Figure 1

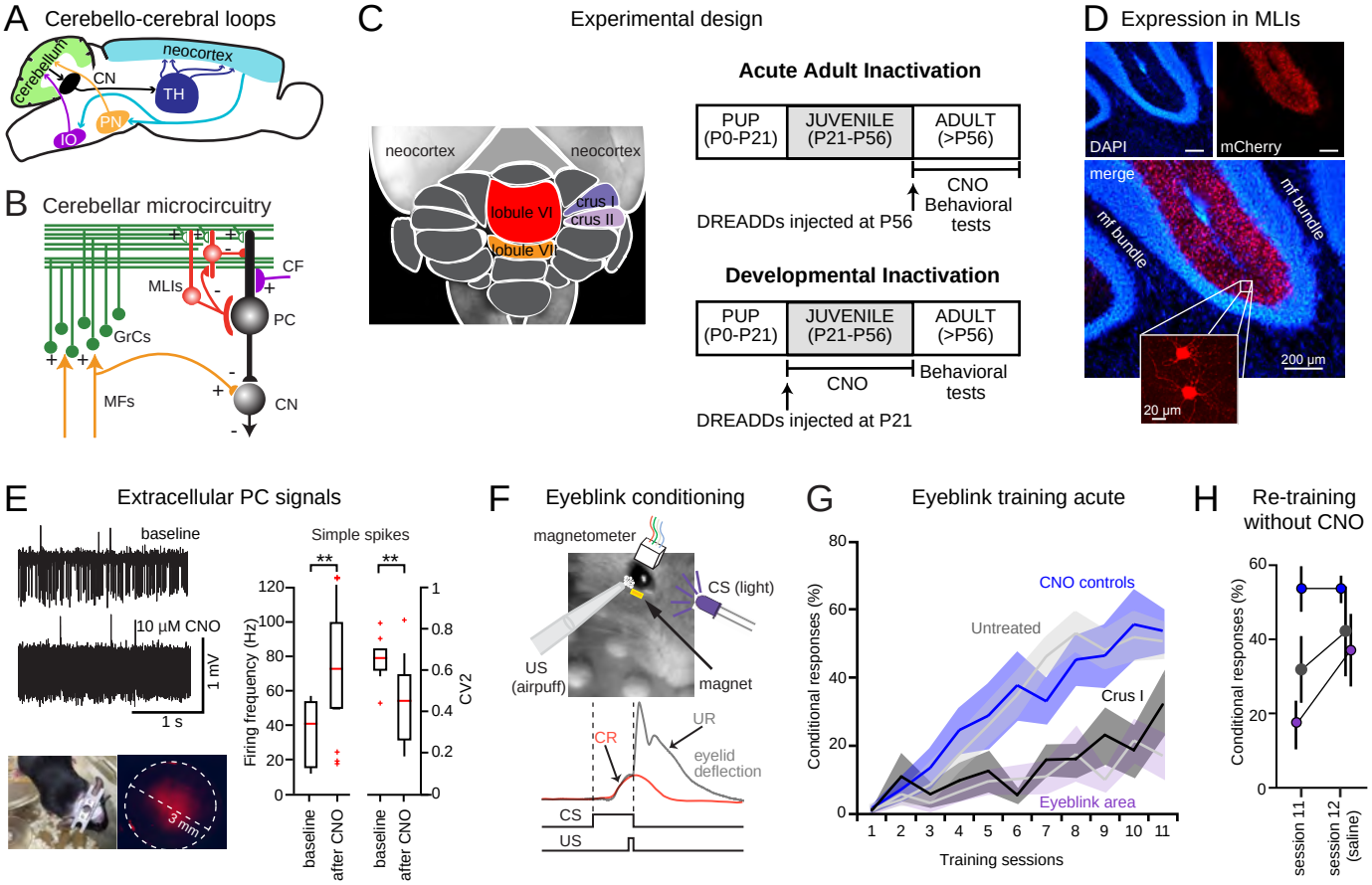

A Cerebello-cerebral loops
cerebellum
neocortex
CN
TH
PN
IO
B Cerebellar microcircuitry
CF
MLIs
PC
GrCs
MFs
CN
C Experimental design
neocortex
neocortex
lobule VI
crus I
crus II
lobule VII
Acute Adult Inactivation
PUP (P0-P21)
JUVENILE (P21-P56)
ADULT (>P56)
CNO
Behavioral tests
DREADDs injected at P56
Developmental Inactivation
PUP (P0-P21)
JUVENILE (P21-P56)
ADULT (>P56)
CNO
Behavioral tests
DREADDs injected at P21
D Expression in MLIs
DAPI
mCherry
merge
mf bundle
mf bundle
200 µm
20 µm
