

Supplementary Information

Pokhilko A., et al. Targeted single-cell RNA sequencing of transcription factors enhances the identification of cell types and trajectories

Table of content

Supplementary Figures	p. 2
Figure S1	p. 2
Figure S2	p. 3
Figure S3	p. 5
Figure S4	p. 7
Figure S5	p. 8
Figure S6	p. 15
Figure S7	p. 16
Figure S8	p. 17
Figure S9	p. 19
Figure S10	p. 21
Figure S11	p. 22
Supplementary Tables	p. 23
Table S1	p. 23
Table S2	p. 39
Table S3	p. 43
Table S4	p. 44
References	p. 44

Figure S1. Capture-Seq improves the quality of scRNA-seq libraries and enriches for targeted TFs. **a**, Post-capture enrichment of 585 captured TFs detected pre-capture. For each gene the enrichment was calculated a ratio between the average CPMs in the post- and pre-capture libraries, plotted in log2 scale after adding a pseudocount of 1 (Curion et al. 2020). **b**, Linear correlation between the pre- and post-capture averaged expression (raw counts) of 585 common TFs. ERCC spike-ins targeted by scCapture-seq are shown in red.

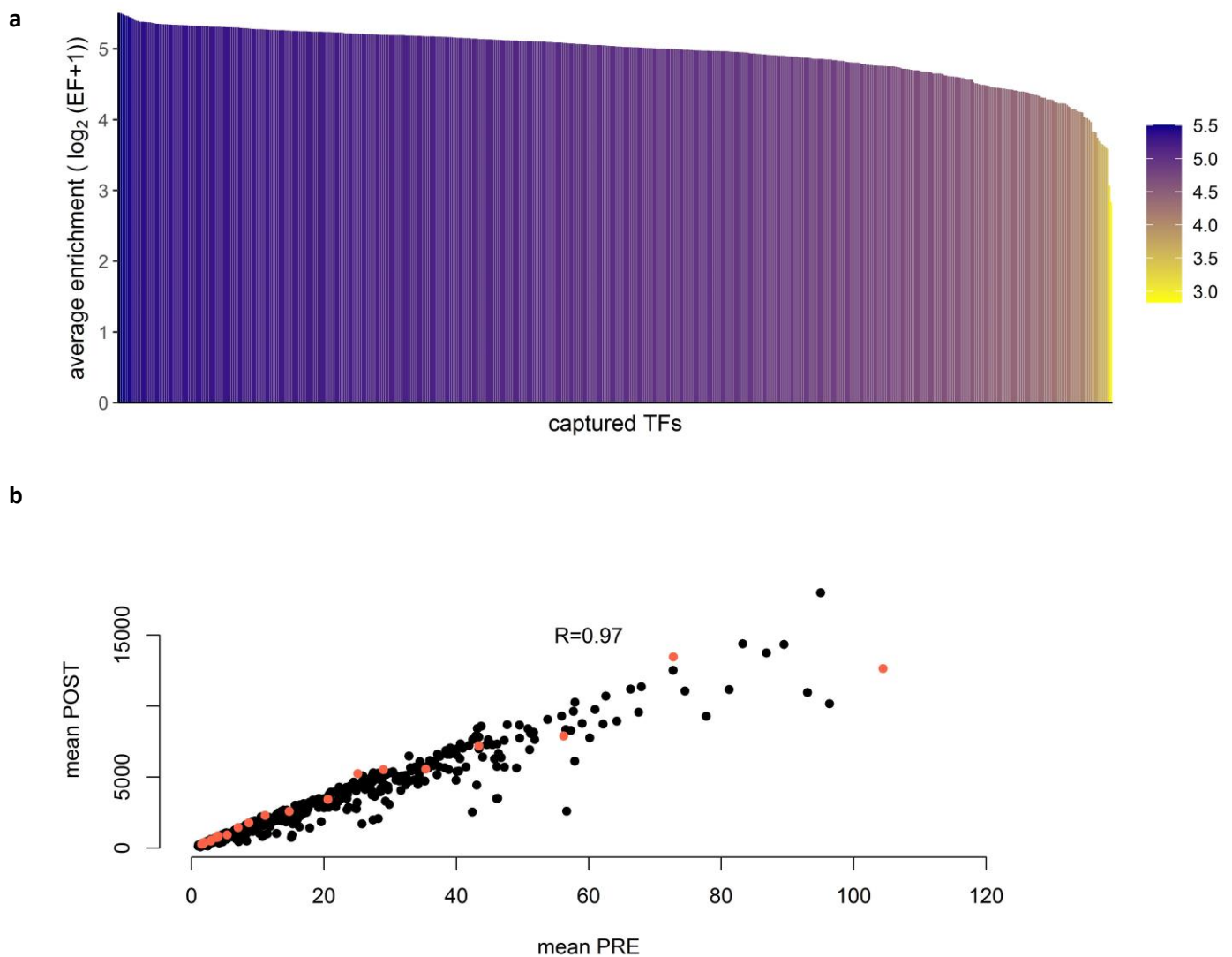
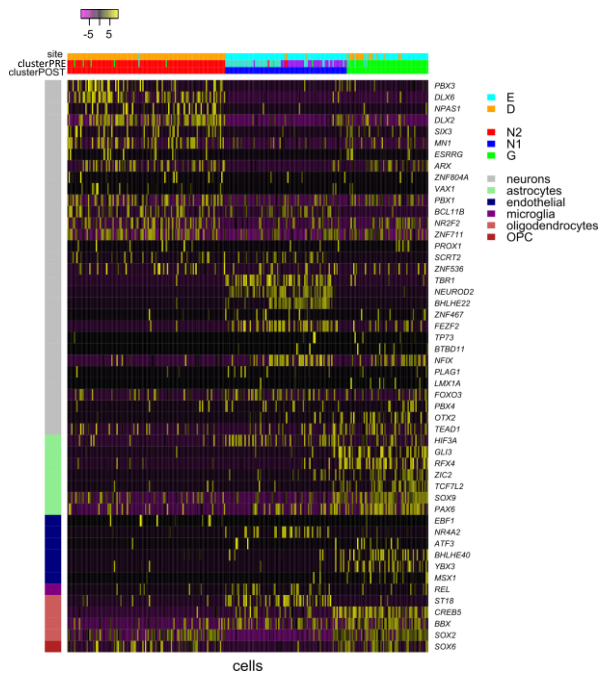
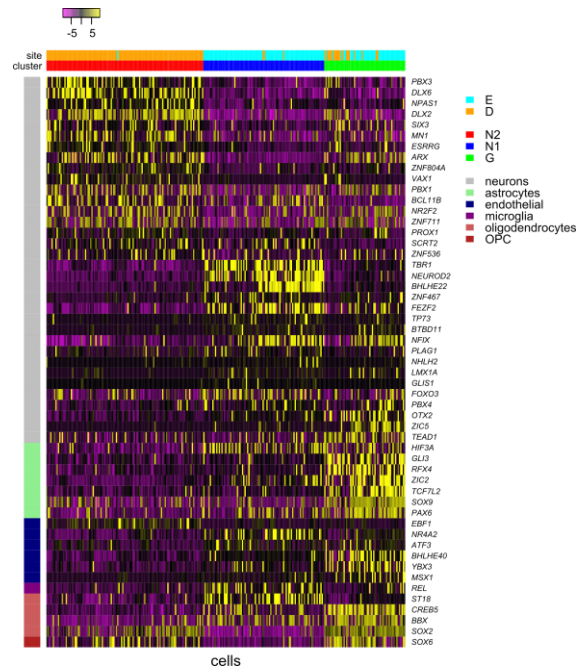


Figure S2. Characterization of cell clusters in pre- and post-capture libraries. **a,b,** Heat maps of cell type TF markers, which were differentially expressed post-capture (b), and their pre-capture expression (a). **c,d,** Heat maps of TF DEGs, which were differentially expressed post-capture (d,e) and their expression in pre-capture (c). Cells are ordered by post-capture clusters on a-d, as annotated above the heatmaps. The assignment of cells to pre-capture clusters is also annotated on a,c. The expression is log-normalized and centred. Only 52 out of 155 post-capture TF DEGs are labelled on c, d, for clarity of the heatmaps. The full list of TF DEGs is shown on e (the larger version of d).

