SUPPLEMENTAL MATERIALS

Shepherd & Freiwald (2018) *Neuron*

Supplemental Tables

Table S1: Details of experimental sessions, Related to STAR Methods

SUBJECT	**BORN**	**SESSIONS**	**#1**	**#2**	**#3**	**#4**	**#5**
S01.Yogi	20090408	1306	**J**	**J**	**J**	**J**	-
S02.Tookie	20090429	1309-10	**J**	**N**	-	-	-
S03.Milo	20090419	1309-10	**N**	**N**	-	-	-
S04.Mo	20080824	1309	**N**	-	-	-	-
S05.Otis	20090417	1312-1401	**N**	**N**	-	-	-
S06.Sam	20110603	1505-06	**J** +T	J +T	J +T	J +T	J +T
S07.Thor	20110523	1505-06	**J** +T	J +T	J +T	J +T	J +T
S08.Bobby	20110503	1508	**N** +T	J +T	J +T	J +T	J +T
S09.Buster	20110327	1508	**N** +T	J +T	J +T	J +T	J +T
S10.Alan	20110515	1511-1601	**N** +T	J +T	J +T	J +T	J +T

Subjects, their birth date, and the date and details of their experimental sessions. All subjects participated in 1-5 experimental sessions. J indicates the primary experiment was conducted with a juice tube and fluid rewards; N indicates no juice tube was present; +T indicates that the experimental session was preceded by a nonsocial oculomotor task featuring fluid rewards. Finally, bold indicates sessions was were manually scored for unambiguous drinking and lipsmack bouts by the subject monkey.

Supplemental Video

Video S1: Neural correlates of produced communicative movement are visible in single trials, Related to Figure 1.

[see video]

The first experimental run of the monkey Milo is shown. Milo is at left, while stimulis are depicted at right with superimposed gaze trace. Because of a calibration error, gaze data are likely shifted down and to the right of their true location. Responses in the primary facial representation of motor cortex (ROI ‘M1’) are shown in green, below; signal decreases in IRON-fMRI indicate increased neural activity. Lightweight black shows the raw computer-scored facial movement; heavy black shows the computer-scored facial movement after convolution with an IRON-fMRI hemodynamic response function. At bottom, hand-scored facial behavior has been convolved with the IRON-fMRI hemodynamic response function as an alternate set of neural predictors (expressive in orange, lipsmack in red, mixed/miscellaneous movements in magenta). Because the juice tube was omitted from this experimental session, no drinking movements are shown or scored.

Supplemental Figures

Figure S1: Simulating Social Interaction, Related to Figure 1.

(**A**) To produce stimuli, expressive behaviors were elicited from different stimulus monkeys and simultaneously recorded from multiple perspectives. We used a half-silvered mirror to record video of expressive facial movements with naturalistic eye-contact. Camera positions (C1-C3) and perspectives are shown in green. (**B**) To assess subject's facial behavior, we recorded the subjects face using a fMRI-compatible infrared video camera, and manually subdivided the video image into face and nonface regions. A bicycle mirror (tinted red, at left) was used to reflect the stimulus, allowing data synchronization across recording systems; this region was concealed with a post-it note during hand scoring of subject responses. An computerized score of facial movement was produced by calculating the mean frame-to-frame difference between successive images in the face region (lighter tint), less the eye region (green tint), z-scored across the run duration and averaged over the 2-second data collection period for each fMRI frame.

Figure S2: Location of ROI used in this study, Related to STAR Methods.

(**A**) Flatmap (described in **Figure 2**) showing ROI locations superimposed on cortex; lighter regions are gyruses, darker are sulci. ROI were defined spatially for the overall group; subjects were cross-registered by warping to the Reveley atlas [48, 49]. ROI were defined post-hoc for descriptive purposes after collecting and analyzing the data; note that temporal lobe ROI reflect aggregate responses rather than individual subjects' face patches as identified in subject-specific localizer scans (but cf. **Figure S3**). Cortical ROI are shown as projected onto one subject's digitally-flattened right hemisphere and include temporal lobe region PITd, implicated in attention and gaze-following; large regions including the temporal lobe face patches PL, ML, MF, MD, AL, AF, AD, and AM; the frontal lobe face patches PA, PV, and PO; PM, a face-sensitive region found in this study in Brodmann Area 14; medial regions dmPFC, ACCs, ACCg, and mPFC; motor patches M1, M2, M3, M4; and a complex of ventrolateral premotor areas including VLMPC, ALPMC, and OMC; the somatosensory part of the primary somatomotor complex, sM1; insula areas AI and DI; auditory cortex, AC; dorsolateral and frontopolar regions 46, 11, and 10m. (**B**) Subcortical ROI are shown in volumetric slices and include cerebellar areas CbmD, CbmL, and CbmV; amygdala, Amyg; a region just dorsal to the amygdala, dAmyg; the striatum, St, and globus pallidus, GP; thalamic regions Th.LGN, Th.MGN, and Th.Pulv; brainstem including facial, hypoglossal and trigeminal motor nuclei with associated reticular networks, BS; and the periacqueductal gray, PAG.