E Extracellular PC signals
baseline
10 µM CNO
1 mV
1 s
3 mm
Simple spikes
Firing frequency (Hz)
CV2
baseline
after CNO
baseline
after CNO
F Eyeblink conditioning
magnetometer
CS (light)
US (airpuff)
magnet
UR
CR
eyelid deflection
CS
US
G Eyeblink training acute
CNO controls
Untreated
Crus I
Eyeblink area
Conditional responses (%)
Training sessions
H Re-training without CNO
Conditional responses (%)
session 11
session 12 (saline)

Figure 2

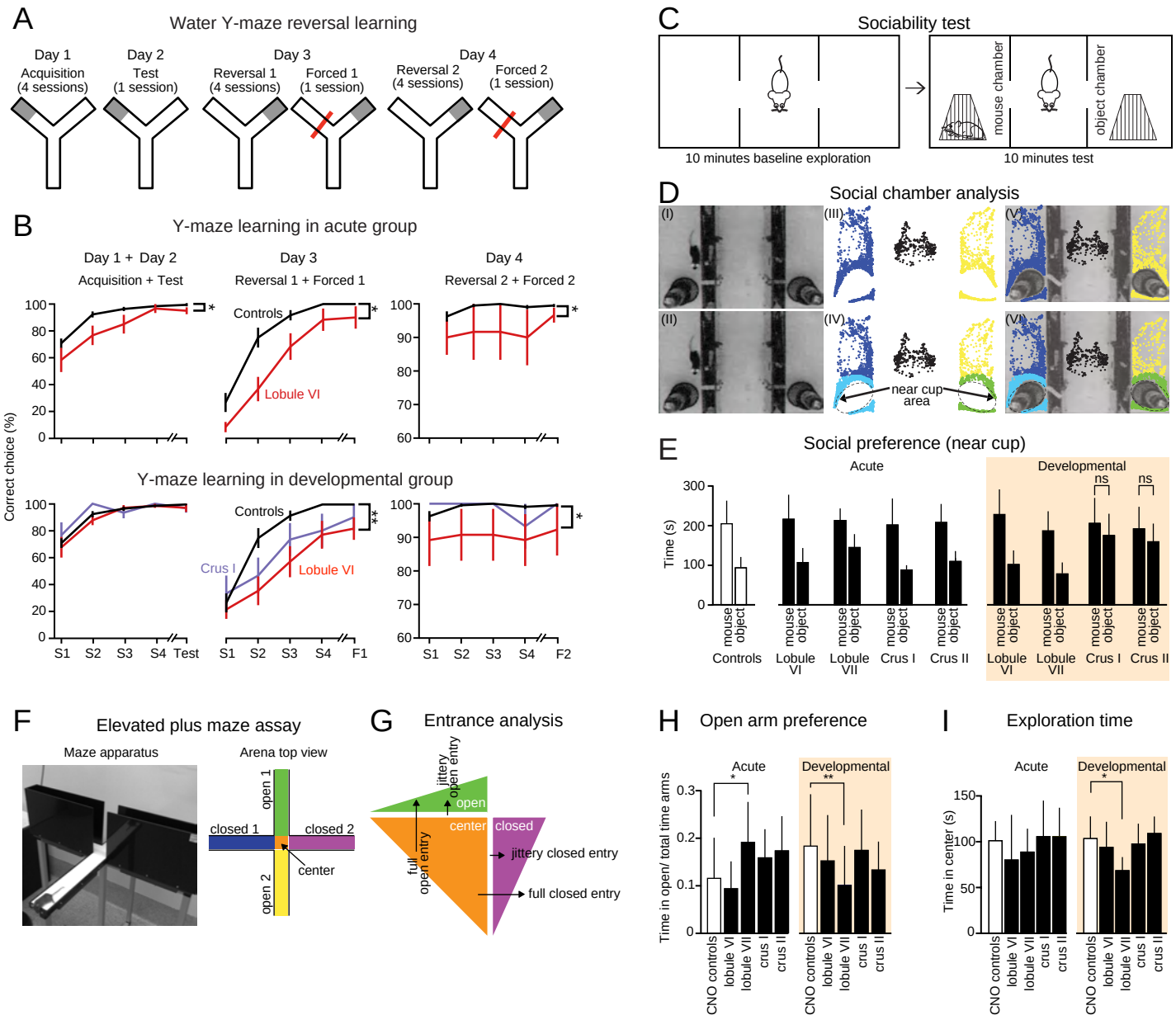
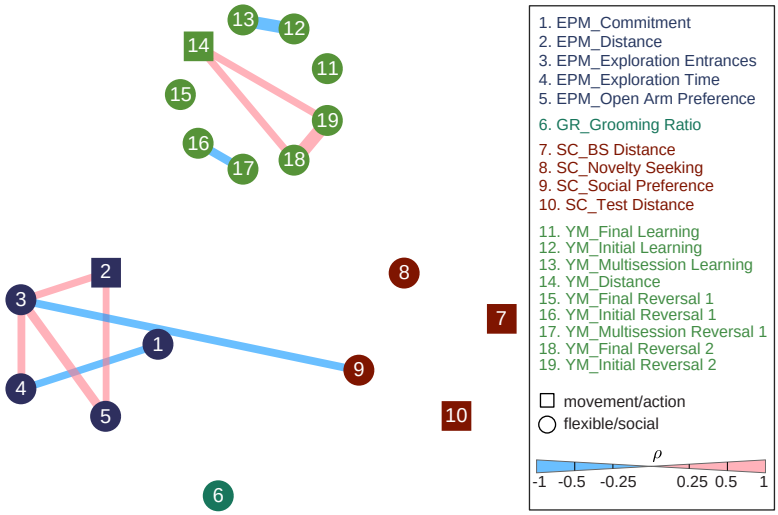
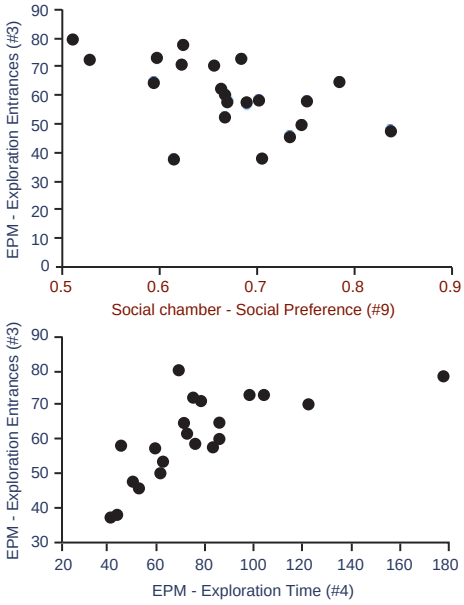

