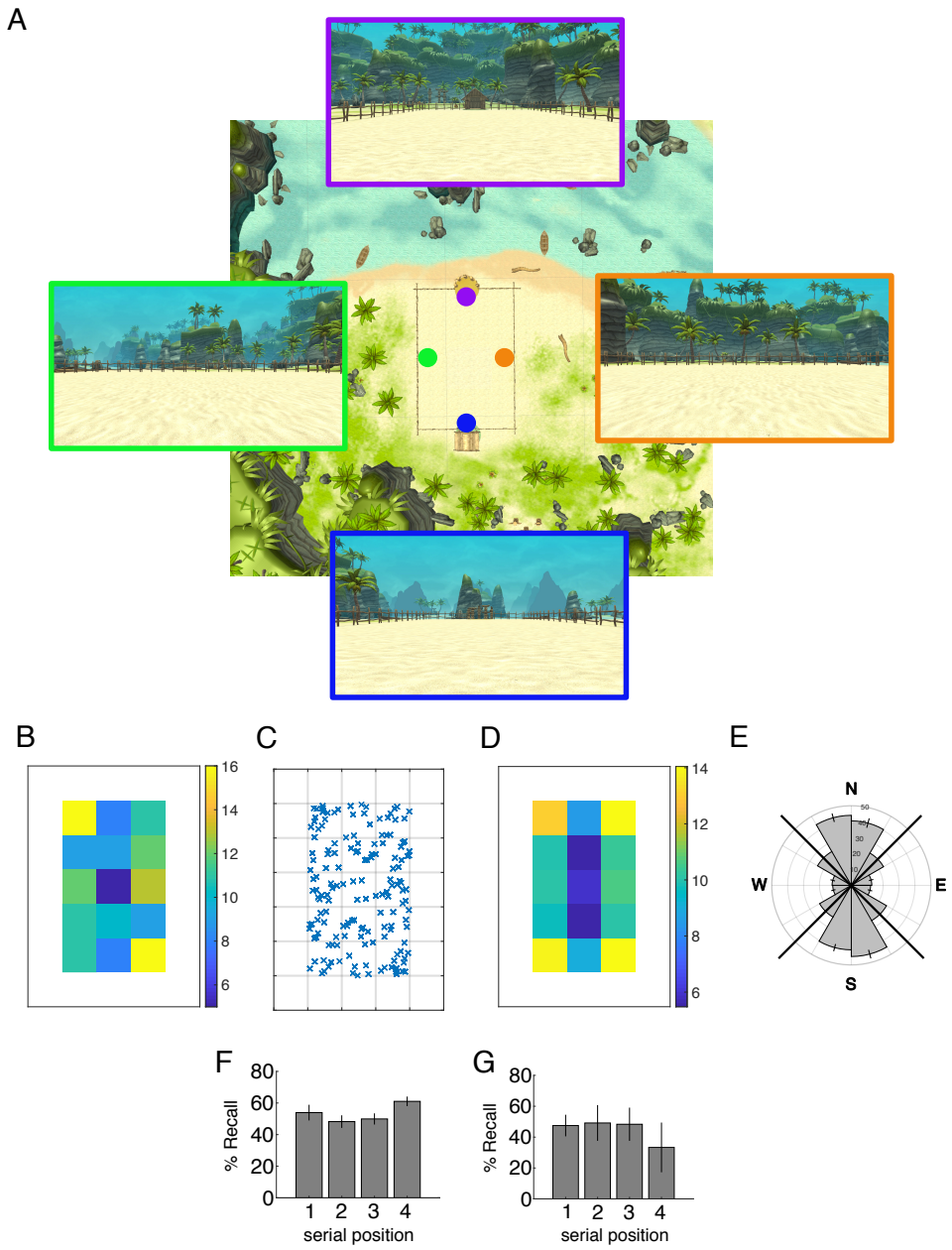

Figure S1: Behavior in the Treasure Hunt task, Related to Figure 1. *A. Central image is a map (overhead view) of the Treasure Hunt environment. The rectangular arena that subjects navigate in is in the middle. At the top end of the arena there are totem poles in a semicircle, and water in the background behind them. At the bottom end of the arena there is a hut, and behind that there is a forest. The four overlayed panels show the subjects' view from each of the locations indicated by the colored circles, with the border color matching the corresponding location. B-E. Distribution of chest position and heading direction across sessions. B. Number of chests in each location in a representative example session. Chests are never located in the outer border of the environment, shown in white. C. Same data with an 'X' indicating each chest location, with gray lines indicating the environmental binning. D. Number of chests in each grid location, averaged across all sessions. E. Circular histogram indicating the seconds (mean and SEM) spent in each heading direction during navigation, across all sessions. Black diagonal lines indicate NESW quadrants. F-G. Recall by serial position. Mean and SEM of the percentage of object-location pairs successfully recalled, split by the serial position the object was encountered in, for the object-cued task sessions in panel F ($p = 0$ .008; repeated measures ANOVA) and the location-cued task session in panel G ($p = 0$ .1; repeated measures ANOVA).*

