Extended Data Fig. 1 | Additional behavioral metrics during reward competition in unimplanted mice. 

a, Mice learned the tone reward association at the same rate across social ranks. Left, latency to reward consumption following tone onset decreased over sessions. Right, the percent of trials with a reward consumption latency of less than 10 s increased over sessions (n = 8 mice). Data are plotted as a function of social rank as measured by wins in the tube test.

b, Example frames from reward competition assay showing intertrial interval time and during the tone period.

c, Body weight difference between competitors does not correlate with rewards won (n = 12 dyads from 8 mice, Pearson's correlation, p = 0.83).

d, Relative dominant mice have higher pushing success during the tone (n = 12 per group, paired t-test p = 0.025).

e, Latency to pick up the reward across trials for relative dominants vs subordinates (dom = 101, sub = 41, Two-sample Kolmogorov-Smirnov test p = 0.29).

f, Area occupied by dominants or subordinates in the 10 s prior to the tone onset for win vs lose trials (n = 12 dyads).

g, Distance to reward port across time by trial type and relative rank (trials n: dom win = 68, dom lose = 24, sub win = 24, sub lose = 68 from 12 dyads; early baseline −30 to −20 s prior to cue there is no effect of trial nor relative rank; 2-way ANOVA using the mean distance from −5 s to cue onset: main effect of trial type F(3,180) = 44.4, p = 3x10−10, rank p = 0.94, interaction p = 0.09; 2-way ANOVA using the mean distance from 5 s prior to tone until 10 s post tone: main effect of trial type F(3,180) = 68, p = 2.5x10−14, rank p = 0.071, interaction p = 0.79). Gray rectangle indicates contact range for the reward port.

h, Total distance traveled immediately before the tone and during the tone period (baseline:10 s prior to tone; tone: 10 s of the tone) across trial types for relative dominant and subordinate mice (dom win = 68, dom lose = 24, sub win = 24, sub lose = 68 from 12 dyads; Wilcoxon rank-sum, baseline win p = 0.59, baseline lose p = 0.59, tone win p = 0.028, tone lose p = 0.86). Gray zone indicates contact with port.

i, Percent body weight during food restriction did not differ across relative dominant and subordinate mice (n = 12 dyads, paired t-test, p = 0.23).
**Extended Data Fig. 2 | AlphaTracker tracking metrics.** a, Root mean square error (RMSE) and identity error rate of AlphaTracker when tracking different body parts in videos with high resolution (1920x1080 pixels). Left plots have training and tracking done on 2 unmarked mice videos and right plots have training and tracking done on 4 unmarked mice videos. For both datasets two humans annotated the data and the RMSE between humans is indicated with the dashed line. For identity error rate 2 mouse tracking done with 9737 frame video and 4 mouse tracking done with 6020 frame video. b, Screenshot of user interface (UI) to fix errors made by AlphaTracker tracking. In addition, this UI can be used for exploring the clustering data.
Extended Data Fig. 3 | AlphaTracker unsupervised clustering results.

a, Diagram depicting features used for AlphaTracker’s unsupervised clustering of the tracking datapoints. The features include head length, body length, body-head angle, displacement of the nose, distance between mice, angle between mice. 

b, Example frames from clips belonging to a specific cluster (cluster ID indicated with the color outline in c). 

c, Dendrogram and UMAP plot showing all video clips color coded by cluster ID for social behavior clustering. The mean cluster outputs are shown in (e) and features used are shown in (g). 

d, Dendrogram and UMAP plot showing all video clips color coded by cluster ID for individual behavior clustering. The mean cluster outputs for this clustering are shown in (f) and features used are shown in (h). 

e, Average normalized skeleton for nose, ears and tail base across clusters for the social behavior clustering across 500 ms of video clip time. Red arrow indicates self skeleton and green indicates the other skeleton. Each arrow represents 33.3 ms of data (1 frame). 

f, Average normalized skeleton for nose, ears and tail base across clusters for the individual behavior clustering across 500 ms of video clip time. Each arrow represents 33.3 ms of data (1 frame). Legend in bottom applies to panels e-f. 

g, Heatmap of normalized values for the self and other features used for social behavior clustering. 

h, Heatmap of normalized values for the self features used for individual behavior clustering.
Extended Data Fig. 4 | Histological validation of electrode placements. 