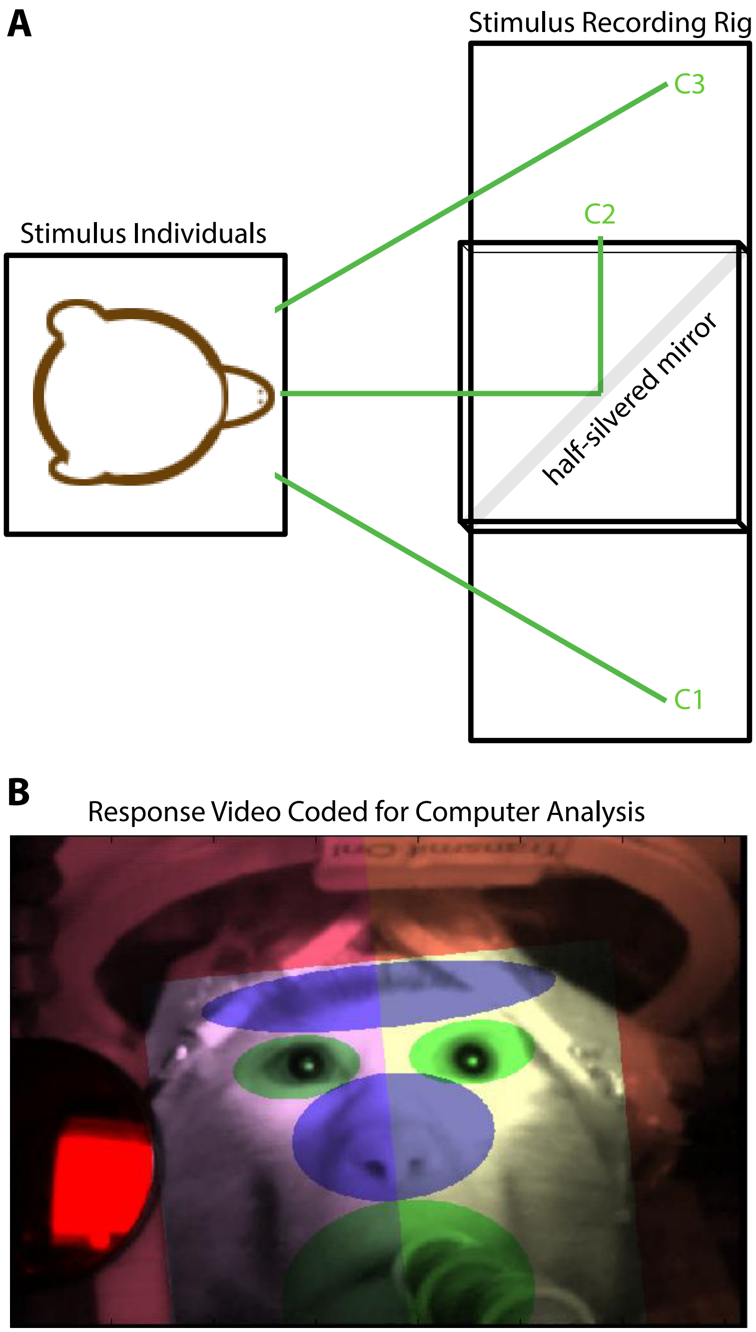
Figure S3: Cortical responses to task variables across subjects, Related to Figure 4.

(**A**) The FDR-corrected contrast of social-video-correlated less scrambled-video-correlated activity across all subjects' cortical flatmaps, with superimposed face patches from an independent localizer scan. All data from IRON-fMRI, with variable q thresholds from $10^{-1.3}$ to 10^{-4}. White outlines depict faces > objects and black outlines bodies > objects (q matched to social-vs-scramble contrast). (**B**) The FDR-corrected map of correlates with computer-scored face movement *production*, across all subjects' cortical flatmaps, showing consistent activation in the ventrolateral central sulcus corresponding to sM1 and M1. Q thresholds were matched within subjects to panel A.

