Supplementary Results

Additional analyses and statistics on the spatial dimension of dynamic social attention

We focused on the post-gaze epoch (within 1.5 sec after the onset of a microstimulation or sham) because it was the common time window for both animals where we observed a significant decrease in social gaze distance following OFC microstimulations. In fact, this effect was present and lasted longer beyond 1.5 sec in one of the stimulated monkeys (within 2 sec after trial onset: $p = 0.003$ for both monkeys combined; $p = 0.008$ for monkey L and $p = 0.204$ for monkey T; within 3 sec: $p = 0.004$ for both combined; $p = 0.007$ for L and $p = 0.204$ for T).

In addition to looking at social gaze distance in a continuous manner, we also examined fixations in a binary fashion (a fixation within an ROI or not). Following OFC microstimulations, unlike more clustered subsequent gaze fixations around another social agent, we did not observe any change in the total number of fixations within partner's *Eyes* (within 1.5 sec: $p > 0.18$ for both monkey L and monkey T; 2 sec: $p > 0.24$; 3 sec: $p > 0.30$) or *whole Face* (within 1.5 sec: $p > 0.12$; 2 sec: $p > 0.20$; 3 sec: $p > 0.22$), suggesting that the enhanced social attention from OFC microstimulations was driven by having spatially closer gaze fixations around another social agent but not necessarily increased the number of fixations within the social agent's eyes or face regions. However, this conclusion might be limited to the closed-loop microstimulation paradigm and to our specific stimulation parameters.

Additional analyses and statistics on low-level properties of saccades

The observed effects of OFC and dmPFC microstimulations were not driven by any change in the duration of current looking to partner's *Eyes* that triggered a microstimulation or sham (**Fig. S3a**, OFC: $p = 0.302$ for both monkeys combined; $p = 0.679$ for monkey L and $p = 0.339$ for monkey T; dmPFC: $p = 0.269$ for both combined; $p = 0.107$ for L and $p = 0.970$ for T; Wilcoxon signed rank, two-sided), number of microsaccades (**Fig. S3b**, OFC: $p = 0.456$ for both combined; $p = 0.978$ for L and $p = 0.233$ for T; dmPFC: $p = 0.581$ for both combined; $p = 0.303$ for L and $p = 0.569$ for T), number of macrosaccades (**Fig. S3c**, OFC: $p = 0.055$ for both combined; $p = 0.188$ for L and $p = 0.110$ for T; dmPFC: $p = 0.230$ for both combined; $p = 0.978$ for L and $p = 0.003$ for T), macrosaccade kinematics indexed by saccade peak velocity over amplitude (**Fig. S3d**, OFC: $p = 0.665$ for both combined; $p = 0.762$ for L and $p = 0.424$ for T; dmPFC: $p = 0.904$ for both combined; $p = 0.639$ for L and $p = 0.569$ for T; Wilcoxon signed rank, two-sided; **Fig. S3e**, OFC: $p = 0.515$ for both combined; $p = 0.507$ for L and $p = 0.178$ for T; dmPFC: $p = 0.164$ for both combined; $p = 0.240$ for L and $p = 0.509$ for T; permutation test), or macrosaccade kinematics when considering saccade direction (**Fig. S3f**, II: macrosaccades from ipsilateral hemifield to ipsilateral hemifield; IC: macrosaccades from ipsilateral hemifield to contralateral hemifield; CI; CC; OFC: all $p > 0.47$ for both combined; all $p > 0.59$ for L and all $p > 0.12$ for T; dmPFC: $p > 0.31$ for both combined; $p > 0.30$ for L and $p > 0.26$ for T; Wilcoxon signed rank, two-sided).