**a**, Representative images showing electrode track and lesions of mPFC electrode wires. **b**, Location of center for electrode lesions for all mice color coded by absolute rank across animals.

**Rank 1**
Bregma 2.10

**Rank 2**
Bregma 1.98

**Rank 3**
Bregma 2.10

**Rank 4**
Bregma 1.94

Bregma 1.78
Bregma 1.70
Bregma 1.54
Extended Data Fig. 5 | Behavior in competition with logger and HMM-GLM model controls. a, Left, diagram of wireless electrophysiology recording device used for mPFC recordings. Image modified from SpikeGadgets’ MiniLogger product illustration. Middle, latency to collect reward over four days of training (n = 16 mice). Right, latency to collect reward while performing reward task alone was not affected by wearing the logger (n = 12 mice; paired t-test, p = 0.83). b, Percent competitions won by absolute rank is highest for rank 1 mice in dataset used for mPFC recordings (number of competitions per rank 1 n = 12; rank 2 n = 12; rank 3 n = 15; rank 4 n = 14). c, Left, number of rewards obtained by relative dominants (dom) and subordinates (sub) during the reward competitions between animals wearing loggers (n = 22 mice per group; paired t-test, p = 0.86). Right, % body weight difference between competitors significantly correlates with rewards won (sub n = 19 dom n = 20, Pearson’s correlation, *p = 0.01). For correlation only mice with same day weight measurements were used. d, Subordinates had longer latencies to pick up the reward during win trials (center line, median; box limits, upper and lower quartiles; whiskers, 1.5x interquartile range; points, outliers). Left, latency per group. Right, histogram of the distribution of latencies across all trials (dom trials n = 326, sub trials n = 358, Wilcoxon rank-sum, p = 0.012; Two-sample Kolmogorov-Smirnov test, dom vs sub trials p = 0.015; One way RM-ANOVA F_{1,20} = 2.06, p = 0.002). e, Percent port occupancy during tone across relative rank (n = 31 sessions, paired t-test p = 0.90). f, Relative dominants were more successful displacing subordinates from the reward port throughout the competition (left; n = 32 sessions, paired t-test, p = 0.002) and during the tone time (right; n = 31 sessions, paired t-test, p = 0.005). g, Total time being displaced from reward port by relative rank in dataset used for mPFC recordings (n = 31 sessions; paired t-test p = 0.15). h, Percent time (normalized by total time per behavior) for 9 behaviors analyzed for win and lose trials separated by relative social rank. i, Percent time difference between relative dominant and subordinates for behavioral transitions during win trials (left) vs lose trials (right). j, Left, model selection for HMM-GLM state number using 10-fold cross-validation method results in a 6 state model being optimal. Error bars indicate standard error across the 10 cross-validations. Right, HMM-GLM 6 state model performance predicts behavioral label regardless of training method utilized (AUC n = 9, one per each behavior label; Sign test of model performance vs chance p = 0.004 for both methods). k, HMM-GLM 6 state model predicted behavioral label regardless of which dataset was used for training or testing (n = 9 behavior labels using 482 trials for dom vs 478 trials for sub; Sign test performance vs 0.5 (chance) p = 0.004 for all tests). l, Distribution of percent time spent in each hidden state by relative rank group (n = 10 cross-validations using 482 trials for dom vs 478 trials for sub from 14 mice).
Extended Data Fig. 6 | Additional data for mPFC population dynamics during social competition. **a**, Data arrangement across all animals (m1 = mouse 1, m2 = mouse 2) for the dimensionality reduction to a common subspace for the six task-relevant events. Neural trajectories were created for dominant and subordinate data using mean firing rate per event and the principal component analysis coefficients. **b**, Neural trajectory lengths (using principal components that captured 90% of variance) for win and lose trials are longer for relative subordinates in intermediate (ranks 2 or 3) mice (n indicated on plots; win 2-way RM-ANOVA main effects of relative rank F(1,14) = 165, p = 2x10^-6; lose 2-way RM-ANOVA effect of relative rank F(1,14) = 262, p = 6x10^-7). **c**, Firing rate rate of change is higher for relative dominants only in win trials (number of neurons indicated in plots, inset plot has average across