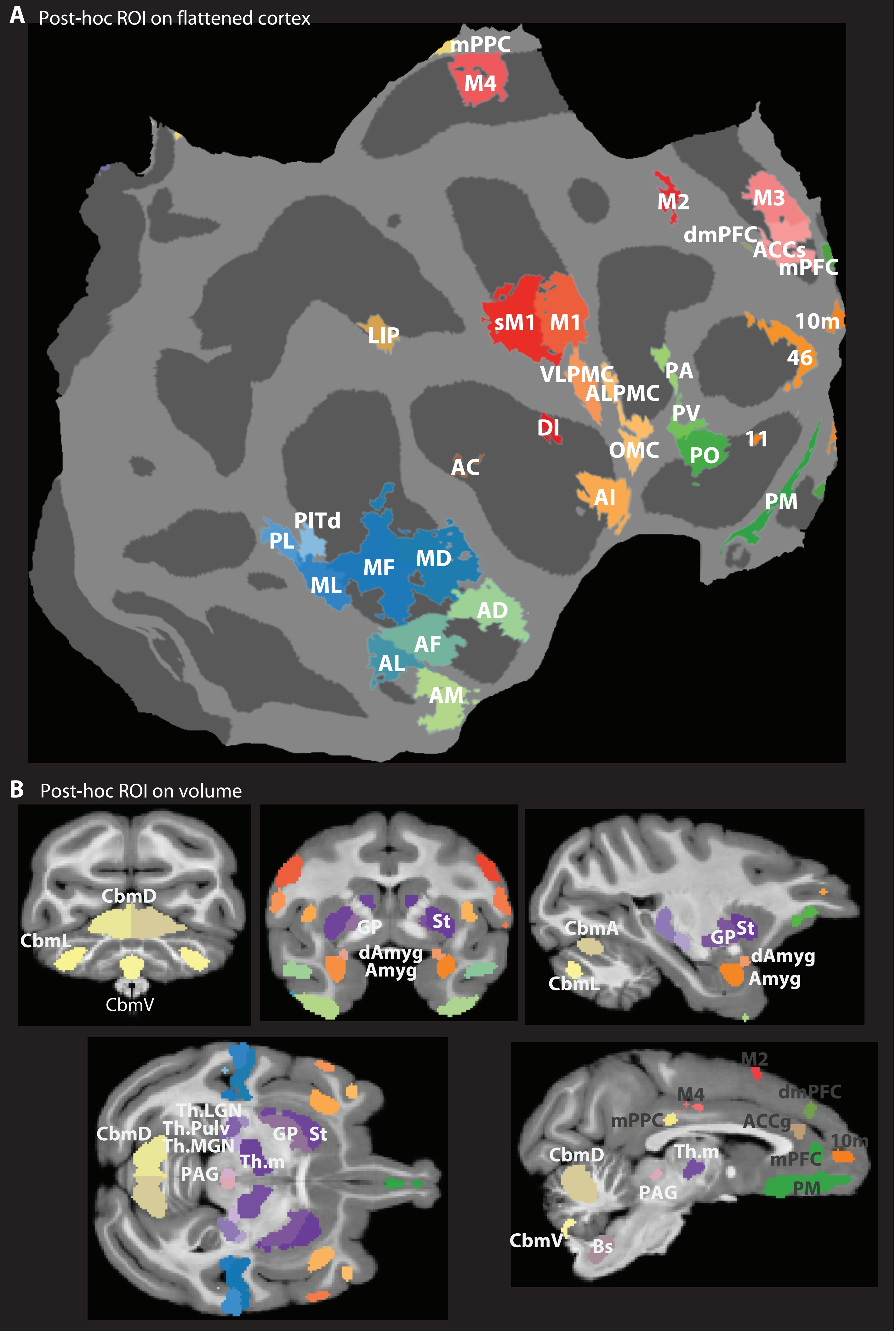
Figure S4: Reliability of responses to task variables across subjects, Related to Figure 4.

(**A**) Volume and cortical maps of the frequency across hemispheres of significant ($q<0.001$) responses to subject's (autocoded) produced facial movement, in a full model considering both task-driven and subject-driven responses. Range from is 25% hemispheres significant (magenta) to 100% hemispheres significant (dark red). Hemispheric representations in volume plots are redundant with the cortical flatmap. (**B**) Counts across hemispheres of increased (red, significant; yellow, trend) or decreased (blue, significant; cyan, trend) activity by ROI and condition: at top, social > scrambled video presentation and subject-directed > averted gaze; below, autocoded face movement, explicitly observed lipsmacks, and autocoded background movement.