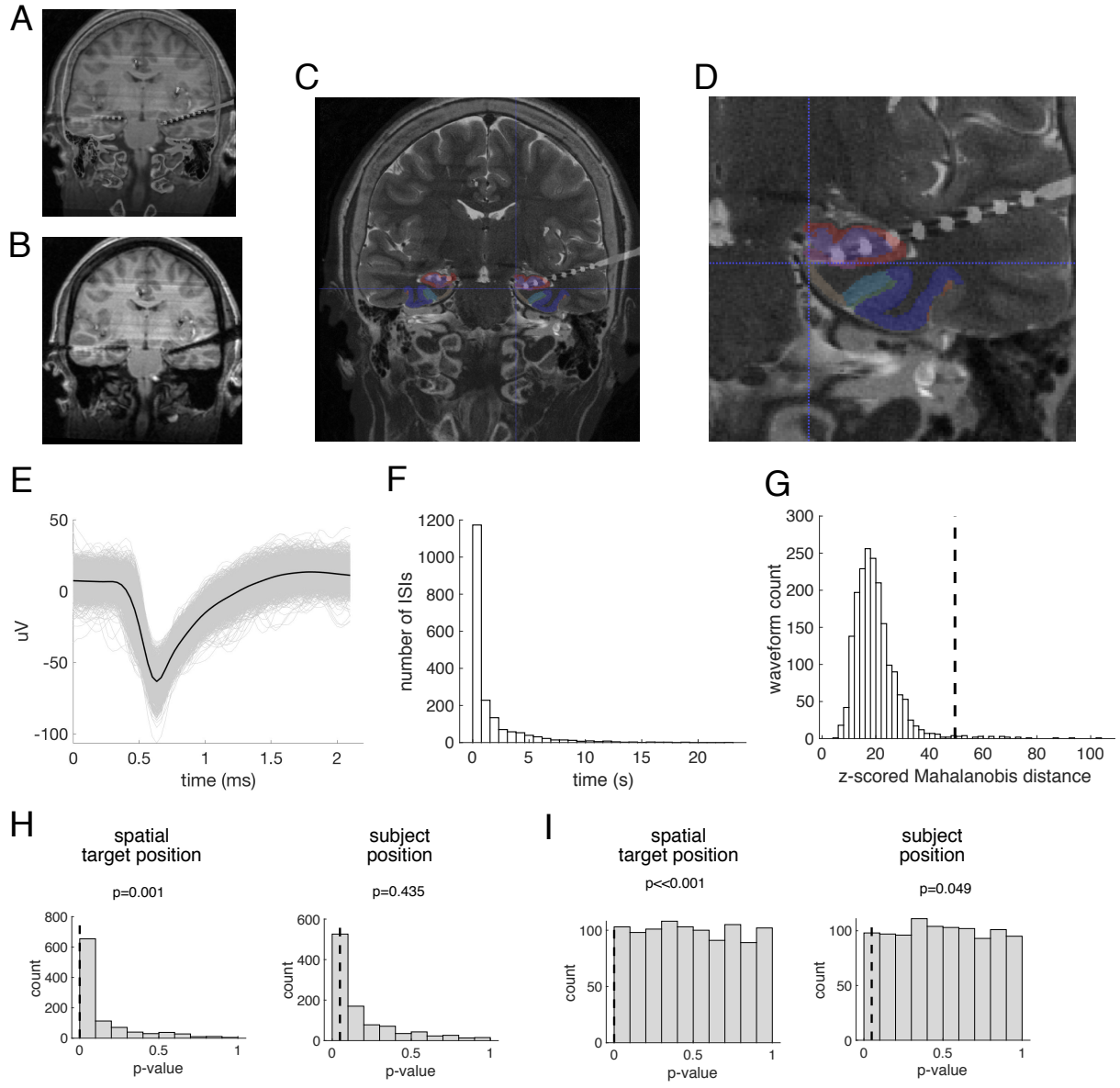

Figure S2: Methodological information on single-unit recordings and statistics, Related to STAR Methods. *A-D. Example localization of microwire bundle from Patient 11. A. Coregistered postoperative T1 MRI and CT scan. B. Postoperative T1 MRI scan without CT. C. Preoperative T2 structural MRI coregistered to postoperative CT. MTL subregion automatic segmentation is shown superimposed in color. ERC (tan), BA35 (light blue), BA36 (dark blue), subiculum (pink), dentate gyrus (purple), CA1 (red). D. Close-up of the same image as in C, with crosshair on microwire bundle, showing localization to ERC. E-G. Single-unit classification example from Patient 15. A. All waveforms across the task session in grey, and the average waveform in black. B. Histogram of interspike intervals (ISIs), showing less than* 5% *(*0.3163%*) contamination of the refractory period of 3ms. C. Histogram of normalized Mahalanobis distances from the mean of the cluster to each wave-form. We compared that to a chi-squared distribution, and the dotted line represents the cutoff for the odds of there being any data this extreme less than 50%. Fewer than* 5% *of the waveforms (*1.4%*) were classified as outliers. H-I. Comparison of p-value distributions generated from different shuffling procedures for example spatial-target cell. H. Histogram of p-values from ANOVA assessing a parameter's modulation of firing rate for the observed data (dotted line) versus shuffled data (gray). Surrogate distribution is generated by circularly shifting spikes. Left plot is for spatial target position, and right plot is for subject position. This cell's activity is significantly modulated by the spatial target position (p=0.001) but not subject position (p=0.435). I. Same plots as in A, but surrogate distributions are generated by randomly shuffling the spikes. Using this procedure both spatial target position and subject position are significant ($p << 0.001$; $p = 0.049$, respectively).*