groups; win trials rate of change: Kolmogorov-Smirnov (KS) test p = 0.009, Wilcoxon rank sum p = 0.01; lose trials rate of change: KS test p = 0.40, Wilcoxon rank sum p = 0.19). **d**, Neural trajectories for win and lose trials plotted in the first Principal Component (PC) for win and the orthogonal lose subspace show little overlap. Top right, inset of dominant neural trajectories. Bottom right, alignment of win and lose trajectories was significantly lower for dominant mice (n = 13 per group; Wilcoxon rank-sum, p = 1.5x10^-5). **e**, Left, neural trajectories of mPFC population firing rate differ by relative rank for port entries that occur during the tone period in a lower dimensional common principal component (PC) sub-space (trajectories are the average across leave one out iterations leaving out one mouse at a time, total neurons recorded from dominants: n = 507 and subordinates: n = 490 units from 20 mice). Self entry events are aligned to port entries of the subject mouse while other entry events are aligned to the competitor’s port entries. Right, trajectory lengths (using PCs that captured 90% of variance) for self entry (top) and other entry (bottom) during the tone are longer for relative subordinates (self entry 2-way RM-ANOVA effect of relative rank F(1,25) = 452, p = 5x10^-14 and interaction of relative rank and event F(1,25) = 5,950, p = 1x10^-17; other entry 2-way ANOVA effect of relative rank F(1,25) = 728, p = 3x10^-15 and interaction of relative rank and event F(1,25) = 90, p = 5x10^-7). **f**, Left, Neural trajectories of mPFC population firing rate for port entries that occur during inter-trial interval (ITI) projected into the first two principal components of the common behavioral subspace. Insets show closer look to the dominant trajectories. Right, neural trajectory lengths for self entry (top) and other entry (bottom) during the ITI (n = 14 relative dom mice, n = 13 relative sub mice; self entry: 2-way RM-ANOVA main effect of rank F(1,25) = 77.7, p = 1x10^-9; other entry: 2-way RM-ANOVA main effect of rank F(1,25) = 110, p = 2x10^-10). Self entry events are aligned to port entries of the subject mouse while other entry events are aligned to the competitor’s port entries. ITI port entries refer to port entries that occurred outside of the tone period.
Extended Data Fig. 7 | See next page for caption.
Extended Data Fig. 7 | mPFC population dynamics during social competition are not driven by location or mouse identity. a, Average occupation in different parts of the chamber for win vs lose trials for the five seconds prior to tone vs first five seconds of tone. Black squares represent the reward port location. b, Distance to reward port differed by trial-type but not by rank (trials: dom win = 290, dom lose = 349, sub win = 349, sub lose = 290; 2-way ANOVA, main effect of trial-type F(1,1274) = 353, p = 8.8x10−70, rank p = 0.098 and interaction p = 0.066). c, Distribution of the correlation coefficients for firing rate and distance to port for the population of mPFC single units did not differ by rank (dom = 321, sub = 479; KS test, p = 0.48). d, To determine if distance to reward port affected the population dynamics during win and lose trials a subset of data with matched video conditions was split by distance to reward port. Neural trajectory lengths were higher for relative subordinates during win trials in which mice were close or far to the reward port during tone onset (dom n = 19 sessions, sub n = 18 sessions; win close to port: 2-way RM-ANOVA main effect of rank F(1,35) = 738, p = 5x10−21; win far from port: 2-way RM-ANOVA main effect of rank F(1,35) = 588, p = 3x10−20). e, Neural trajectory lengths were higher for relative subordinates during lose trials in which mice were close or far from reward port during tone onset (dom n = 19 sessions, sub n = 18 sessions; lose close to port: 2-way RM-ANOVA main effect of rank F(1,35) = 588, p = 3x10−20; lose far from port: 2-way RM-ANOVA main effect of rank F(1,35) = 46.7, p = 5x10−13). f, To determine if reward port “place cells” contributed to neural trajectory rank differences we calculated the neural trajectory lengths without cells that were correlated to distance to port in a subset of data with equivalent video settings (video resolution and camera angle). Left, neural trajectories for self entry during the tone are highest for relative subordinates