Supplementary Figure 1 (Pesaran)

**Controls for timing of choice information**

a) Area under the curve values for a ROC analysis on population average firing rates for movements into and out of the RF when 5 neuron averages are used. Fewer neurons were used due to the smaller population size.
of long-range coherent neurons. 95% confidence intervals are shown. **b)** P-values for a Wilcoxon rank sum test comparing the AUC values for each group against 0.5. **c)** STs for three different populations of dual coherent (solid), local-only coherent (solid-gray) and not coherent (dashed) neurons. Error bars indicate standard error of the mean. Neuron–pools of size 11 were used. **d)** Individual monkey STs for dual coherent neurons. For reference, the local-only and not coherent neuron STs are presented. (Monkey C: Dual ST =188.7 ± 3 ms. Dual vs Local-only: p = 5.5e-10. Dual vs Not: p = 7.5e-10; Monkey R: Dual ST: 210.6 ± 1 ms. Dual vs Local-only: p = 3.7e-10. Dual vs Not: p = 3.7e-10. Rank sum test).
Supplementary Figure 2 (Pesaran)

Supplementary Figure 2

Choice timing across the medial and lateral banks of the IPS

a) Choice selection times for the lateral bank (solid) and medial bank (dashed). Selection times decrease for the choice prediction method as more cells are added. For the lateral bank eight trial averages were used in the 47 cell analysis due to insufficient trials (circle). b) Same as c) for increasing trial averages. d) Probability of a correct classification for decoding in the lateral bank (solid) and medial bank (dashed). Mean ± SEM are shown.
Supplementary Figure 3

Locations of neurons classified by coherence

Recording locations along the IPS separated into different subpopulations defined by coherence. The number of neurons for each population was expected given the sample in the database, with the exception of the long-range-only population (Total number of MIP neurons in database 42/72=58%. The proportion of locally coherent population MIP neurons was not significantly different from the whole proportion of the population (30/53 57%, p = 0.11 Binomial test). The same was true for the complement of LIP neurons (p=0.10). However, the proportion of long-range coherent population MIP neurons was significantly different from the proportion of the population (27/36, 75% p = 0.01 Binomial test).
Firing rates across neuronal ensembles separated by coherence

a) Population average firing rate for the four populations of neurons defined according to the presence of local and long-range coherence.  
b) Population average firing rate between populations after the spike trains were decimated so that the mean firing rates is equal during the baseline epoch. Firing rate averaged over trials when the target in the response field is chosen (solid). Firing rate averaged over trials when the target out of the response field is chosen (dashed). The standard error of the mean of the firing rates (gray shaded).
Supplementary Figure 5 (Pesaran)

Comparing the timing of choice information in ensembles of neurons with high and low firing rates

STs for all neurons when separated by the firing rate in the a) baseline period and b) the delay period. Neuron–pools of size 11 were used. The ST for the dual coherent population is shown for comparison. Mean ± SEM are shown.
Supplementary Figure 6

Average firing rates for neurons separated based in firing rate measures

Average firing rates for populations defined by a) baseline and b) delay period firing rates as well as by c) rate correlations. The SEM is shown in grey.
Supplementary Figure 7

Center-out firing rates for neural ensembles

In vs out of the RF firing rate differences for a center-out task for each population. While firing rates for dual coherent neurons tended to have larger differences in firing rate, these differences were not significant (Dual: 45.1 ± 14.2 spikes/s (mean ± s.e.m); Local-only: 24.3 ± 8.0 spikes/s; Long-range-only: 24.1 ± 11.3 spikes/s; Not: 14.9 ± 9.2 spikes/s. p > 0.05 all comparisons; Rank sum test).
Supplementary Figure 8

Firing rate controls for the timing of choice information across neuronal ensembles

a) Difference in decimated firing rate for movements into and out of the RF for different groups of neurons. Mean ± S.E.M. are shown. b) P-values for a Wilcoxon rank sum test comparing decimated firing rates into and out of the RF for each group. Arrows indicate the first point the statistical tests fell below 0.05 for three consecutive bins and remained significant. c) Area under the curve values for a ROC analysis on population decimated average firing rates for movements into and out of the RF. Mean ± 95% confidence intervals are shown. The symbols above the AUC lines indicate significant differences between each pair of lines using a FDR corrected Wilcoxon rank sum test. d) P-values for a Wilcoxon rank sum test comparing the AUC values for each group against 0.5. Arrows indicate the first point the statistical tests fell below 0.05 for three consecutive bins and remained significant. e) STs calculated with decimated firing rates. f) STs calculated with firing rates for populations of neurons classified via spike-field coherence using decimated firing rates.
Supplementary Figure 9 (Pesaran)

Comparison of spike-field coherence when measured on the same and different electrodes

Baseline local spike-field coherence averaged across 27 same-electrode pairs (red) and 45 different-electrode spike-field pairs (black). 95% confidence interval (shaded). At 20 Hz same-electrode: 0.13 ± 0.03, different-electrode: 0.14 ± 0.02, p = 0.47 Rank sum test.
Supplementary Figure 10 (Pesaran)

**Spike widths for neurons separated into neuronal ensembles**

**a)** Scatter plot of the width of the spike waveforms for the dual coherent (red cross), not coherent (black circle), local only coherent (blue cross) and long-range only coherent (green box) neurons. Half-amplitude duration (vertical axis) and trough-to-peak time (horizontal axis).

**b)** Histogram of trough-to-peak times for dual coherent (red), local-only coherent (blue), not coherent (black) and long-range only coherent (green) neurons.