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Supplementary Data 3 Case 1. Social bonds gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-val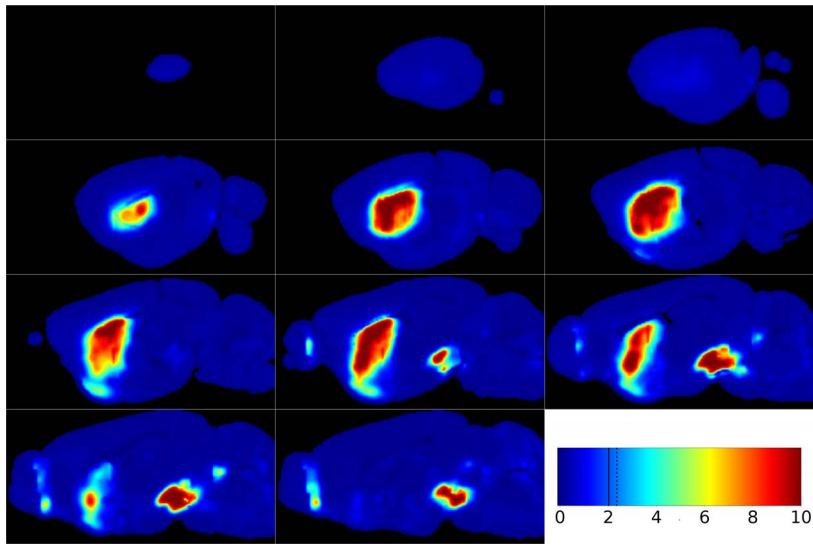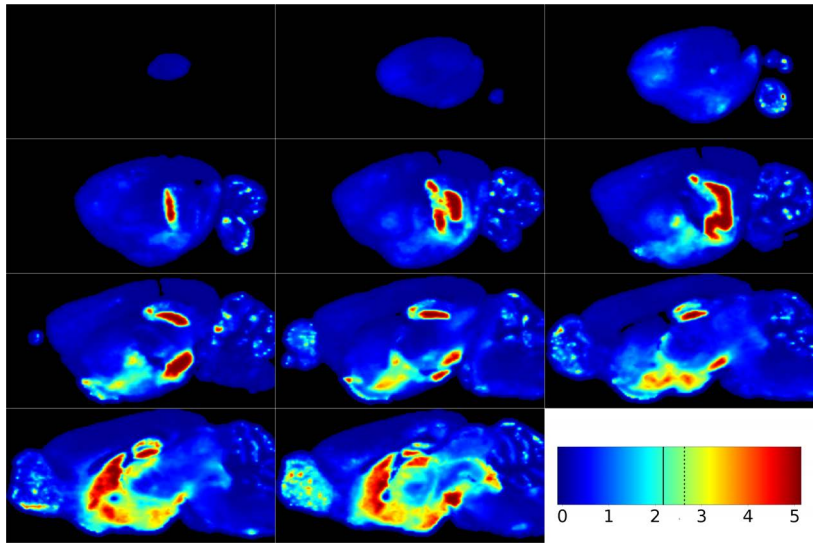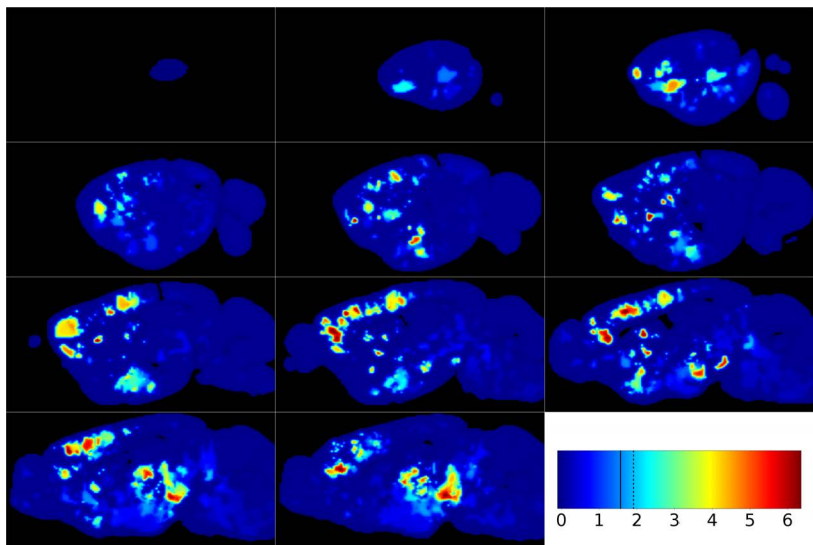ues. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.