without the distance correlated cells (dom n = 18 sessions, sub n = 18 sessions; 2-way RM-ANOVA main effect of rank F(1,34) = 94.4, p = 1x10−13). Right, neural trajectories are highest for relative subordinates without the distance correlated cells (dom n = 18 sessions, sub n = 18 sessions; excluding correlated cells: 2-way RM-ANOVA main effect of rank F(1,34) = 100, p = 1x10−13). g, Neural trajectories of mPFC population activity for two randomly selected halves of the data for (left) win and lose trials, (middle) port entries during the tone and (right) ITI port entries (data from 49 recording sessions from 20 mice). All trajectories reflect the mean trajectories across 50 bootstrapping iterations. h, Left, trajectory lengths for win and lose trials when data is divided randomly show no effect of group indicating that the effect of rank is not due to chance (n = 50; win: 2-way ANOVA, event F(1,196) = 8.41, p = 0.004, group p = 0.62; lose: event p = 0.13, group p = 0.65). Right, mean trajectory distances between groups for win and lose trials. i, Left, trajectory lengths for port entries during the tone when data is divided randomly show no effect of group (n = 50; self entry: 2-way ANOVA, event F(1,196) = 14.2, p = 0.0002, group p = 0.97; other entry: F(1,196) = 6.76, p = 0.01, group p = 0.31). Right, mean trajectory distances between groups for self entry and other entry during the tone. j, Left, trajectory lengths for ITI port entries when data is divided randomly show no effect of group (n = 50; self entry: 2-way ANOVA, event F(1,196) = 10.3, p = 0.001, group p = 0.93; other entry: event p = 0.96, group p = 0.87). Right, mean trajectory distances between groups for self entry and other entry during the ITI.
Extended Data Fig. 8  Decoding performance for relative and absolute social rank, and competitive success with different datasets. a, Support Vector Machine (SVM) data pipeline to decode rank or competition outcome based on single trial population mPFC data in the common behavioral subspace. b, mPFC population encoding of win/lose in relative dominants generalizes to relative subordinates. Decoding performance (area under the receiving operating curve; AUC) when (left) training and testing on relative dominant data or (right) training on dominant and tested on relative subordinate data was higher than chance (shuffled performance indicated in gray). (Wilcoxon rank sum, dom/dom p = 0.0002, dom/sub p = 0.003). c, mPFC population encoding of win/lose in relative subordinates does not generalize to relative dominants. Decoding performance (area under the receiving operating curve; AUC) when (left) training and testing on relative subordinate data was higher than chance but not when (right) testing on relative dominant data (shuffled performance indicated in gray). (Wilcoxon rank sum, dom/dom p = 0.0002, dom/sub p = 0.34). d, Decoder performance for classifying competition outcome using training data from winner data (e.g. mouse won majority of trials) and testing data from loser data (e.g. mouse lost majority of trials) and using training data from loser data and testing data from winner data (Wilcoxon rank sum: left, baseline vs shuffle p = 0.10, left, cue vs shuffle p = 0.0002; right, baseline vs shuffle p = 0.02, right, cue vs shuffle p = 0.0002; Wilcoxon sign rank: loser base vs cue p = 0.002, winner base vs cue p = 0.004). All error bars indicate standard error from 10-fold cross-validation. e, SVM performance for decoding relative rank specifically for intermediate (ranks 2 or 3) mice; mean AUC vs shuffled AUC Wilcoxon rank sum: p = 0.0002). f, Absolute rank can be decoded from mPFC population activity during social competition. One model was trained per absolute rank (mean performance across ranks vs shuffled data; Wilcoxon rank sum p = 0.0002). g, Absolute rank can be decoded for rank 1 and 4 animals from mPFC population activity during social competition. One model was trained to discriminate rank 1 trials from rank 4 (mean performance across ranks vs shuffled data; Wilcoxon rank sum p = 0.0002). h, Absolute rank can be decoded from mPFC population activity in mice performing reward task alone. One model was trained per absolute rank (mean performance across ranks vs shuffled data; Wilcoxon rank sum p = 0.0002). i, Left, experimental design. In 15 mice the same neurons were recorded during alone trials and followed by competition trials. Right, mPFC population activity can decode between alone tone presentations and win trials during the competition trials (shuffle performance indicated by gray line; mean AUC vs shuffled AUC Wilcoxon rank sum p = 0.0002). j, mPFC population activity is not sufficient to decode early vs late trials within task (alone mean AUC vs shuffle AUC Wilcoxon sum rank p = 0.47; comp mean AUC vs shuffle AUC Wilcoxon sum rank p = 0.47).