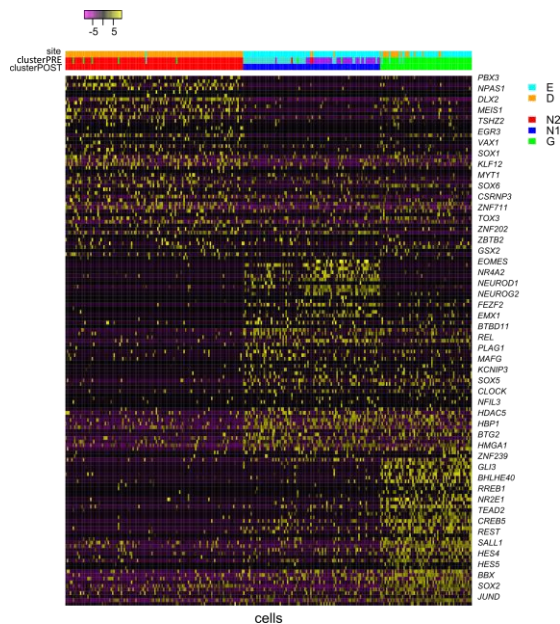
a TF markers pre-capture



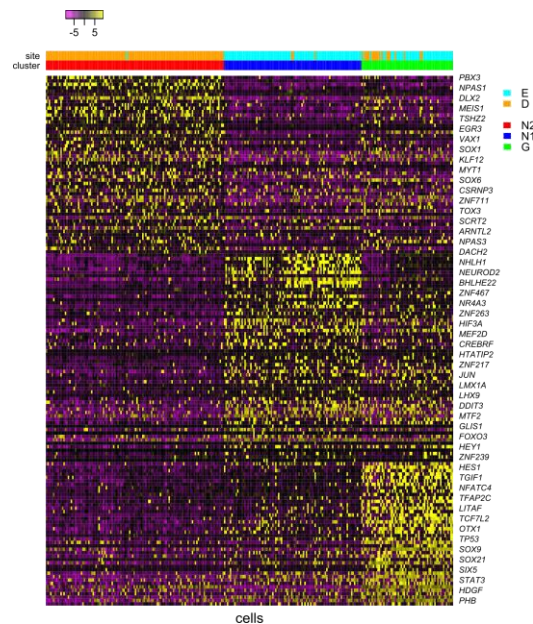