A
Water Y-maze reversal learning
Day 1
Acquisition
(4 sessions)
Day 2
Test
(1 session)
Day 3
Reversal 1
(4 sessions)
Forced 1
(1 session)
Day 4
Reversal 2
(4 sessions)
Forced 2
(1 session)
B
Y-maze learning in acute group
Day 1 + Day 2
Acquisition + Test
Day 3
Reversal 1 + Forced 1
Day 4
Reversal 2 + Forced 2
Correct choice (%)
Controls
Lobule VI
Y-maze learning in developmental group
Crus I
S1 S2 S3 S4 Test
S1 S2 S3 S4 F1
S1 S2 S3 S4 F2
C
Sociability test
mouse chamber
object chamber
10 minutes baseline exploration
10 minutes test
D
Social chamber analysis
(I)
(II)
(III)
(IV)
(V)
(VI)
near cup area
E
Social preference (near cup)
Acute
Developmental
Time (s)
ns
mouse
object
Controls
Lobule VI
Lobule VII
Crus I
Crus II
F
Elevated plus maze assay
Maze apparatus
Arena top view
open 1
open 2
closed 1
closed 2
center
G
Entrance analysis
jittery open entry
open
center
closed
full open entry
jittery closed entry
full closed entry
H
Open arm preference
Acute
Developmental
Time in open/ total time arms
CNO controls
lobule VI
lobule VII
crus I
crus II
I
Exploration time
Time in center (s)

