

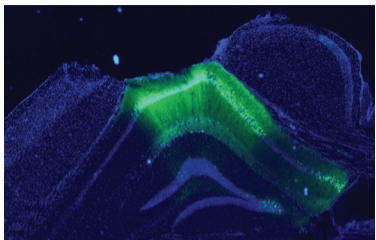
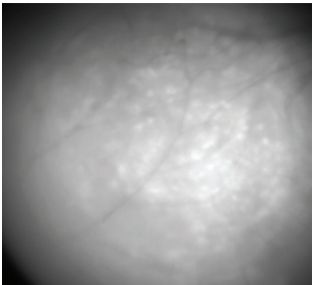
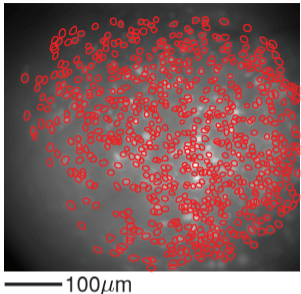
A**B****C**

Figure S1: Details of Calcium Imaging (Related to Figure 1)

A) Histological confirmation of recording location, showing the presence of GCaMP6f primarily localized to dorsal CA1. Note the intact cell layer below where superficial cortex was removed to enable insertion of the GRIN lens. Blue = DAPI, Green = GCaMP6f

B) Example imaging window. Light areas indicate regions of background fluorescence. Dark lines indicate blood vessels. Scale bar = 100 μm.

C) Maximum projection of imaging window for mouse in b with all neuron ROIs overlaid in red. Scale bar = 100 μm.

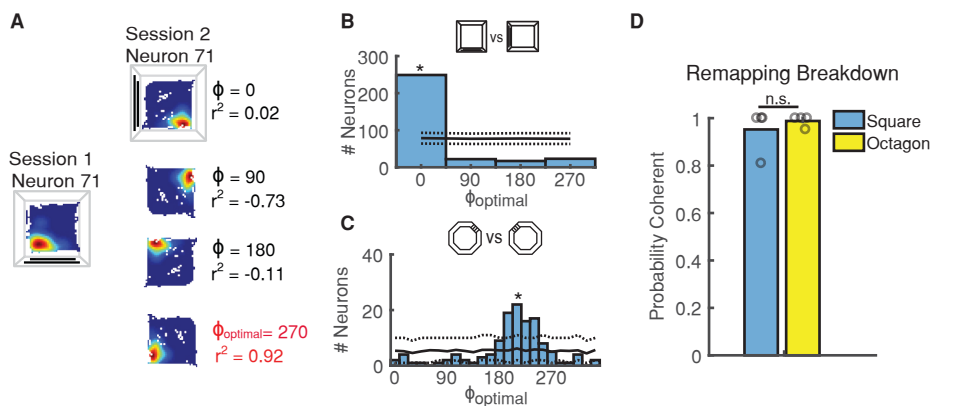


Figure S2: Correlation Based Rotation Method for Identifying Coherent Maps (Related to Figure 2)

A) Methodology for identifying the angle of rotation of a neuron's spatial firing between sessions. The correlation between calcium event maps for session A and session B was calculated after rotating the mouse's trajectory in session B by the angle ϕ in 90 degree increments in the square and 15 degree increments in the octagon. ϕ_{optimal} was defined as the rotation that maximizes the correlation between calcium event maps. This method is less sensitive than the center-of method (Figure 2B, Methods) because the minimum angle change it can resolve is equal to the increments of ϕ noted above (90 degrees in the square and 15 degrees in the octagon). However, it does not require making any arbitrary assumptions required to identify place fields.

B) ϕ_{optimal} distribution between two sessions recorded the same day in the square arena. Clustering of ϕ_{optimal} values at 0 degrees indicates coherent mapping between sessions. Black solid line = shuffled distribution mean, black dashed line = 95% CI of shuffled distribution. * $p = 0$, $\chi^2 = 8.4e4$, $df = 3$.

C) ϕ_{optimal} distribution between two sessions recorded the same day in the octagon arena. Clustering of ϕ_{optimal} values at ~ 210 degrees indicates coherent mapping between sessions. Same conventions as B. * $p = 0$, $\chi^2 = 6.1e4$, $df = 23$.

D) Probability of session-pairs utilizing a coherent map in each arena. Open circles indicate proportions for each mouse. $p = 0.46$, Wilcoxon rank-sum test.