b TF markers post-capture



c pre-capture DEGs



d post-capture DEGs



E

post-capture DEGs

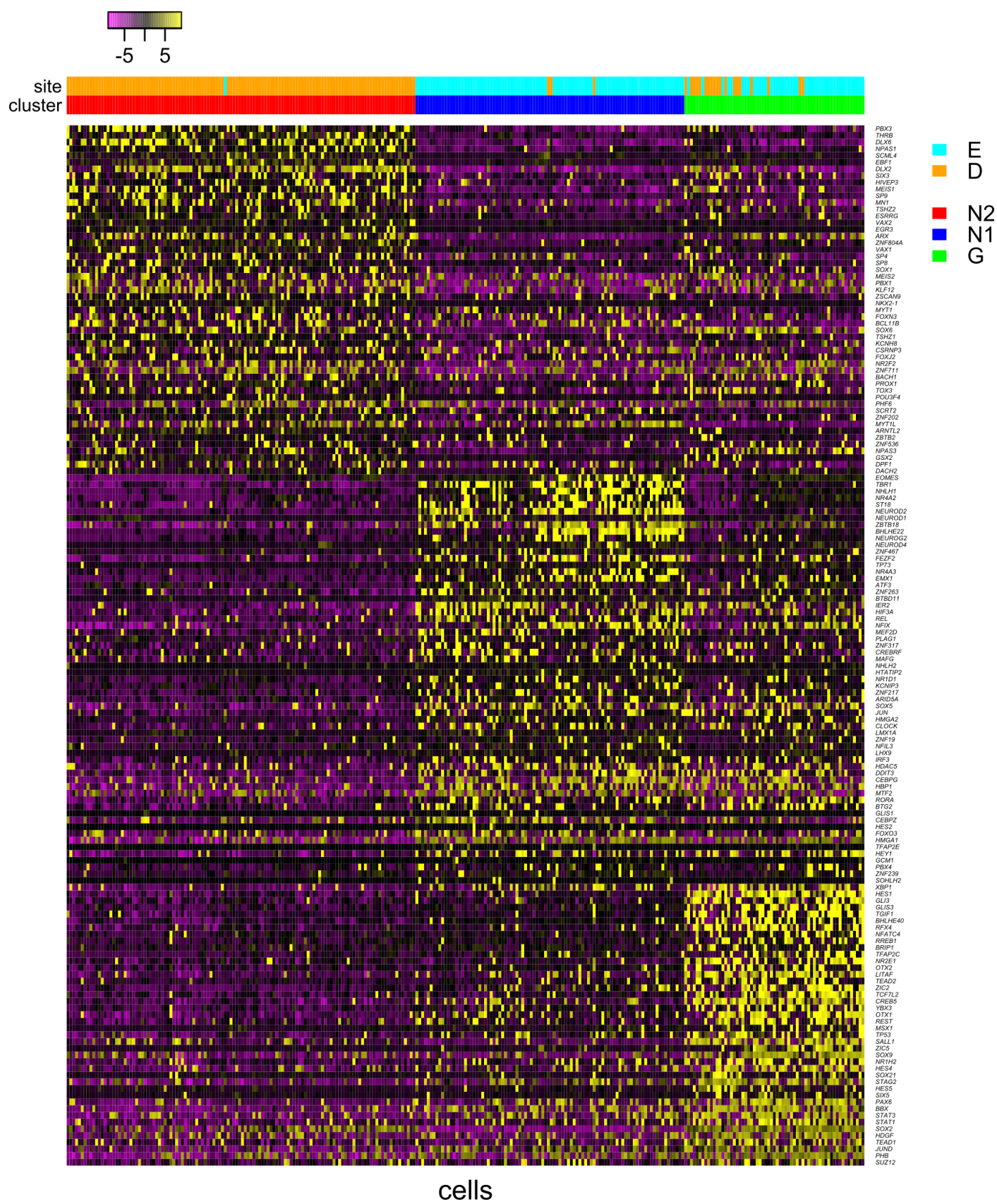
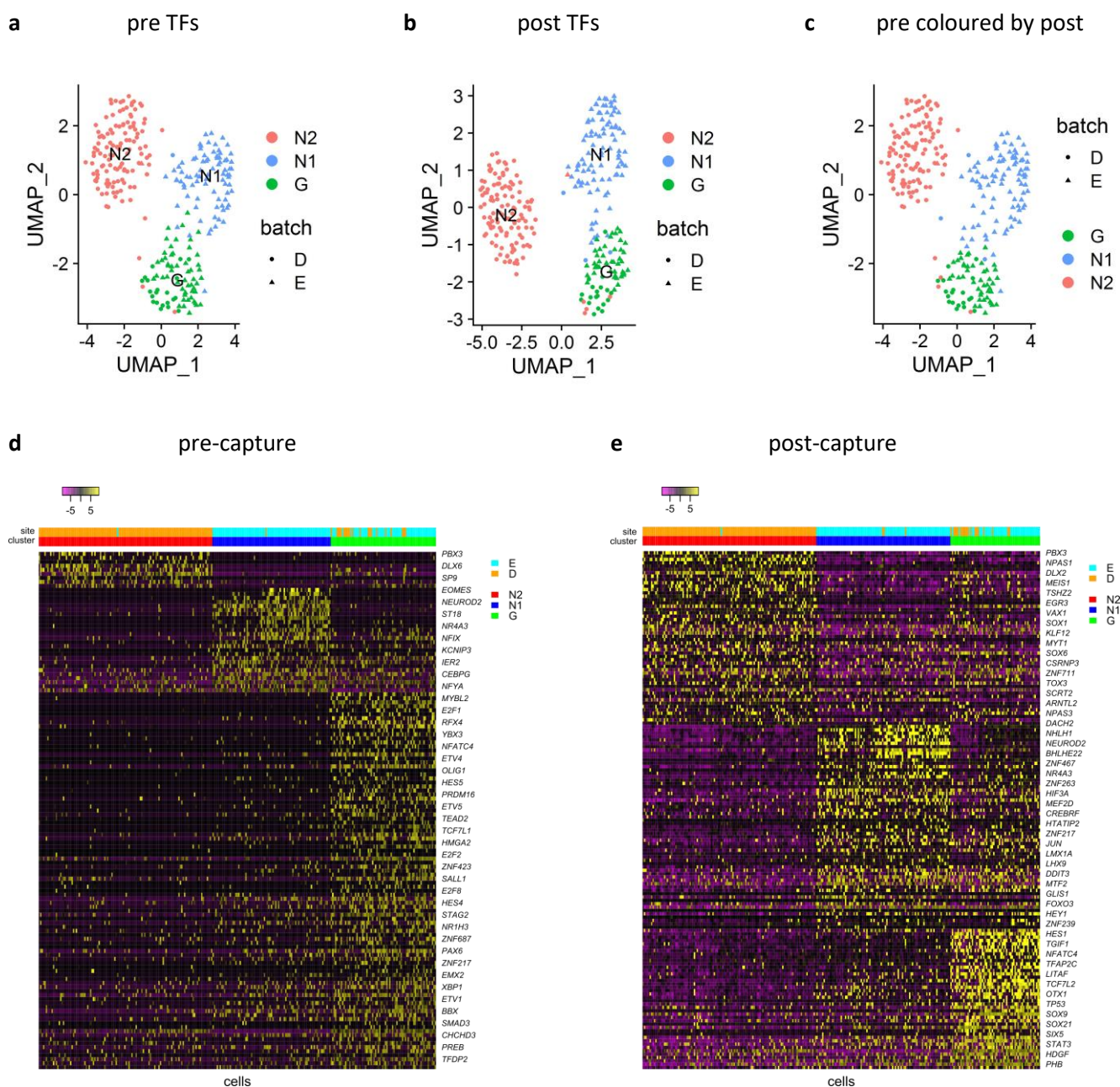