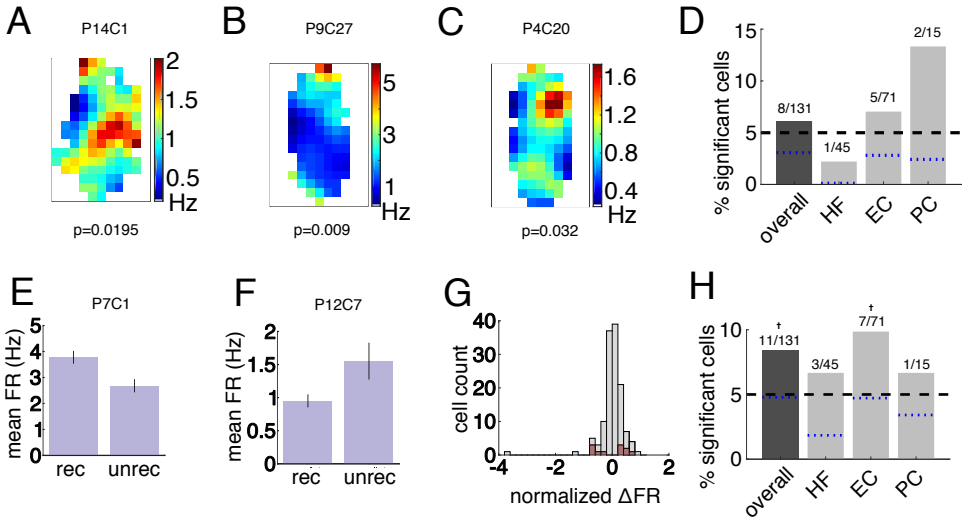

Figure S3: Neural activity related to the subject's current location and subsequent memory performance, Related to STAR Methods. *A-D. Current location. A. Firing rate map of navigation activity binned by subject location for a right parahippocampal cortex neuron from Patient 14. This cell's activity is significantly modulated by the subject's virtual position (permutation-corrected ANOVA,* $p = 0.0195$*). B. Example neuron from left EC in Patient 9 significantly modulated by subject position (*$p = 0.009$*). C. Example neuron from Patient 4 in right EC significantly modulated by subject position. (*$p = 0.032$*). D) Percentage of significant spatially-tuned cells by region. The black dashed line represents the* 5% *false positive rate, and the blue dotted lines are the lower* 95% *confidence interval from the one-sided binomial test for each bar. E-H. Subsequent memory. Firing rate by subsequent memory performance for two example cells significantly modulated by subsequent recall. Error bars are SEM of the trial means in each condition. E. Example neuron from Patient 7 in the left PRC, significantly modulated by subsequent memory (*$p = 0.017$*). F. Example neuron from Patient 12 in the right EC,* $p = 0.044$*. G. Histogram of cell count by normalized firing rate between conditions ((rec-unrec)/rec). Red indicates the significant cells. H. Percentage of significant memory-related cells by region. Symbols above the bars indicate p-values from a one-sided binomial test for each proportion (*$** p < 0.01, *p < 0.05, +p < 0.1$*). The black dashed line represents the* 5% *false positive rate, and the blue dotted lines are the lower* 95% *confidence interval from the one-sided binomial test for each bar.*