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Supplementary Data 3 Case 2. Dopaminergic system gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
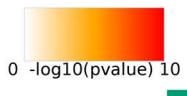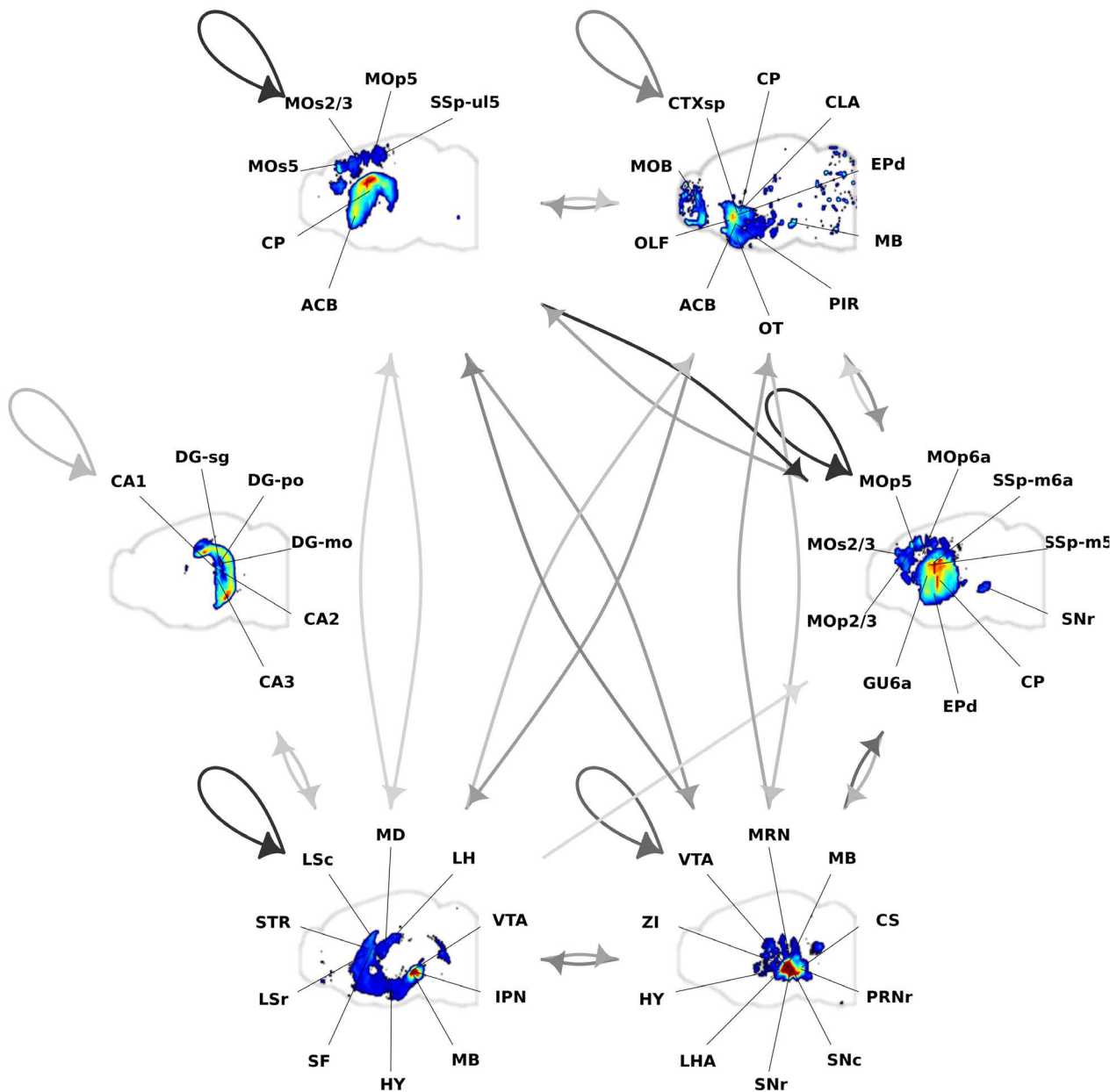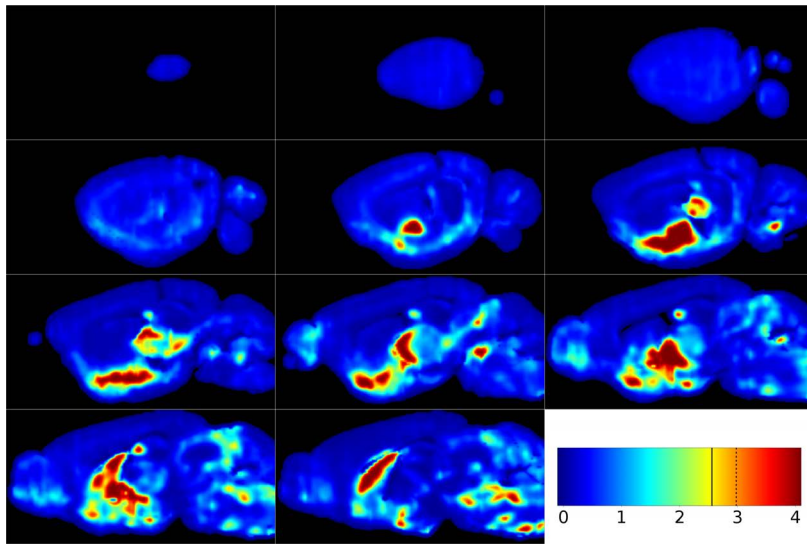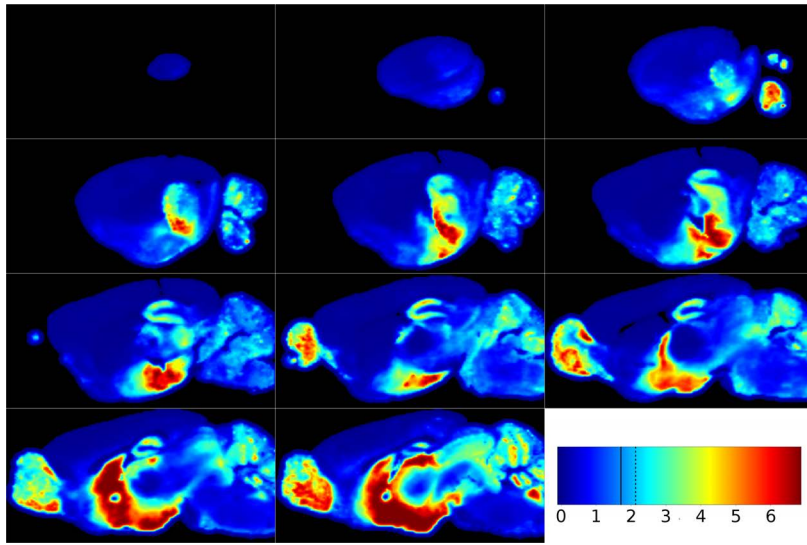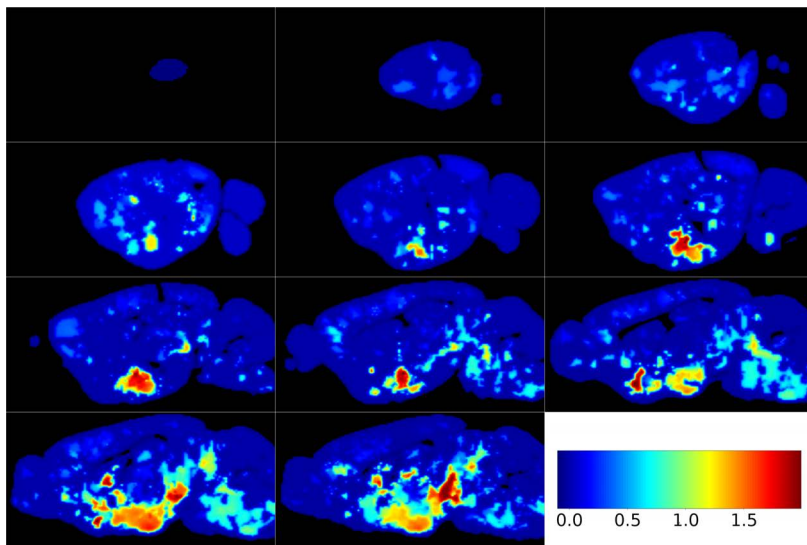
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Supplementary Data 3 Case 3. Central Amygdala Microcircuitry gene-set from literature research.
(A) Slice-view of first order network measures given as -log10 scaled p-values. (B) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (C) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (D) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (E) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
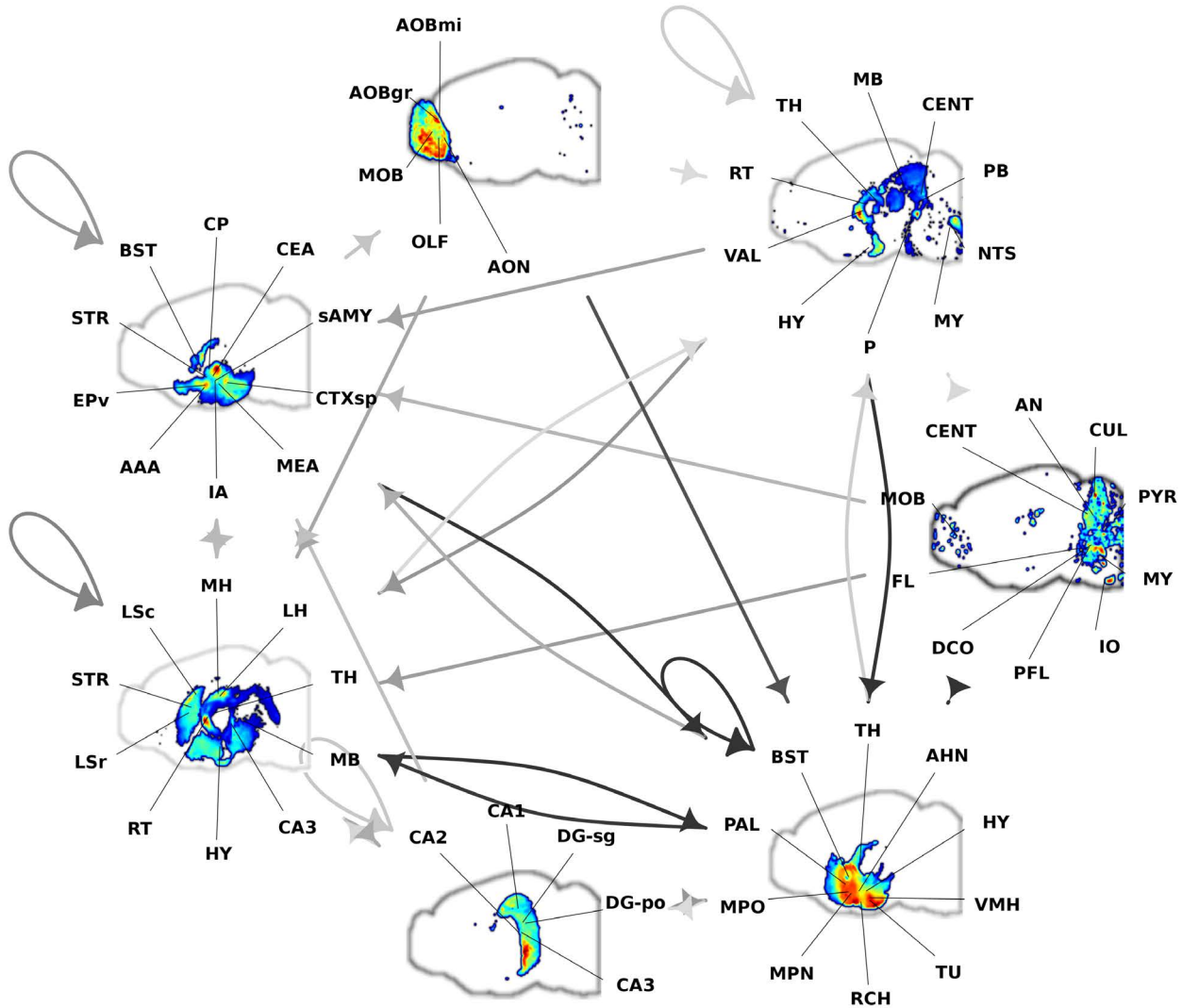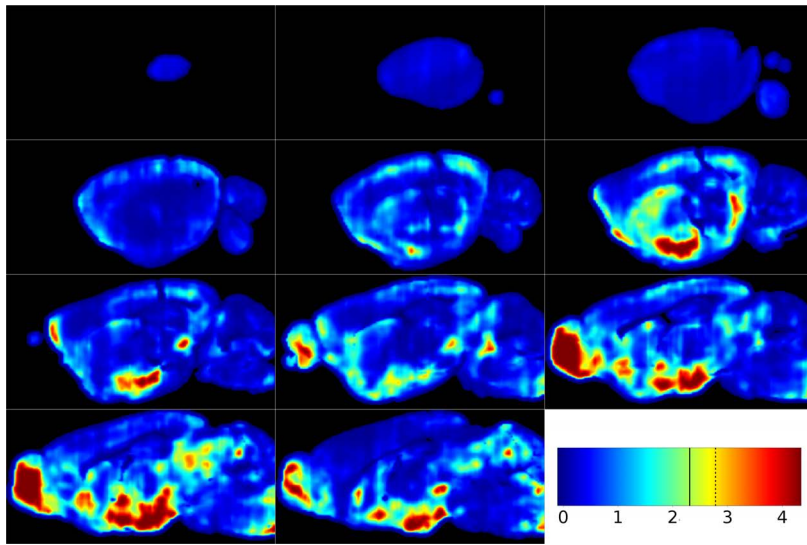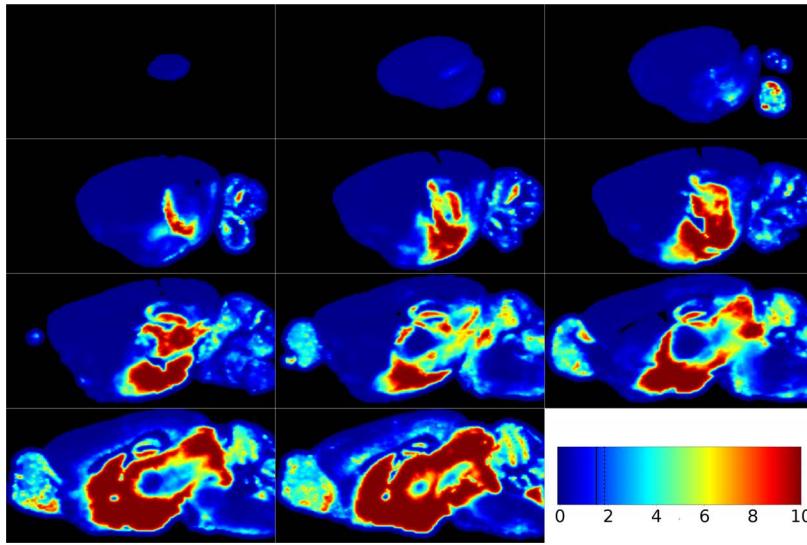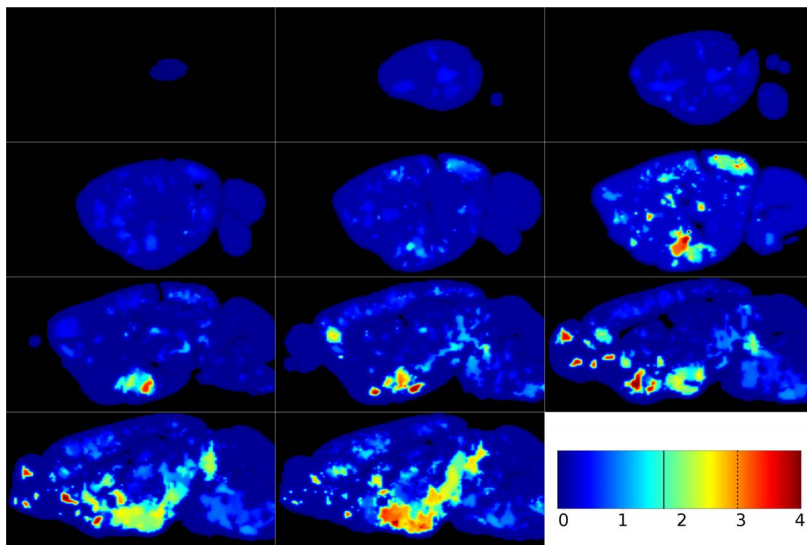
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Supplementary Data 3 Case 4. Feeding gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
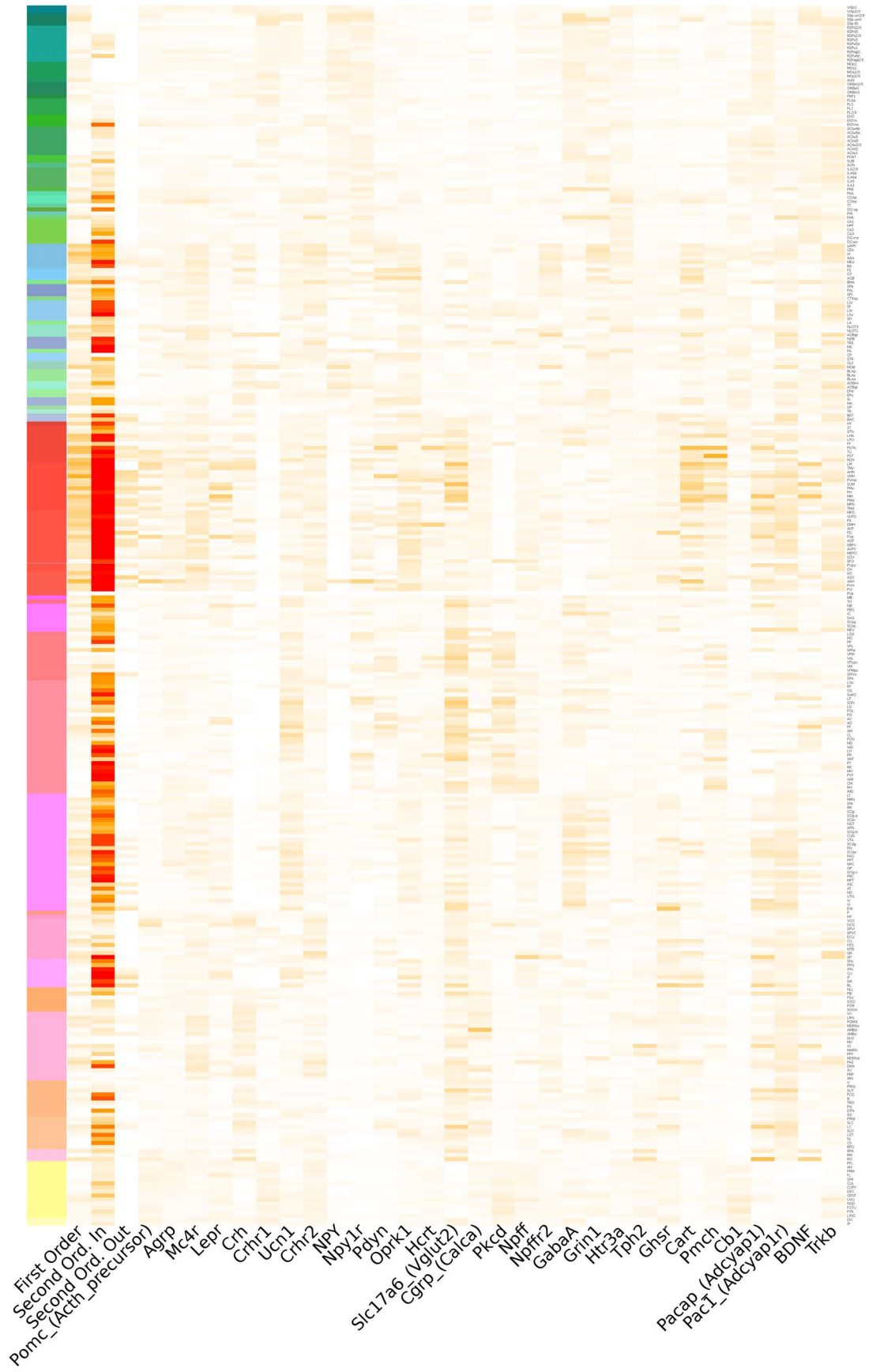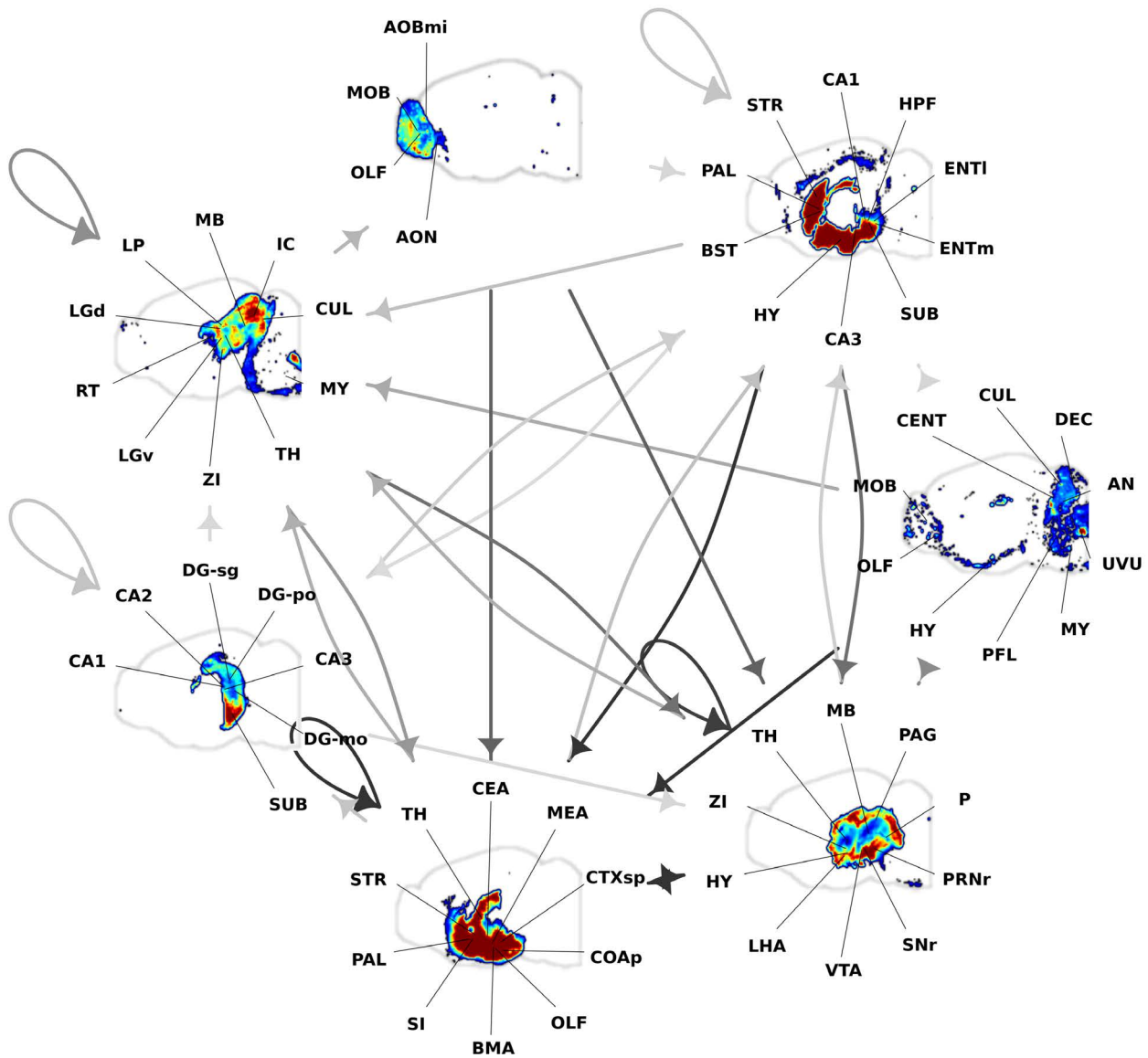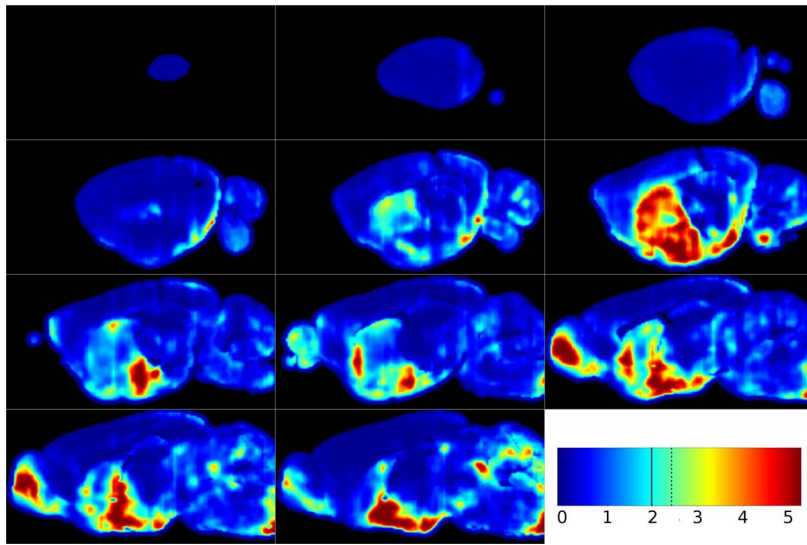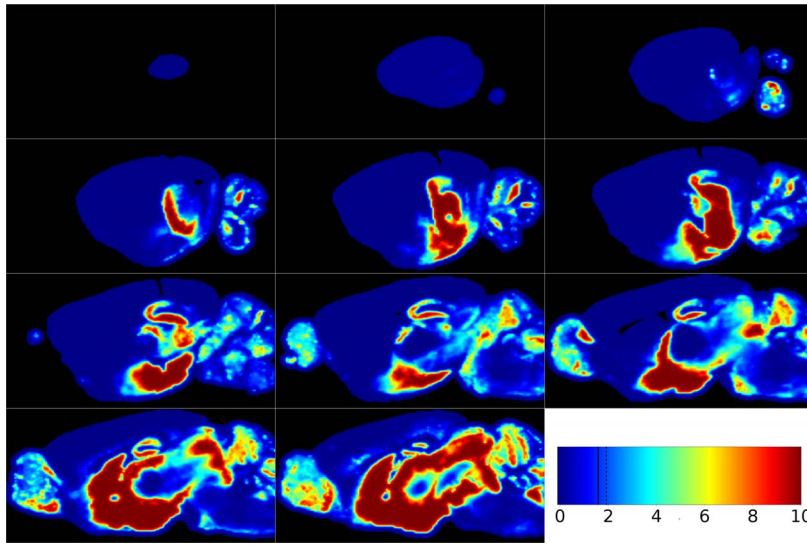
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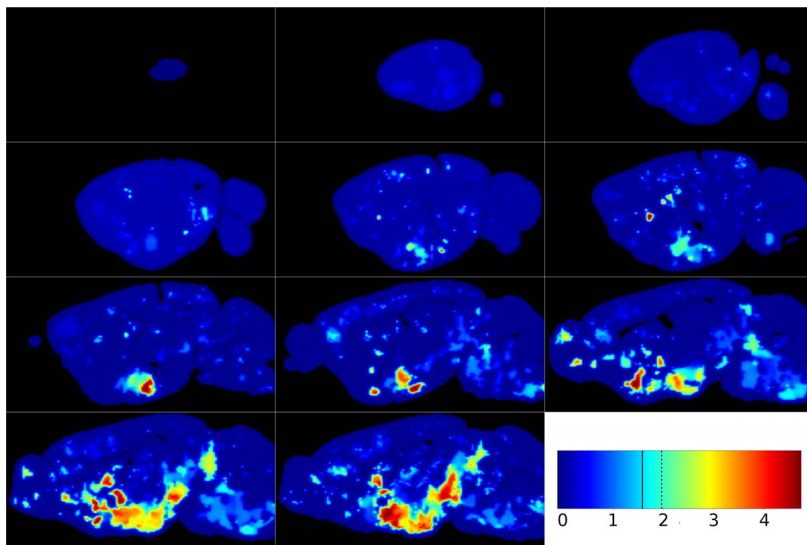
Supplementary Data 3 Case 5. HPA Axis Central Control gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
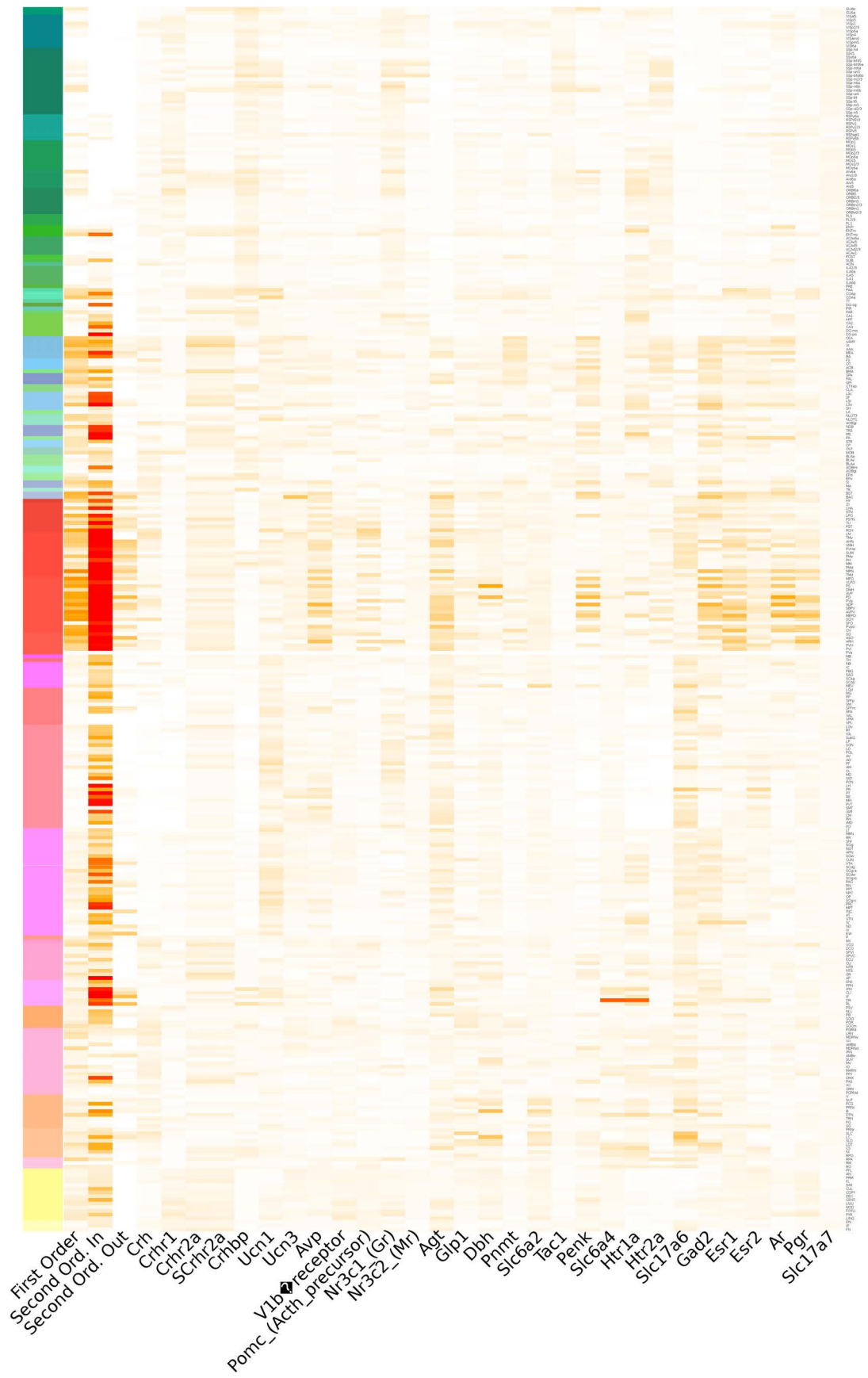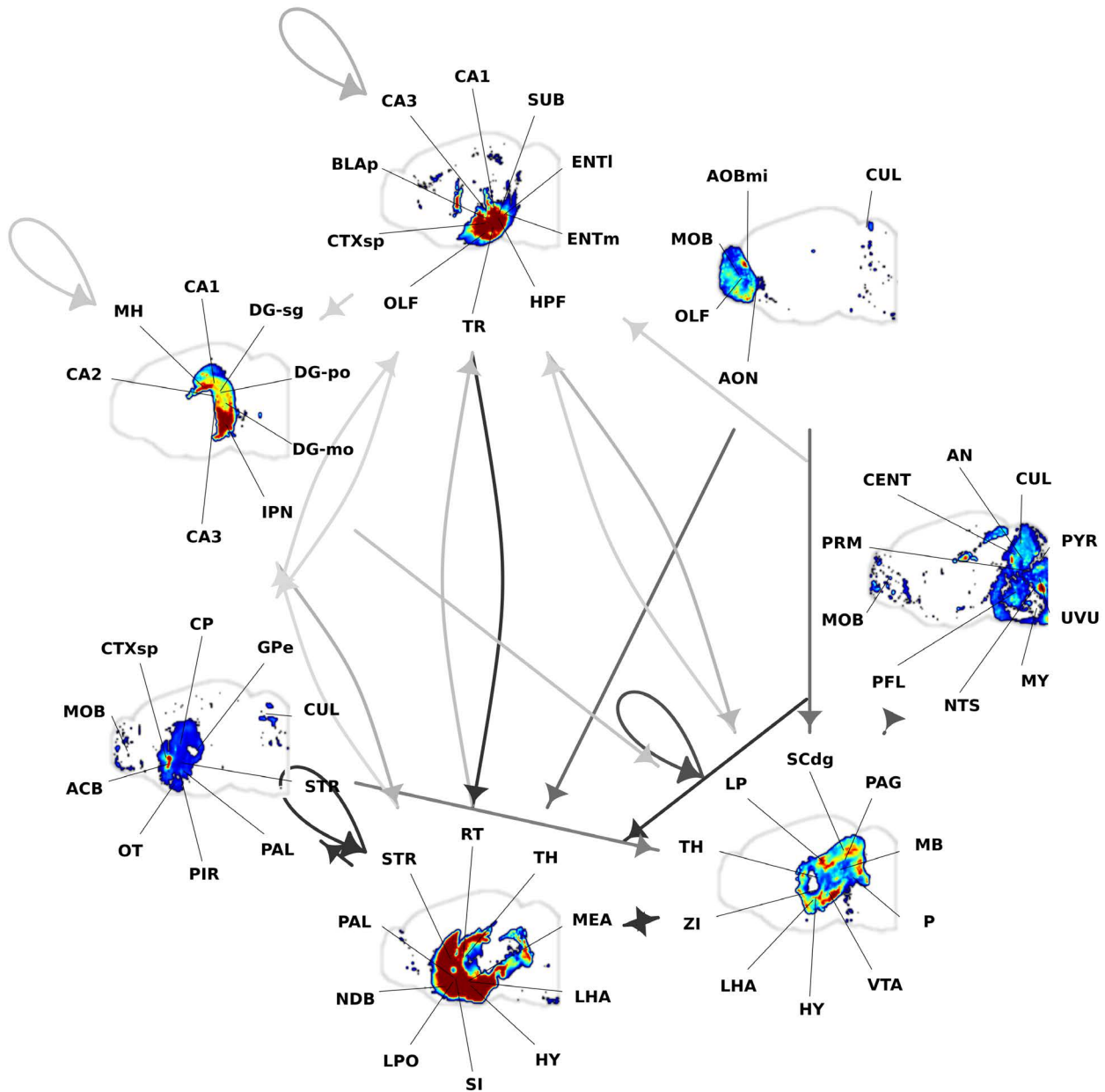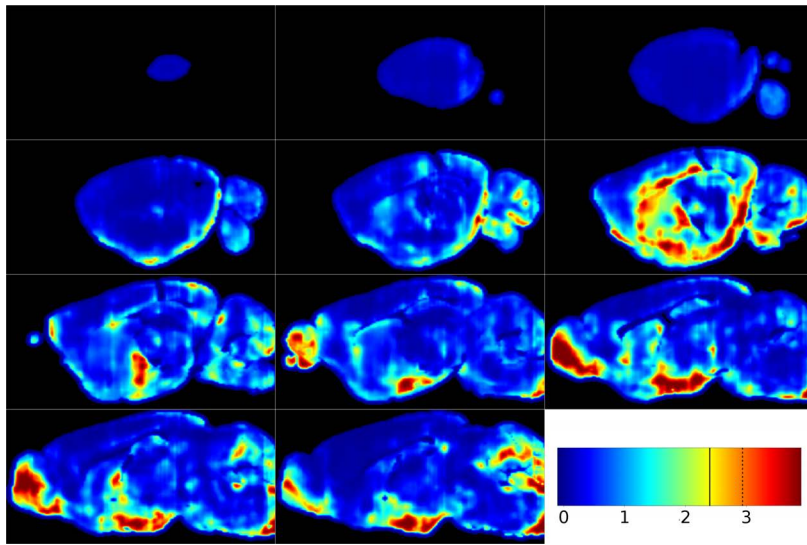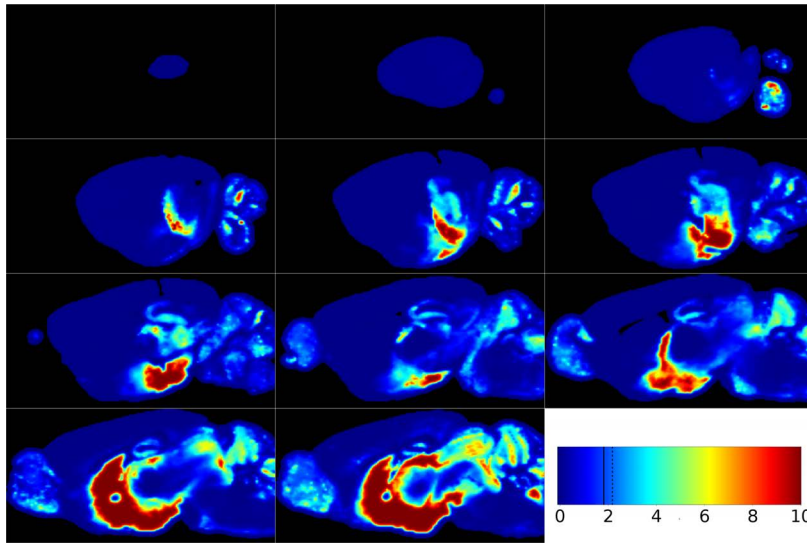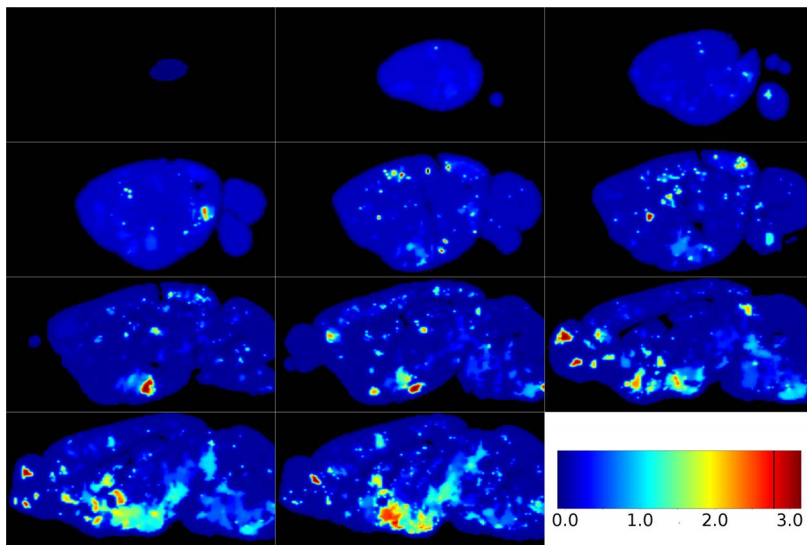
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Supplementary Data 3 Case 6. HPA Axis regulation gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
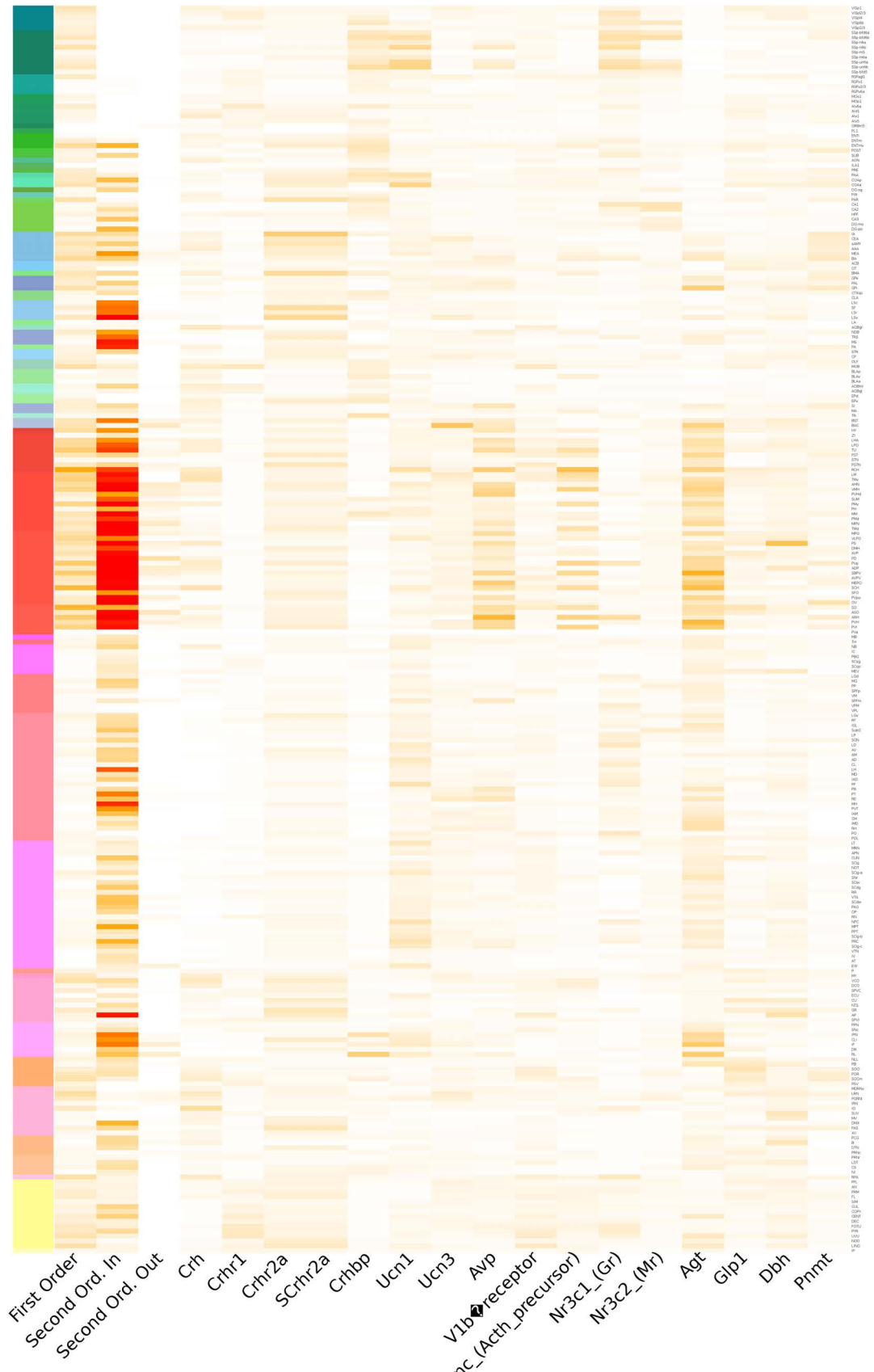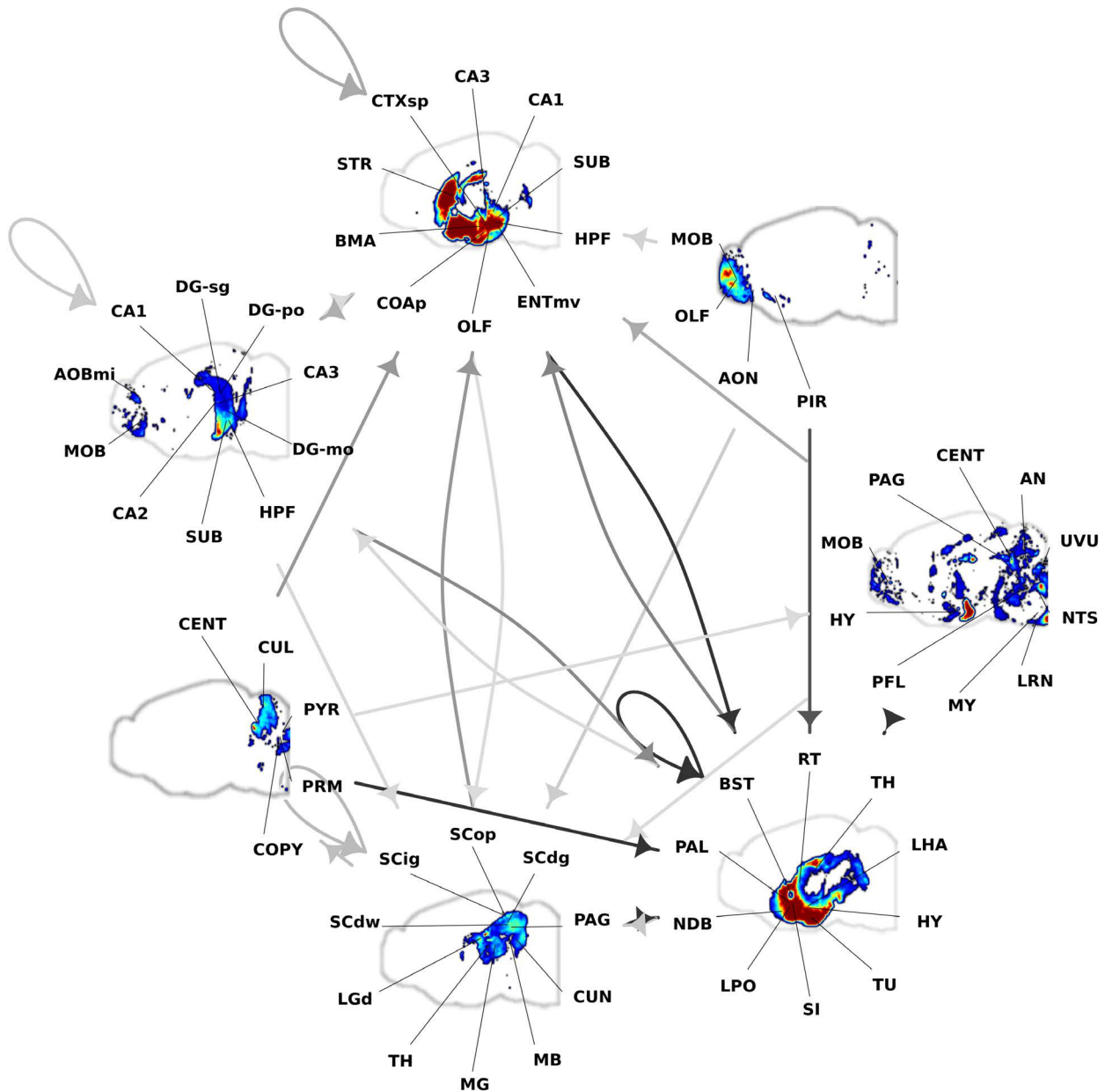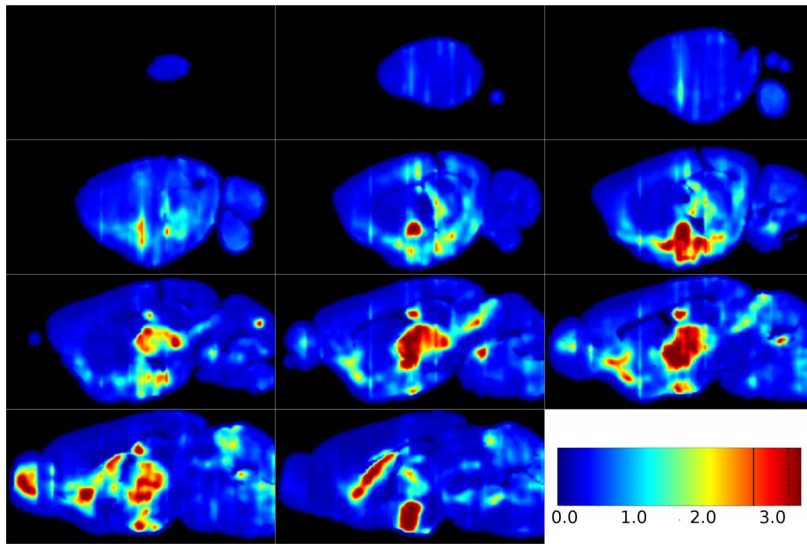
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Supplementary Data 3 Case 7. Hypothalamic Input to Central Amygdala gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
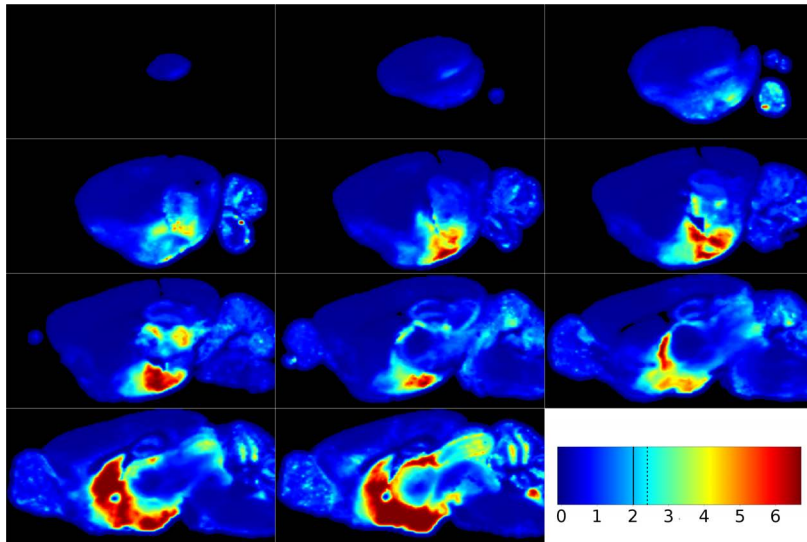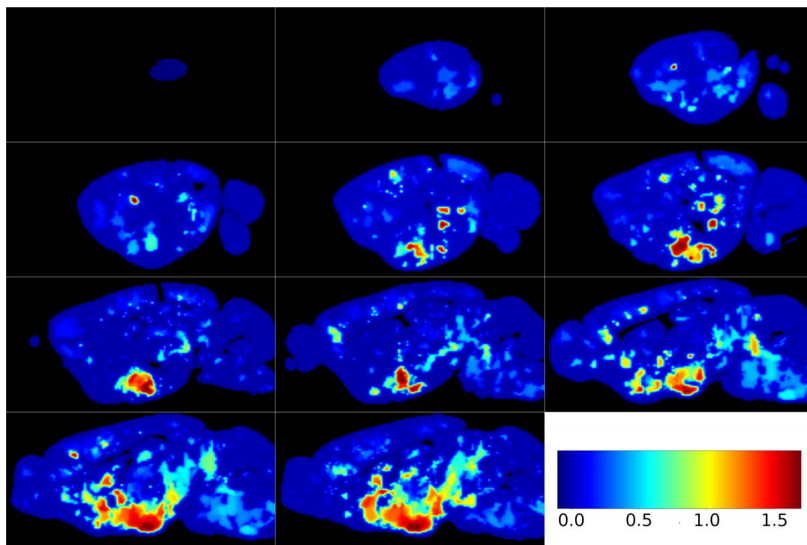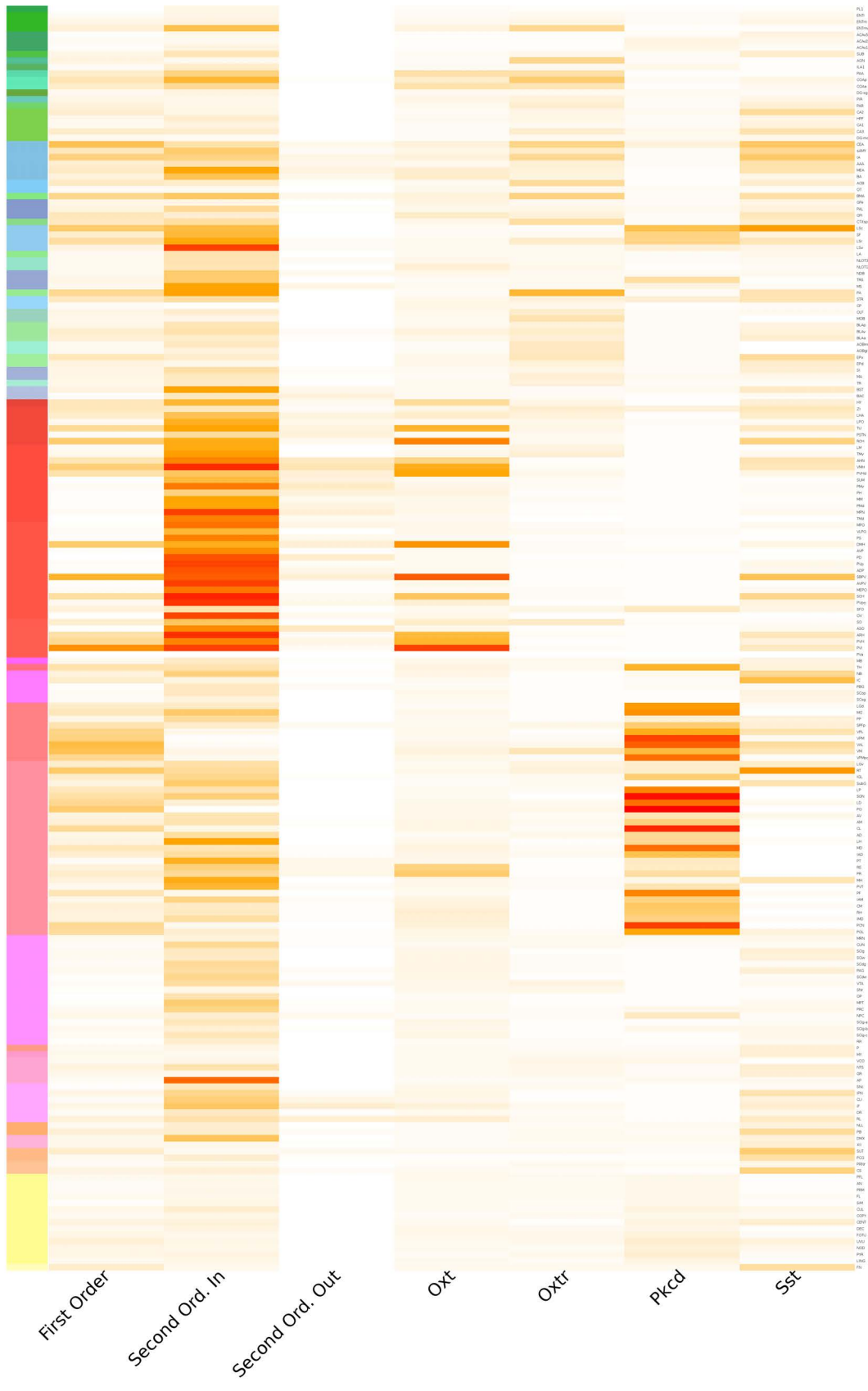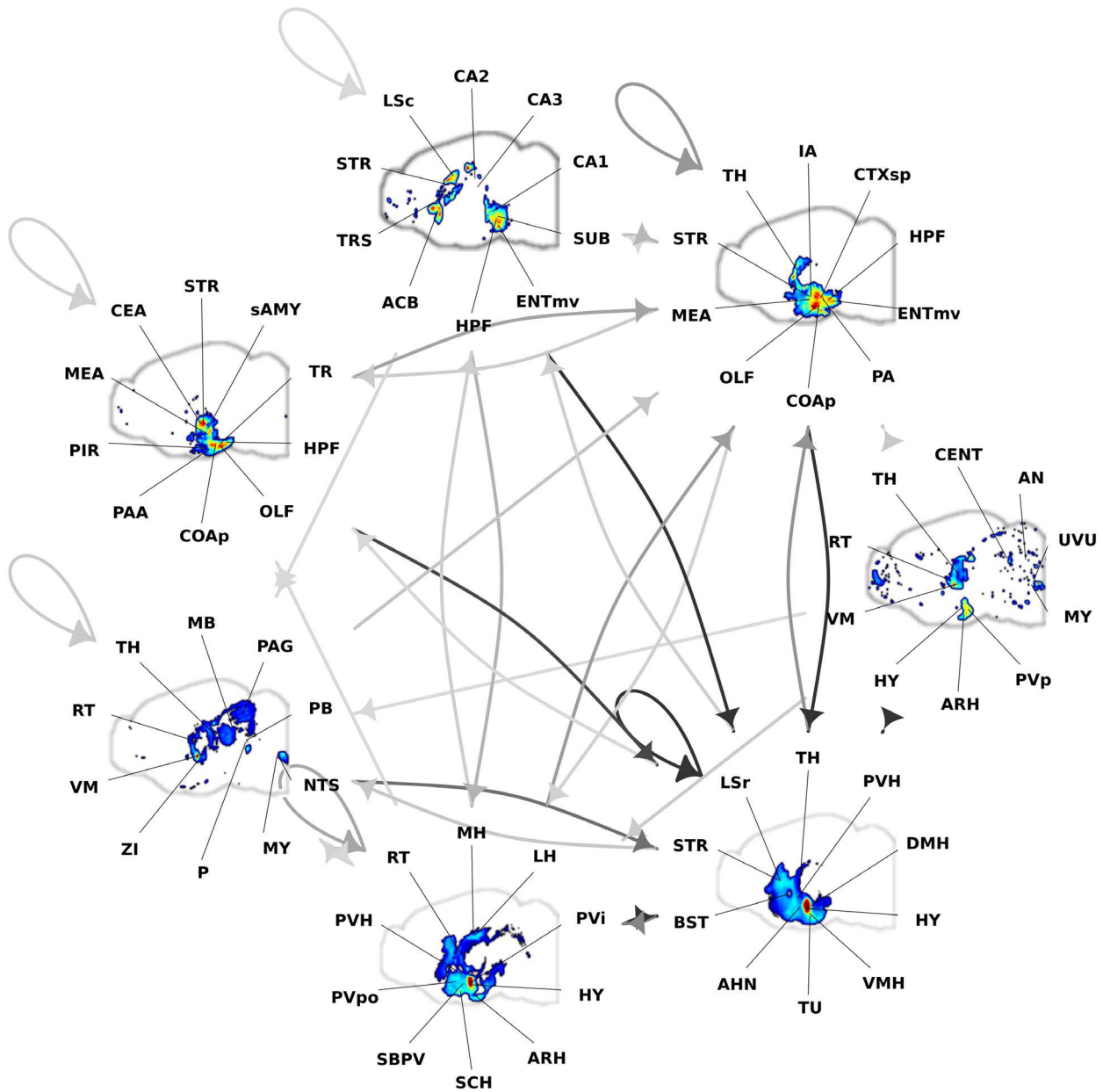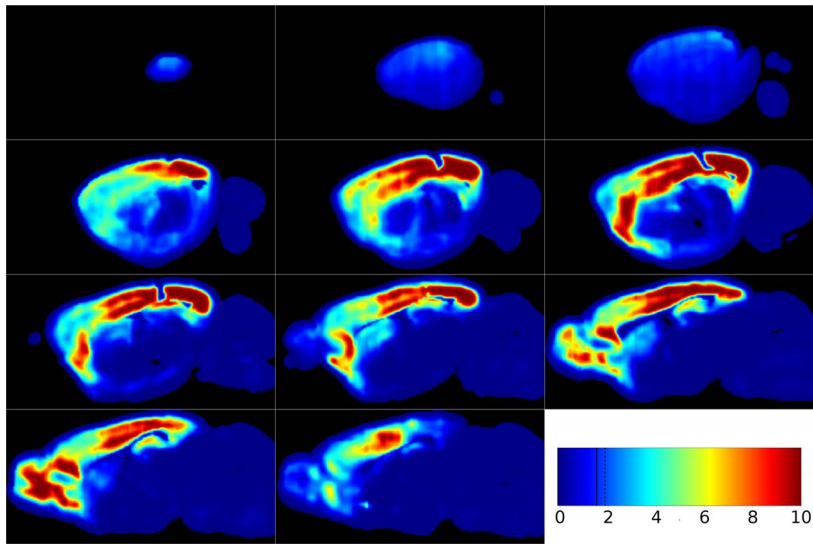
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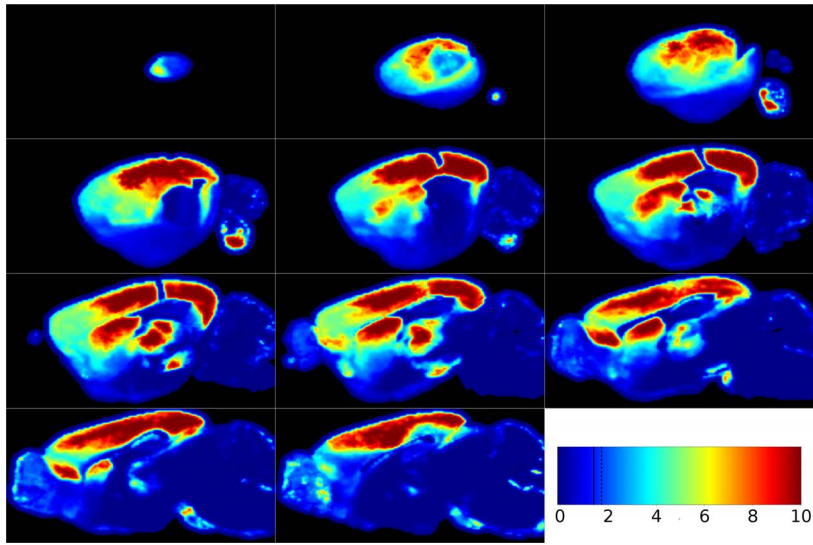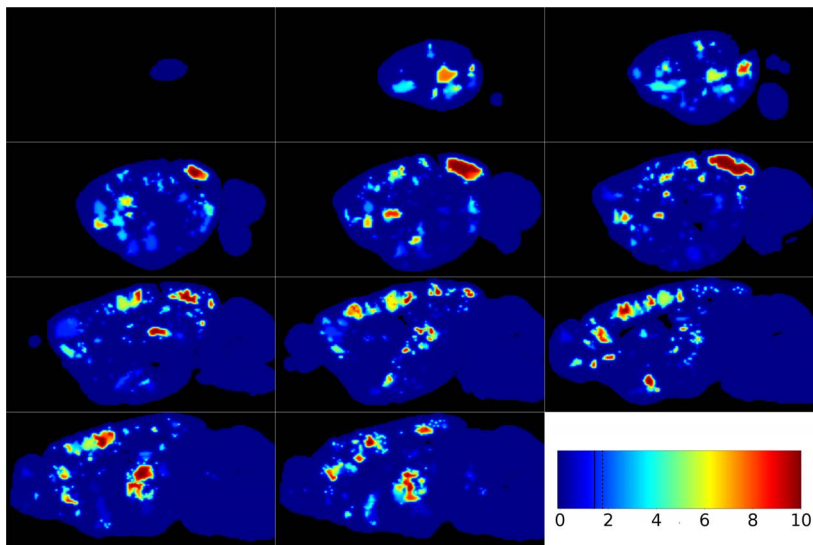
Supplementary Data 3 Case 8. Long Term Potentiation gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
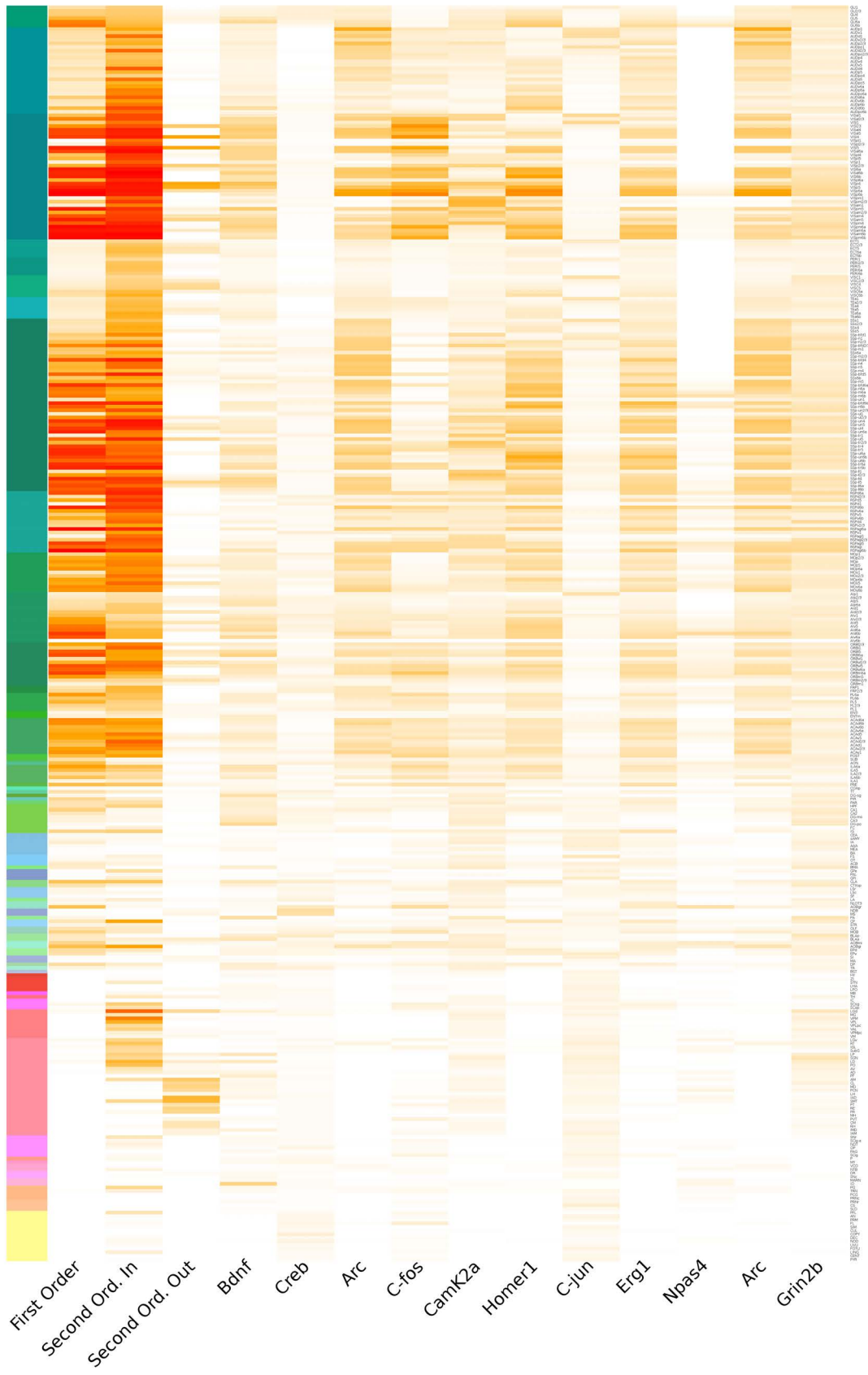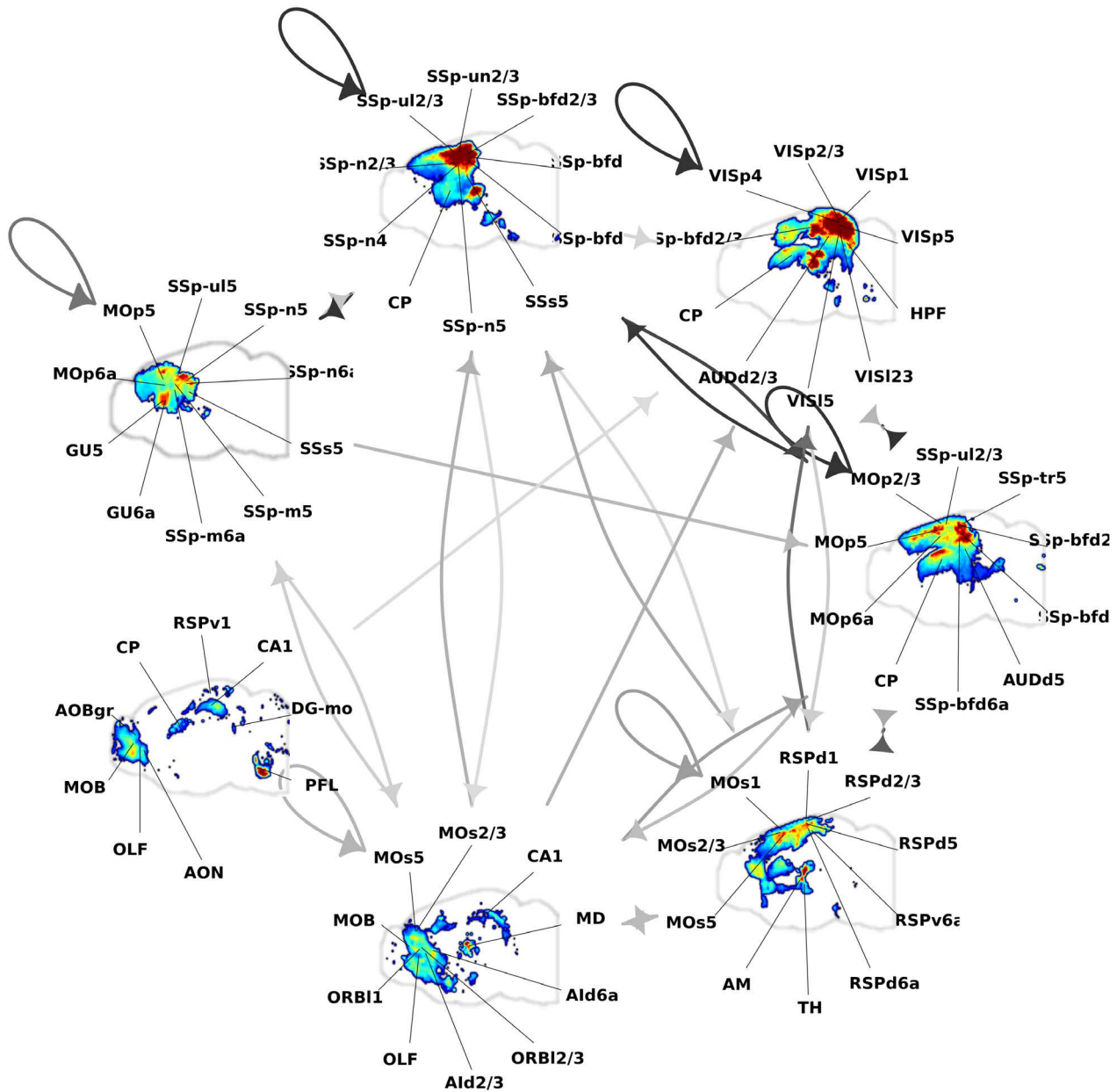
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Supplementary Data 3 Case 9. Social behavior gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
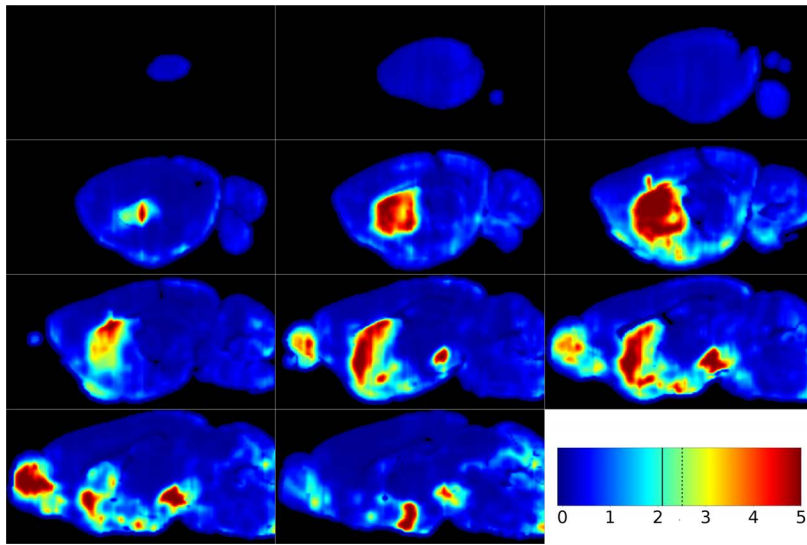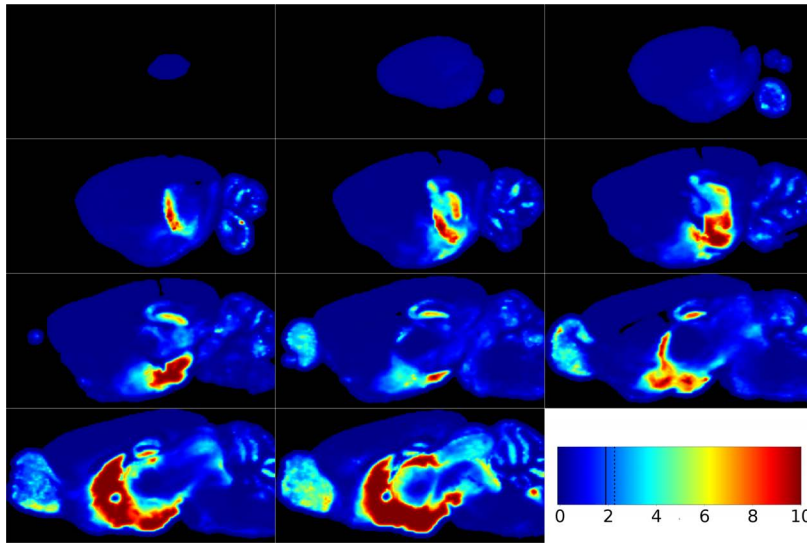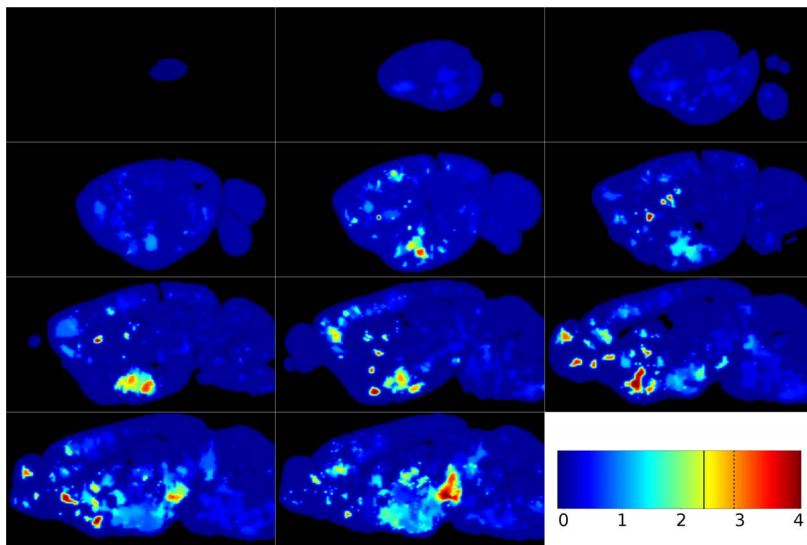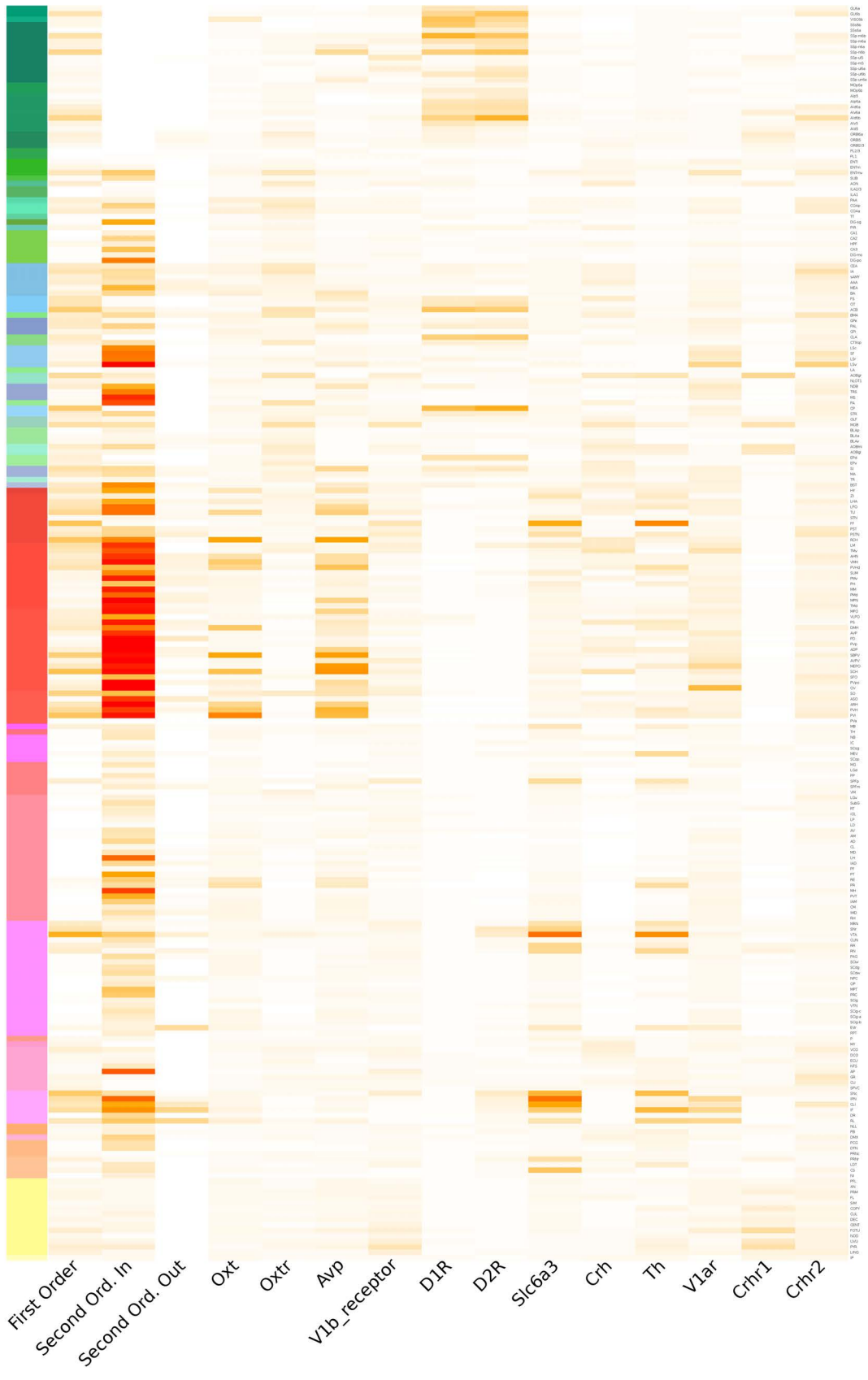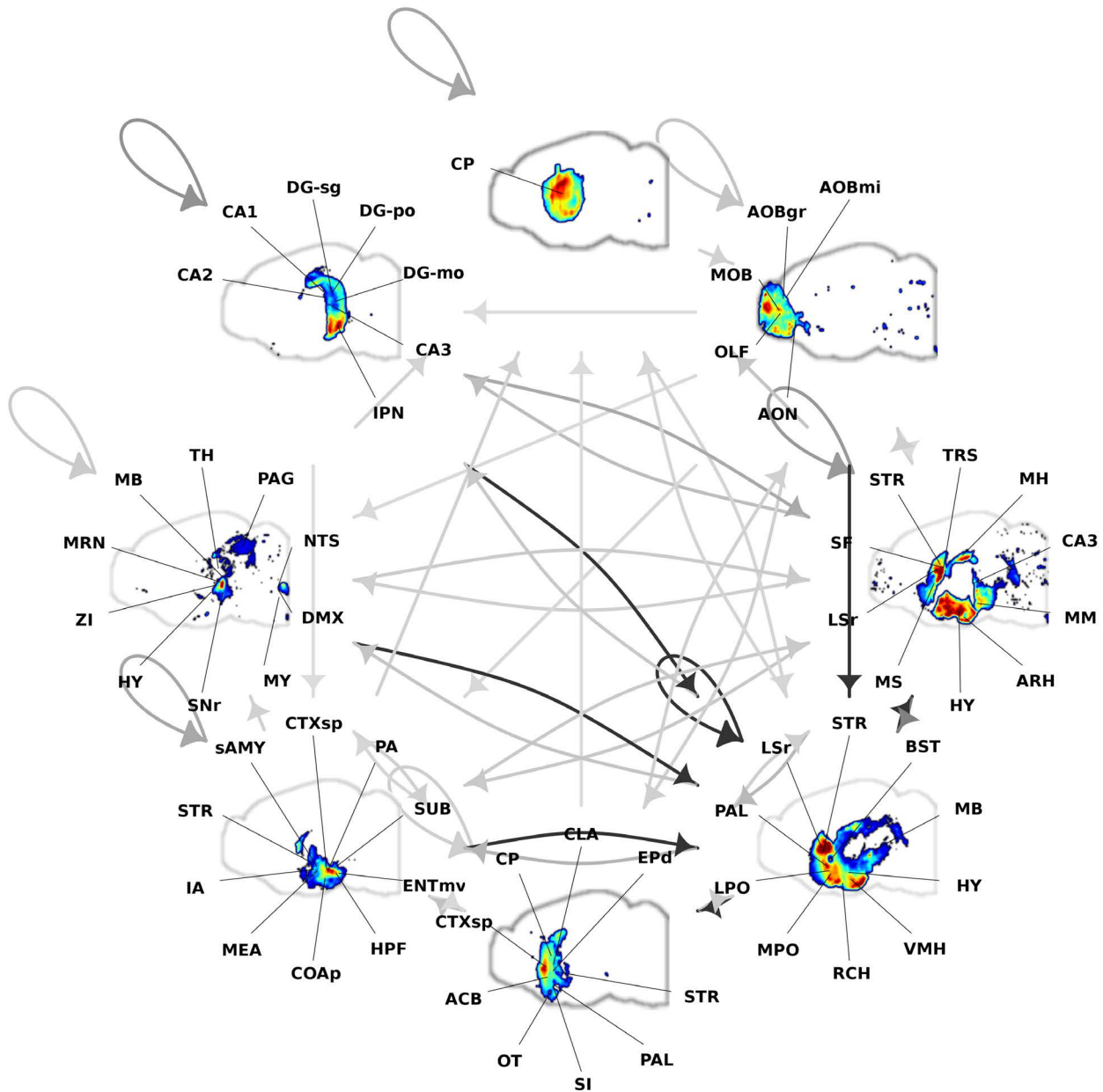
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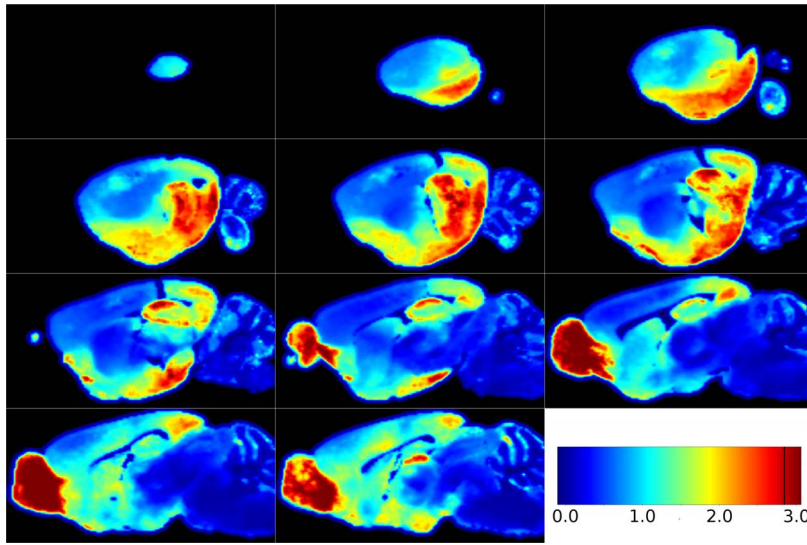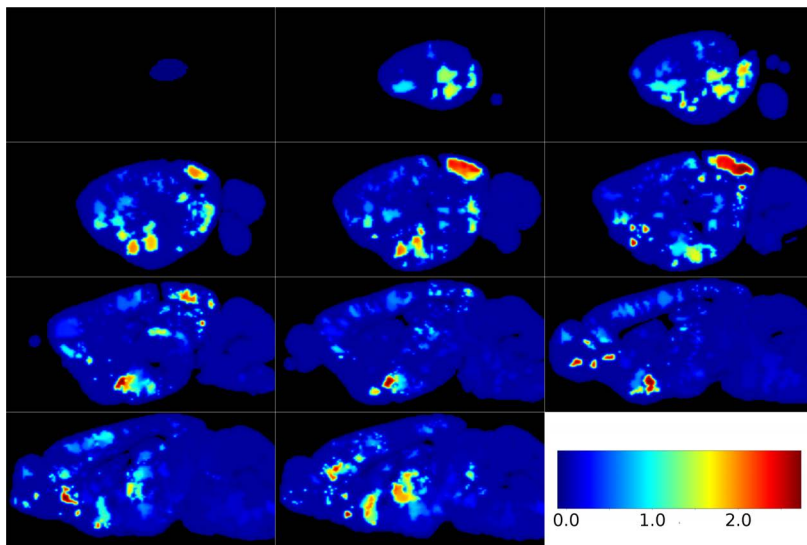
Supplementary Data 3 Case 10. Synaptic plasticity genes after fear learning gene-set from literature research. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
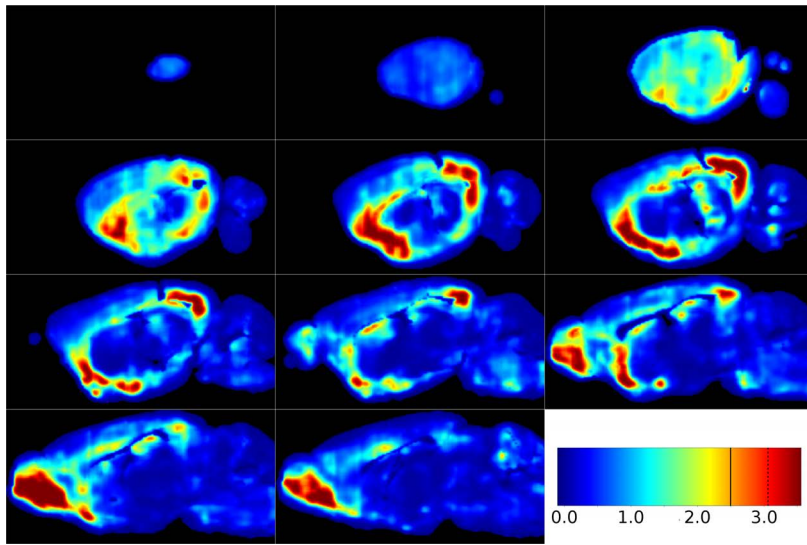
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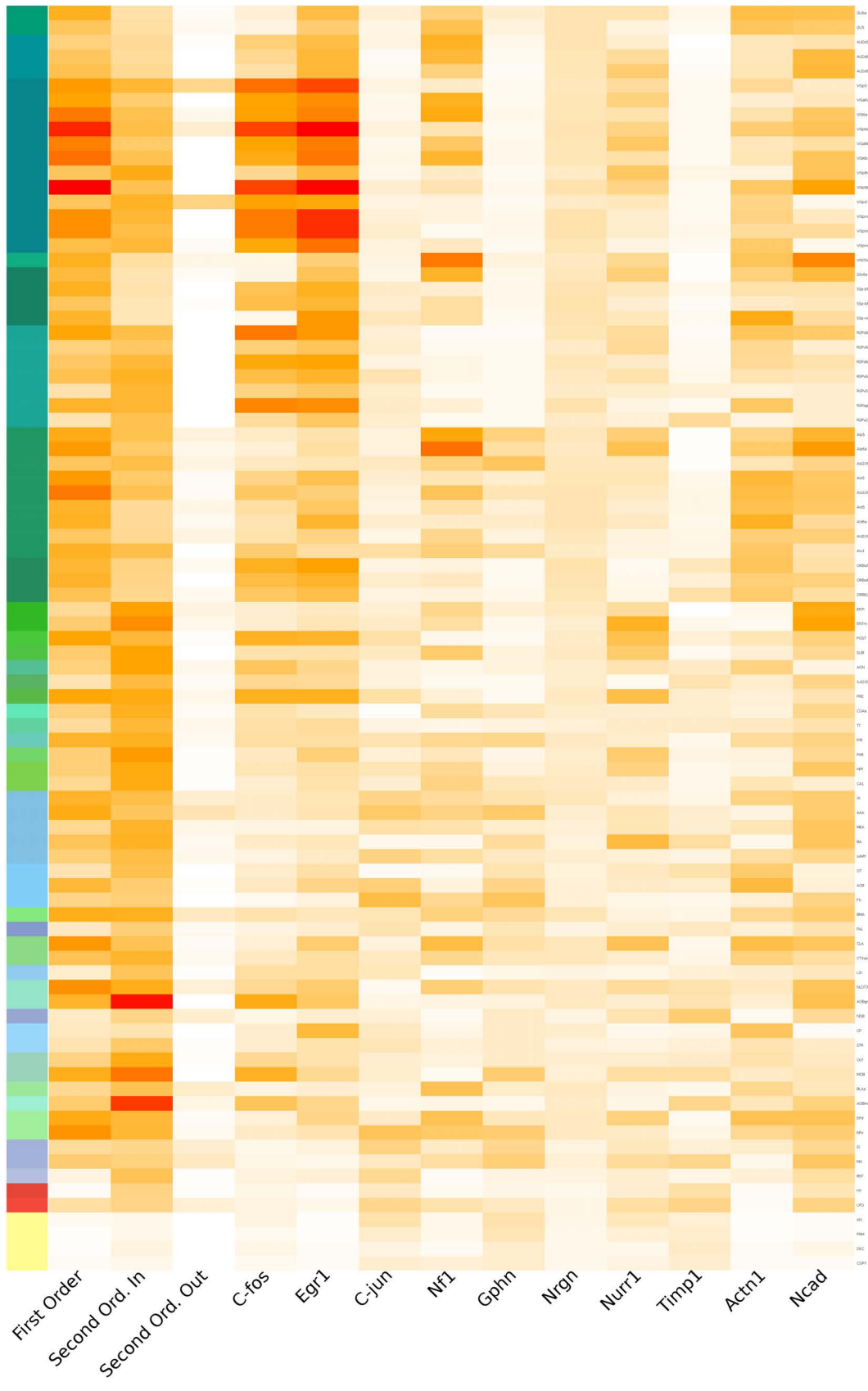**Supplementary Data 3 Case 11. Cacna2d3 gene**. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (norma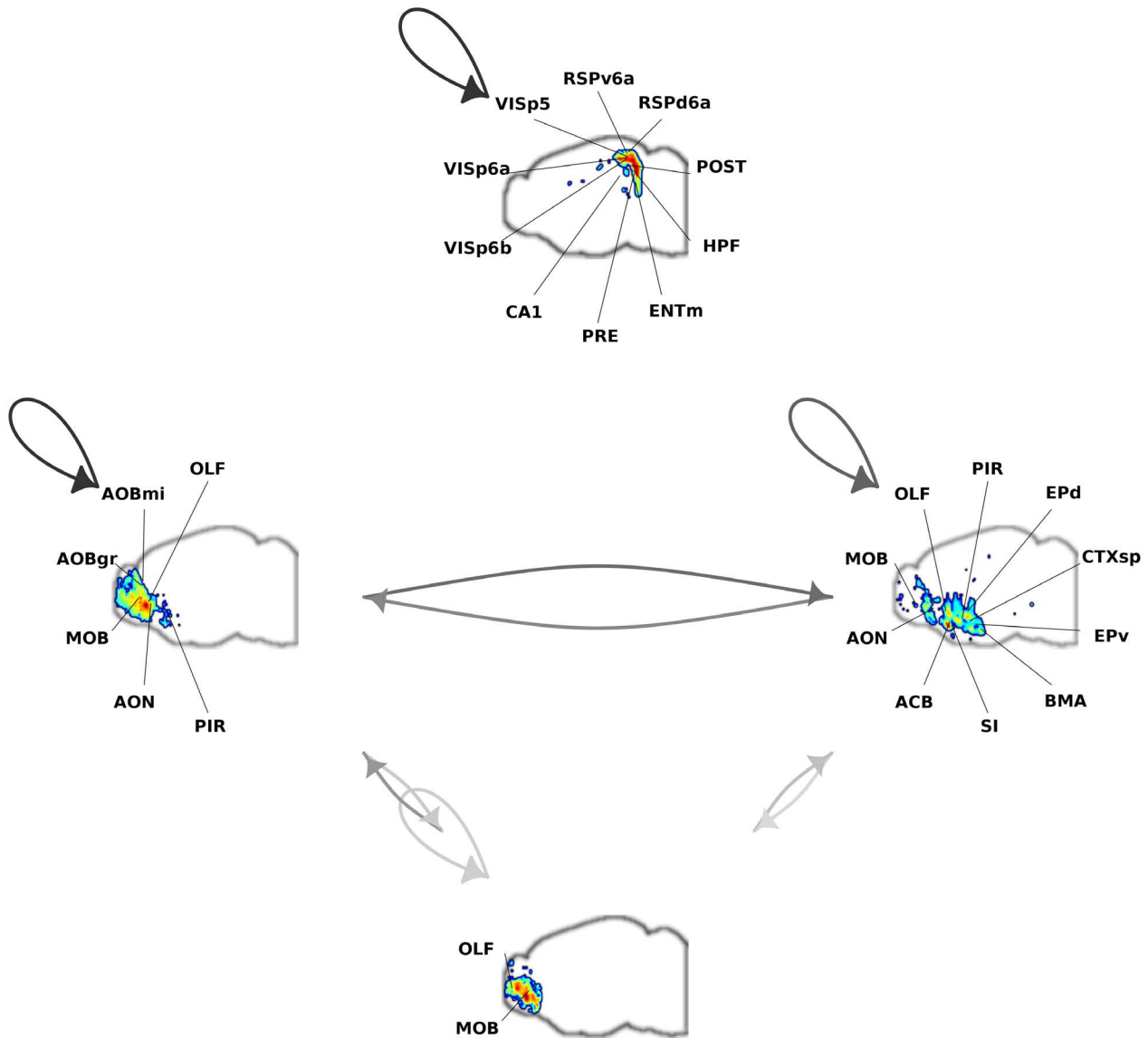l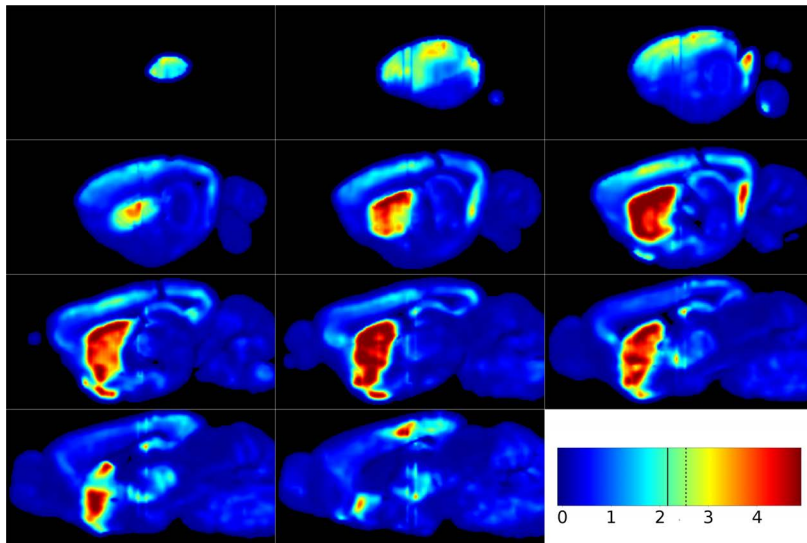ized by the injection volume) given as grey-scale arrows. Red arrows mark selected connections, discussed in the main text.