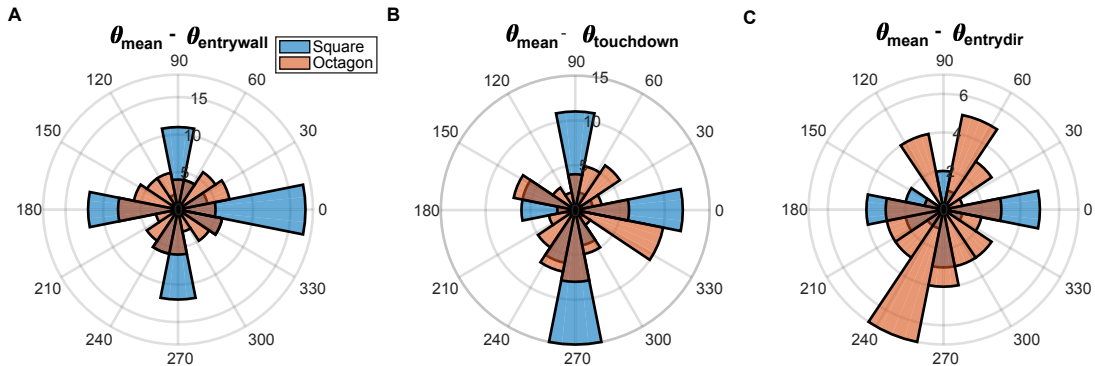


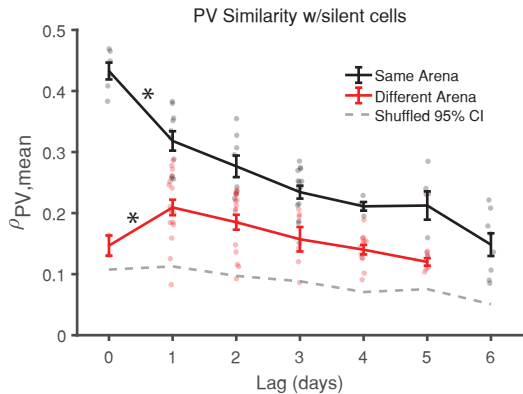
Figure S3: The Direction of Mouse Entry to the Arena Does Not Predict Coherent Place Field Rotations (Related to Figure 3)

A) Circular histogram of mean place field rotation (θ_{mean}) between sessions minus the angle difference between the mouse's entry walls ($\theta_{\text{entrywall}}$). If mice utilized the wall over which they entered the arena to anchor their place field maps between sessions, then the distribution should cluster around 0. Since values do not preferentially cluster at 0 over other orientations, we conclude that mice do not utilize the wall over which they entered the arena to orient their place field maps between sessions. $p = 0.12$ (square), $p = 0.25$ (octagon) shuffle-test.

B) Mouse orientation upon touching the arena floor does not dictate coherent place field rotations. Same as A, but for mouse orientation when his paws first touch the floor ($\theta_{\text{touchdown}}$). $p = 0.06$ (square), $p = 0.31$ (octagon) shuffle-test.

C) Mouse orientation while crossing over the entry wall does not dictate coherent place field rotations. Same as A, but for mouse orientation (nose direction) upon first crossing into the arena while being carried (θ_{entrydir}). $p = 0.57$ (square), $p = 0.15$ (octagon) shuffle-test.

A



B

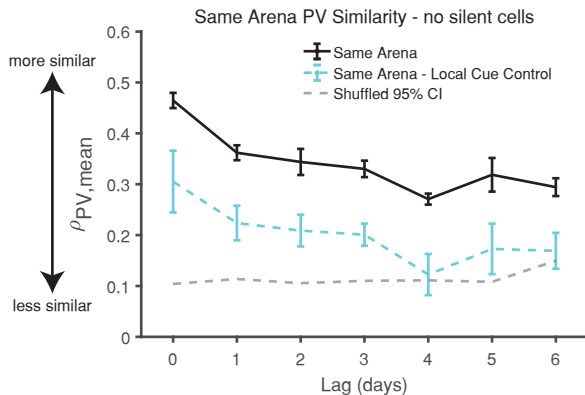


Figure S5: Population Similarity Versus Time (Related to Figure 6)

A) PV correlations at $\phi_{\text{optimal},p}$ vs. time between sessions including silent cells. The distribution of PV correlations remains above chance at each time point, indicating the population remains coherent at short and long time lags even with neurons becoming silent/active between sessions. Black = same arena, red = different arena, gray dashed = upper 95% CI from shuffled distribution. Colored dots indicate mean PV correlation of each session-pair across all mice. Error bars indicate s.e.m. * $p < 0.001$, Student's t-test of mean PV vs. chance at all time lags.

B) Assuming mice use local clues exclusively for orientation produces low PV correlations. Black = same arena PV correlations at $\phi_{\text{optimal},p}$. Blue dashed = same arena PV correlations with place fields calculated after rotating mouse trajectories such that arena cues are aligned between sessions (assumes mice utilize local cues for place field alignment), gray dashed = upper 95% CI from shuffled distribution. Error bars indicate s.e.m.