Extended Data Fig. 9 | See next page for caption.
Extended Data Fig. 9 | Additional data for mPFC single unit responses to task-relevant events during social competition. a, Top, Dendrogram for functional clusters and heatmap of mean firing rate for all the neurons included in the hierarchical clustering (n = 913 cells). Gray cells in the dendrogram indicate cells in functional clusters that did not meet criteria of mean z-score being higher than 2 or lower than −1 for at least one event. Bottom, distribution of mPFC cells across functional clusters in relative subordinates and relative dominants. b, Left, mPFC tone responsive cells when mice perform the reward task alone. Number of responsive cells and response magnitude to the tone does not differ between rank 1 and rank 4 mice (rank 1 exc = 8, rank 1 inh = 8, rank 4 exc = 8, rank 4 inh = 4; Fisher’s exact test, total responsive per group p = 0.16; Wilcoxon rank sum across groups: exc p = 0.87, inh p = 1.0). Middle, mPFC tone port entries responsive cells when mice perform the reward task alone. Number of responsive cells and response magnitude to port entries during tone does not differ across dom (rank 1) vs sub (rank 4) mice (dom exc = 5, dom inh = 25, sub exc = 9, sub inh = 16; Fisher’s exact test, total responsive per group p = 0.09; Wilcoxon rank sum across groups: exc p = 0.23, inh p = 0.62). Right, mPFC inter trial interval (ITI) port entries responsive cells when mice perform the reward task alone. Number of responsive cells and response magnitude to port entries during ITI does not differ between rank 1 and rank 4 mice (rank 1 exc = 10, rank 1 inh = 23, rank 4 exc = 9, rank 4 inh = 49; Fisher’s exact test, total responsive per group p = 0.06; Wilcoxon rank sum across groups: exc p = 0.84, inh p = 0.17). c, Total responsive cells and response magnitude to task-relevant event during social competition for absolute rank 1 vs rank 4 (win trials: dom exc = 20, dom inh = 11, sub exc = 7, sub inh = 14, Fisher’s exact test p = 0.11, Wilcoxon rank sum exc p = 0.23, inh p = 0.03; lose trials: dom exc = 3, dom inh = 3, sub exc = 0, sub inh = 1, Fisher’s exact test p = 0.12, Wilcoxon rank sum inh p = 0.50; self entries tone: dom exc = 23, dom inh = 57, sub exc = 24, sub inh = 32, Fisher’s exact test p = 0.006, Wilcoxon rank sum exc p = 0.42, inh p = 0.77; other entries tone: dom exc = 14, dom inh = 16, sub exc = 27, sub inh = 19, Fisher’s exact test p = 0.11, Wilcoxon rank sum exc p = 0.049, inh p = 0.04; self entries ITI dom exc = 31, dom inh = 89, sub exc = 21, sub inh = 56, Fisher’s exact test p = 2x10^-5, Wilcoxon rank sum exc p = 0.01, inh p = 0.41; other entries ITI dom exc = 13, dom inh = 41, sub exc = 8, sub inh = 21, Fisher’s exact test p = 0.001, Wilcoxon rank sum exc p = 0.11, inh p = 0.008). d, Total responsive cells and response magnitude to task-relevant event during social competition for intermediate rank mice (ranks 2 and 3) by relative rank (win trials: dom exc = 4, dom inh = 3, sub exc = 5, sub inh = 2, Fisher’s exact test p = 0.76, Wilcoxon rank sum exc p = 0.11, inh p = 0.80; lose trials: dom exc = 1, dom inh = 3, sub exc = 3, sub inh = 0, Fisher’s exact test p = 1, Wilcoxon rank sum exc p = 1; self entries tone: dom exc = 17, dom inh = 30, sub exc = 7, sub inh = 14, Fisher’s exact test p = 0.01, Wilcoxon rank sum exc p = 0.89, inh p = 0.57; other entries tone: dom exc = 10, dom inh = 23, sub exc = 3, sub inh = 10, Fisher’s exact test p = 0.01, Wilcoxon rank sum exc p = 0.46, inh p = 0.79; self entries ITI dom exc = 15, dom inh = 42, sub exc = 11, sub inh = 21, Fisher’s exact test p = 0.06, Wilcoxon rank sum exc p = 0.11, inh p = 0.44; other entries ITI dom exc = 9, dom inh = 26, sub exc = 3, sub inh = 16, Fisher’s exact test p = 0.07, Wilcoxon rank sum exc p = 0.20, inh p = 0.90).
Extended Data Fig. 10 | See next page for caption.
Extended Data Fig. 10 | mPFC-LH photostimulation does not affect other motivated behaviors.  