Supplementary Figures and Legends

Supplementary Figure 1

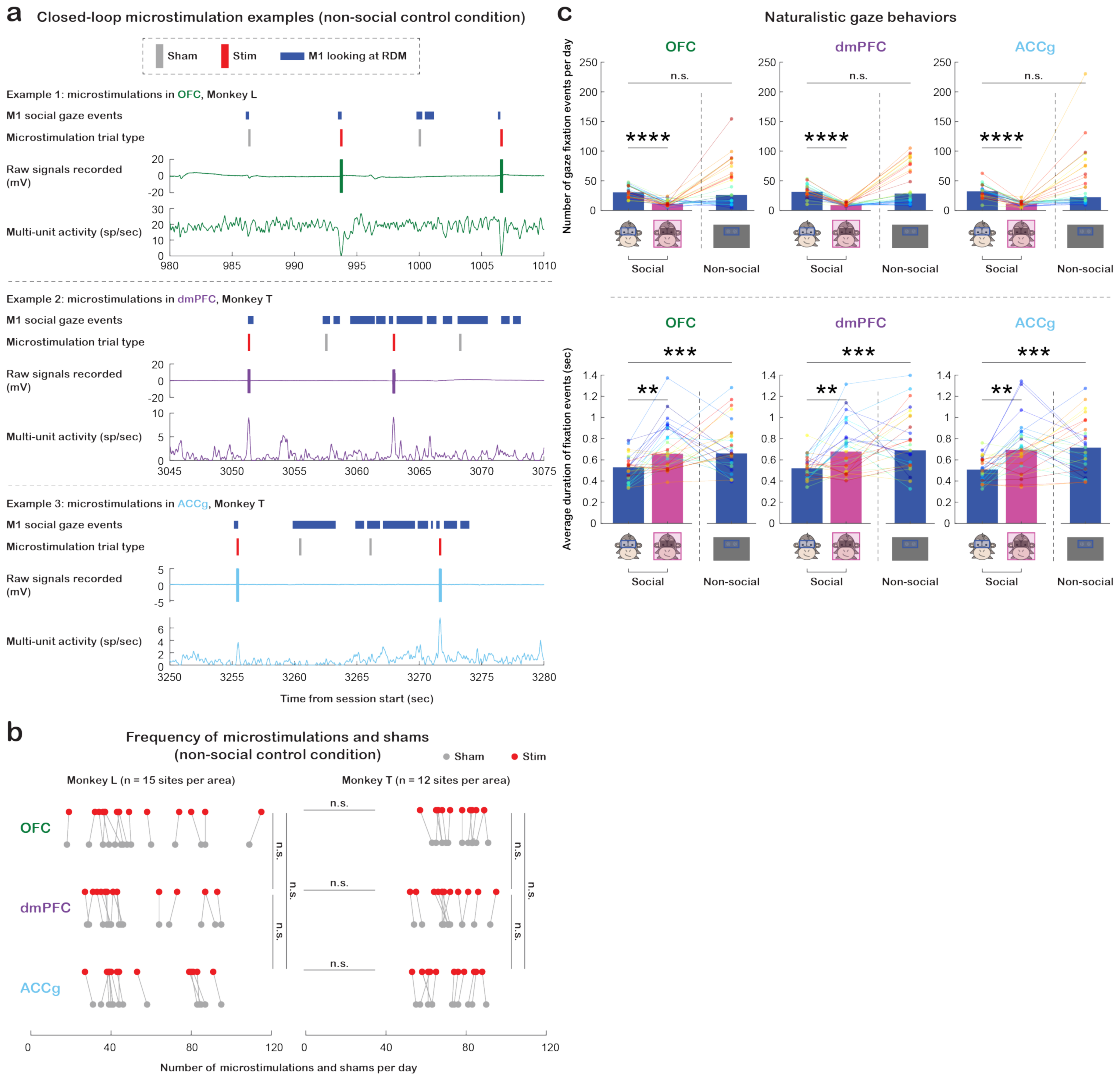

Figure S1. Additional analyses for the non-social control condition and naturalistic gaze behaviors. (**a**) Three examples of 30-sec experiment segments from the non-social control condition. Same format as **Fig. 1d**. Each example, from top to bottom, shows M1's fixations on *RDM stimulus* (blue; other fixations in space are not shown here), real-time shams (gray) and microstimulations (red) triggered by looking at *RDM stimulus*, raw signals recorded, and multi-unit activity. (**b**) Total number of microstimulations (red) and shams (gray) received per day in the non-social control condition for monkey L (left) and monkey T (right). Data points connected with lines indicate measurements from the same day. The total number of microstimulations and shams per day was comparable across the three stimulated regions and comparable between the two animals (all $p > 0.10$). n.s., not significant, Wilcoxon rank sum, two-sided, FDR-corrected. Statistics for shams are not shown in the figure; none of the comparisons is significant. (**c**) Naturalistic gaze behaviors summarized as the total number (top) and average duration per fixation (bottom) within partner monkey's *Eyes* and *non-eye Face* in the live social gaze condition, as well as fixations to the *RDM stimulus* in the non-social control condition. Data points in the same color connected with lines indicate measurements from the same day. ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$, n.s., not significant, Wilcoxon signed rank, two-sided, FDR-corrected.