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Supplementary Data 3 Case 12. Nociception(up-regulated) gene-set of pain QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
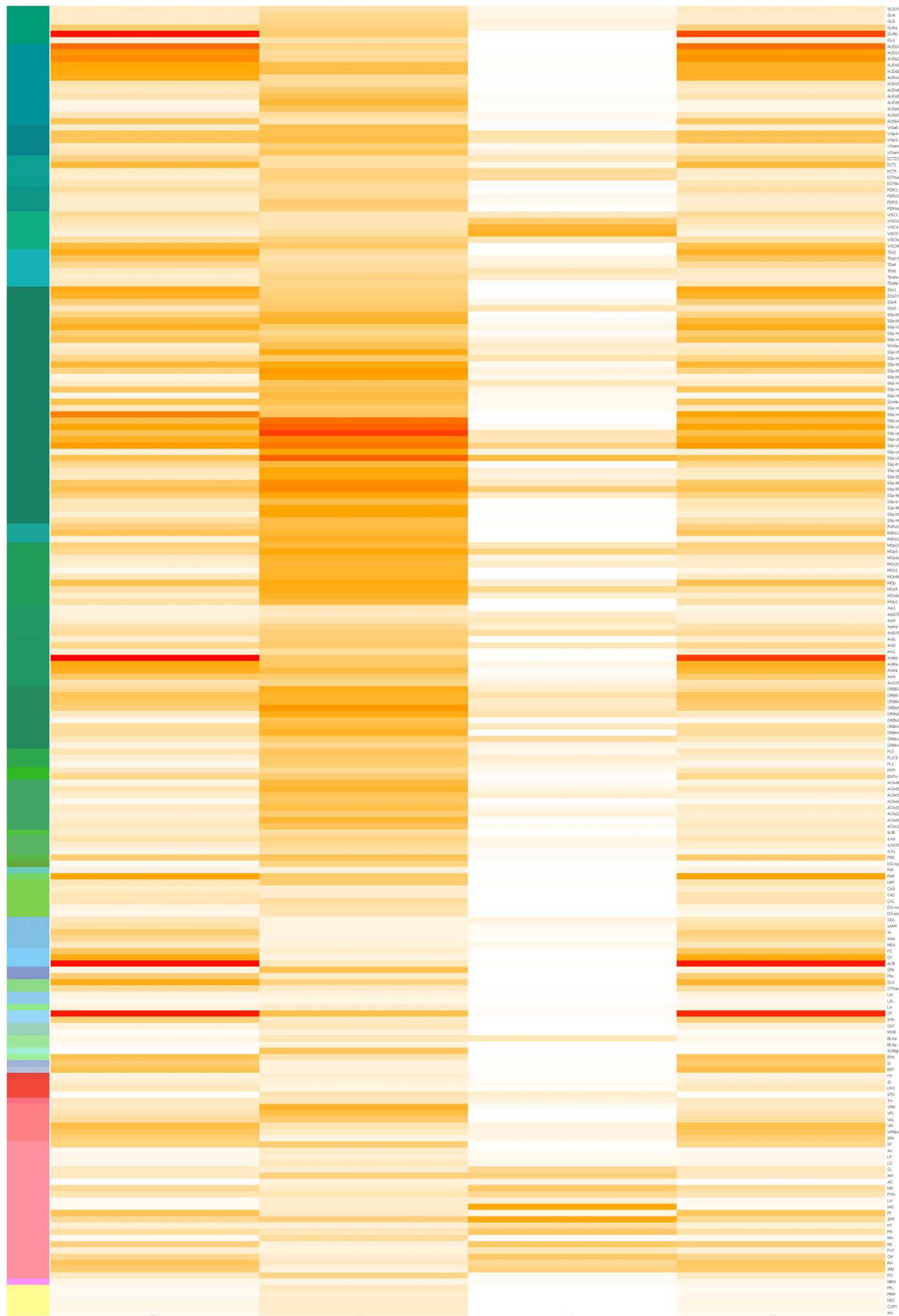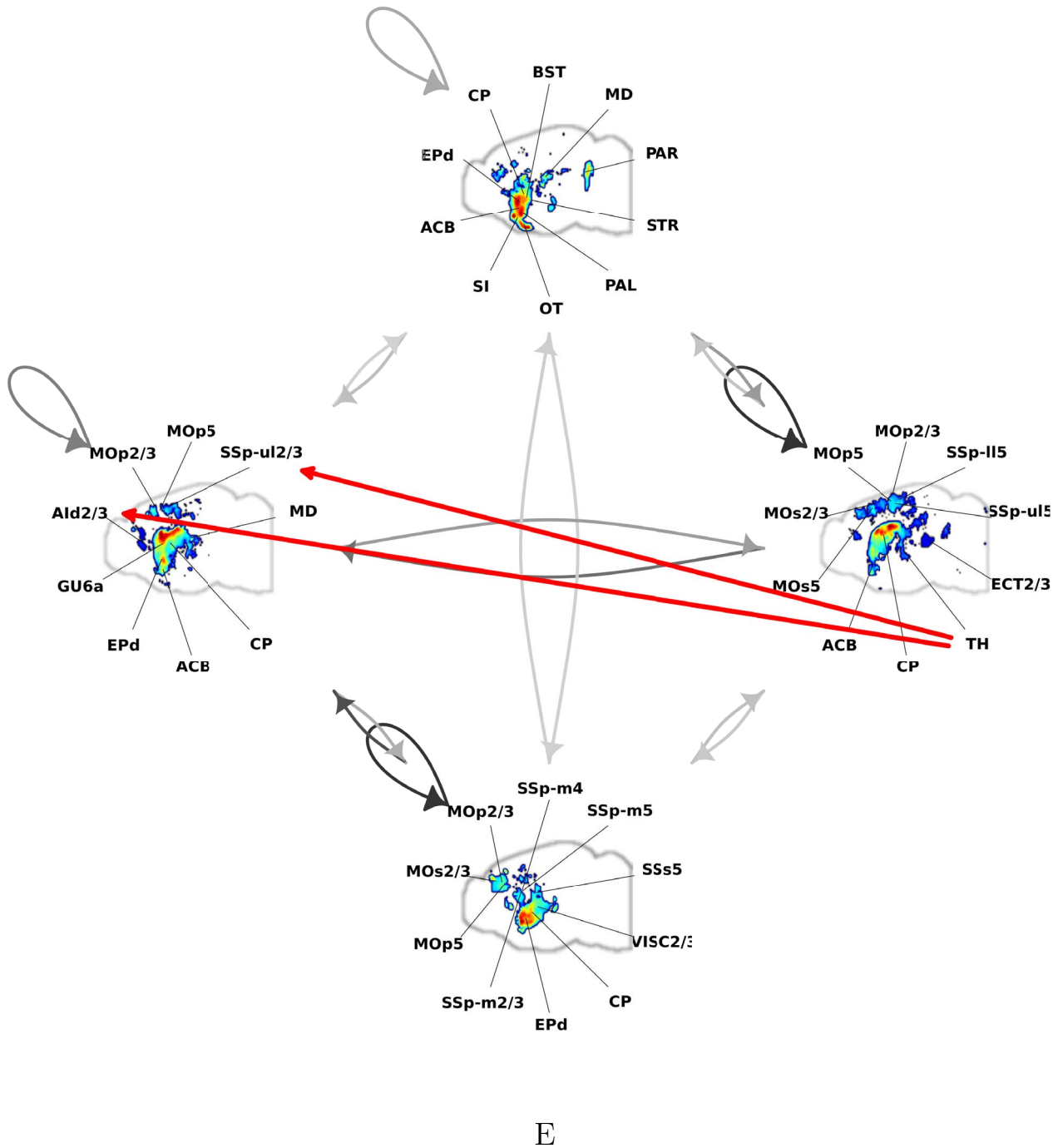
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Supplementary Data 3 Case 13. Analgesia (up-regulated) gene-set of pain QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.