Figure 3

A Correlations between metrics in untreated mice

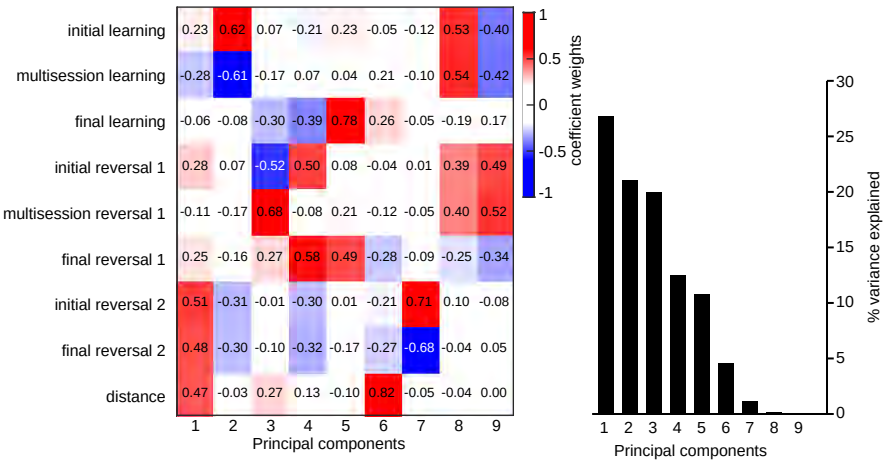


B Example correlations untreated mice

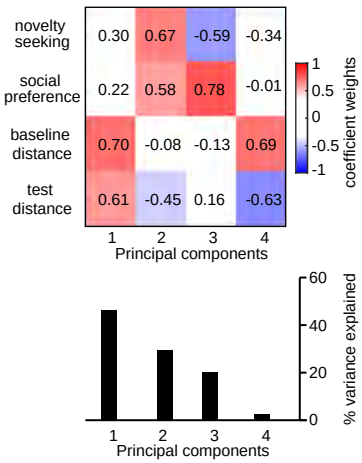


C Principal components of individual behaviors in untreated mice

Y-maze reversal behavioral space



Social chamber behavioral space



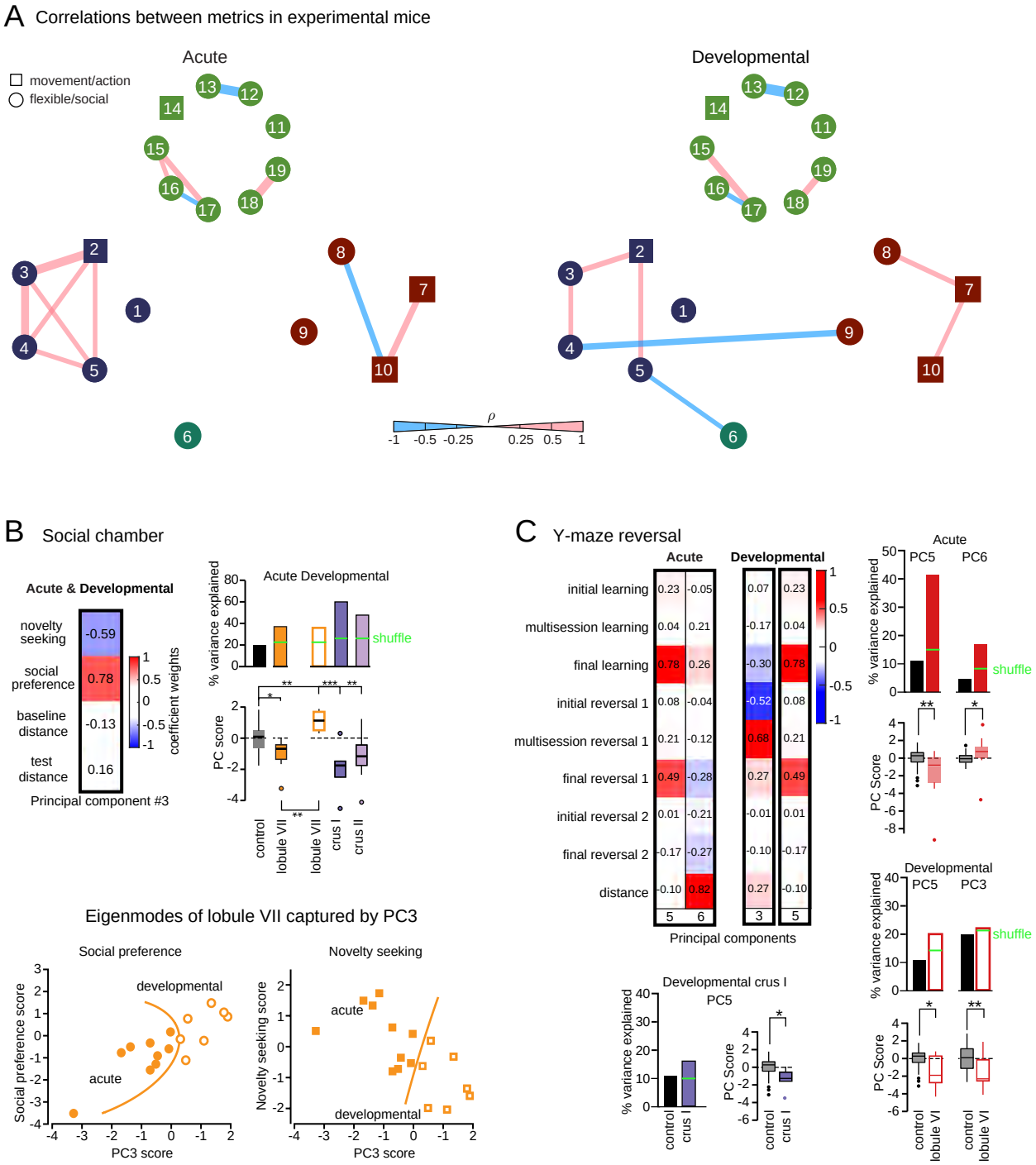

A Correlations between metrics in experimental mice
Acute
Developmental
movement/action
flexible/social
ρ
-1 -0.5 -0.25 0.25 0.5 1
B Social chamber
Acute & Developmental
novelty seeking -0.59
social preference 0.78
baseline distance -0.13
test distance 0.16
Principal component #3
coefficient weights
Acute Developmental
% variance explained
shuffle
PC score
control
lobule VII
lobule VII
crus I
crus II
Eigenmodes of lobule VII captured by PC3
Social preference
Novelty seeking
developmental
acute
Social preference score
Novelty seeking score
PC3 score
C Y-maze reversal
Acute
Developmental
initial learning 0.23 -0.05 0.07 0.23
multisession learning 0.04 0.21 -0.17 0.04
final learning 0.78 0.26 -0.30 0.78
initial reversal 1 0.08 -0.04 -0.52 0.08
multisession reversal 1 0.21 -0.12 0.68 0.21
final reversal 1 0.49 -0.28 0.27 0.49
initial reversal 2 0.01 -0.21 -0.01 0.01
final reversal 2 -0.17 -0.27 -0.10 -0.17
distance -0.10 0.82 0.27 -0.10
5 6 3 5
Principal components
Acute
PC5 PC6
Developmental
PC5 PC3
Developmental crus I
PC5
control
crus I
lobule VI