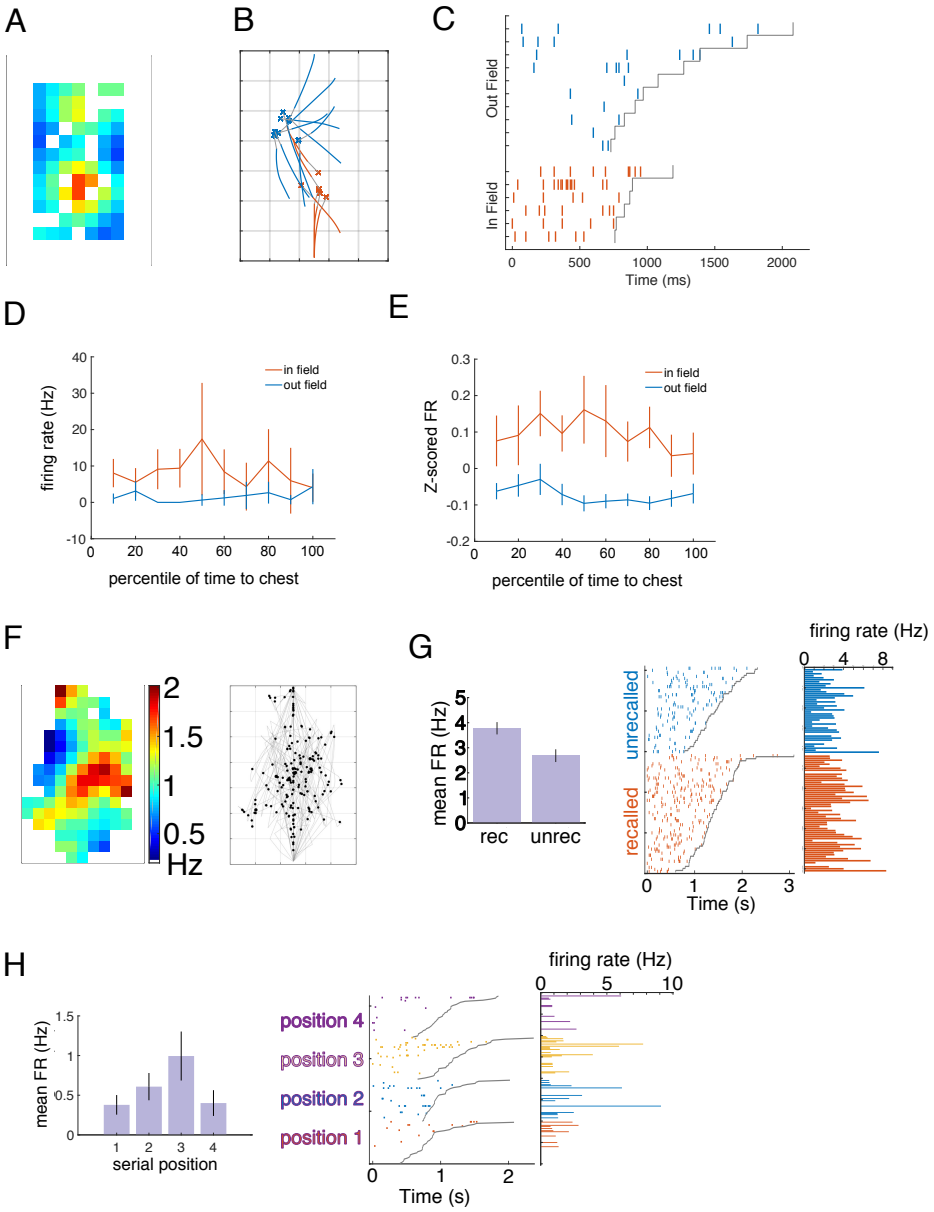

Figure S4: Example raster plots for spatial target, place, memory, and serial position cells, Related to Figures 2 and 4. *A-E. Spatial-target cell firing rates leading to chests in and out of the firing field. A. Firing rate map binned by chest location for example spatial target cell (see also Figure 2B). B. Paths to chests in field and out of field for example cell. In field paths are in orange, out of field paths are in blue. C. Raster of spikes during the paths to in and out of the field for same example cell, again color coded by in and out of field, and sorted by navigation time for each of the fields. D. Mean and 95% confidence intervals of firing rates by normalized time to chest for example cell, split by in and out of field paths. E. Mean and 95% confidence intervals of the z-scored firing rates across all significant spatial-target cells. F. Example place-like cell ($p = 0.0195$) in right PHC, from Patient 14 Cell 1 (same as in Figure S3A). Left plot shows firing rate map, and right panel shows the subject's path in grey with a black dot indicating each spike. G. Example memory cell ($p = 0.017$) in left PRC, from Patient 7 Cell 1 (same as in Figure S3E). Left plot shows mean firing rate by recall. Right plot shows spike rasters and corresponding firing rates split by the two conditions, and ordered by path duration for each group. Grey line indicates when navigation ended. H. Example serial position cell ($p = 0.025$) in left EC, from Patient 9 Cell 17 (same as in Figure 4B. Left plot shows mean firing rate by each serial position. Right plot shows spike rasters and corresponding firing rates split by serial position, and ordered by path duration for each group. Grey line indicates when navigation ended.*

Patient number	Age	Gender	# Sessions	Task version	# MTL Behnke-Fried bundles	# MTL units	Electrode locations