A

B

C

0 -log10(pvalue) 10

First Order
Second Ord. In
Second Ord. Out
Adora1
Adrbk1
Cd274
Chrmb2
Cnr2
F2r
Fam16a4
Frmpd4
Galr1
Glra2
Gpr3
Gria2
Grin2b
Grk6
Grn
Hcrt
Hdc
Kcna1
Kcnk2
Kcnl1
Lrp1
Mme
Nedd4l
Npy
Npy1r
Nt5e
Oprd1
Oprk1
P2rx3
Plcl1
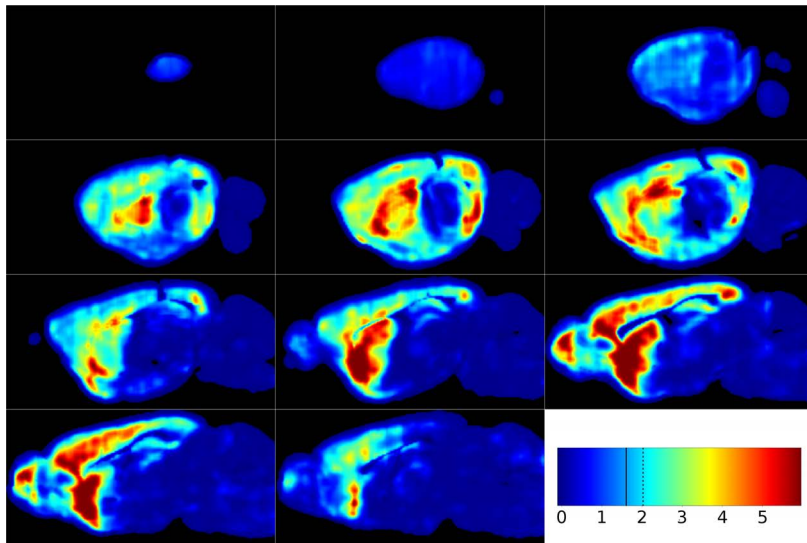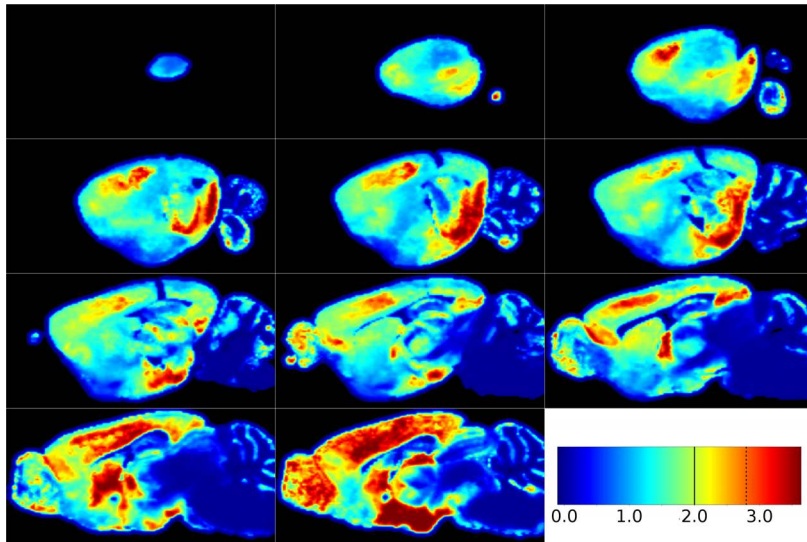Ppara
Prkaa2
Prkca
Serpina3n
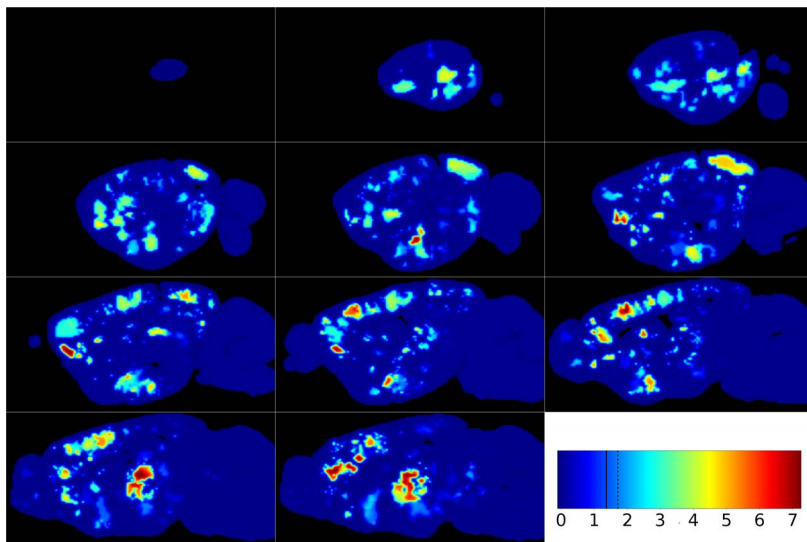Sesn2
Sqdz
Sstr4
Vip

D

E

Supplementary Data 3 Case 14. Hypersensitivity (up-regulated) gene-set of pain QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
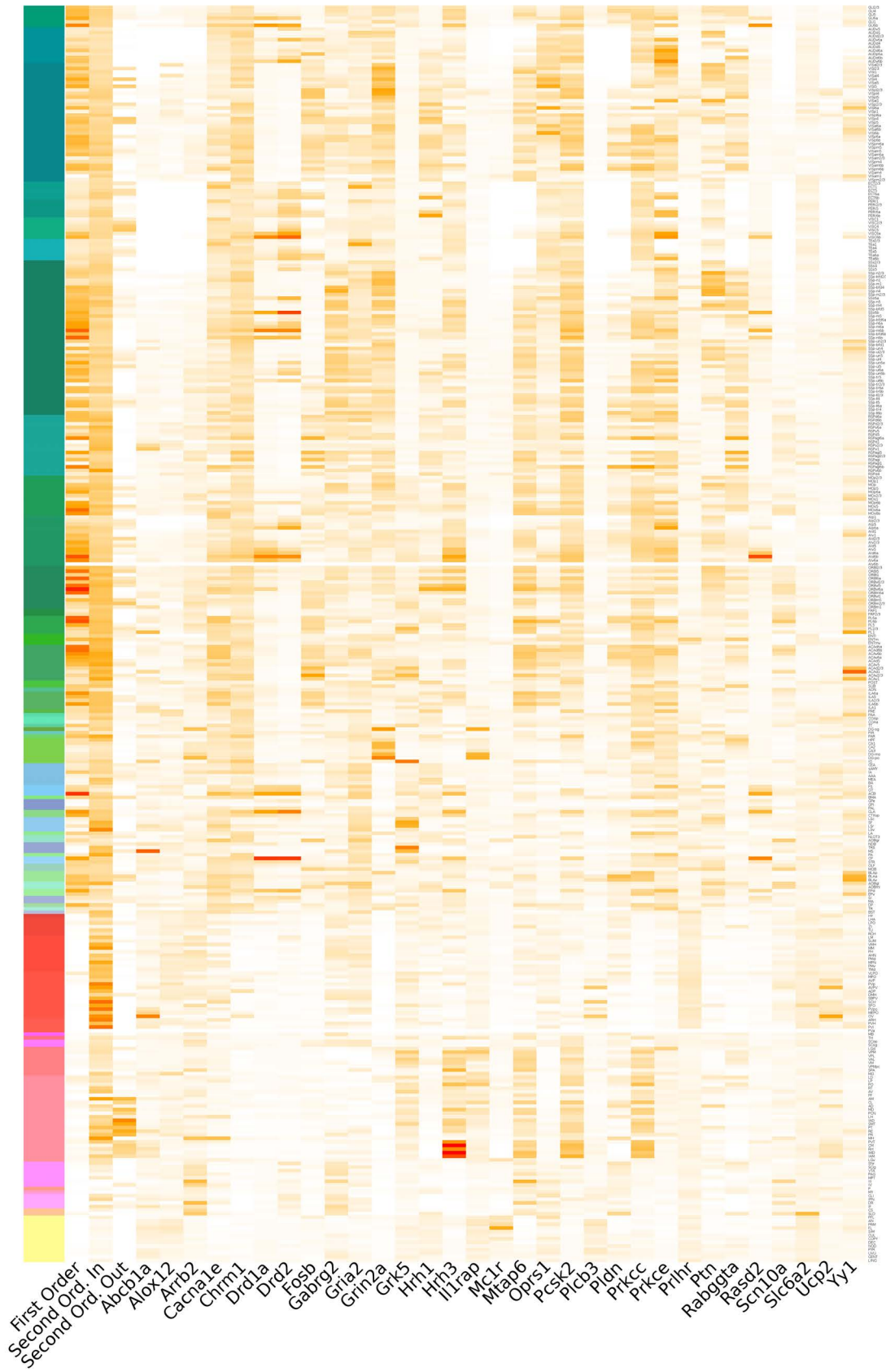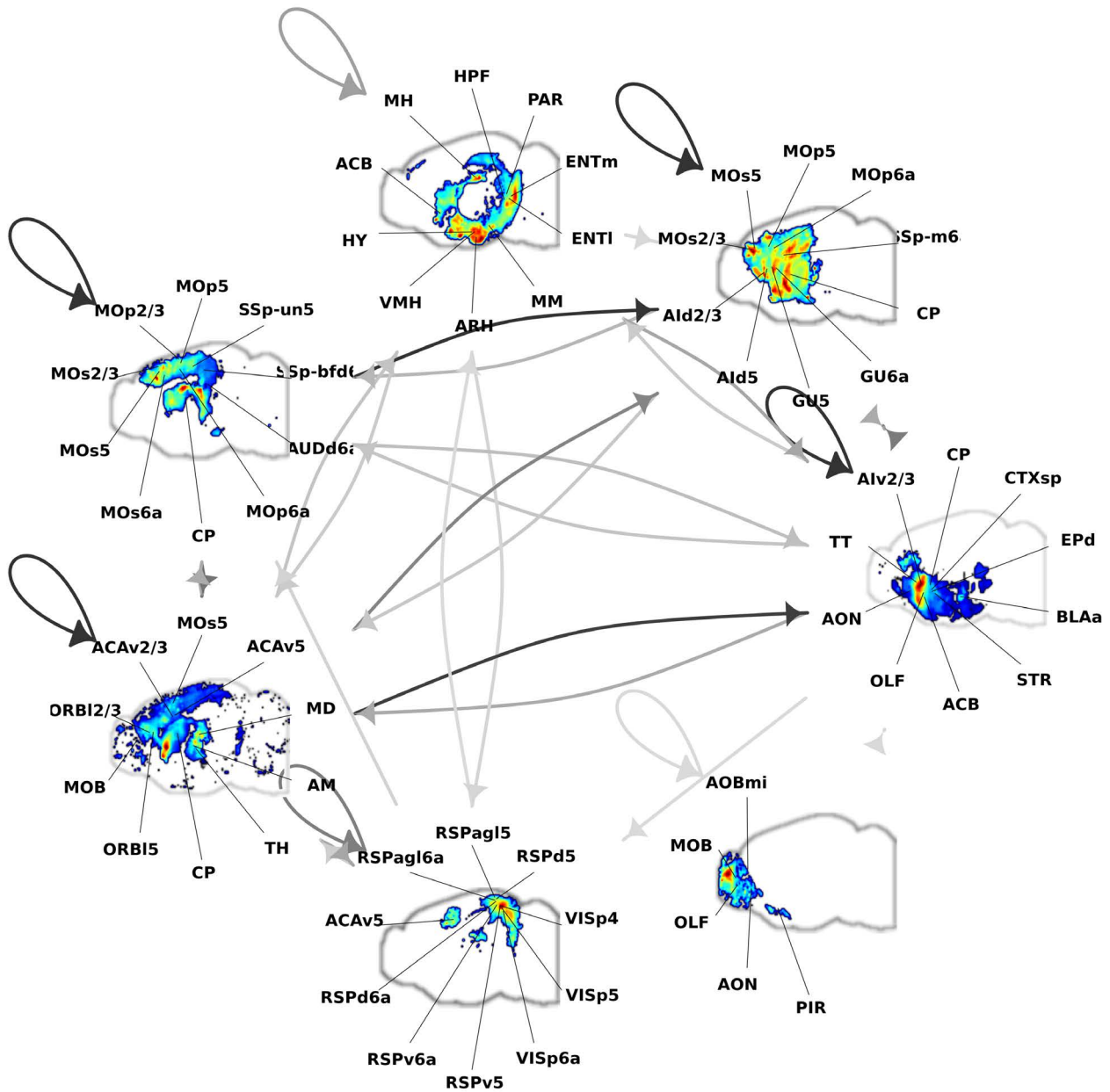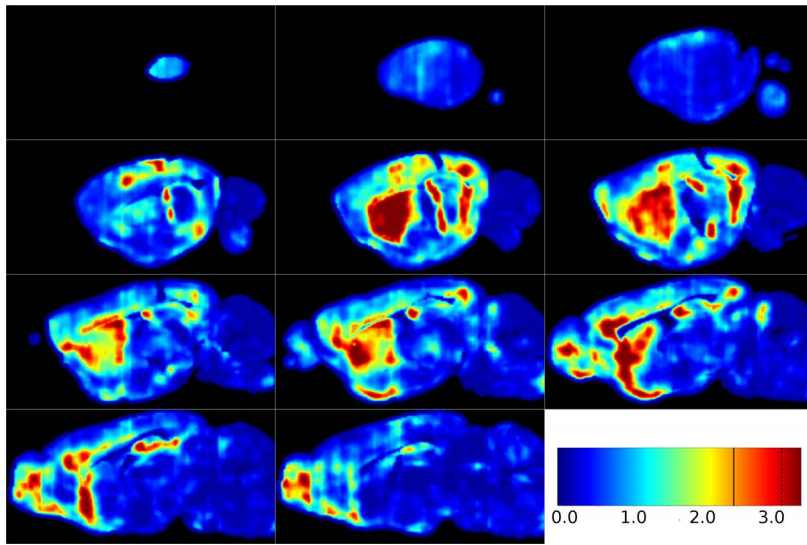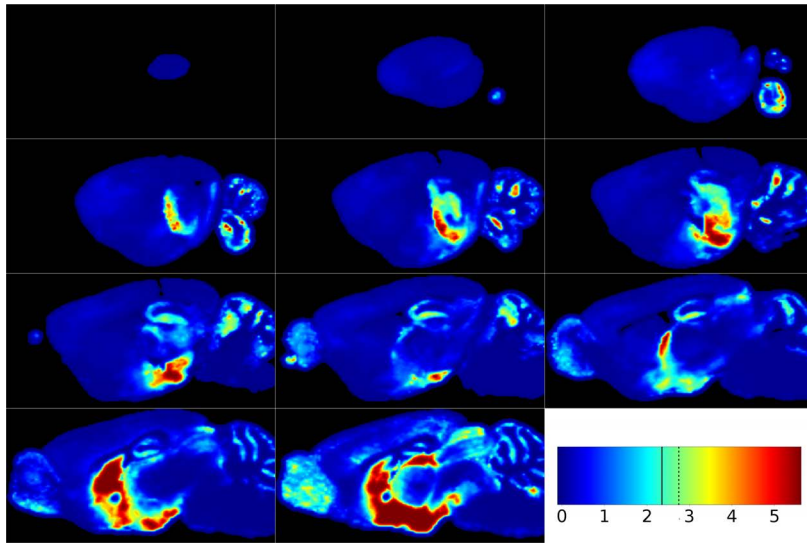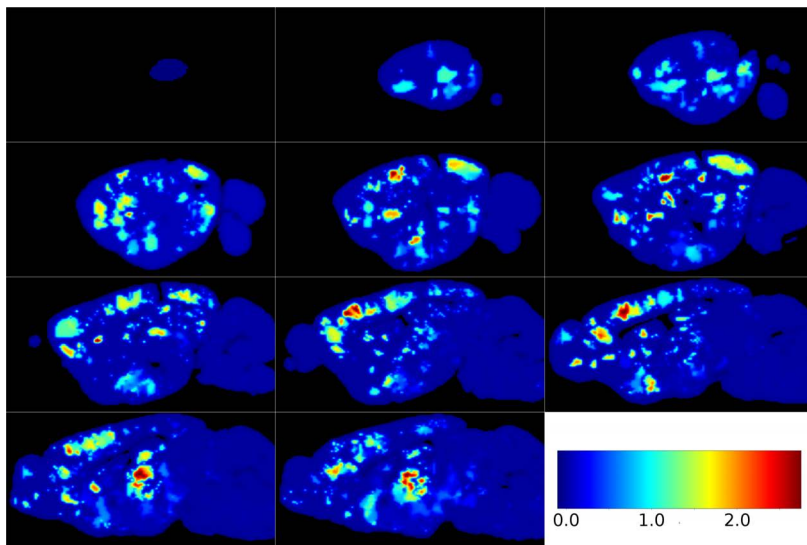
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Supplementary Data 3 Case 15. Calcium signaling gene-set of pain QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
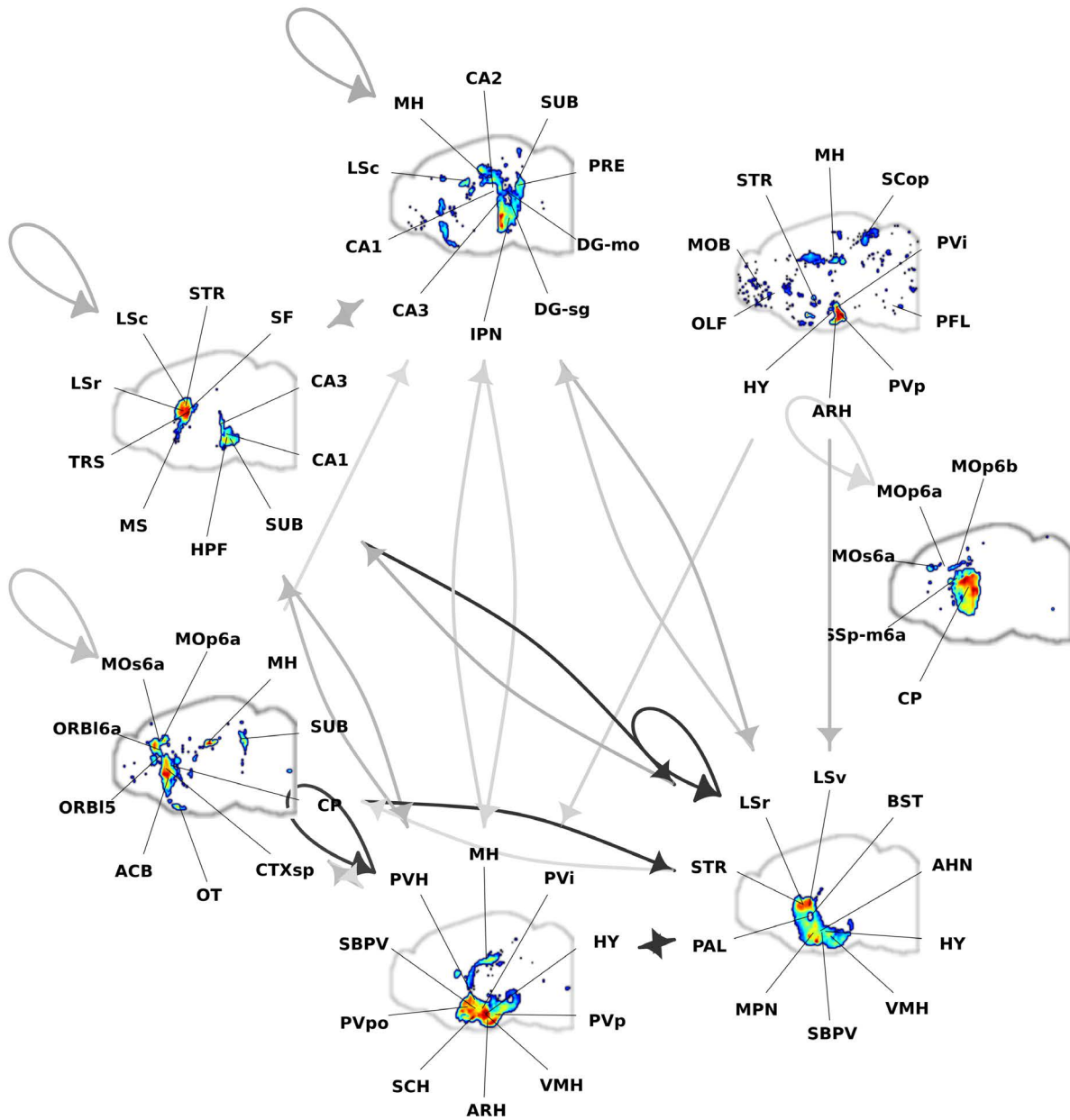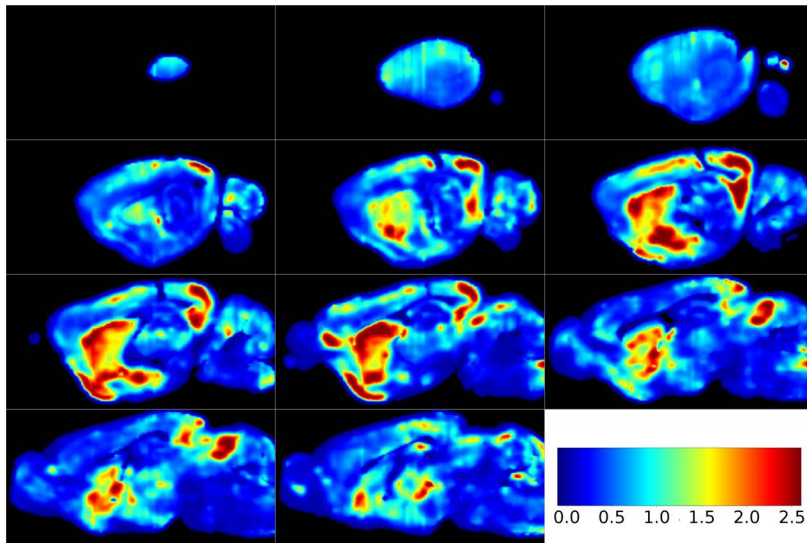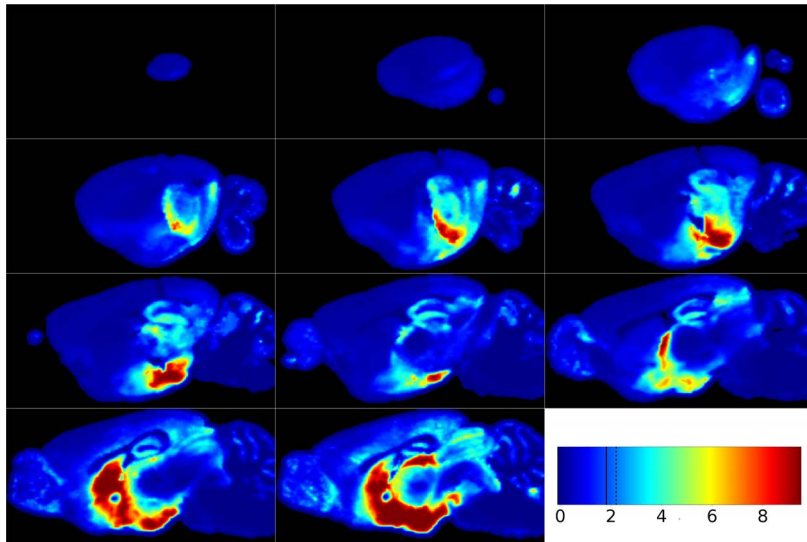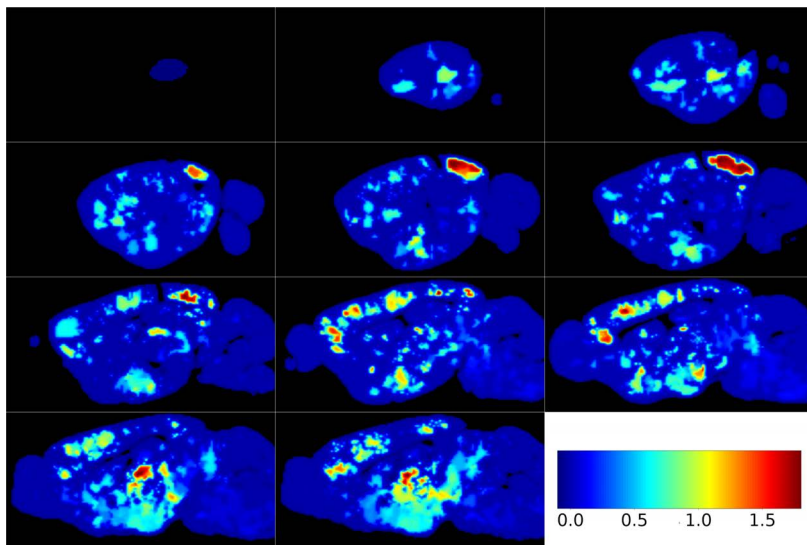
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E

Supplementary Data 3 Case 16. Calmodulin binding gene-set of pain QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.1) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
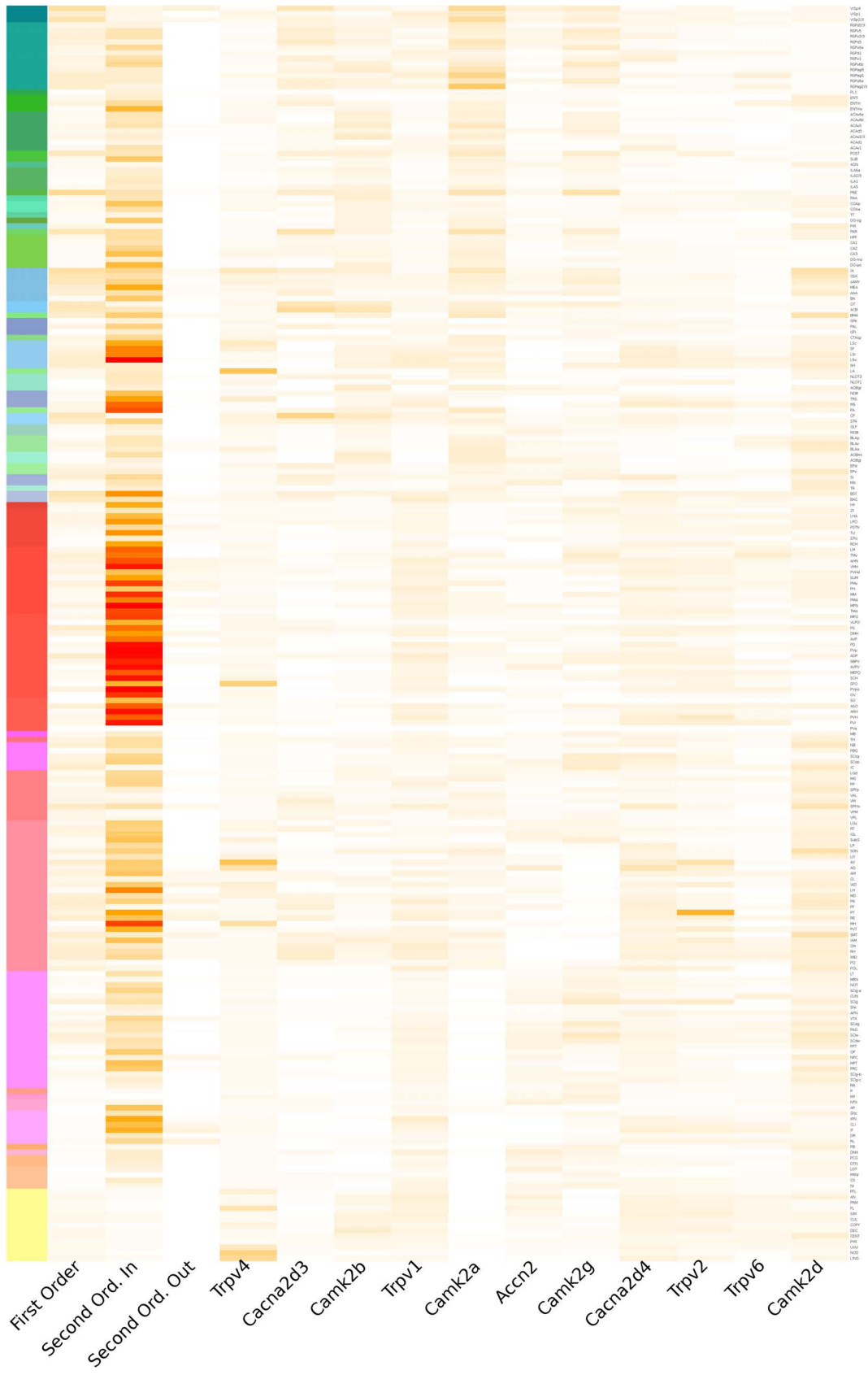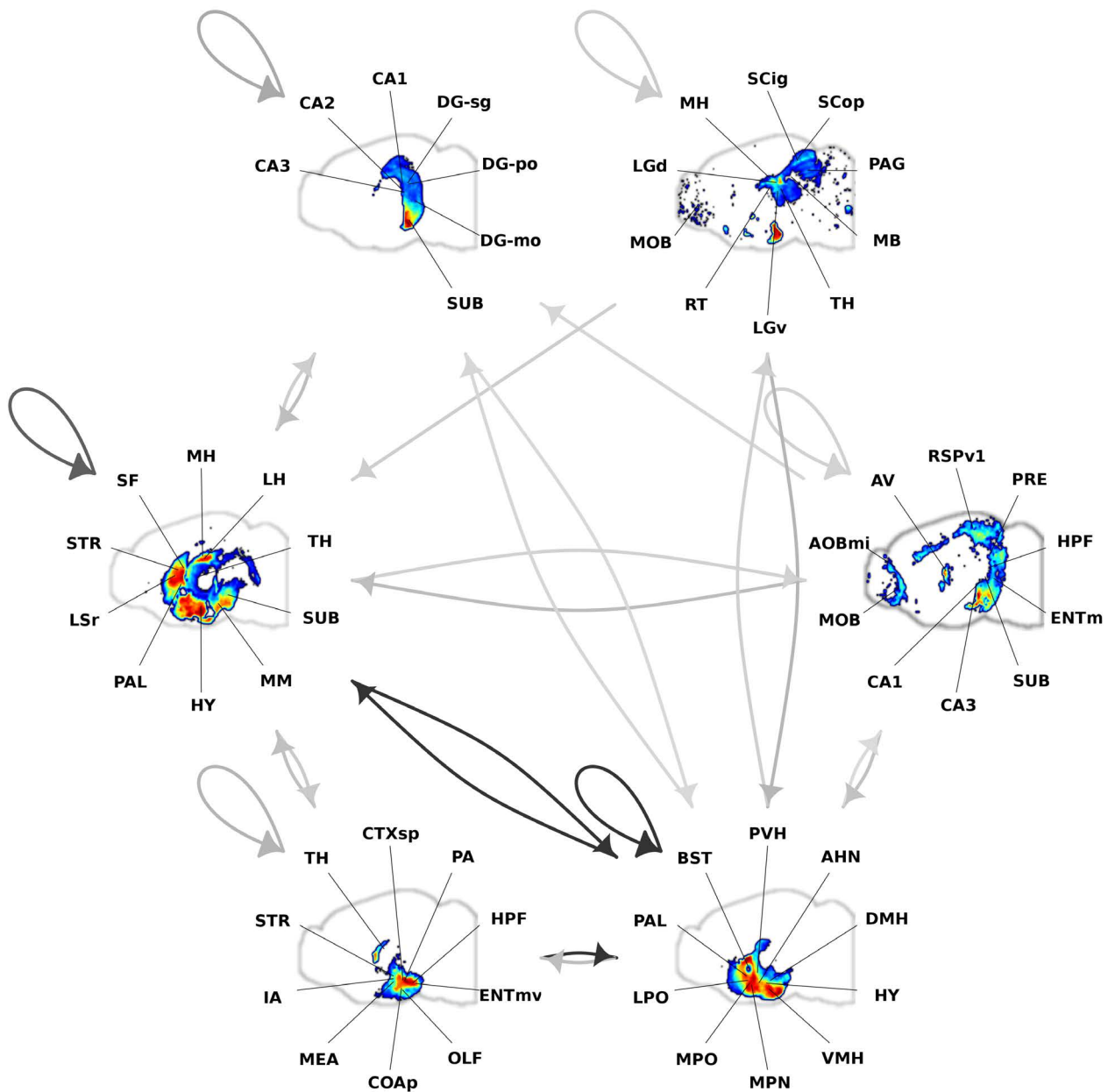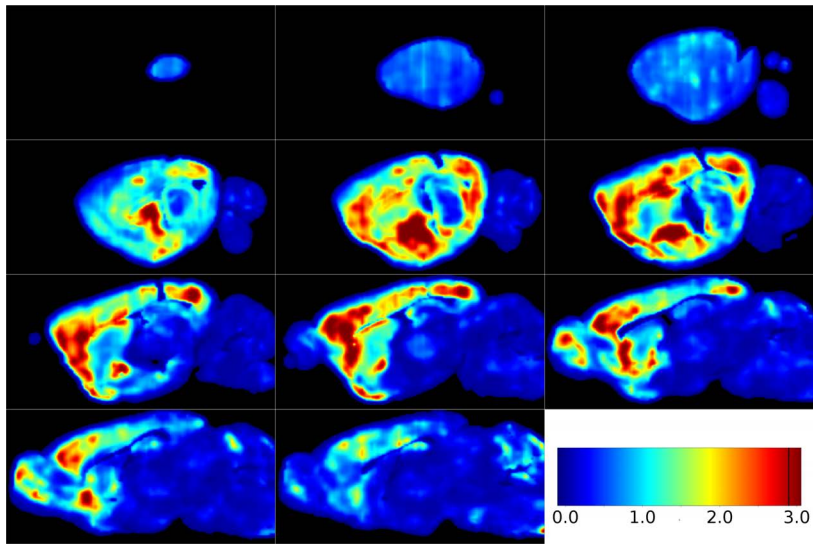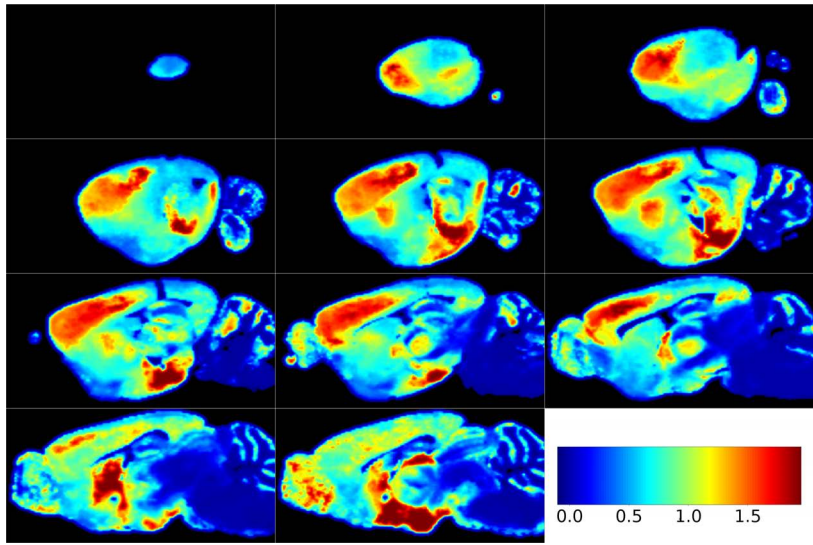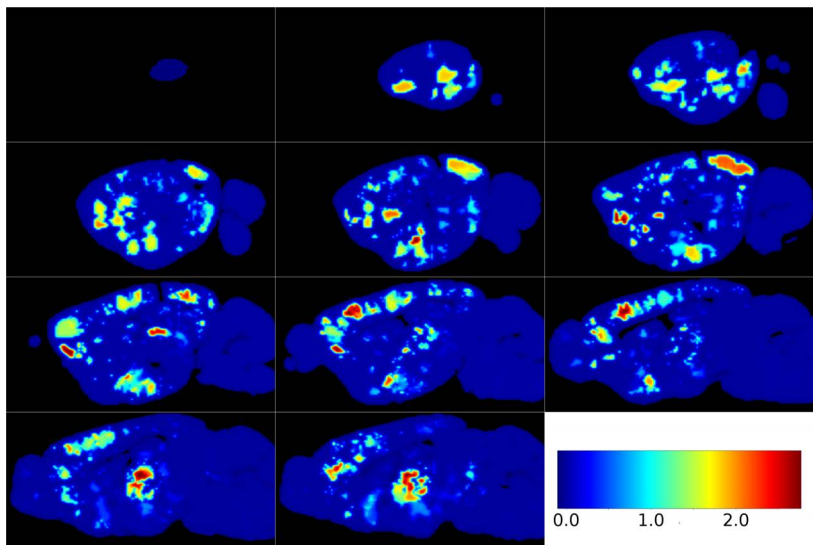
A