Figure 5

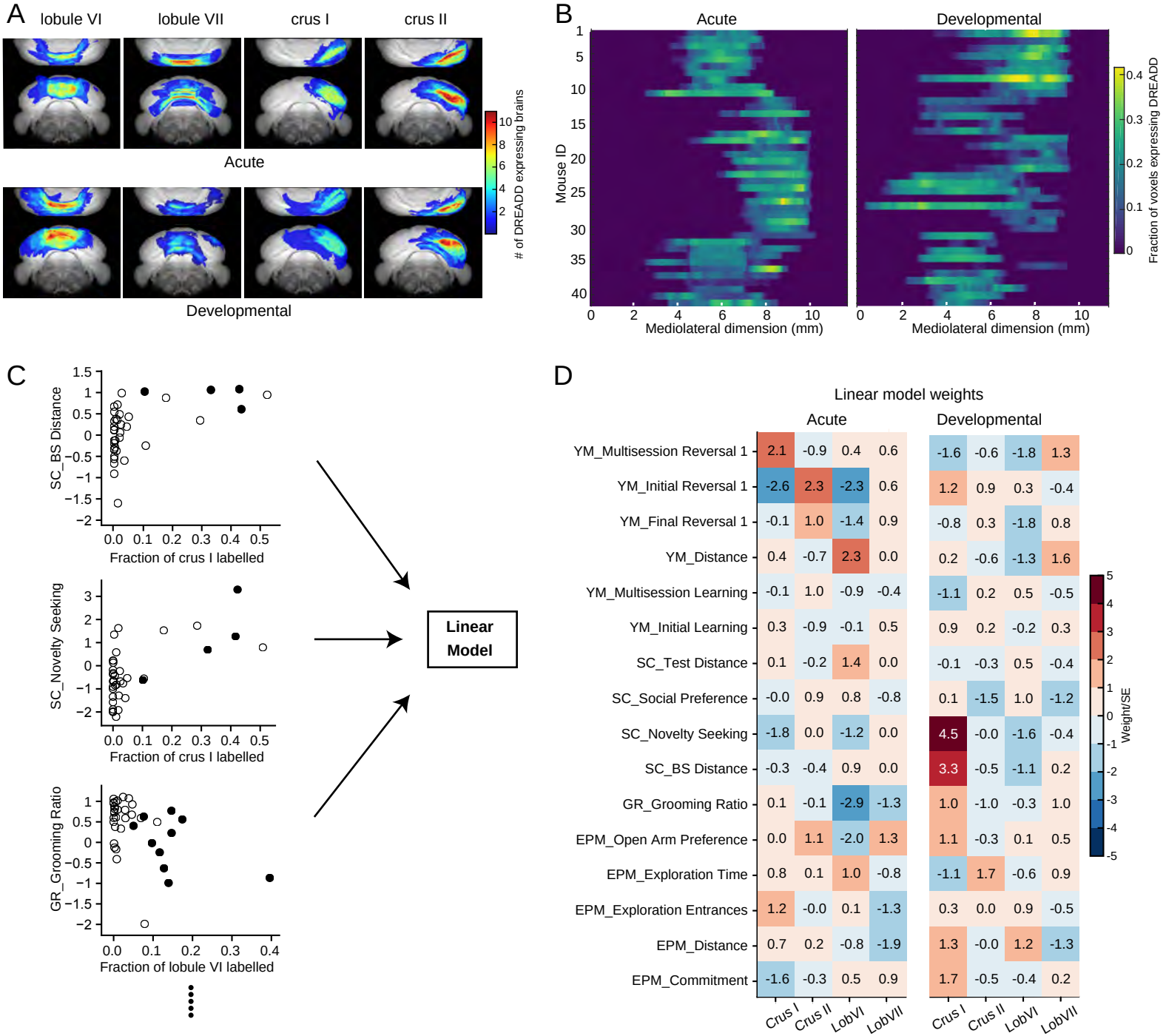
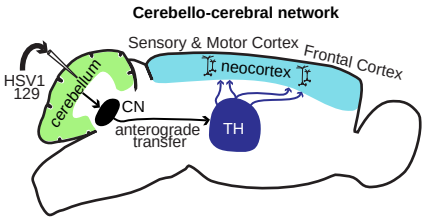

A
lobule VI
lobule VII
crus I
crus II
Acute
Developmental
# of DREADD expressing brains
B
Acute
Developmental
Mouse ID
Mediolateral dimension (mm)
Fraction of voxels expressing DREADD
C
SC_BS Distance
Fraction of crus I labelled
SC_Novelty Seeking
Fraction of crus I labelled
GR_Grooming Ratio
Fraction of lobule VI labelled
Linear Model
D
Linear model weights
Acute
Developmental
YM_Multisession Reversal 1
YM_Initial Reversal 1
YM_Final Reversal 1
YM_Distance
YM_Multisession Learning
YM_Initial Learning
SC_Test Distance
SC_Social Preference
SC_Novelty Seeking
SC_BS Distance
GR_Grooming Ratio
EPM_Open Arm Preference
EPM_Exploration Time
EPM_Exploration Entrances
EPM_Distance
EPM_Commitment
Crus I
Crus II
LobVI
LobVII
Weight/SE