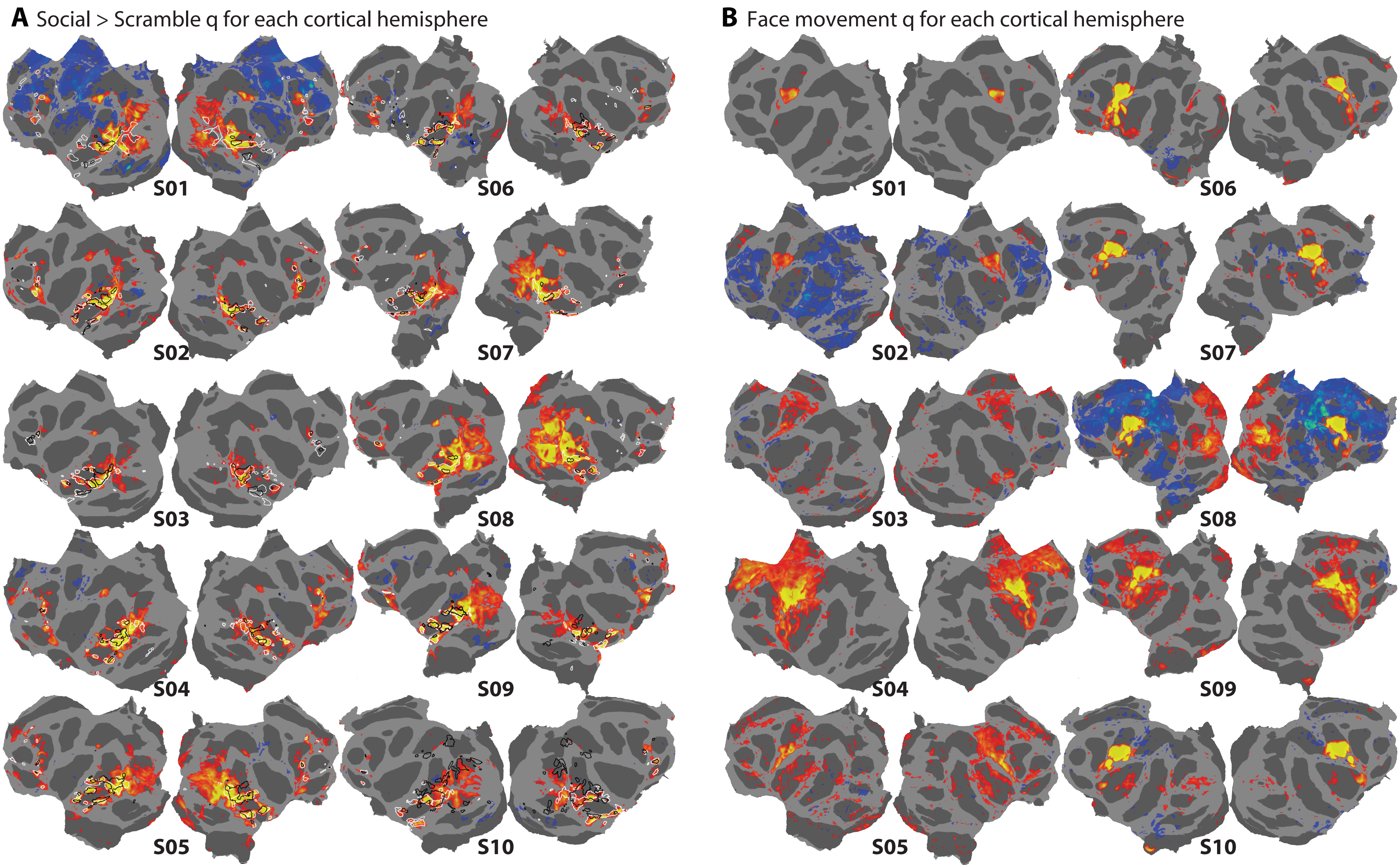
F.S1


A
Stimulus Recording Rig
C3
C2
Stimulus Individuals
half-silvered mirror
C1
B
Response Video Coded for Computer Analysis

F.S2


A Post-hoc ROI on flattened cortex
mPPC
M4
M2
M3
dmPFC
ACCs
mPFC
sM1
M1
10m
LIP
46
VLPMC
PA
ALPMC
PV
DI
11
OMC
PO
AC
AI
PM
PITd
PL
MF
MD
ML
AD
AF
AL
AM
B Post-hoc ROI on volume
CbmD
CbmL
CbmV
GP
St
dAmyg
Amyg
CbmA
GP
St
CbmL
dAmyg
Amyg
Th.LGN
Th.Pulv
CbmD
Th.MGN
GP
St
Th.m
PAG
M2
M4
dmPFC
mPPC
ACCg
10m
Th.m
CbmD
mPFC
PAG
PM
CbmV
Bs