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Supplementary Data 3 Case 17. Panic disorder gene-set of the fear-QTLs. (A) Slice-view of first order network measures given as -log10 scaled p-values. (B) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (C) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (D) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (E) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
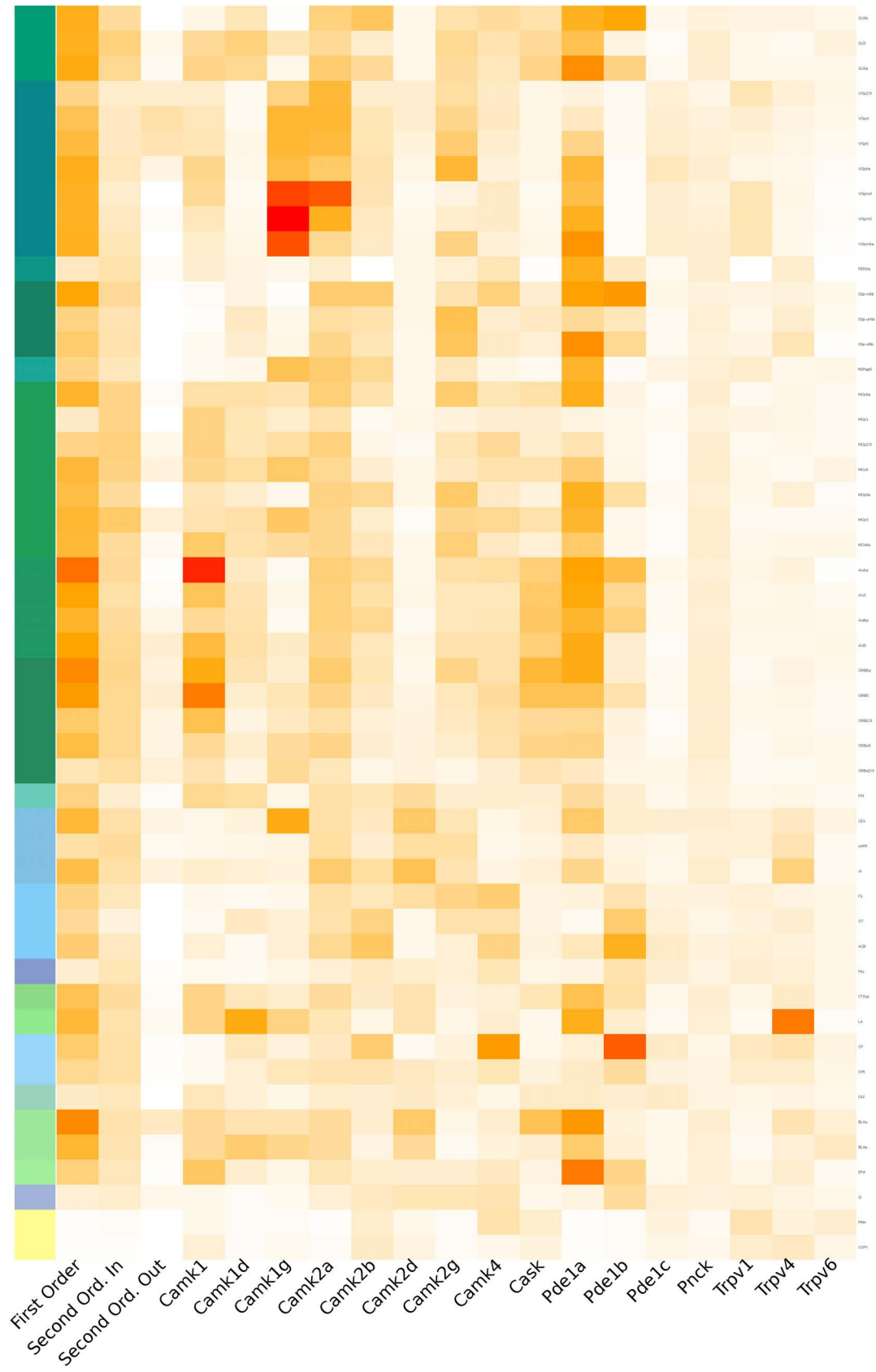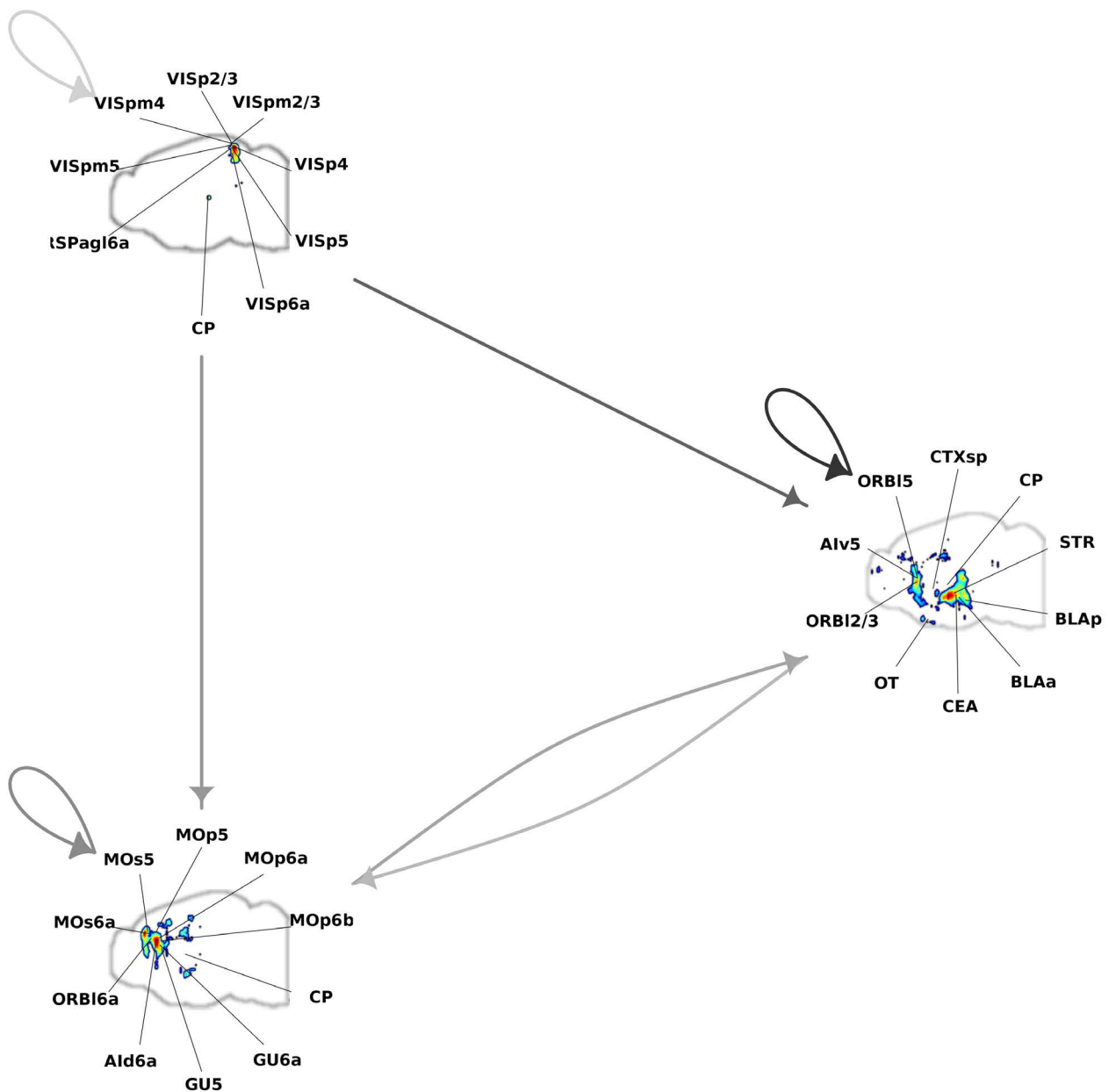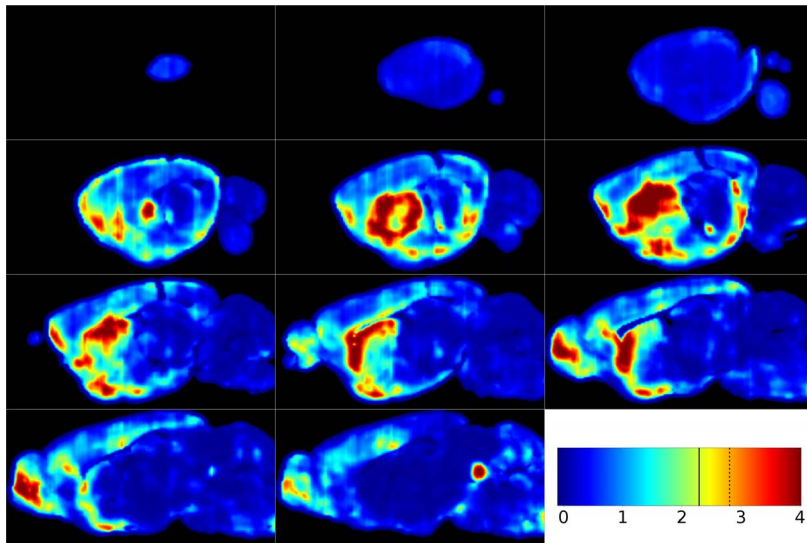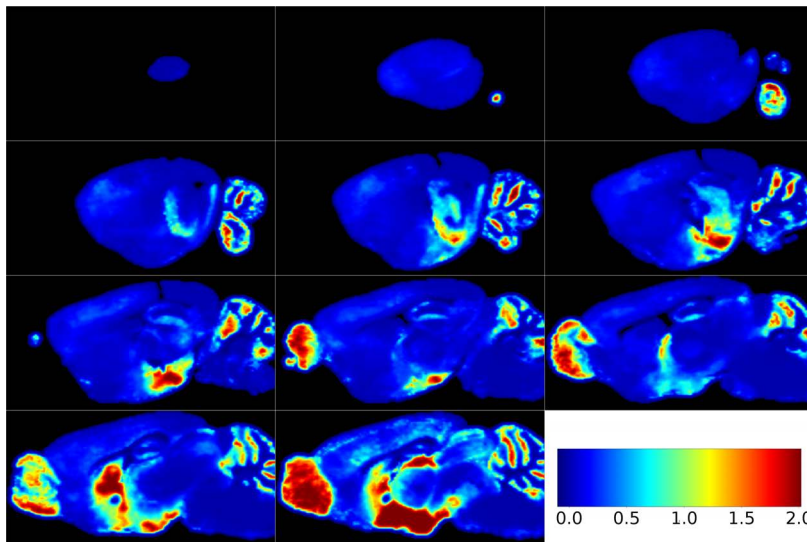
A

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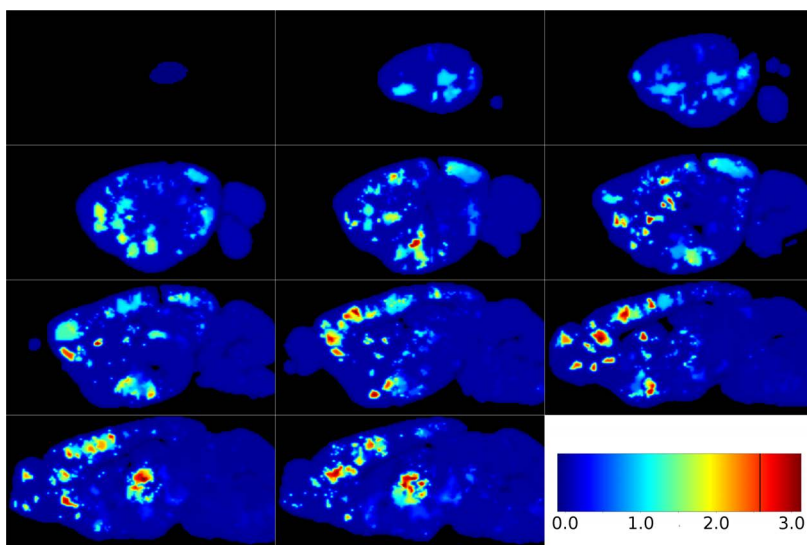**Supplementary Data 3 Case 18. Anxiety gene-set of the fear-QTLs**. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
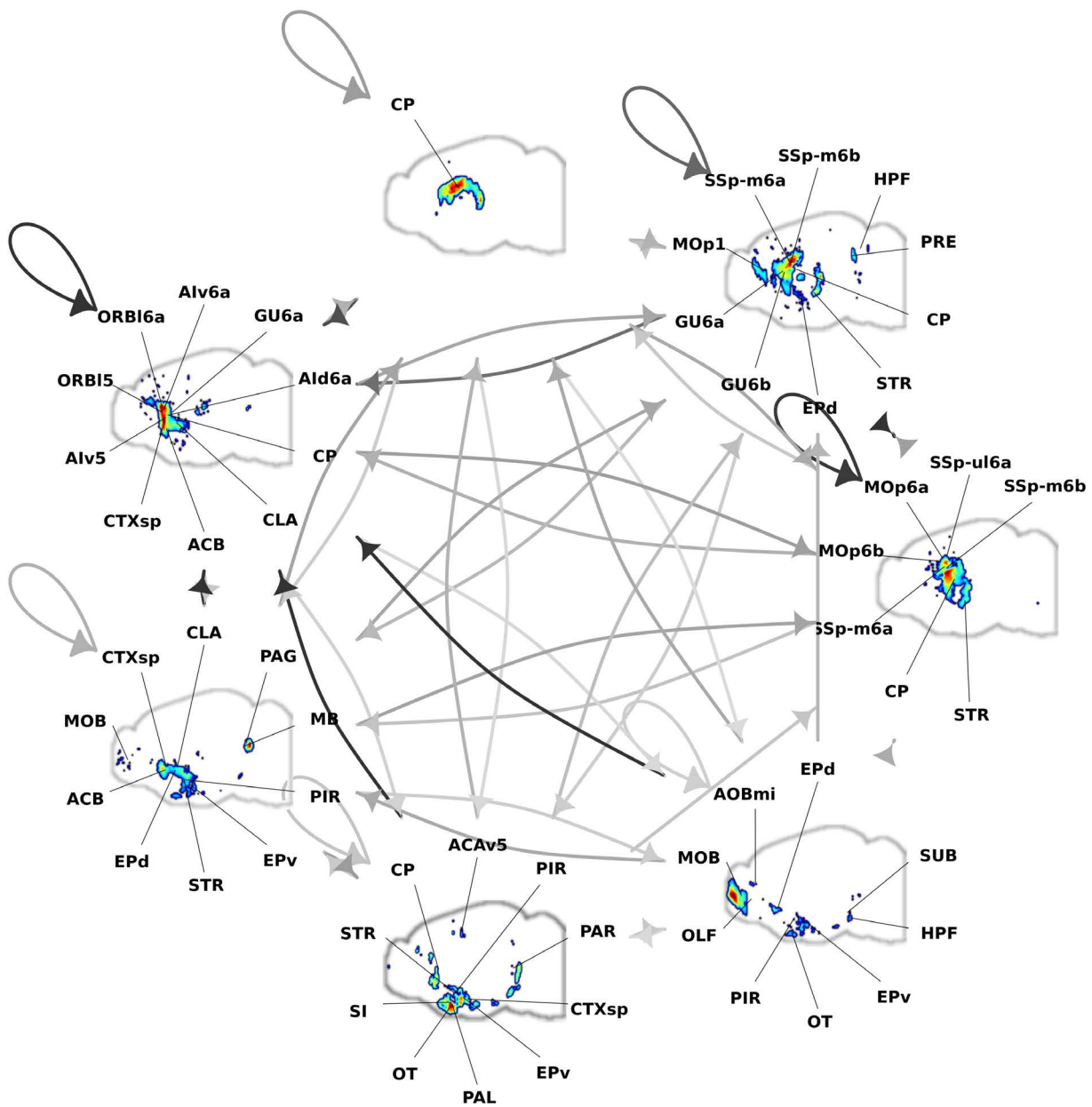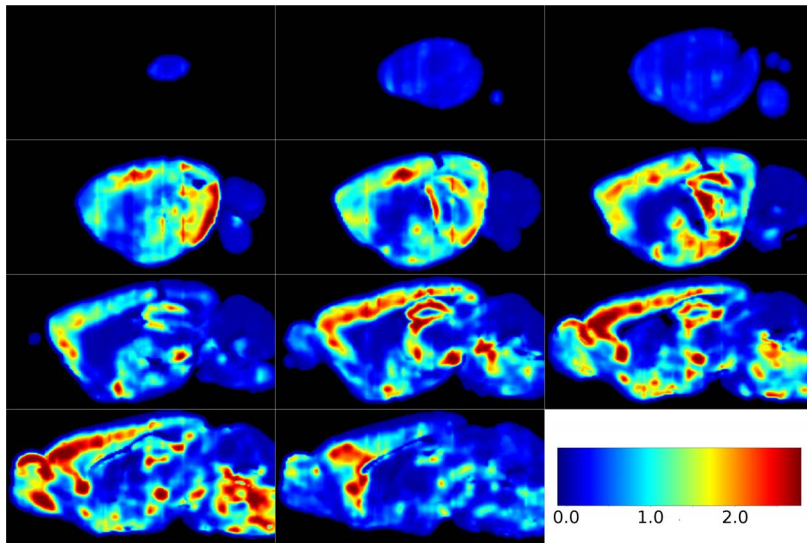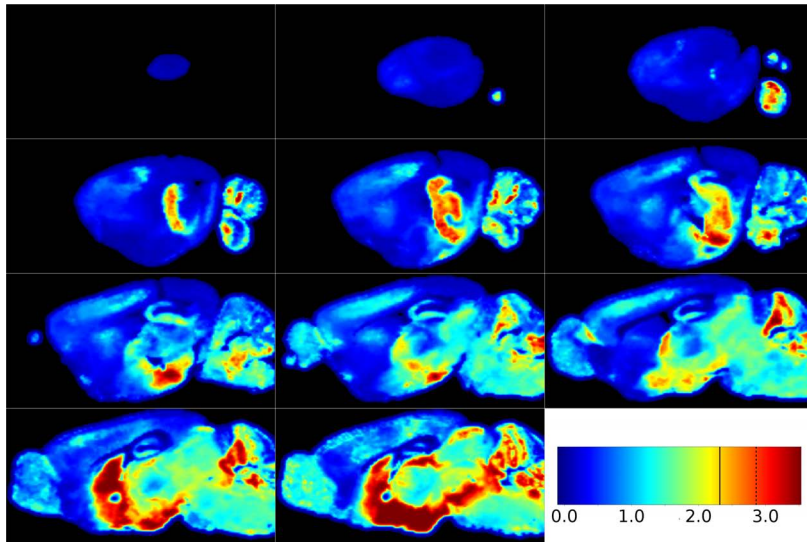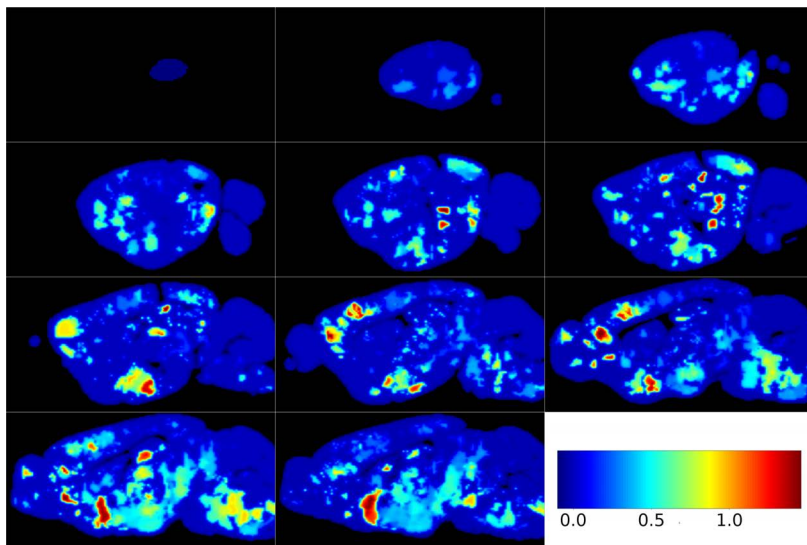
A

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E

Supplementary Data 3 Case 19. Decreased anxiety gene-set of the fear-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.1) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
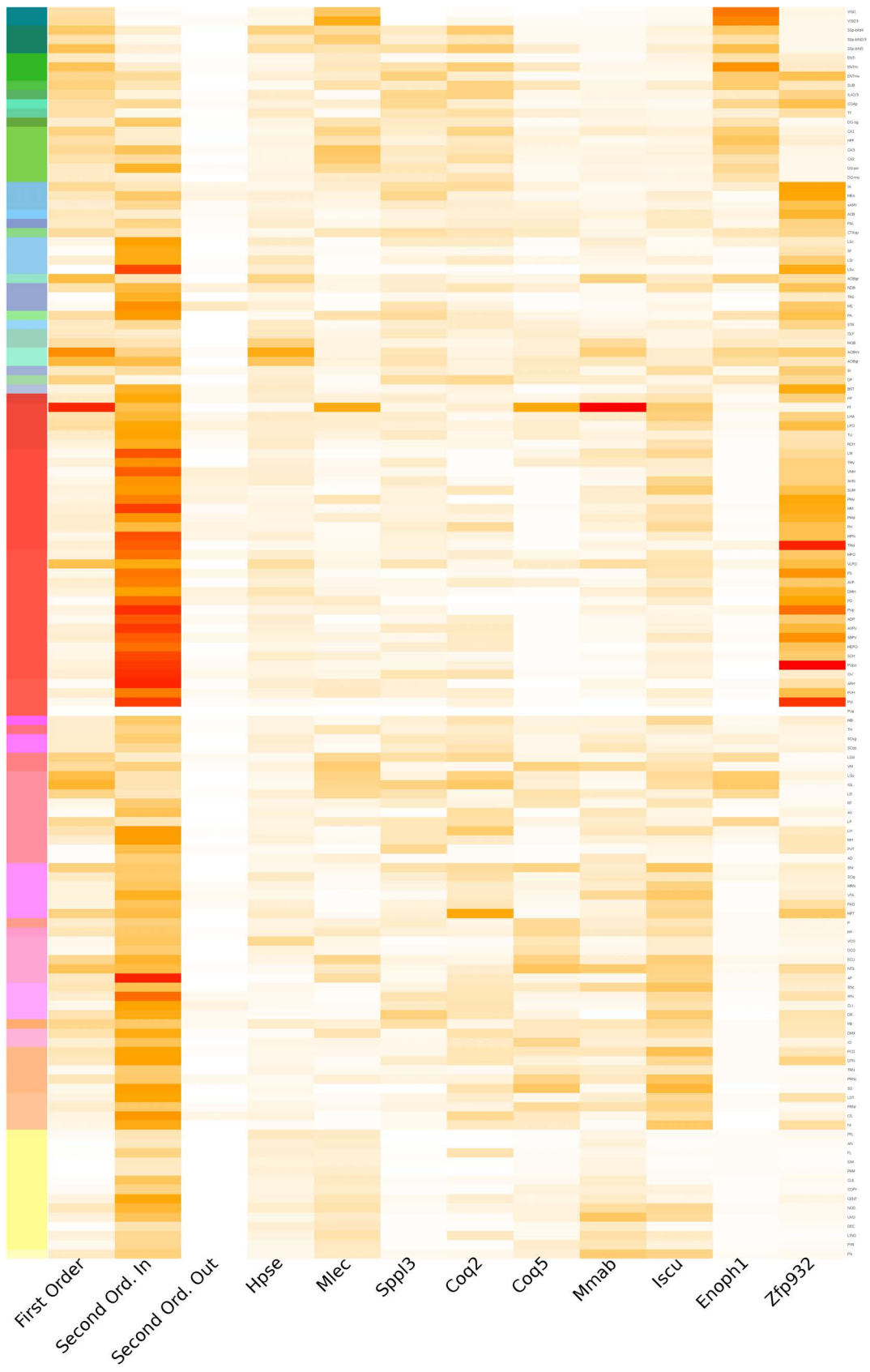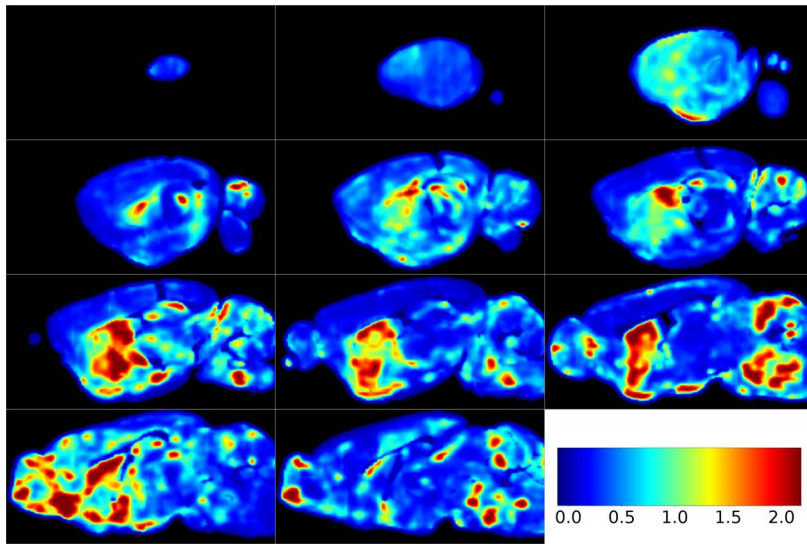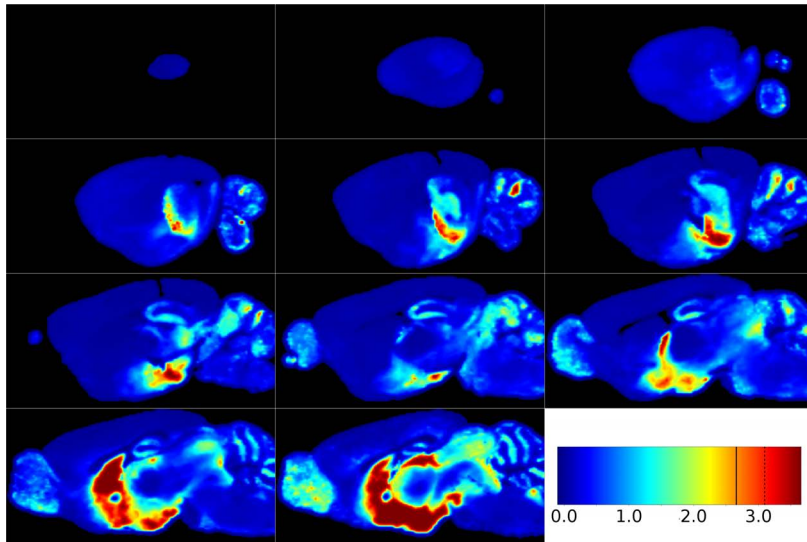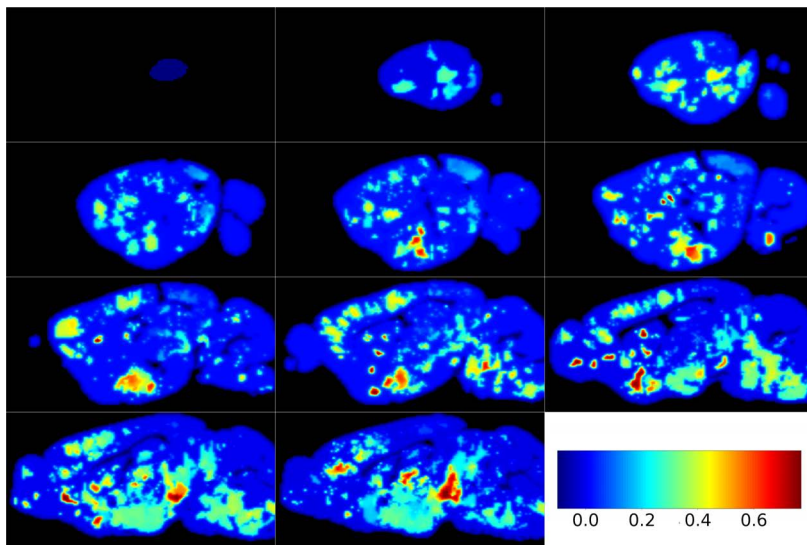
A

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E

Supplementary Data 3 Case 20. Depression gene-set of the fear-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
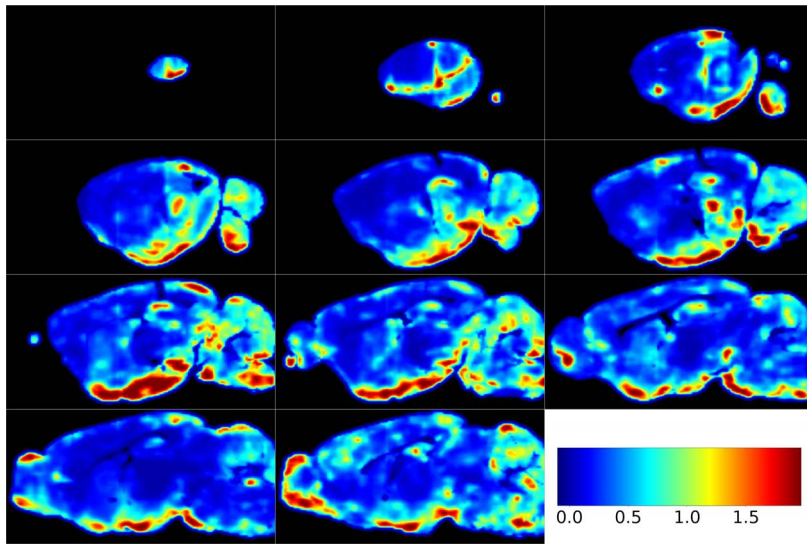
A