**a.** Representative images showing electrode lesions and mPFC-LH cells and LH axon terminals (tdTomato). **b.** Representative images showing electrode lesions and mPFC-BLA cells and BLA axon terminals (tdTomato). **c.** Responsive cells to tones and port entries while performing the reward task alone vs in social competition (alone: tone mPFC-LH n = 2/13, mPFC-BLA n = 3/5, non-phototagged n = 54/470; entries during tone: mPFC-LH n = 8/13, mPFC-BLA n = 2/5, non-phototagged n = 115/470; entries during ITI: mPFC-LH n = 5/13, mPFC-BLA n = 3/5, non-phototagged n = 170/470; competition win trials: mPFC-LH n = 3/43, mPFC-BLA n = 1/10, non-phototagged n = 62/920; self entries during tone mPFC-LH n = 11/43, mPFC-BLA n = 1/10, non-phototagged n = 193/920; self entries during ITI: mPFC-LH n = 19/43, mPFC-BLA n = 2/10, non-phototagged n = 271/920, Fisher’s exact test non-photo vs LH p = 0.011). **d.** Summary of mPFC optical fiber location (indicated with horizontal gray lines), mPFC viral expression and LH CAV2-Cre injection sites across mice for experiments shown below and in Figure 4. Distance to bregma is indicated under each brain slice. Top row shows LH injection and bottom row shows mPFC injection and fiber. **e.** mPFC-LH photostimulation in ChR2 mice did not change latency to pick reward while performing reward task alone (n = 10; paired t-test, p = 0.42). **f.** mPFC-LH photostimulation did not increase chow eating in the homecage (eYFP n = 8, ChR2 n = 7; 2-way RM ANOVA no significant effect of light, virus or interaction). **g.** mPFC-LH photostimulation in ChR2 mice did not change time spent in social chamber in the 3-chamber social interaction assay (n = 10; paired t-test, p = 0.79). **h.** mPFC-LH photostimulation did not change anxiety-like behavior in the open field (ChR2 n = 8, eYFP n = 8; 2-way repeated measures (RM) ANOVA no significant effect of light, virus or interaction). **i.** mPFC-LH photostimulation did not evoke conditioned placed preference or aversion (ChR2 n = 5, eYFP n = 5; 2-way RM ANOVA no significant effect of light, virus or interaction). **j.** Effort based T-maze allows mice to choose between a low reward low effort arm or a high reward high effort arm in which they must climb a wall to obtain the reward. **k.** mPFC-LH photostimulation did not increase high effort choice in the effort T-maze (ChR2 n = 8, eYFP n = 9; 2-way RM ANOVA no significant effect of light, virus or interaction for both 14 and 7 cm walls).
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  Give P values as exact values whenever suitable.
- For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
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Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection
All data were collected with commercially available software reported in the methods. More information is available upon request.