Supplementary Figure 2

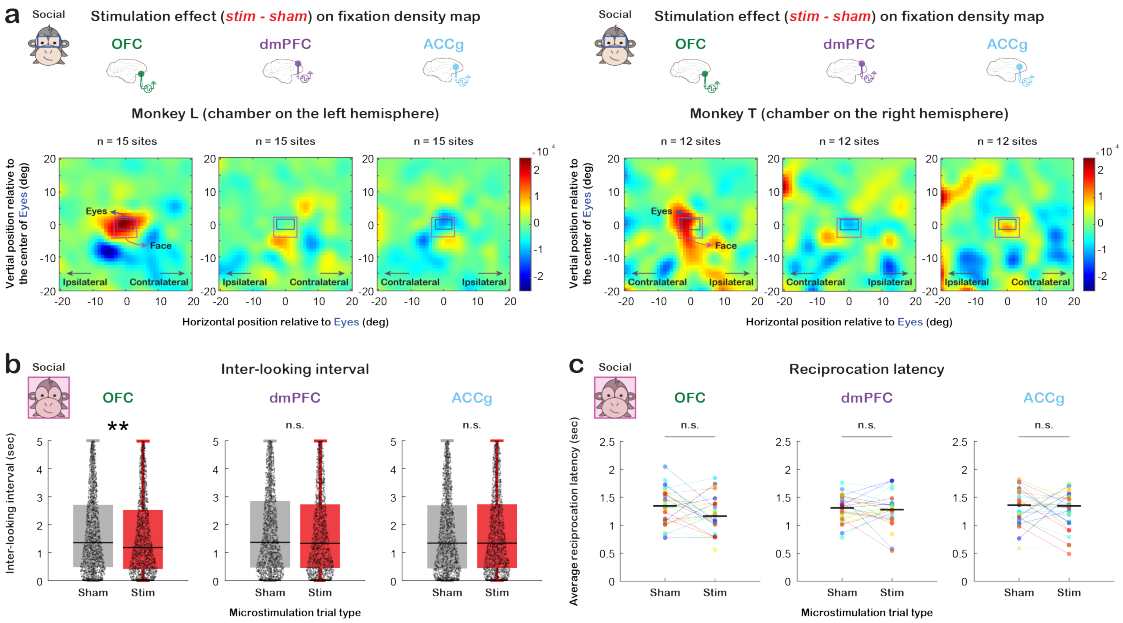

Figure S2. Additional analyses for dynamic social attention in the spatial and temporal dimensions. (**a**) Microstimulation effect (difference between microstimulation and sham trial types) shown on the fixation density map of space surrounding partner monkey's *Eyes* (blue rectangle) and *whole Face* (pink rectangle) for OFC, dmPFC, and ACCg for monkey L (n = 15 sites per area, left) and monkey T (n = 12 sites per area, right) separately. Same format as **Fig. 2a**. (**b**) Distribution of inter-looking interval for sham (gray) and microstimulation (red) trial types separately for OFC, dmPFC, and ACCg. Trial-level data were collapsed across all days for each stimulated brain region. Microstimulations of OFC decreased inter-looking interval ($p = 0.010$ for both monkeys combined; $p = 0.026$ for monkey L and $p = 0.143$ for monkey T). ** $p < 0.01$, n.s., not significant, Wilcoxon rank sum, two-sided. (**c**) Average reciprocation latency per day for sham and microstimulation trial types separately for OFC, dmPFC, and ACCg. Data points in the same color connected with lines indicate measurements from the same day. On the day level, microstimulations did not seem to greatly reduce reciprocation latency (OFC: $p = 0.130$; dmPFC: $p = 0.701$; ACCg: $p = 0.400$). n.s., not significant, Wilcoxon signed rank, two-sided.