B

C

D

E
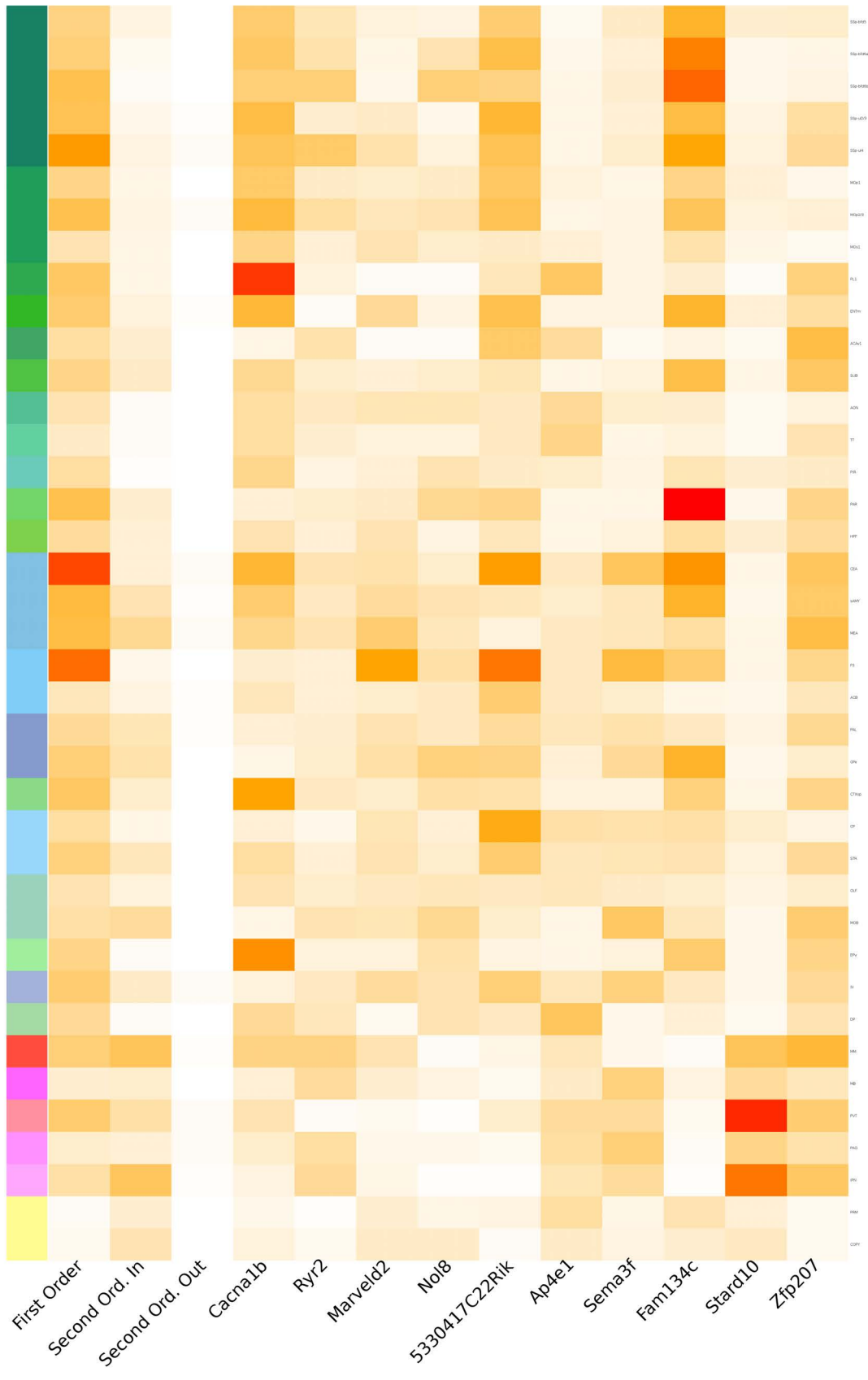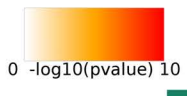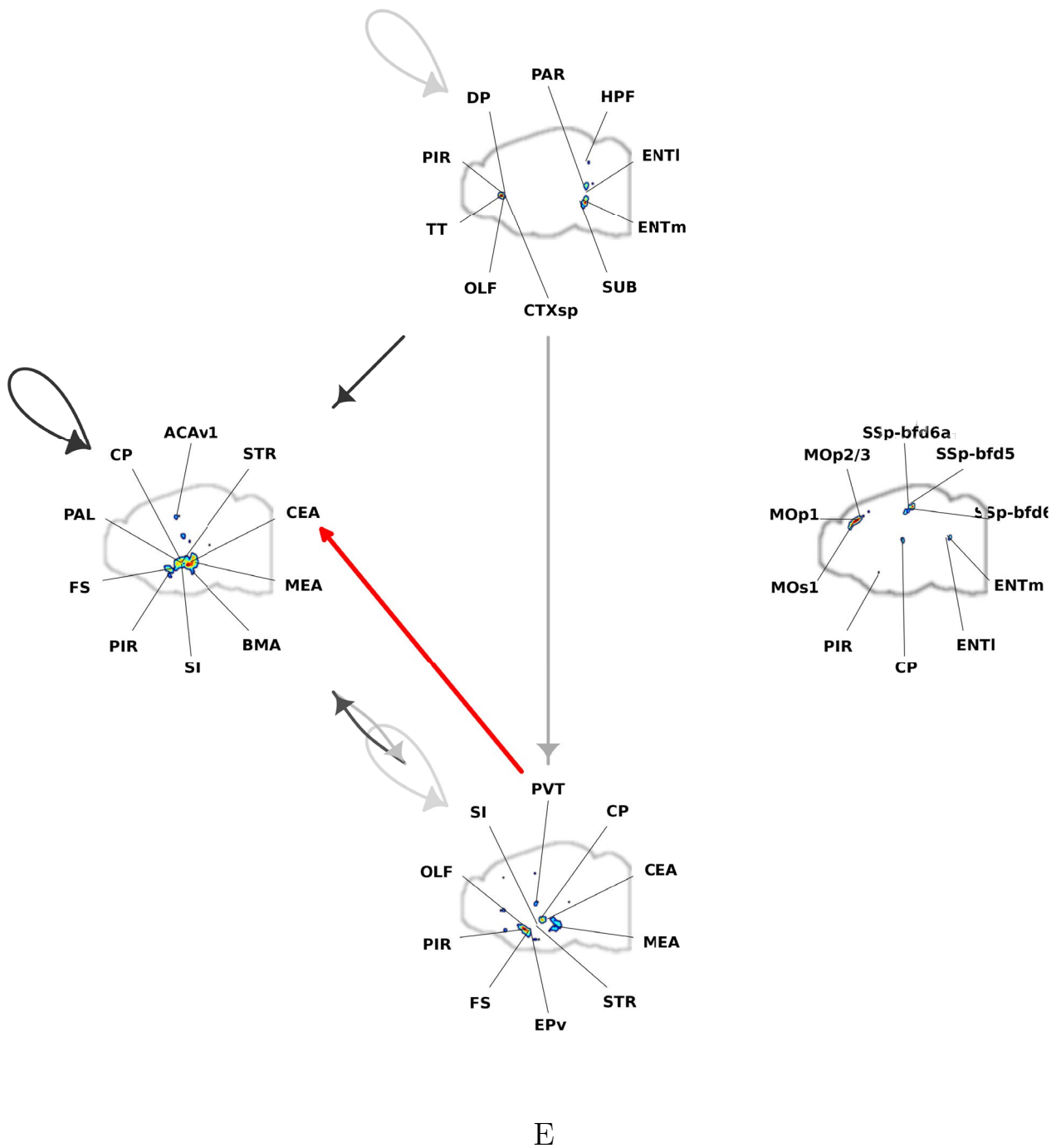
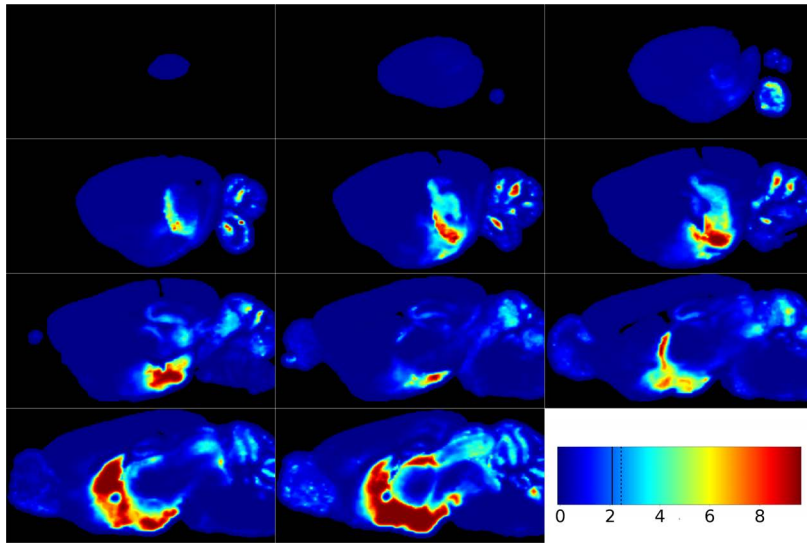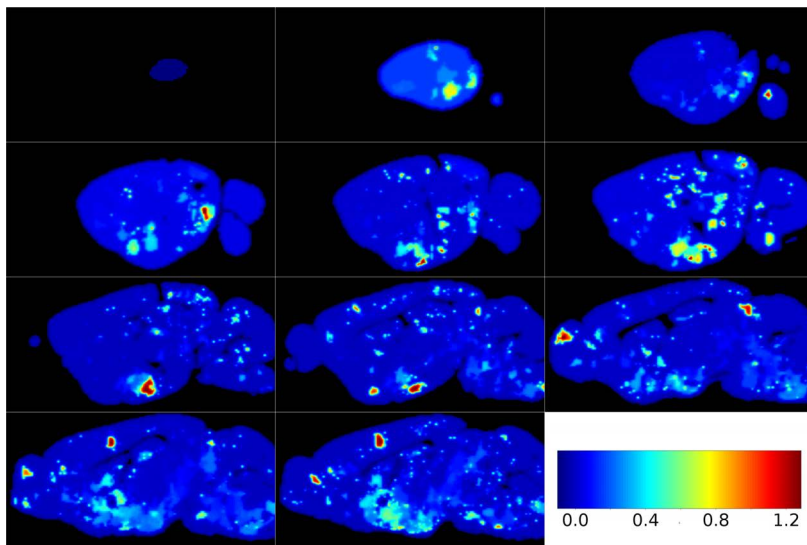**Supplementary Data 3 Case 21. Startle response gene-set of the fear-QTLs.** (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.1) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows. Red arrows mark selected connections, discussed in the main text.
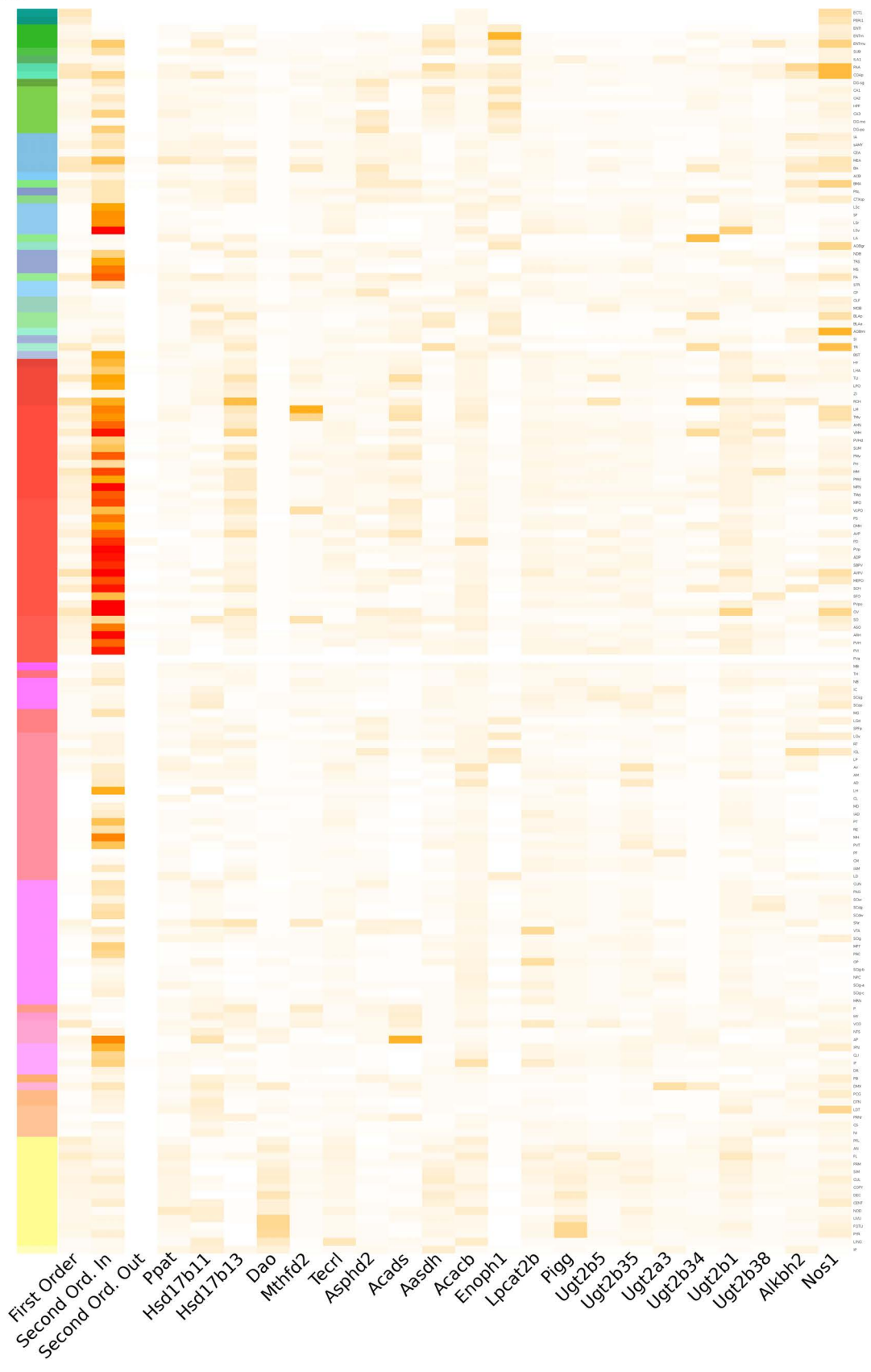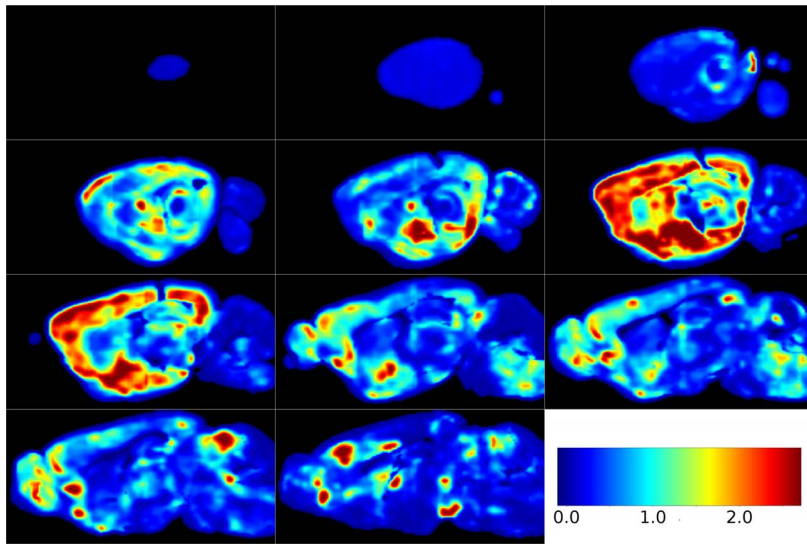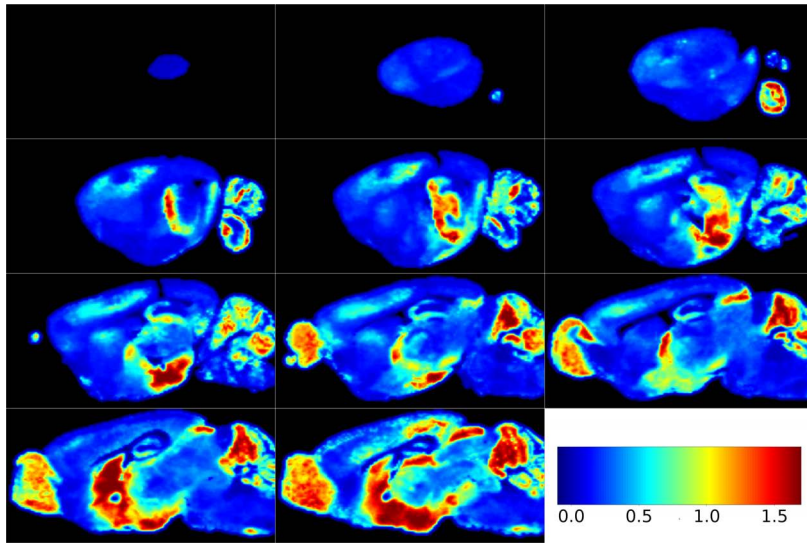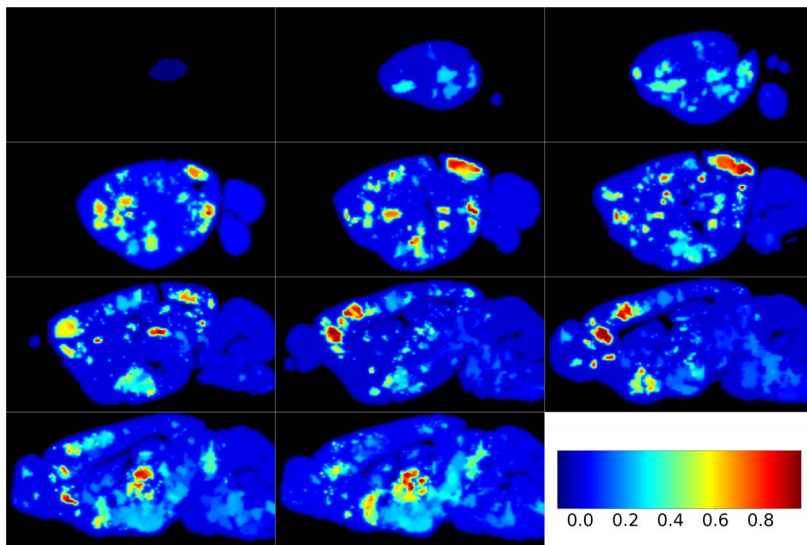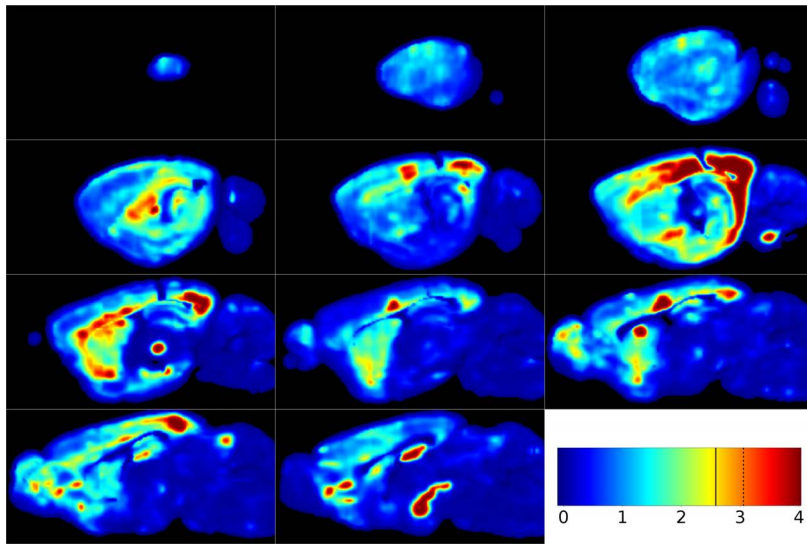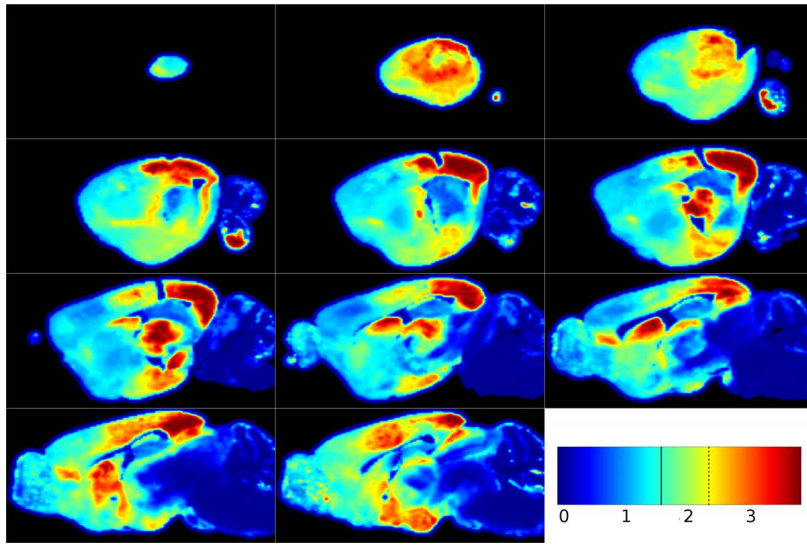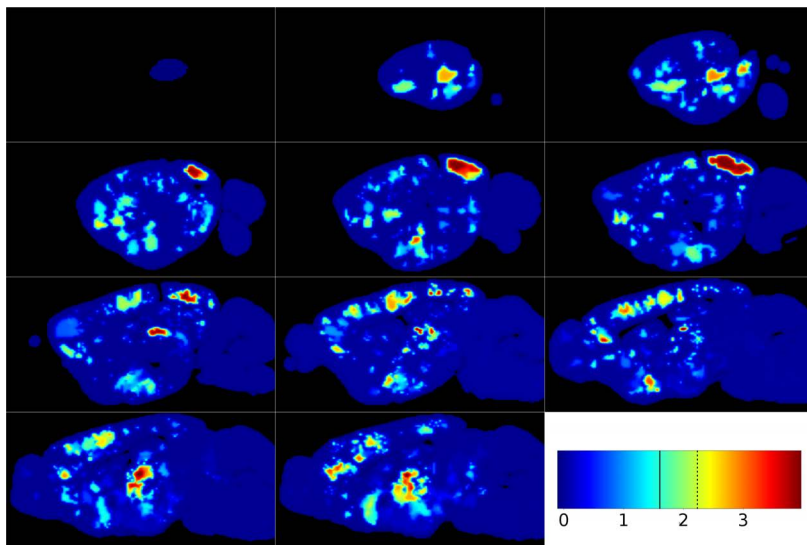
A

B

C

D

E

Supplementary Data 3 Case 22. Decreased exploration gene-set of the fear-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.

A

B

C

First Order Second Ord. In Second Ord. Out Ncam1 Trim66 Stx16 Slc1a1 Ppp1r9b Pitx3
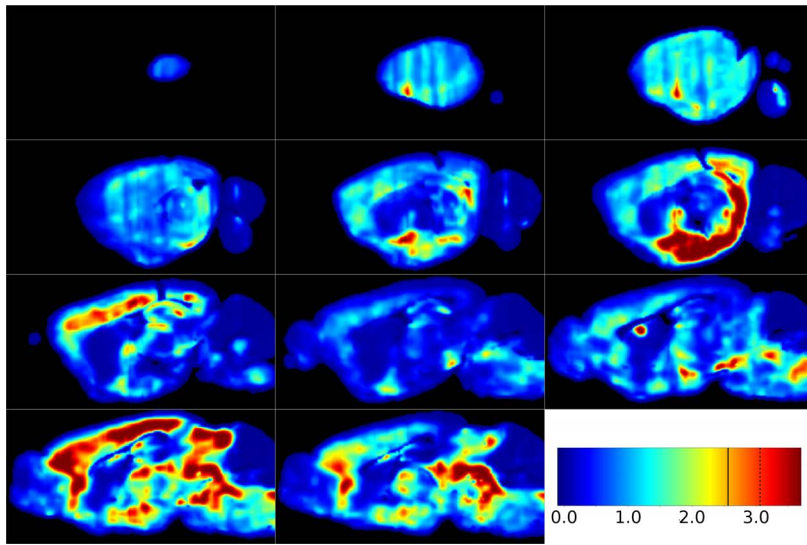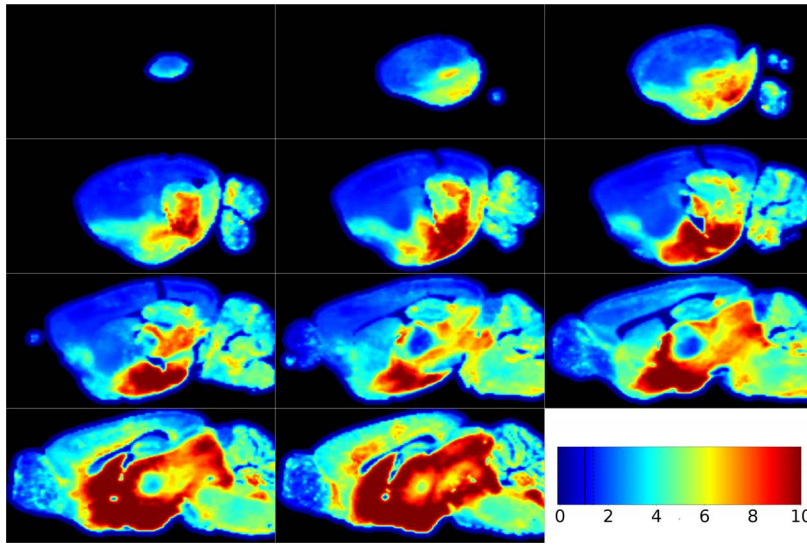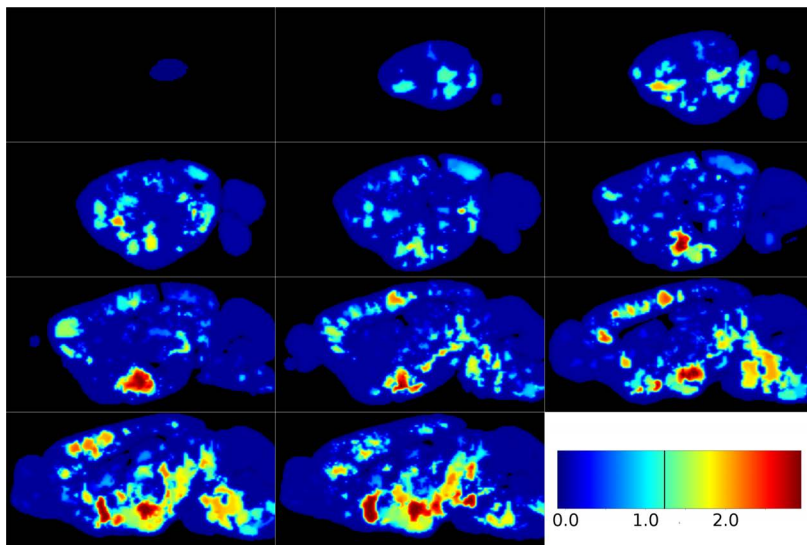
D

E

Supplementary Data 3 Case 23. Increased exploration gene-set of the fear-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
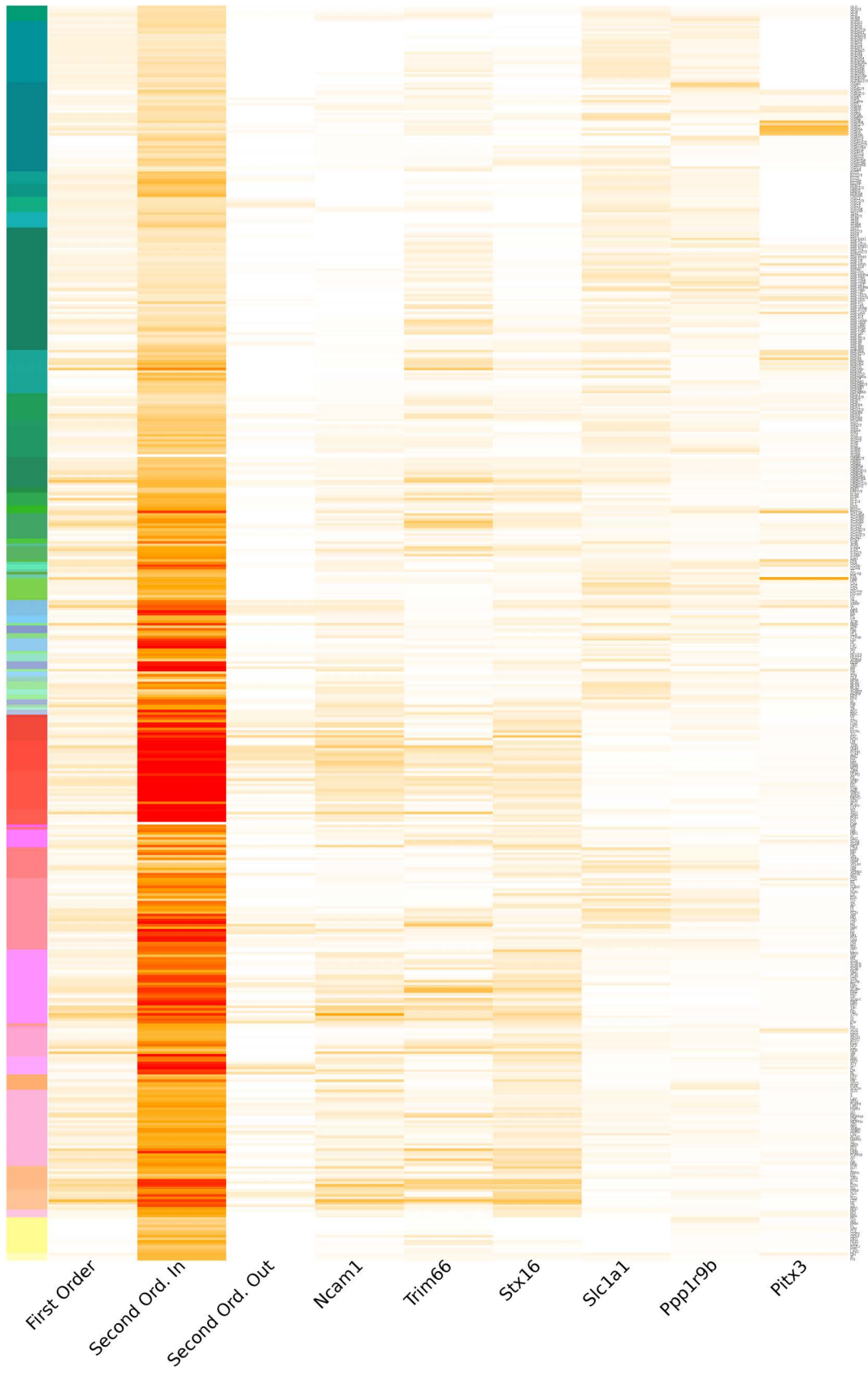
A

B

C

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E
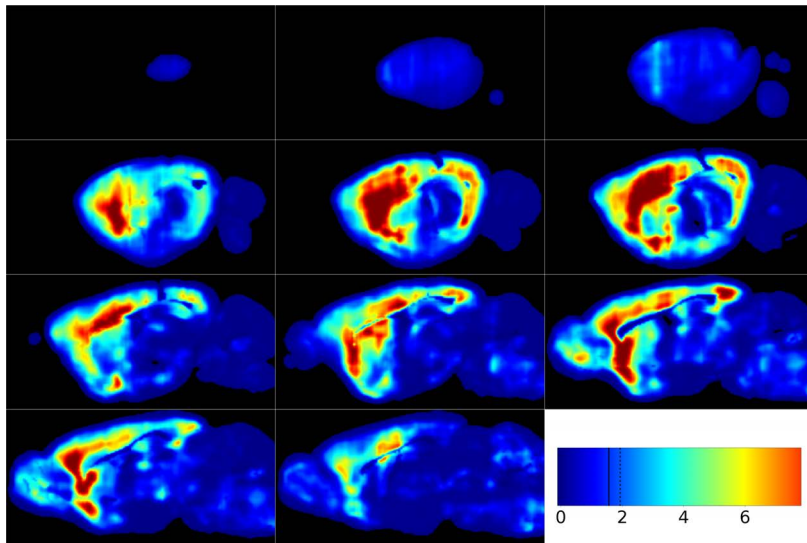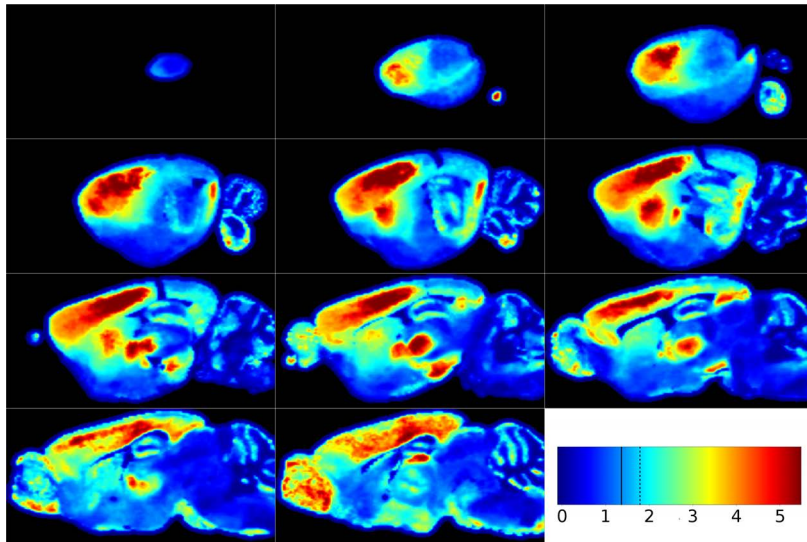
Supplementary Data 3 Case 24. Behaviour gene-set of the autism-QTLs. (A) Slice-view of first order network measures given as -log10 scaled p-values. (B) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (C) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (D) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (E) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (norma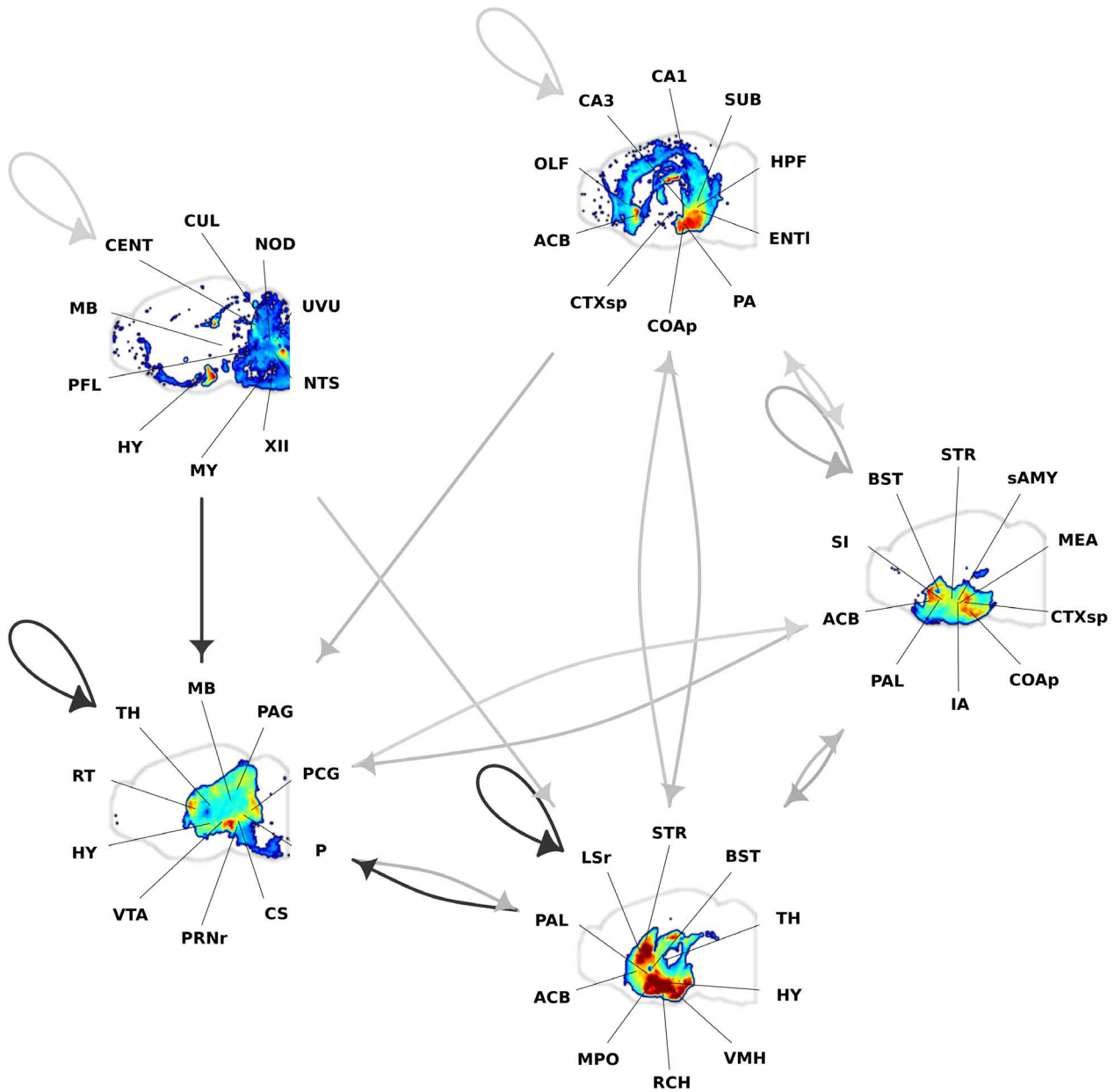lized by the injection volume) given as grey-scale arrows. Red arrows mark selected connections, discussed in the main text.