Data analysis
Data were analyzed with commercially available, open-source and custom made code. Descriptions of these analyses are found in the methods. In cases that there are published descriptions of the methods, full references are included. AlphaTracker software is available on github and other custom code is available upon request.

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Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

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<th>Sample size</th>
<th>Sample sizes were not predetermined and based on similar studies in the literature (Wang et al., 2011; Zhou et al., 2017). Sample size is reported in the legends and methods.</th>
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<td>Data exclusions</td>
<td>Subjects with mistargeted viral injections were excluded from analyses. Animals with electrodes that did not have any cells were used as competitors in competition sessions. Electrophysiology recording sessions in which there was battery failures in the recording devices were excluded from the study.</td>
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<td>Replication</td>
<td>Our behavioral assay was piloted in a separate group of mice that was not included on this study. In both the pilot and the study we see the same behavioral effects of relative social rank. Our optogenetic experiments were ran in two cohorts and in both we saw the same effect. Many of our neurophysiological findings replicate across different groups of relative rank; using all mice across all ranks, restricting it to intermediate ranks, and looking at just absolute rank 1 vs rank 4 animals.</td>
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<td>Randomization</td>
<td>For optogenetic manipulation experiments the cage assignment to control or experimental group was randomized. For behavioral competition experiments and tube testing the order of the competitions was randomized. Given that control recordings with the animals alone were done in the same arena as the competition, all the recording alone controls happened before the competition recordings to avoid context associations of previous competitions during the control recordings. Animals were determined to be relative dominant vs subordinates based on the ranks determined by the tube test which occurred in a randomized order daily for the duration of the experiment.</td>
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<td>Blinding</td>
<td>During behavioral testing investigators were not always blind to the animal’s ranks given familiarity with the subjects. However, for behavioral scoring the experimenters were blinded to the animal’s ranks. For optogenetic experiments the experimenters were blinded to the group assignment of the animals (eYFP vs ChR2). During electrophysiological data processing and analysis experimenters were blinded to the animal’s ranks until the point that all data was processed such that group comparisons could be made.</td>
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Animals and other organisms

Policy information about studies involving animals: ARRIVE guidelines recommended for reporting animal research

| Laboratory animals | Group housed male mice of C57 strain, between the ages of 8-20 weeks were used for all the experiments. |
| Wild animals | No wild animals were used in this study |
| Field-collected samples | No field-collected samples were used in this study |
| Ethics oversight | IACUC Salk Institute for Biological studies and MIT |

Note that full information on the approval of the study protocol must also be provided in the manuscript.