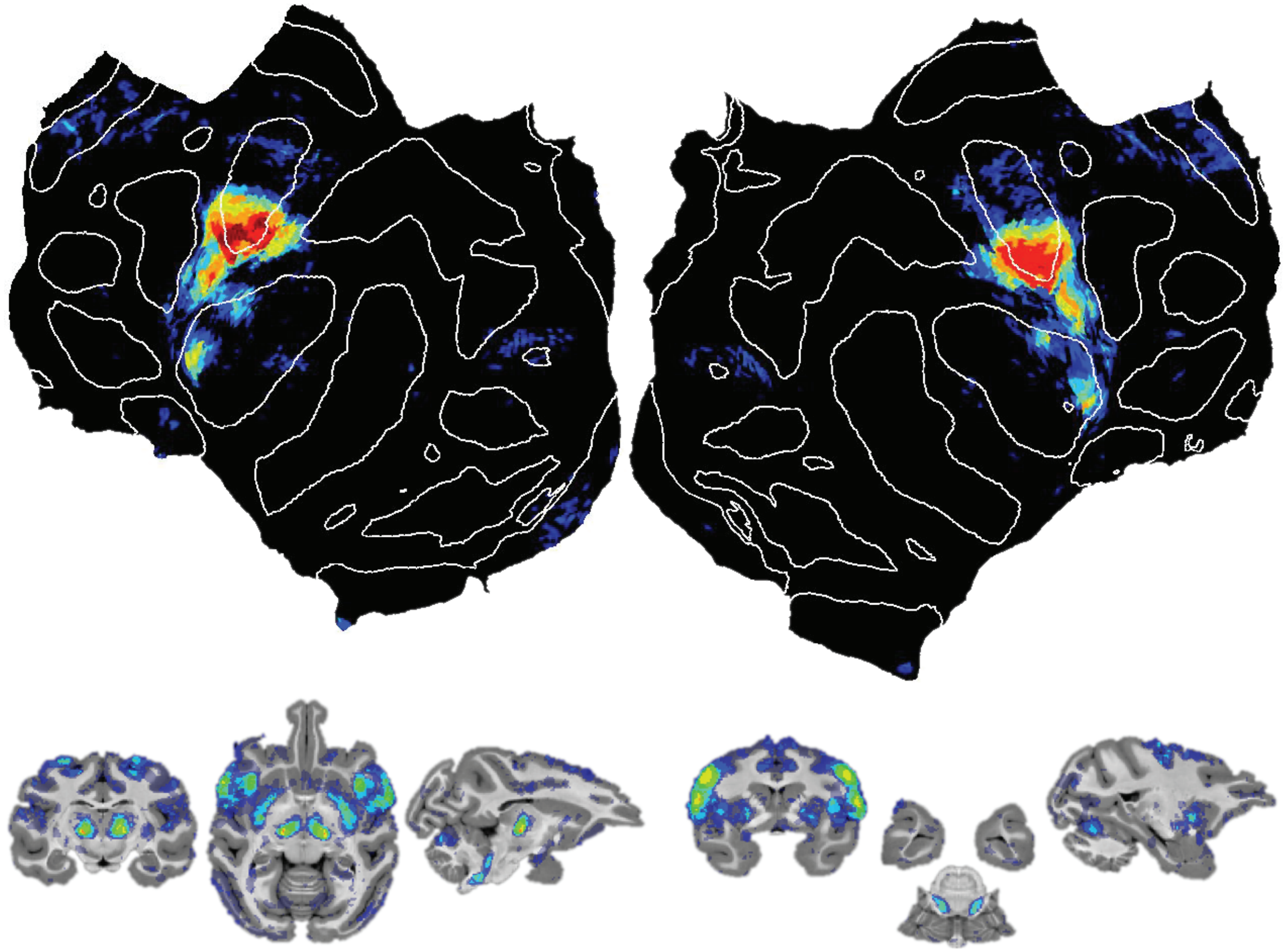
F.S3



A Social > Scramble q for each cortical hemisphere
B Face movement q for each cortical hemisphere
S01
S06
S02
S07
S03
S08
S04
S09
S05
S10
S01
S06
S02
S07
S03
S08
S04
S09
S05
S10

F.S4

A Volumetric and flat maps of the portion of hemispheres with significant facial motor activation



B Sign and significance (p<0.001) of association across subject hemispheres for each post-hoc ROI