A

B

C

First Order   Second Ord. In   Second Ord. Out   APP   GRIN1   GRIN2B   Mecp2   AVPR1A   NLGN3
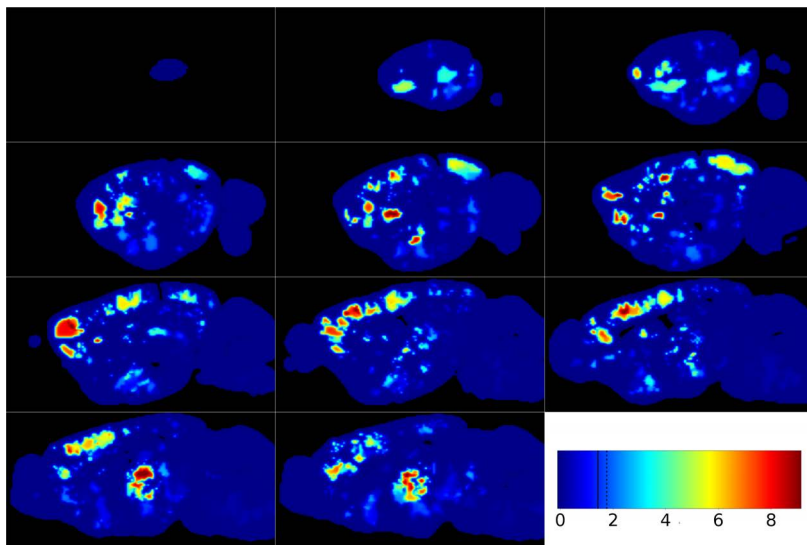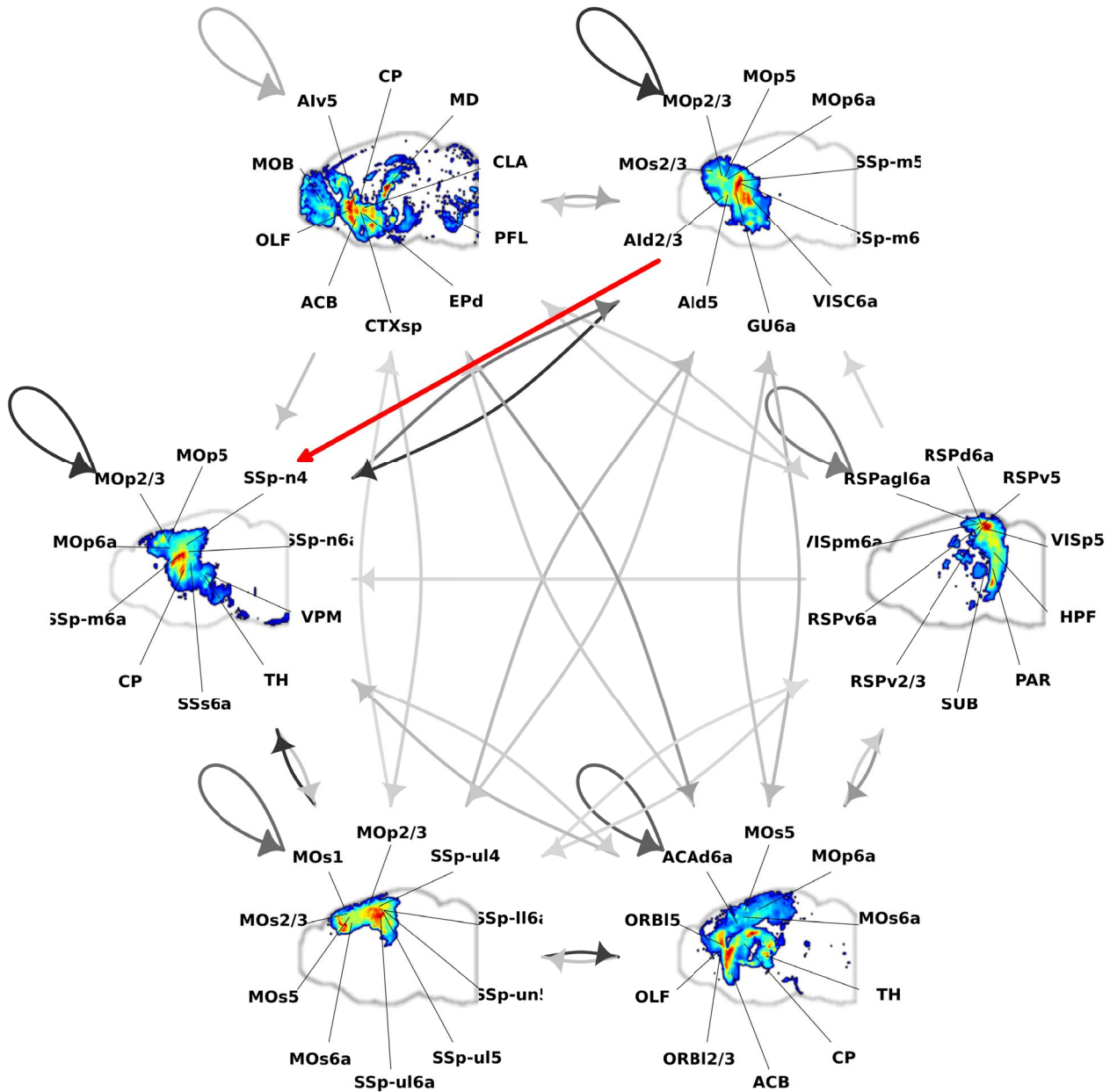
0   -log10(pvalue)   10

D

E

Supplementary Data 3 Case 25. Social interaction gene-set of the autism-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.
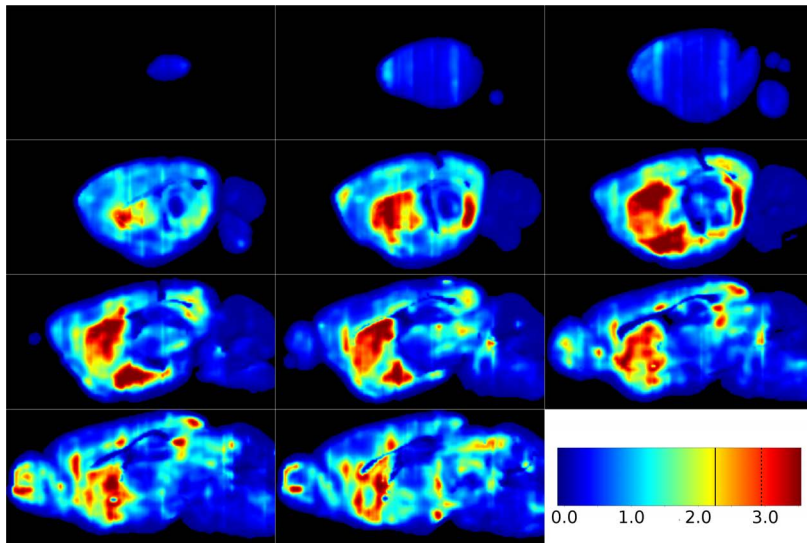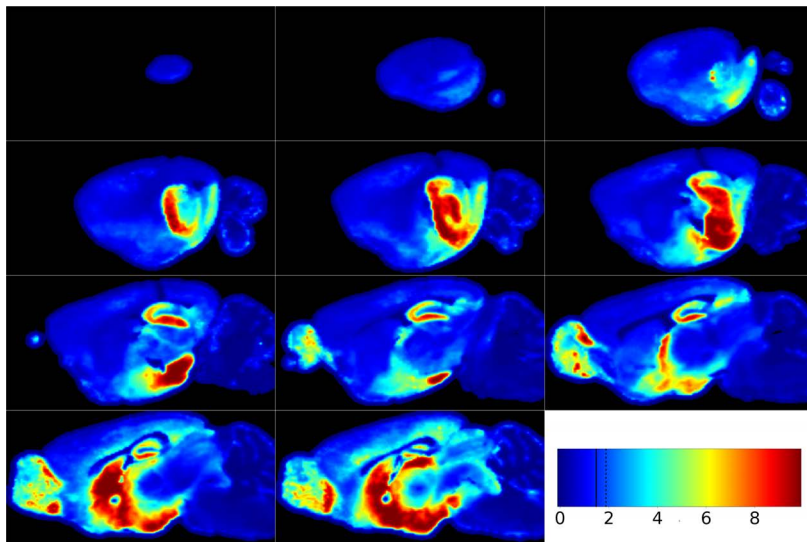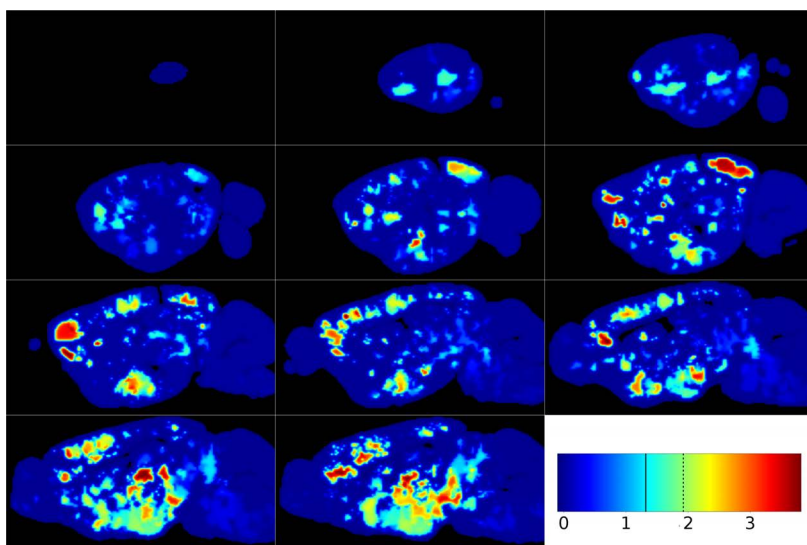
A

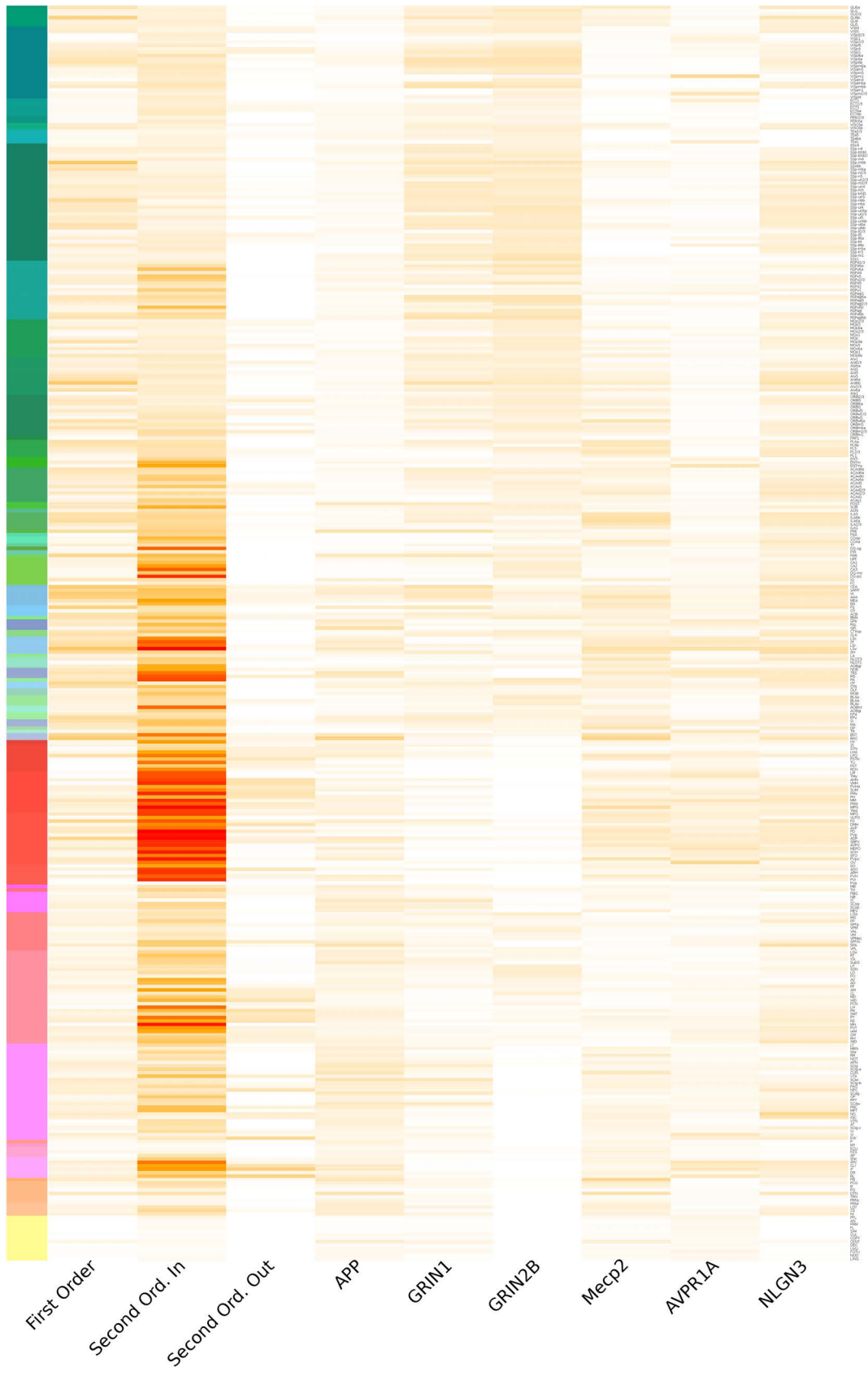
B

C

0 -log10(pvalue) 10

First Order | Second Ord. In | Second Ord. Out | APP | BDNF | CACNA1C | DRD3 | GRIN1 | GRIN2B | HTR2A | Mecp2 | NF1 | CTNND2 | Pafah1b1 | Park2 | Grm5 | FOXP2 | SYNGAP1 | NLGN3
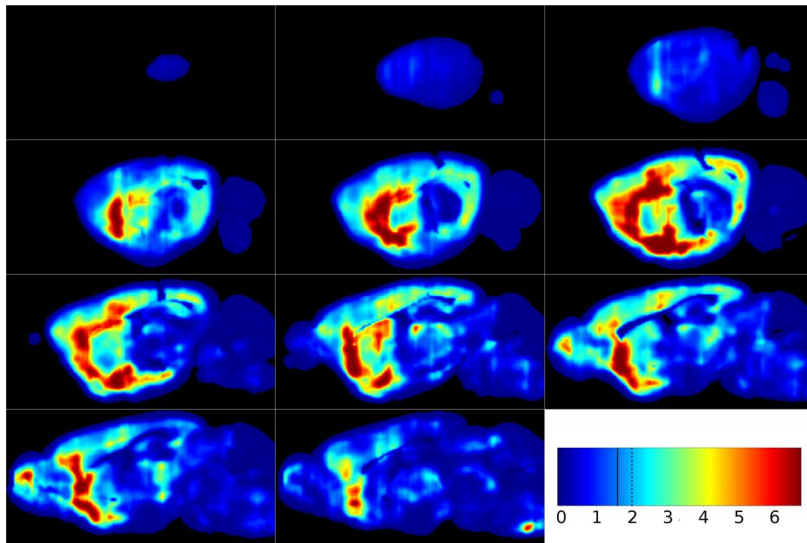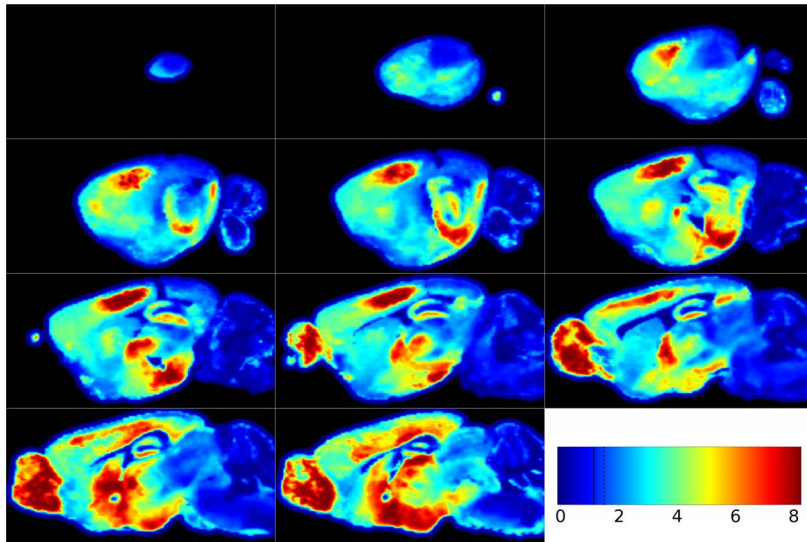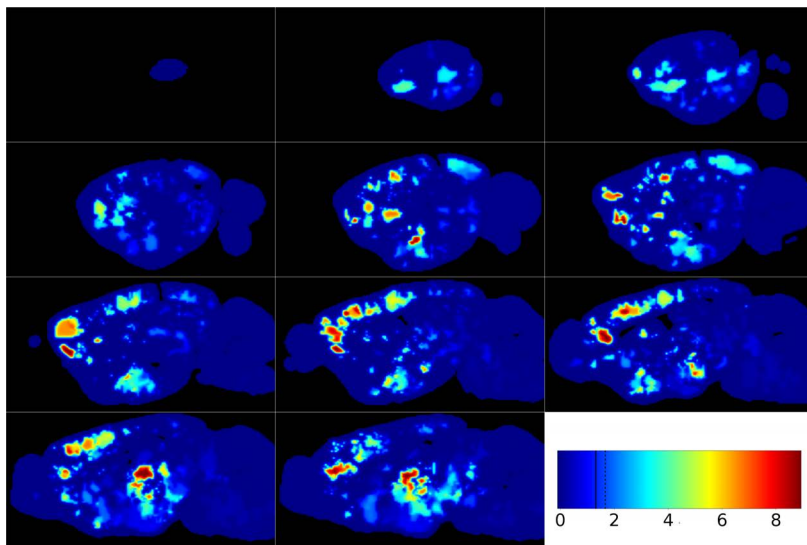
D

E

Supplementary Data 3 Case 26. Learning and memory gene-set of the autism-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows. Red arrows mark selected connections, discussed in the main text.
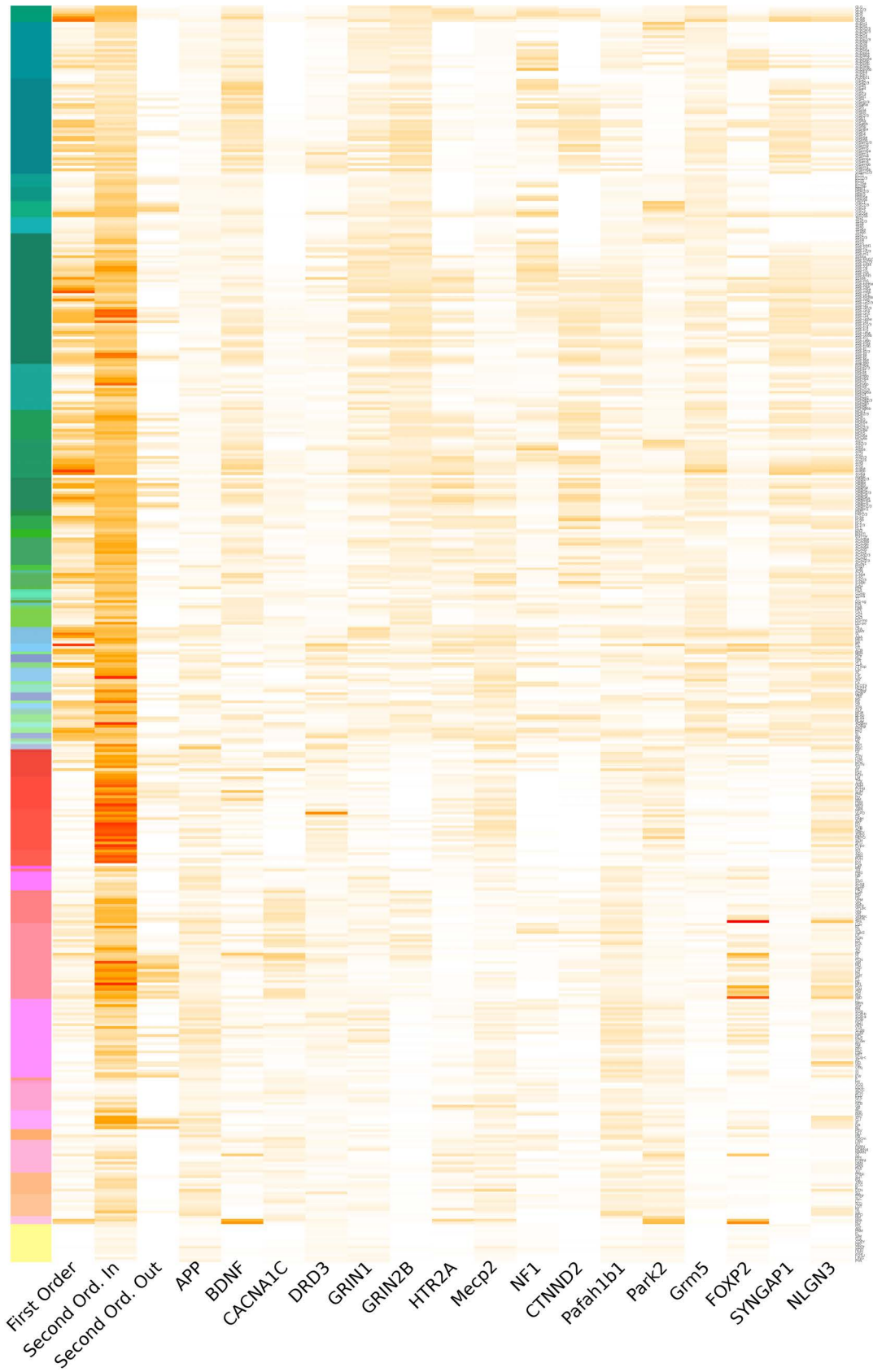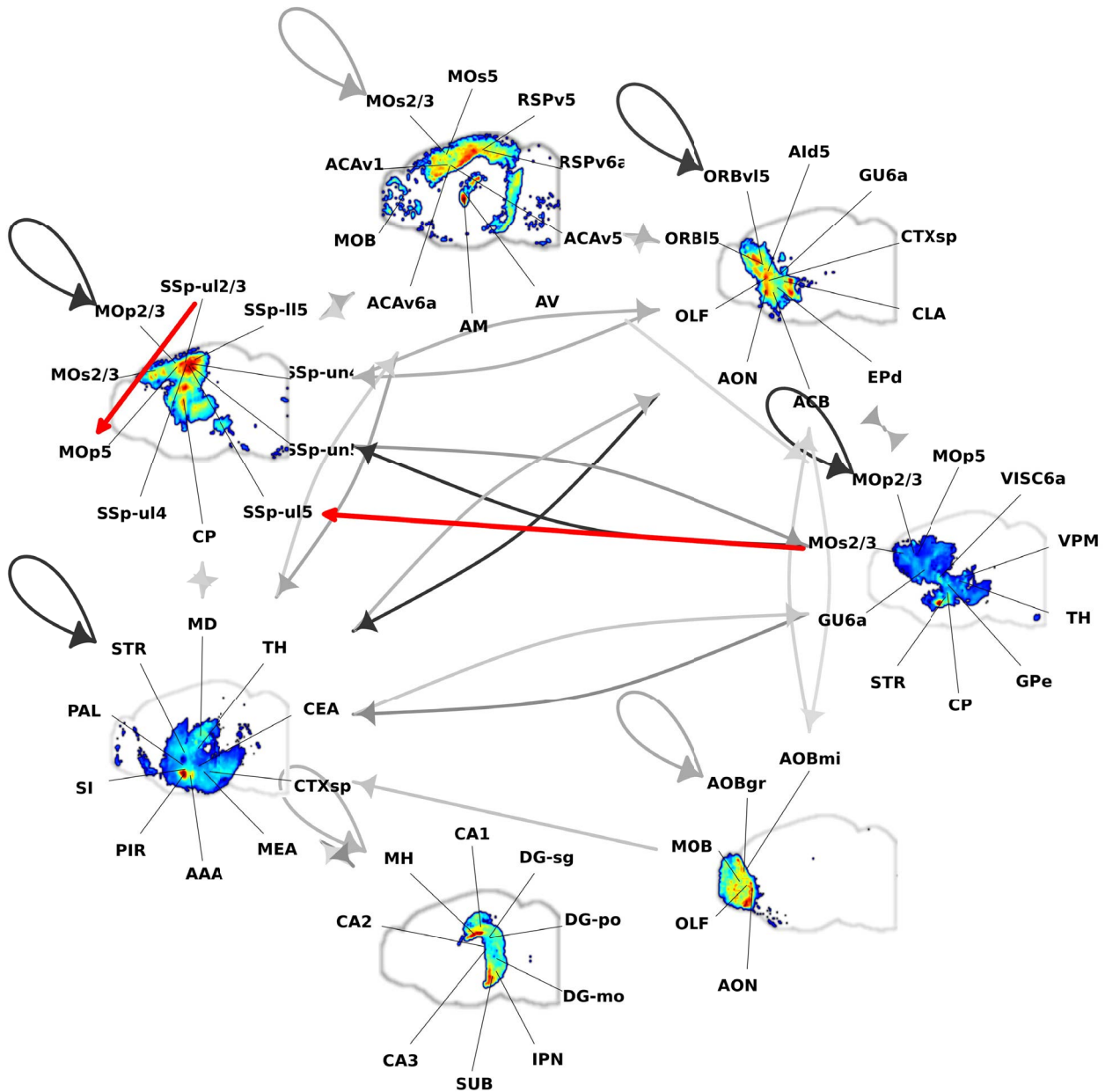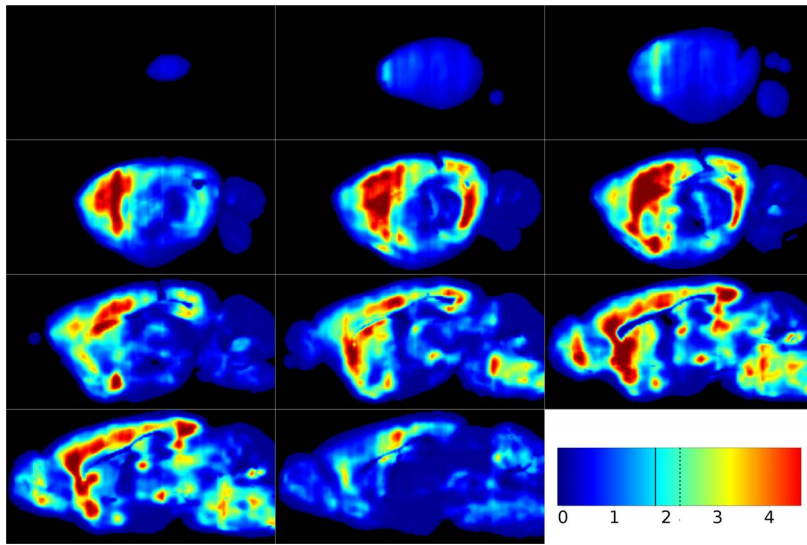
A

B

C

First Order Second Ord. In Second Ord. Out Adora2a APBA2 APP ATP2B2 CACNA1C Slc6a3 DLG4 DRD3 DRD4 Dscam Eps8 GRIN1 KCNMA1 Mecp2 NPAS2 NRP2 Pafah1b1 RELN Scn1a SCN8A TSC2 Park2 FEZF2 Atg7 Grm5 NRG1 Chd7
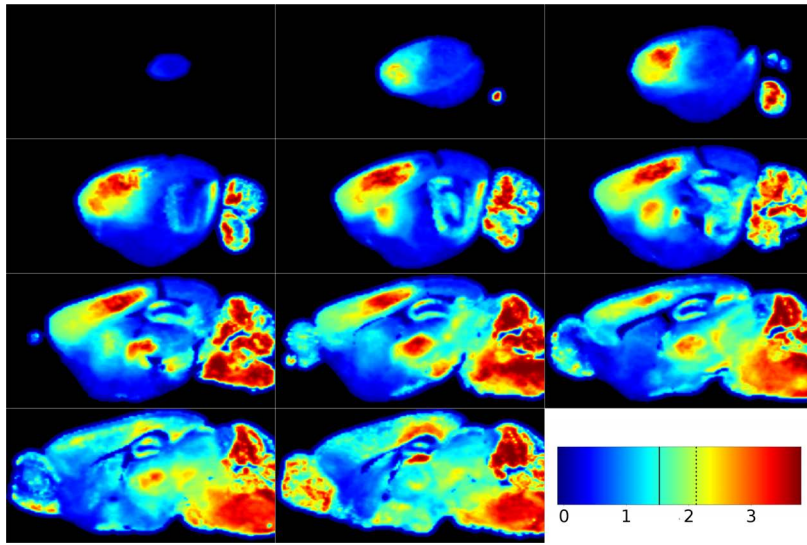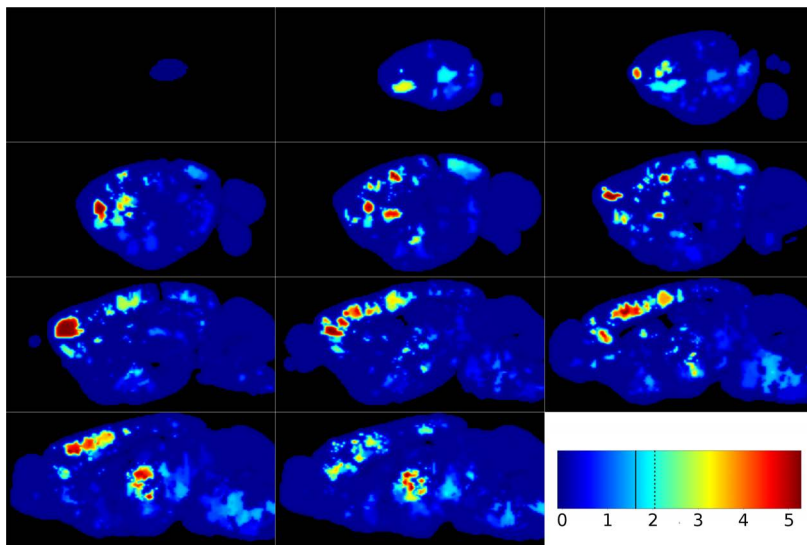
0 -log10(pvalue) 10