Supplementary Figure 3

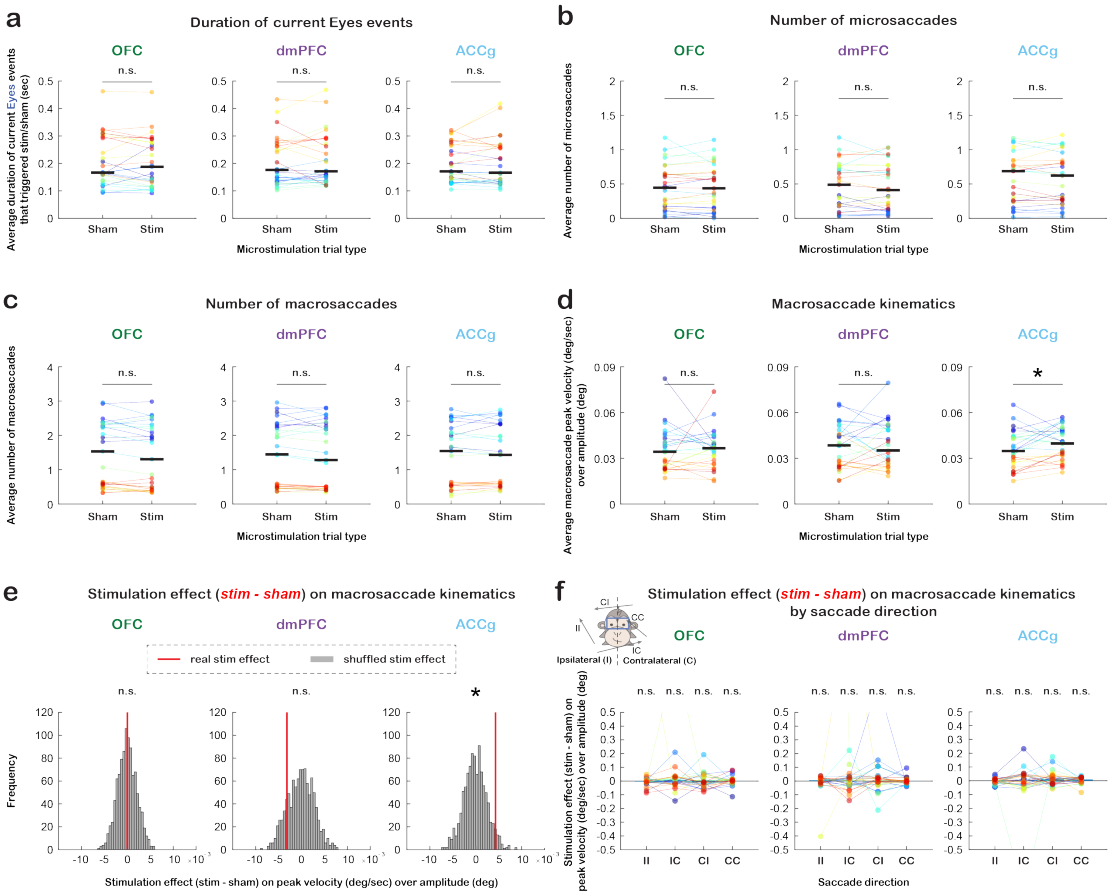

Figure S3. Control analyses on current gaze events and saccades. (**a**) Average duration per day of current *Eyes* events that triggered a microstimulation or sham, for sham and microstimulation trial types separately for OFC, dmPFC, and ACCg. Data points in the same color connected with lines indicate measurements from the same day. Please see Supplementary Results for more statistics. n.s., not significant, Wilcoxon signed rank, two-sided. (**b-c**) Average number of microsaccades (**b**) and macrosaccades (**c**) per day during post-gaze epoch for the two trial types separately for OFC, dmPFC, and ACCg. n.s., not significant, Wilcoxon signed rank, two-sided. (**d**) Average macrosaccade kinematics per day indexed by saccade peak velocity over amplitude for the two trial types separately for OFC, dmPFC, and ACCg. * $p < 0.05$, n.s., not significant, Wilcoxon signed rank, two-sided. (**e**) Microstimulation effect (difference between microstimulation and sham trial types) on macrosaccade kinematics. Red lines show the real median stimulation effect, whereas gray bars show the shuffled null distribution (shuffling microstimulation trial type label 1,000 times for each day). * $p < 0.05$, permutation test. (**f**) Microstimulation effect on macrosaccade kinematics by saccade direction separately for OFC, dmPFC, and ACCg. II: macrosaccades from ipsilateral hemifield to ipsilateral hemifield; IC: macrosaccades from ipsilateral hemifield to contralateral hemifield; CI; CC. n.s., not significant, Wilcoxon signed rank, two-sided.

