**Supporting Information**

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**Fig. S1.** Spatial task and stimuli. (A) In the spatial task, the monkeys viewed the same sequence of images as in the passive spatial task; however, at the end of the experiment, monkeys needed to make a saccade to the green target if the stimulus locations matched, or to the blue target if the stimulus locations did not match. (B) Stimulus locations used in the spatial task (only square stimuli were used in the spatial task). Stimuli were also shown at the central location, but data from these trials were not analyzed in our decoding analysis.

**Fig. S2.** Decoding results using or excluding the most selective neurons in the feature task. (A) Comparing posttraining match/nomatch decoding accuracies using only the eight most selective neurons (cyan trace) or using all neurons (red trace). Using the top eight neurons captures almost all of the information in the larger population, showing that, at any one point in time, all of the information is contained in a compact subset of neurons. (B) Comparing posttraining match/nomatch decoding accuracies excluding the 128 most selective neurons (cyan trace) or using all neurons (red trace). Excluding the top 128 neurons still leads to above-chance decoding performance, showing that there is redundant information in neurons that are more weakly tuned.
Fig. S3. Information in PFC pre- and posttraining during the spatial task. (A) Comparison of information about the position of the first stimulus pretraining (blue) and posttraining (red). Conventions are the same as in Fig. 2. As can be seen, training created small increases in information about the position of the first stimulus around times when the second stimulus and the decision stimuli were shown. (Note: information about the first stimulus after the time when the second stimulus was shown could be attributable to the second stimulus; see Methods). (B) Comparison of information about the match/nonmatch trial status pretraining (blue) and posttraining (red). As can be seen, there is a large increase in the match/nonmatch status of a trial after training. (C) Match/nonmatch selectivity of individual neurons before training (Left) and after training (Right). (Black horizontal line is for visualization purposes to make the pre- and posttraining differences easier to compare.) (D) Comparing posttraining match/nonmatch decoding accuracies using only the eight most selective neurons (cyan trace) or using all neurons (red trace). Using the top eight neurons captures all of the information in the larger population, showing that, at any one point in time, the majority of information is contained in a compact subset of neurons. (E) Comparing posttraining match/nonmatch decoding accuracies excluding the 64 most selective neurons (cyan trace) or using all neurons (red trace). Excluding the top 64 neurons still leads to above-chance decoding performance showing that there is redundant information in neurons that are more weakly tuned (because of the overall lower level of match/nonmatch information in the spatial task, excluding 128 neurons led to fewer time periods above chance).
Fig. S4. Dynamic coding of task relevant information after training in the spatial task. (A) Results from training a classifier at one time period (y axis) and testing the classifier at a second time period (x axis) for decoding the match/nonmatch trial status, before the monkey was trained on the spatial task (Left) or after the monkey was trained on the spatial task (Right). The black solid vertical lines indicate the times when the first, second, and match/nonmatch stimuli appeared, and the black dashed lines indicate the offset times of the first and second stimuli. After the monkey was trained, high classification accuracies are seen only when the classifier is built and tested using data from around the same time periods, which shows that different patterns of neuron activity contain the task relevant information at different time points in the experiment. (B) Firing rates for the match trials (blue) and nonmatch trials (red) for the three most selective neurons in spatial task. As can be seen, differences in firing rates between match and nonmatch trials appear to be added on top of other firing rate changes that are occurring over the course of a trial (and are carrying information about other variables). Additionally, some neurons (e.g., Right) only contain large firing rate differences between match and nonmatch trials for short periods of time, which give rises to the dynamic coding of information at the population level. Error bars indicate 1 SEM.
Fig. S5. Match/nonmatch selective neurons also contain stimulus information. (A) Decoding accuracy for the identity of the first stimulus using the 50 most highly match/nonmatch selective neurons in the feature task (these 50 neurons had match/nonmatch ANOVA $P$ values $<10^{-6.5}$, which was a value that was smaller than any $P$ values obtained on the pretraining data). (B) Decoding accuracy for the position of the first stimulus using the 18 highly match/nonmatch selective neurons in the spatial task. As can be seen, above-chance decoding accuracies for stimulus information can still be obtained when using only match/nonmatch selective neurons, which shows that match/nonmatch neurons also contain information about stimulus identity/position. (C) $\eta^2$ values for match/nonmatch information (green trace) and for stimulus identity information (purple trace) for the three most highly selective match/nonmatch neurons on the feature task (these are the same neurons shown in Fig. 3B). As can be seen, these highly selective match/nonmatch neurons also contain information about the stimulus identity. (D) Same results as in C but for the spatial task (Fig. S2B, neurons).
Fig. S6. Comparing information in dorsal PFC (magenta) vs. ventral PFC (green) on the spatial task. (A) Match/nonmatch information pretraining (Left) and posttraining (Right). After training, there is task relevant match/nonmatch information in both dorsal and ventral PFC. (B) In contrast, information about the position of the first stimulus (stimulus position information) was only seen in dorsal PFC in both the pretraining and postraining data (left and right plots, respectively).
Fig. S7. Comparing information in area 46 (green) vs. area 8a (magenta) on the feature task. These results are similar to the results in comparing dorsal PFC vs. ventral PFC (Fig. 4 and Fig. S6), except, here, we are comparing the information content for two dorsal PFC regions, namely, area 8a (encompassing recordings posterior to the principal sulcus) and area 46. The decoding procedure uses 50 neurons at a time to make these comparisons. (A) Match/nonmatch information pretraining (Left) and posttraining (Right). (B) Stimulus identity information pretraining (Left) and posttraining (Right). Overall, the results are very similar between these two regions of dorsal PFC. Bars indicating times when the decoding results are above chance are not shown. Results from the spatial task also show little difference between area 46 and area 8a (1).


Fig. S8. Decoding match/nonmatch information from posterior parietal cortex (PPC). (A) Comparison of the decoding accuracies for PFC (red) to PPC (purple) reveals that there is a similar level of match/nonmatch information in these two brain regions after training. (B) Training the classifier at one time and testing the classifier at a second time shows that information in PPC is also contained in a dynamic population code.
Fig. S9. Dynamics of stimulus information. Training the classifier at time 1 and testing the classifier at time 2 reveals that stimulus information is coded by dynamics patterns of neural activity both pretraining and posttraining for both the feature task (A) and the spatial task (B). Note: information about the first stimulus after the time when the second stimulus was shown could be attributable to the second stimulus (see Methods).