D

E

Supplementary Data 3 Case 27. Locomotor behaviour gene-set of the autism-QTLs. (A) Slice-view of first order network measures given as -log10 scaled p-values. (B) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (C) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (D) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (E) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows. Red arrows mark selected connections, discussed in the main text.
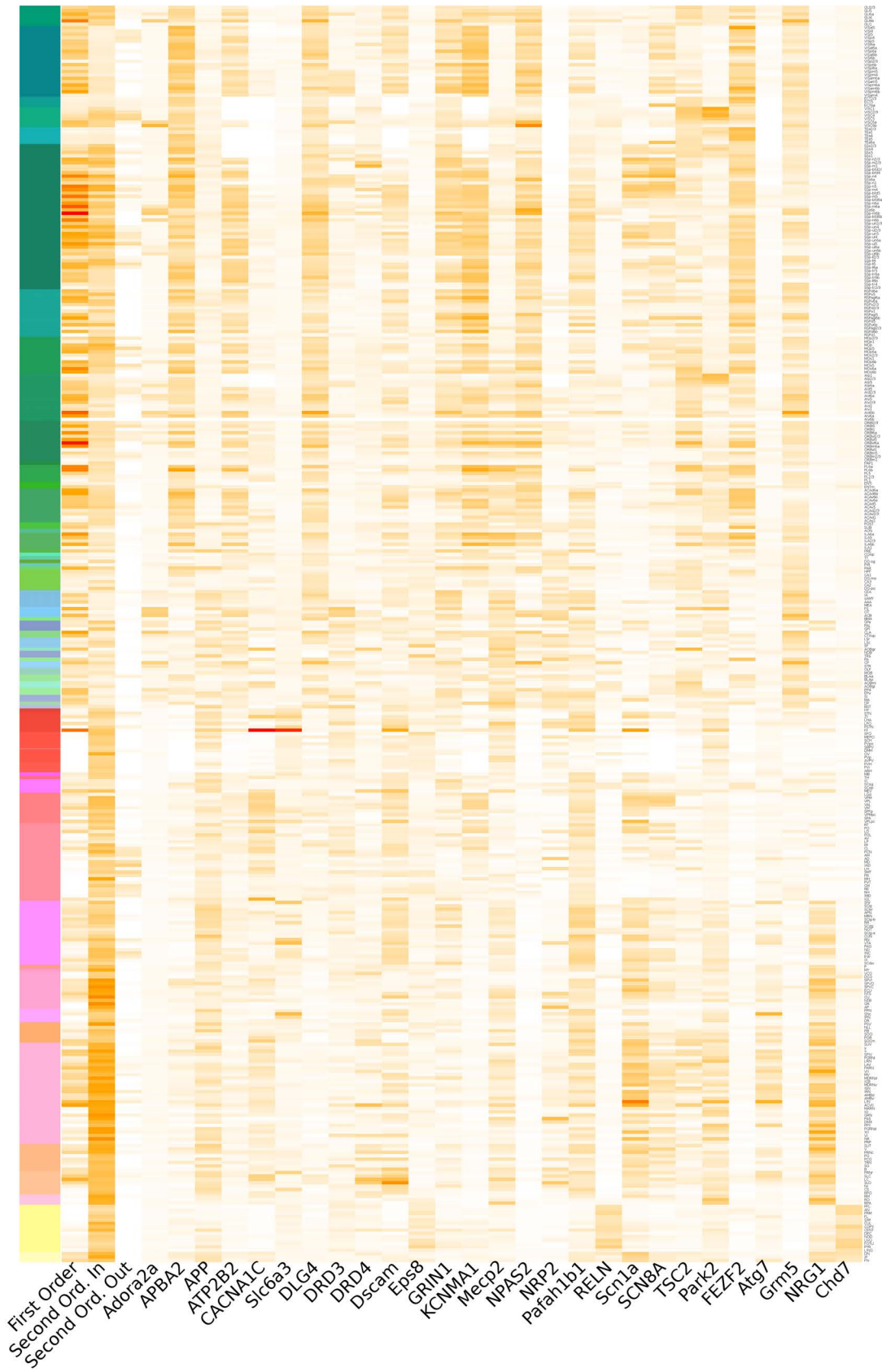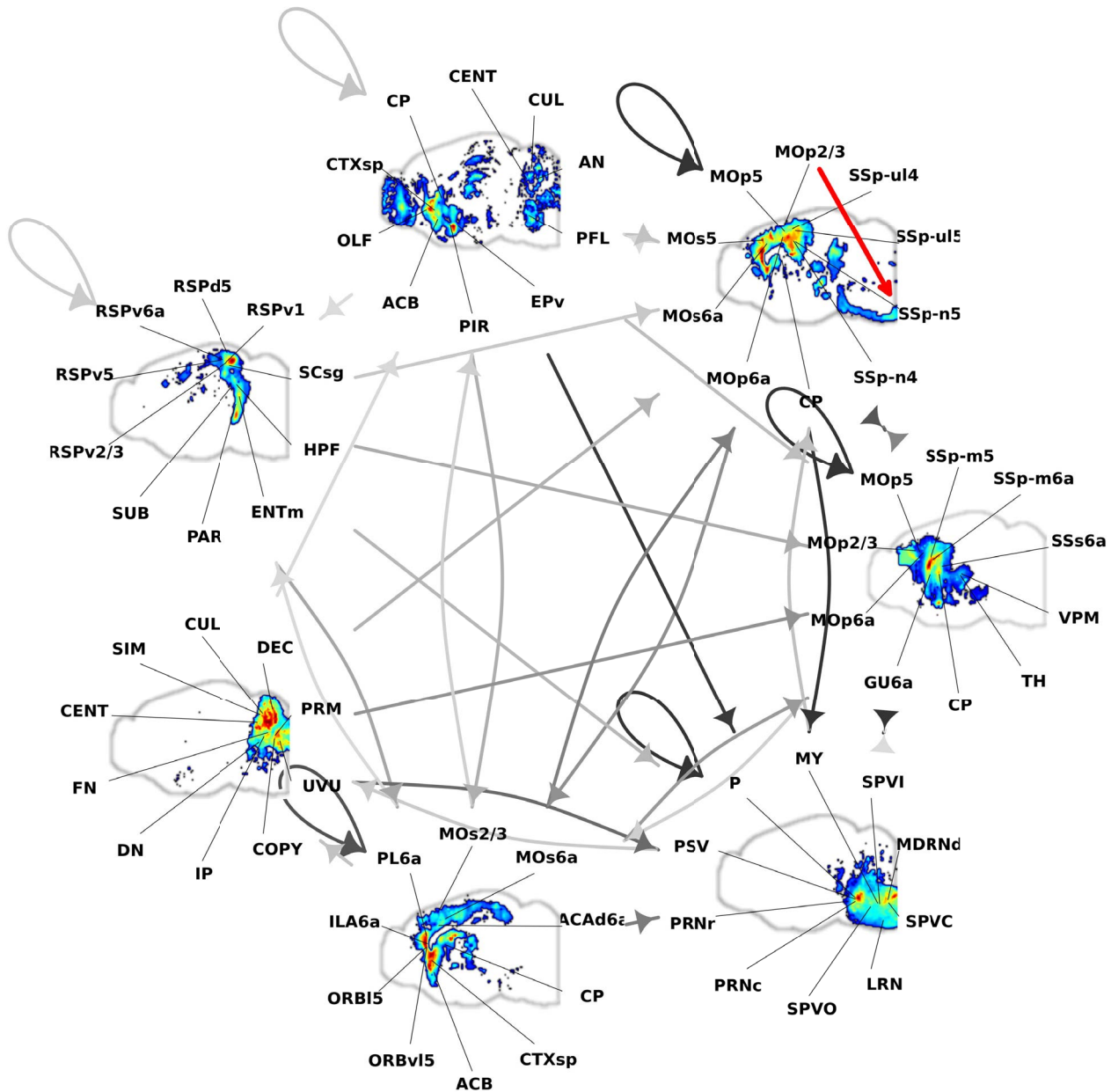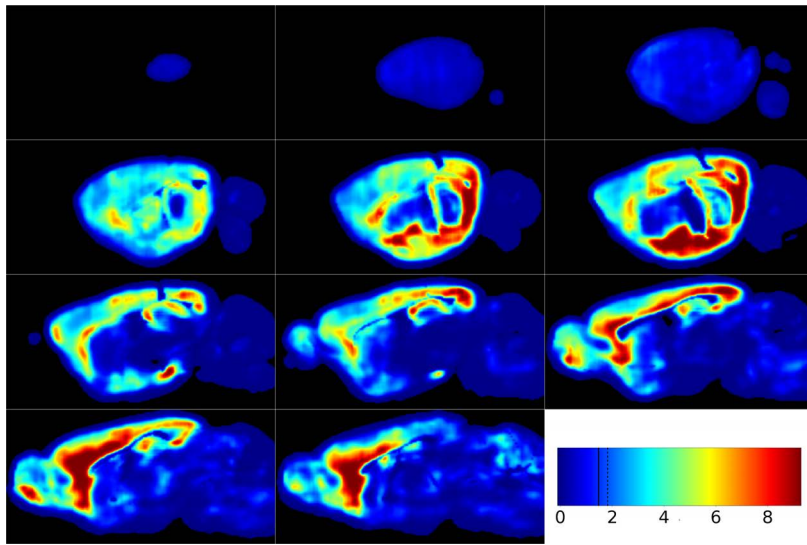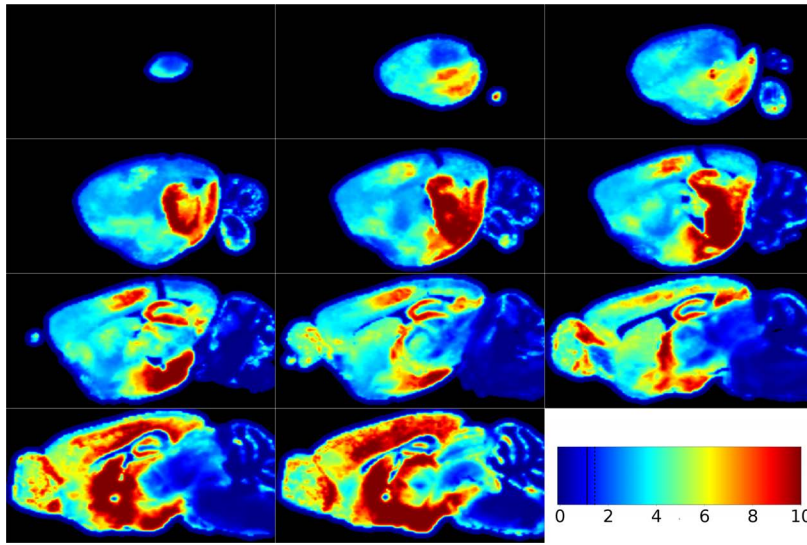
A

B

C

First Order
Second Ord. In
Second Ord. Out
Adora2app
Atp
DLG4
Drd
Epo8
GABRB3
Gap43
GRIA2
GRID1
Grick2
Glk2
GRIN1B
GRIN4B
GHR8
Itr3A
KCNMA1
NRXN1
CLTC1
Slc1a2
Syn1
Syn2
NBEA
HOMER1
Homer2
HOMER3
EYN3
P3DM1
C3DM1
SHANK2
Rps6kB1
GRIPA1
OPHN1
Nlgn1
HDAC4
SHANK1
Nlg1
Nlgh2
Clstn3
Nli2h3
Nlcam
Cadps2

D

E

Supplementary Data 3 Case 28. Synaptic function and structure gene-set of the autism-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows. Red arrows mark selected connections, discussed in the main text.
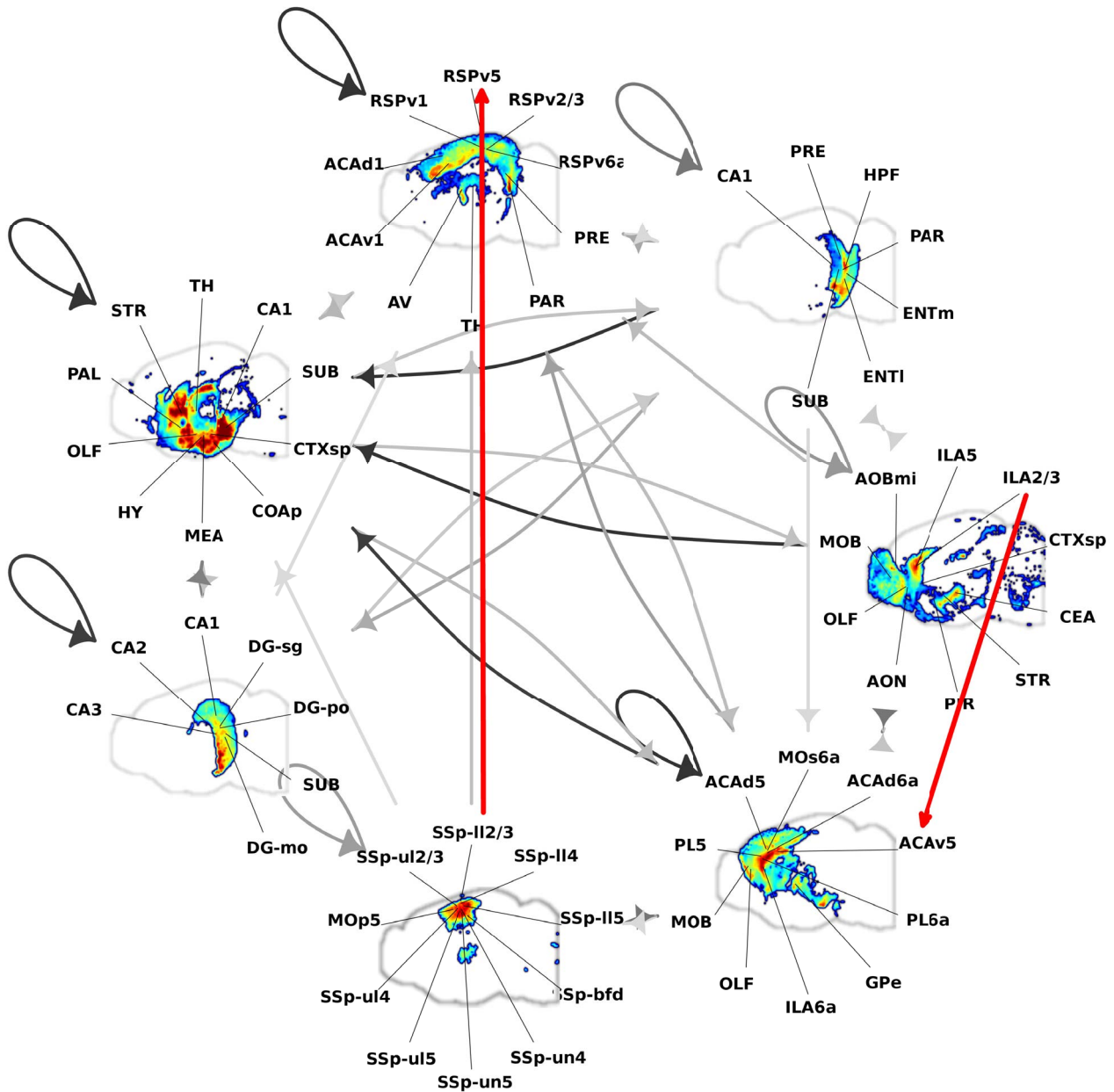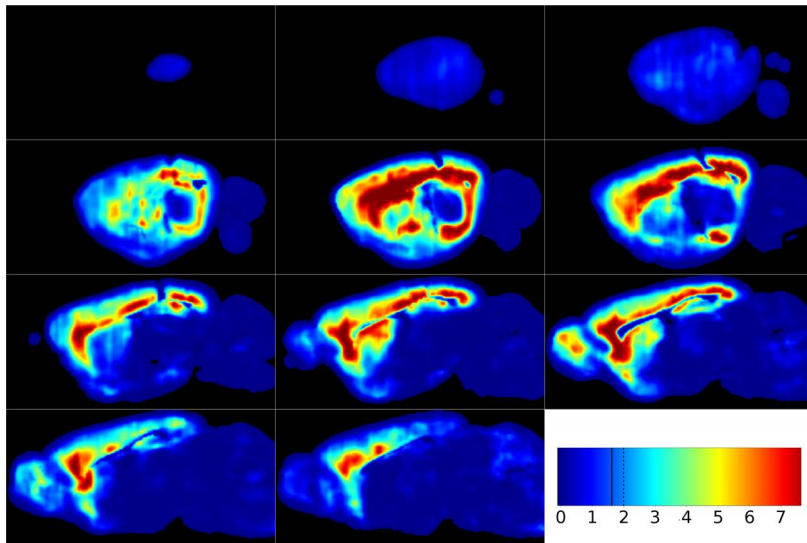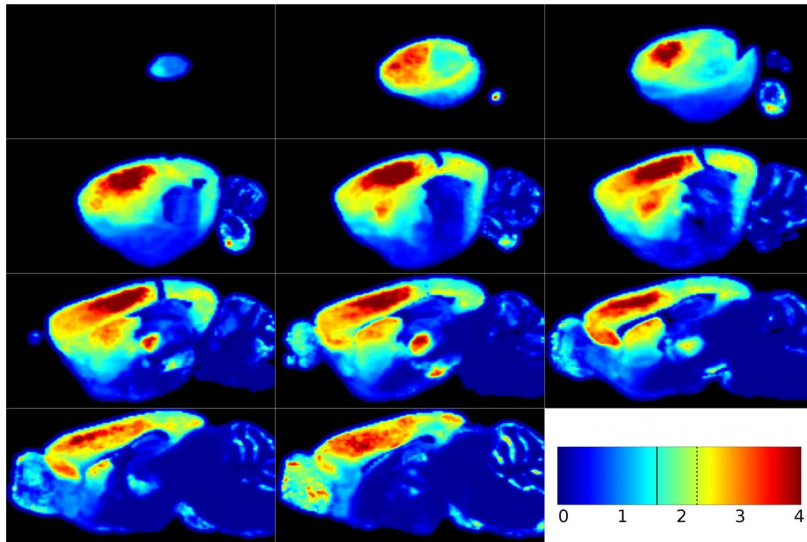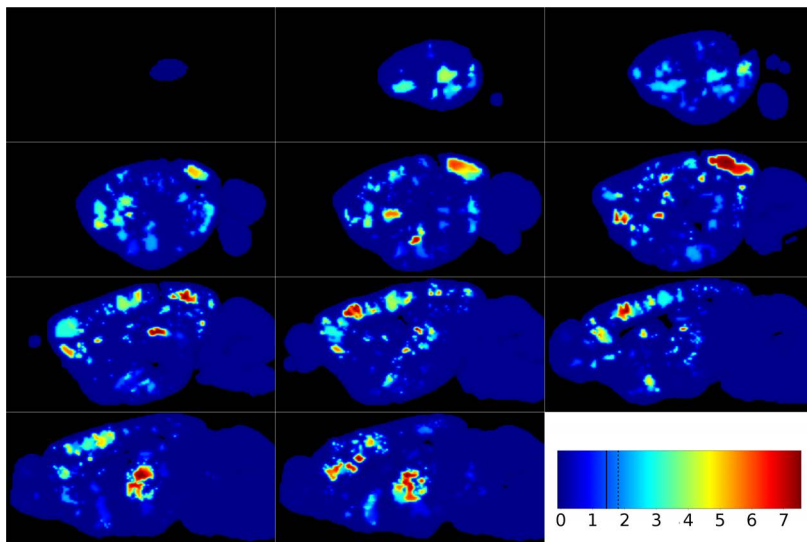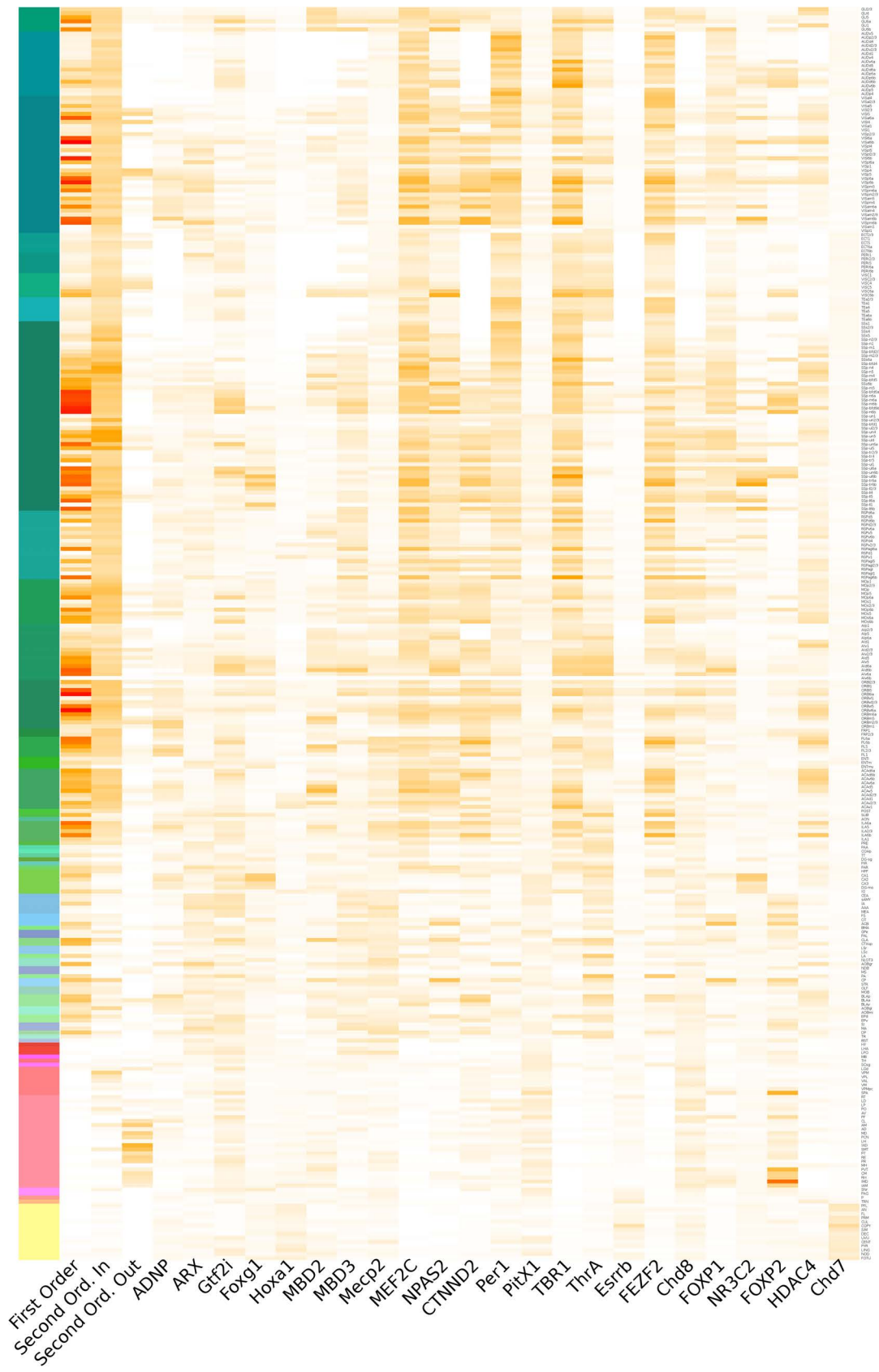
A

B

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D

E

Supplementary Data 3 Case 29. Transcriptional control gene-set of the autism-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows. Red arrows mark selected connections, discussed in the main text.
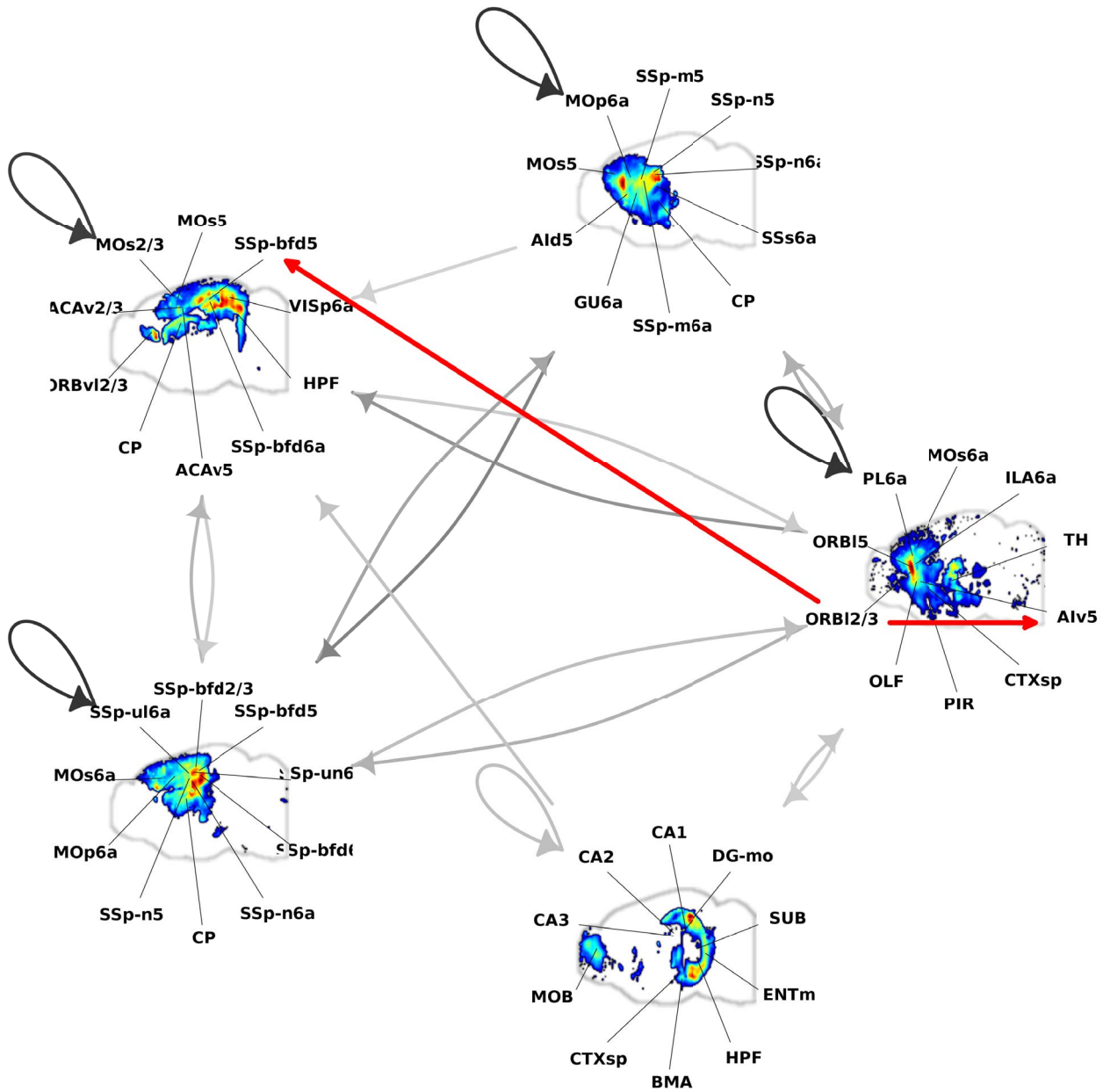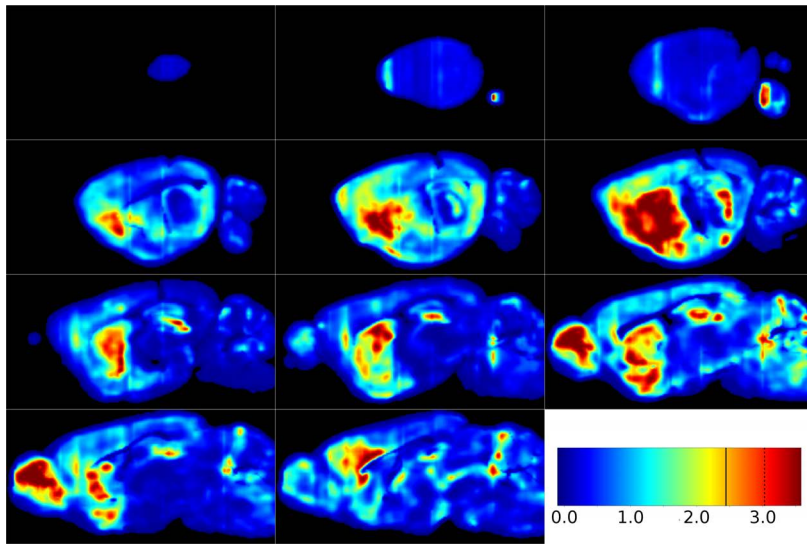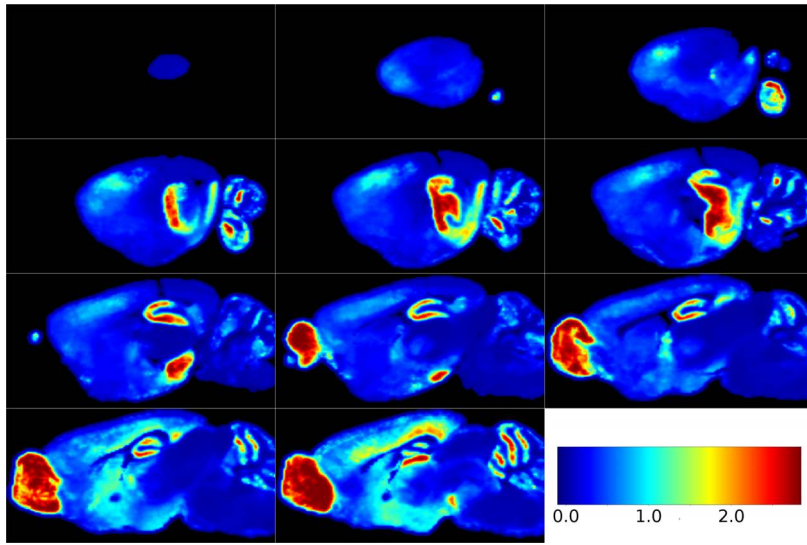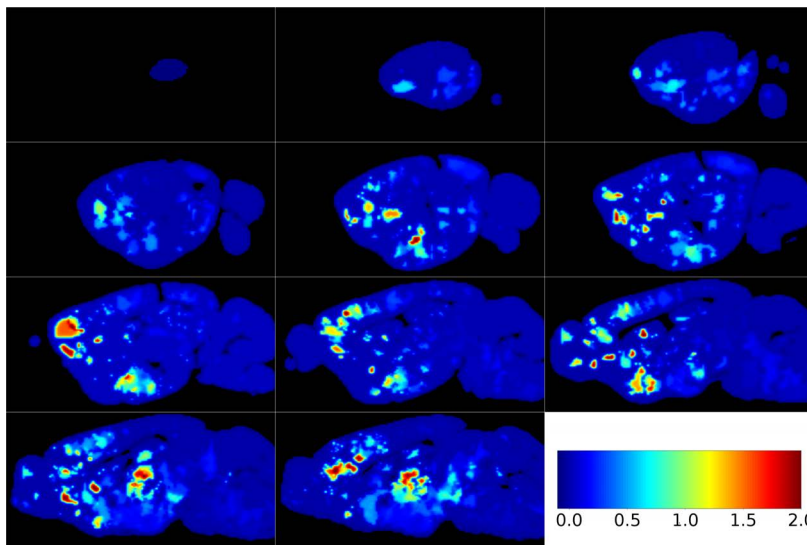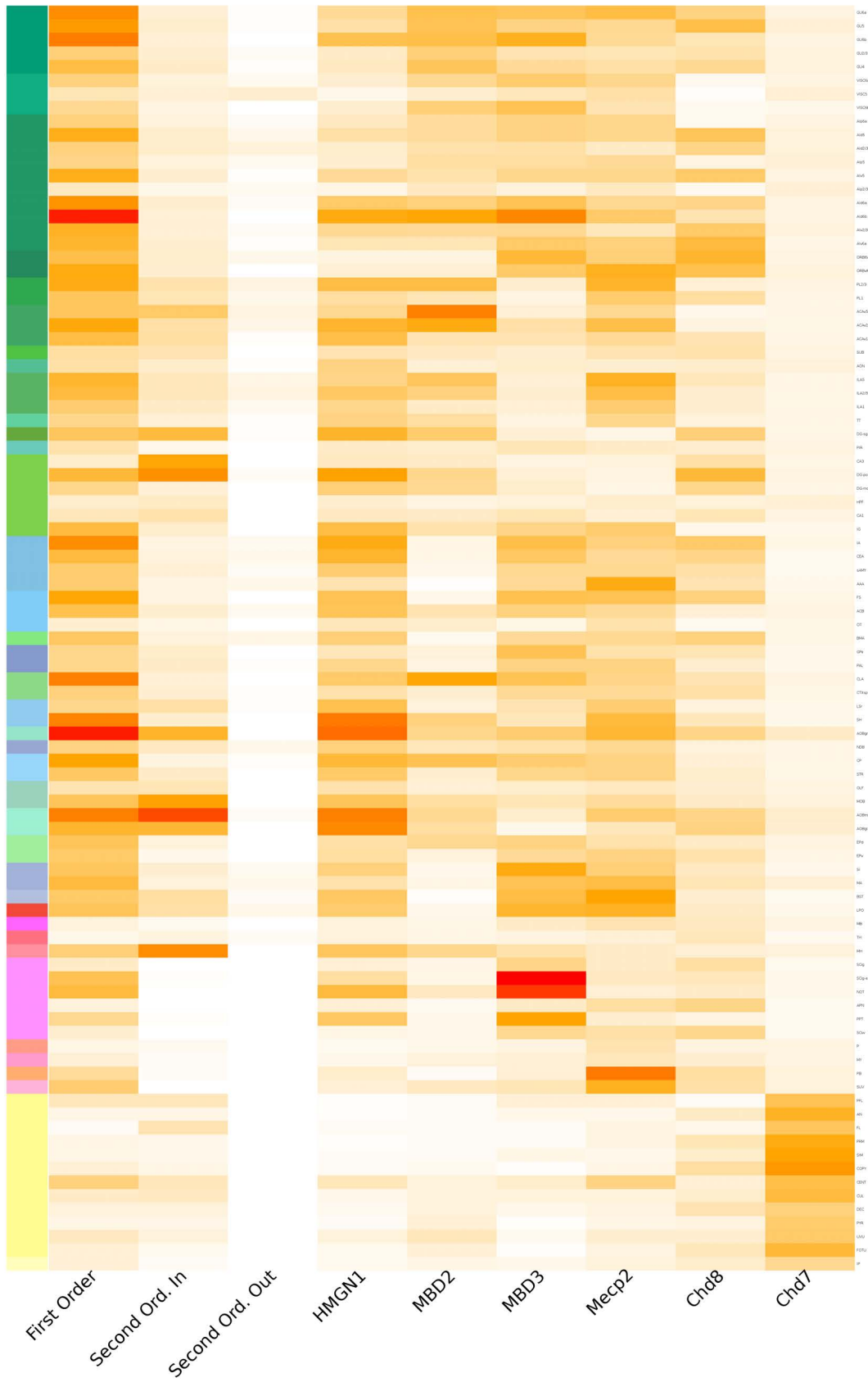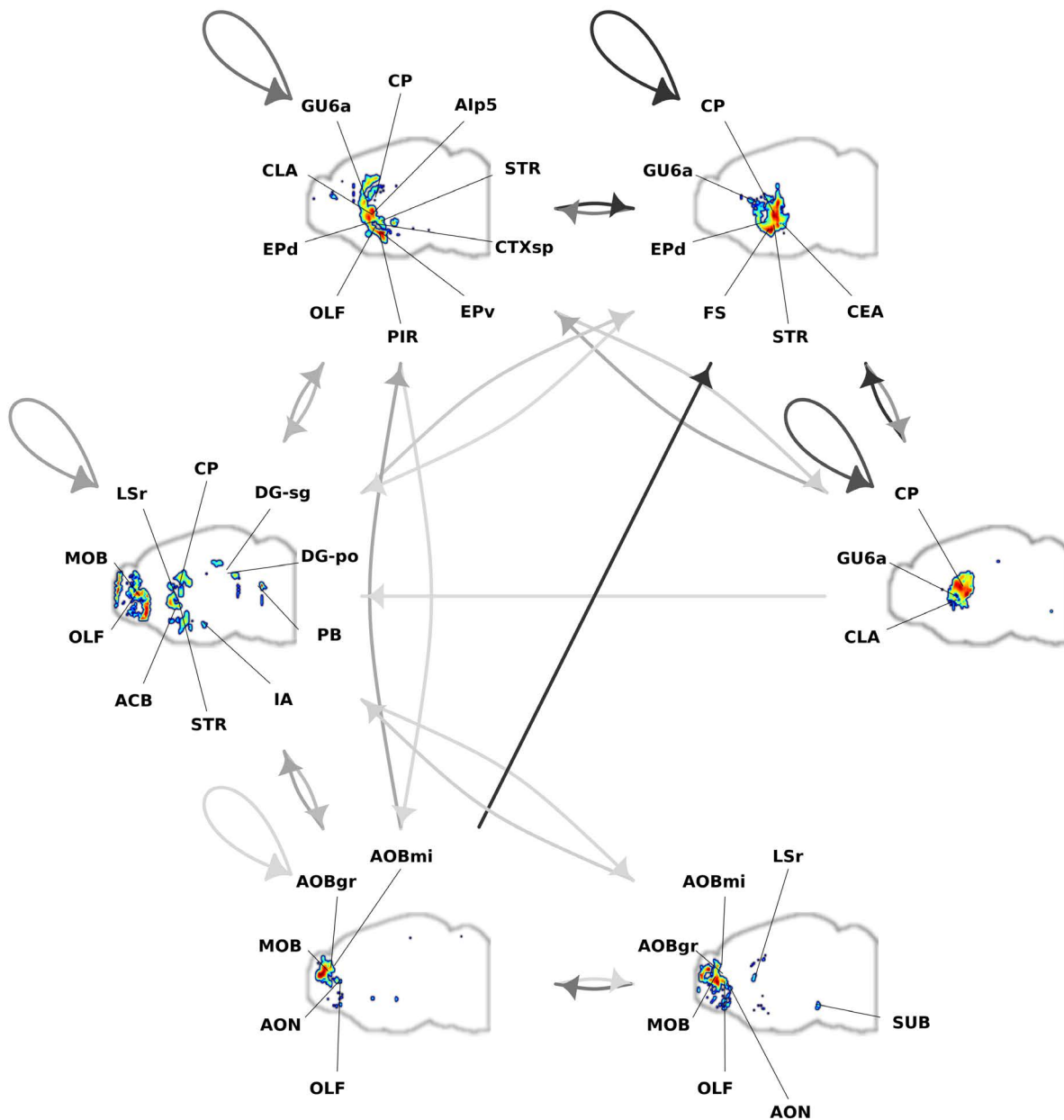
A

B

C

D

E

Supplementary Data 3 Case 30. Chromatin remodeling gene-set of the autism-QTLs. (*A*) Slice-view of first order network measures given as -log10 scaled p-values. (*B*) Slice-view of second order network measures (incoming node strength) given as -log10 scaled p-values. (*C*) Slice-view of second order network measures (outgoing node strength) given as -log10 scaled p-values. (*D*) Heatmap of average log-scaled p-values of first and second order effects as well as single gene effects. (*E*) Clustered network graph. Clusters of significant brain regions (FDR=0.05) with similar connectivity and their structural connectivity (normalized by the injection volume) given as grey-scale arrows.