Figure 6

A


Cerebello-cerebral network
Sensory & Motor Cortex
Frontal Cortex
HSV1
129
cerebellum
neocortex
CN
anterograde
transfer
TH

B

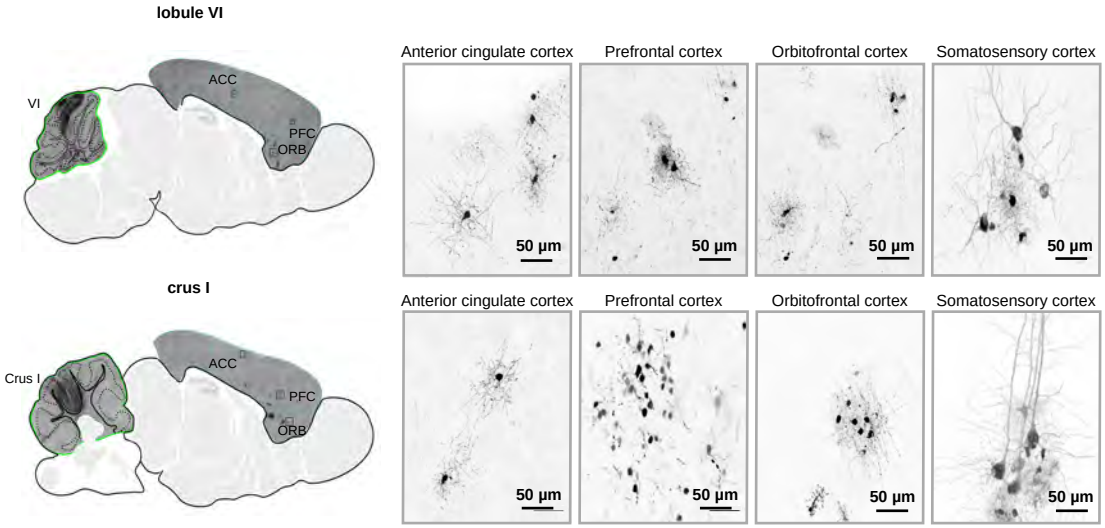

lobule VI
VI
ACC
PFC
ORB
crus I
Crus I
ACC
PFC
ORB
Anterior cingulate cortex
Prefrontal cortex
Orbitofrontal cortex
Somatosensory cortex
50 µm
Anterior cingulate cortex
Prefrontal cortex
Orbitofrontal cortex
Somatosensory cortex
50 µm