1	22.7	M	1	object cued	2	4	R SUB, R HPC
2	52.3	M	2	object cued	6	3	L AMY, L HPC, R EC, R SUB, R HPC
3	41	M	1	object cued	1	2	L HPC
4	22.4	M	3	object cued	1	5	R EC
5	21.5	F	2	object cued	2	7	L HPC, L SUB
6	25.6	F	1	object cued	2	11	R EC
7	29.4	M	2	object cued	2	9	L SUB, L PRC
8	23.4	F	1	object cued	1	1	R HPC
9	21.9	F	3	object cued	2	39	L EC
10	27.6	M	1	object cued	2	4	L SUB, L PHC
11	47	M	1	object cued	1	8	L EC
12	20	M	1	object cued	1	8	R EC
13	21	M	1	location cued	2	12	L HPC, R HPC
14	55	M	1	location cued	2	2	R HPC, R PHC
15	43.5	F	2	location cued	2	16	L HPC, R SUB

Table S1: Patients and unit information, Related to STAR Methods. *Table indicates each patient's demographics and their MTL unit counts. R/L: right/left; HPC: hippocampus, SUB: subiculum, AMY: amygdala, EC: entorhinal cortex, PRC: perirhinal cortex, PHC: parahippocampal cortex.*

Brain region	Total # units	Spatial target	Place	Heading	Memory	Serial position	Spatial target and place	Spatial target and heading	Spatial target and serial position	Heading and serial position	No effects
HF	45	9	1	6	3	3	0	1	0	0	24
EC	71	12	5	7	7	16	0	1	3	4	37
PC	15	5	2	3	1	1	0	1	0	1	5
total	**131**	**26**	**8**	**16**	**11**	**20**	**0**	**3**	**3**	**5**	**66**

Table S2: Significant cell counts, Related to STAR Methods. *Number of cells with significant responses at different recording sites. The number of significant cells across MTL subregions are shown for each main effect and combination of main effects. Significance is determined using a shuffle-corrected ANOVA at alpha = 0.05. Counts of cells that were significant for place and another main effect, or or memory and another main effect, are not shown because place-like cells and memory cells were not found at significant proportions. Counts of cells that did not show any significant effects are also shown.*