Supplementary Figure 4

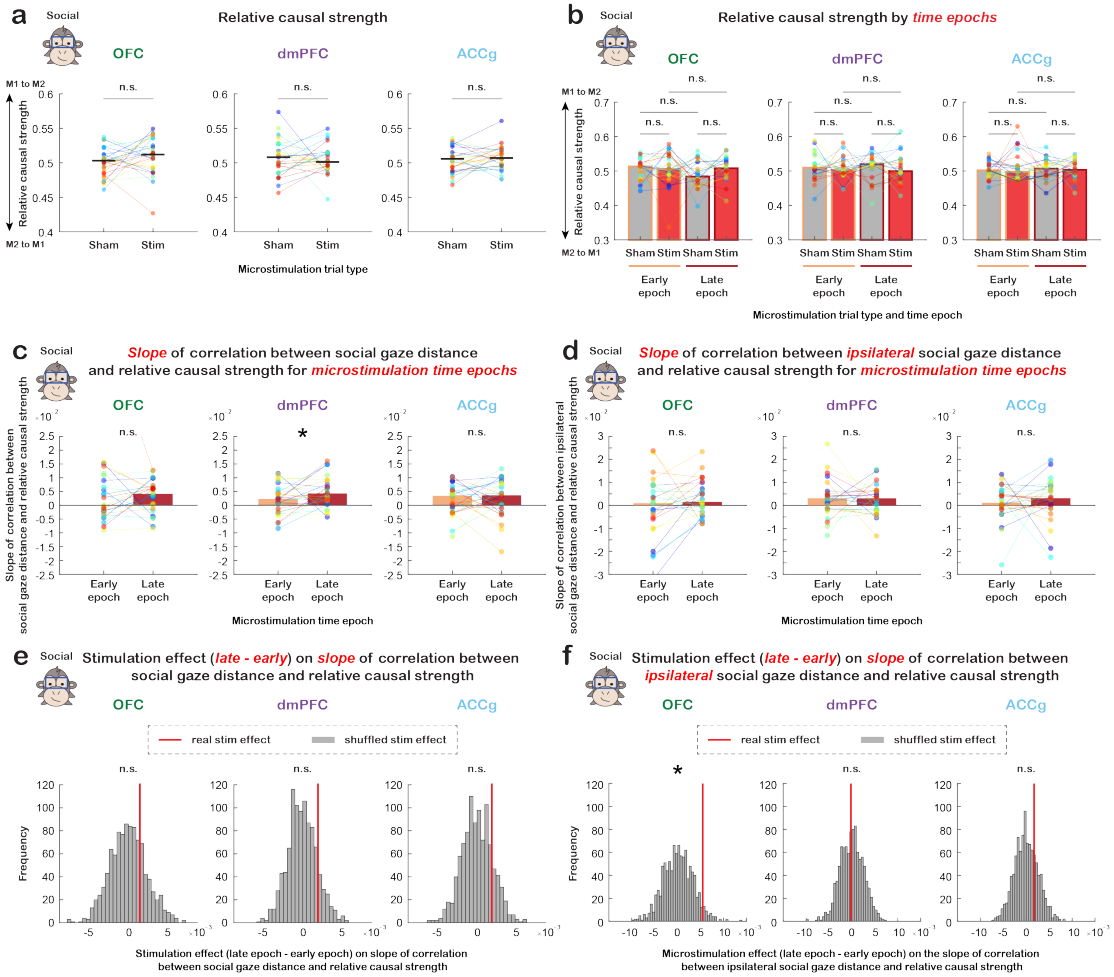

Figure S4. Additional analyses on longer timescale social gaze exchanges. (**a**) Average relative causal strength per day for sham and microstimulation trial types separately for OFC, dmPFC, and ACCg. Data points in the same color connected with lines indicate measurements from the same day. We did not observe stimulation effect on the magnitudes of relative causal strength (OFC: $p = 0.239$; dmPFC: $p = 0.962$; ACCg: $p = 0.361$; Wilcoxon signed rank, two-sided). n.s., not significant, Wilcoxon signed rank, two-sided. (**b**) Average relative causal strength per day for different microstimulation trial types and time epochs (orange: early epoch; red: late epoch) separately for OFC, dmPFC, and ACCg. Data points in the same color connected with lines indicate measurements from the same day. We did not observe effect of microstimulation trial type or time epoch on relative casual strength (OFC: all $p > 0.16$; dmPFC: all $p > 0.67$; ACCg: all $p > 0.46$). n.s., not significant, Wilcoxon signed rank, two-sided. (**c**) Slope of correlation between social gaze distance and relative causal strength for early epoch and late epoch separately for OFC, dmPFC, and ACCg. The slope of this fitted correlation was stronger for the late epoch than early epoch for dmPFC, but not for the other two regions (dmPFC: $p = 0.037$; OFC: $p = 0.757$; ACCg: $p = 0.770$). * $p < 0.05$, n.s., not significant, Wilcoxon signed rank, two-sided. (**d**) Same format as (**c**) but when using social gaze distance in the ipsilateral hemifield. The slope of this fitted correlation was comparable between the two time epochs (OFC: $p = 0.098$; dmPFC: $p = 0.757$; ACCg: $p = 0.381$). n.s., not significant, Wilcoxon signed rank, two-sided. (**e**) Microstimulation effect (difference between late epoch and early epoch) on the slope of examined correlation in (**c**). Red lines show the real median slope difference between late epoch and early epoch, whereas gray bars show the shuffled null distribution of slope difference medians (shuffling time epoch label 1,000 times for each day). n.s., not significant, permutation test. (**f**) Same format as (**e**) but when using social gaze distance in the ipsilateral hemifield. * $p < 0.05$, n.s., not significant, permutation test.