Table 1

#	Measure	Description	Quantification
Elevated Plus Maze metrics (EPM_)			
1	Commitment	Full entrances to the open arms ($\mathrm{Entr_{Ofull}}$) relative to sum of full entrances and jittery entrances to the open arms ($\mathrm{Entr_{Ojitter}}$)	$\frac{\mathrm{Entr_{Ofull}}}{\mathrm{Entr_{Ofull}} + \mathrm{Entr_{Ojitter}}}$
2	Distance	Distance traveled (cm) during the ten minutes in the Elevated Plus Maze	$\mathrm{EPM_{distance}}$
3	Exploration Entrances	Entrances into the crossroads central area	$\mathrm{Entr_{central}}$
4	Exploration Time	Time in the crossroads central area	$\mathrm{Time_{central}}$
5	Open-Arm Preference	Time in the open arms ($\mathrm{Time_{open}}$) relative to total time in closed ($\mathrm{Time_{closed}}$) and open arms	$\frac{\mathrm{Time_{open}}}{\mathrm{Time_{closed}} + \mathrm{Time_{open}}}$
Grooming metrics (GR_)			
6	Grooming Ratio	Difference between average grooming bout length in CNO ($\mathrm{AVG_{CNO}}$)and No CNO condition ($\mathrm{AVG_{NoCNO}}$) relative to No CNO condition	$\frac{\mathrm{AVG_{NoCNO}} - \mathrm{AVG_{CNO}}}{\mathrm{AVG_{NoCNO}}}$
Social Chamber metrics (SC_)			
7	Baseline Distance	Distance traveled (m) during baseline phase (10 minute free exploration of the empty social chamber apparatus)	$\mathrm{BS_{distance}}$
8	Novelty-Seeking	Difference between summed entrances to mouse ($\mathrm{Entr_M}$) and object ($\mathrm{Entr_O}$) chambers in test ($_{\mathrm{test}}$)and baseline ($_{\mathrm{bs}}$)sessions relative to baseline session	$\frac{((\mathrm{Entr_{Mbs}} + \mathrm{Entr_{Obs}}) - (\mathrm{Entr_{Mtest}} + \mathrm{Entr_{Otest}}))}{(\mathrm{Entr_{Mbs}} + \mathrm{Entr_{Obs}})}$
9	Social Preference	Time spent interacting with the novel mouse ($\mathrm{Time_{NearM}}$) relative to total time interacting with either the novel mouse or novel object ($\mathrm{Time_{NearO}}$)	$\frac{\mathrm{Time_{NearM}}}{\mathrm{Time_{NearM}} + \mathrm{Time_{NearO}}}$
10	Test Distance	Distance traveled (m) during test phase (10 minute exploration of the social chamber apparatus with the novel mouse and object present)	$\mathrm{Test_{distance}}$
Y-maze metrics (YM_)			
11	Final Learning	Mean of the percent correct trials in acquisition sessions 3 ($\mathrm{ACQ_{S3}}$) and 4 ($\mathrm{ACQ_{S4}}$)	$\frac{\mathrm{ACQ_{S3}} + \mathrm{ACQ_{S4}}}{2}$
12	Initial Learning	Percent correct trials in acquisition session 1 ($\mathrm{ACQS1}$)	$\mathrm{ACQS1}$
13	Multisession Learning	Slope of the linear regression of acquisition sessions 1 ($\mathrm{ACQ_{S1}}$), 2 ($\mathrm{ACQ_{S2}}$), and 3 ($\mathrm{ACQ_{S3}}$)	linear regression slope of ($\mathrm{ACQ_{S1}}$; $\mathrm{ACQ_{S2}}$; $\mathrm{ACQ_{S3}}$)
14	Distance	Combined distance swum (m) in the three habituation trials (HAB1, HAB2 and HAB3) (60 seconds each) of free swimming in the empty Y-maze apparatus	$\mathrm{HAB1_{distance}}$ + $\mathrm{HAB2_{distance}}$+ $\mathrm{HAB3_{distance}}$
15	Final Reversal 1	Mean of the percent correct trials in reversal day 1 sessions ($3\mathrm{RD1}_{S3}$) and 4 ($\mathrm{RD1}_{S4}$)	$\frac{\mathrm{RD1}_{S3} + \mathrm{RD1}_{S4}}{2}$
16	Initial Reversal 1	Percent correct trials in reversal day 1 session 1 ($\mathrm{RD1_{S1}}$)	$\mathrm{RD1_{S1}}$
17	Multisession Reversal 1	Slope of the linear regression of reversal ray 1 sessions 1 ($\mathrm{RD1_{S1}}$), 2 ($\mathrm{RD1_{S2}}$) and 3 ($\mathrm{RD1_{S3}}$)	linear regression slope of ($\mathrm{RD1_{S1}}$; $\mathrm{RD1_{S2}}$; $\mathrm{RD1_{S3}}$)
18	Final Reversal 2	Mean of the percent correct trials in reversal day 2 sessions1 ($\mathrm{RD2_{S1}}$), 2 ($\mathrm{RD2_{S2}}$) ,3 ($\mathrm{RD2_{S3}}$) and 4 ($\mathrm{RD2}_{S4}$)	$\frac{\mathrm{RD2}_{S1} + \mathrm{RD2}_{S2} + \mathrm{RD2}_{S3} + \mathrm{RD2}_{S4}}{4}$
19	Initial Reversal 2	Percent correct trials in reversal day 2 session 1	$\mathrm{RD2_{S1}}$