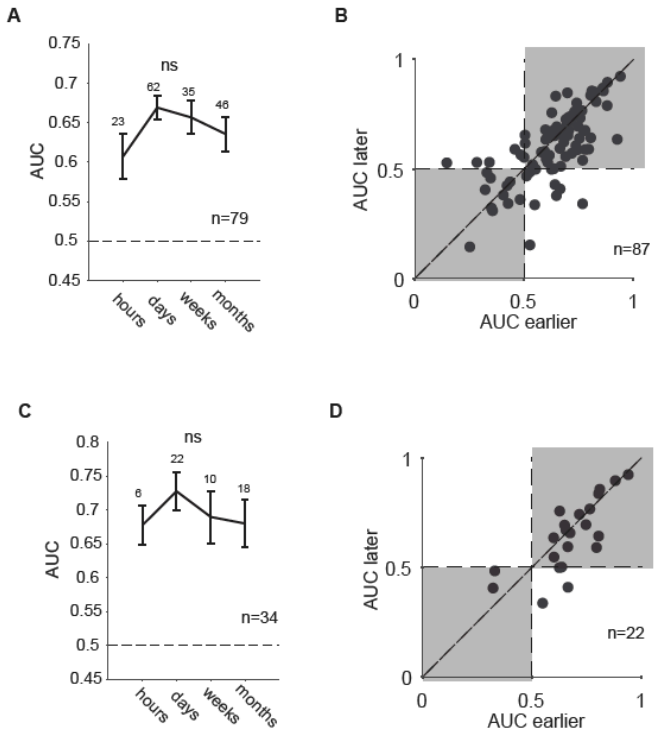

Figure S7. PFC retains long-term memory of object values in the absence of reward. Related to Figure 4. (A) Similar to Figure 4D but only including neurons that were tested in at least two or more memory periods as summarized in Table 1 left (preferred vs non-preferred AUC $F_{3,52}$=1.45, P=0.22). (B) AUC of neurons that were tested in two (n_1=71) or three periods (n_2=8) in a later period vs earlier period. Later vs earlier AUC were not significantly different (i.e. if a neuron is tested in days and months, months AUC is plotted against days AUC). Neurons that were tested in three periods contributed two points to the plot (e.g. A neuron tested in hours, weeks and months gives a dot weeks vs hours and another dot months vs weeks thus n_1+2n_2=87). Later vs earlier AUC were not significantly different ($F_{1,172}$=2.12, P=0.14). Furthermore 70 out of 87 comparisons showed the same value preference (dots in highlighted 1st and 3rd quadrants) ($\chi_1^2 = 17.7$, P<1e-4). (C) Similar to Figure 4D but only including neurons that were tested during reward learning in Figure 2 (preferred vs non-preferred AUC $F_{3,52}$=0.53, P=0.65). (D) Same format as B but for neurons that were tested in multiple memory periods (two periods n_1=16 , three periods n_2=3) from among neurons that were recorded in value training task (19 out of 34 neurons). Later vs earlier AUC were not significantly different ($F_{1,42}$=0.7, P=0.4). Furthermore 18 out of 22 comparisons showed the same value preference (dots in highlighted 1st and 3rd quadrants) ($\chi_1^2 = 4.9$, P=0.02).

Supplemental References:

S1. Reveley, C., Gruslys, A., Frank, Q.Y., Glen, D., Samaha, J., Russ, B.E., Saad, Z., Seth, A.K., Leopold, D.A., and Saleem, K.S. (2016). Three-dimensional digital template atlas of the macaque brain. Cereb. Cortex.

S2. Saleem, K.S., and Logothetis, N.K. (2012). A combined MRI and histology atlas of the rhesus monkey brain in stereotaxic coordinates (Academic Press).