Figure S3. Comparison of the clustering of pre- and post-capture TFs. The clustering and differential expression were performed in Seurat using pre- and post-capture expression of the captured TFs. **a,b,c**, Umaps of cell clusters using 585 pre-capture (a) or 731 post-capture TFs (b). **c** Clustering of 585 pre-capture TFs coloured by the post-capture clusters of the panel b, illustrating that cell identities are preserved between a and b. **d,e**, Heat maps of differentially expressed TFs for a and b. The capture improves the detection of TFs, resulting in a substantial enrichment with N2 DEGs (e). Only 43 out of 129 pre-capture TF DEGs are labelled on d, and 52 out of 155 post-capture TF DEGs are labelled on e, for clarity of the heatmaps. The full list of post-capture TF DEGs is shown on Fig. S2e (larger version of Fig. S3e), while the full list of pre-capture TF DEGs is shown on Fig. S3f (larger version of Fig. S3d).



f

pre-capture

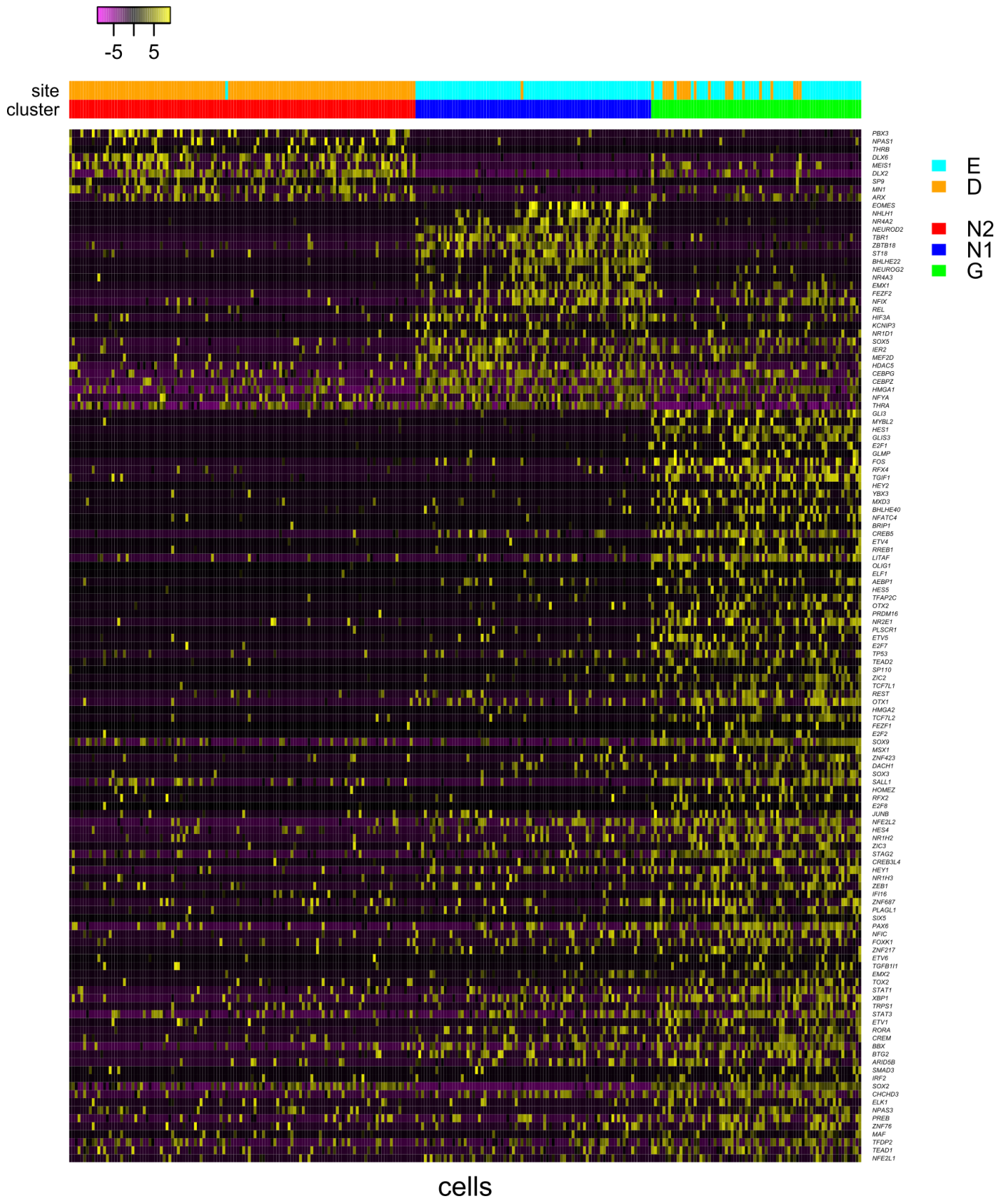


Figure S4. Numbers of cells expressing key TFs of the early differentiation stages from (Inoue et al. 2019) in each of 3 groups of cells (N1, N2 and G). The lab D N2 neurons, G cells and lab E N1 neurons were defined by clusters 1, 2 and 3+4 for pre-capture and by clusters N2, G and N1 for post-capture cells. Pre- and post-capture numbers of cells are shown by empty and solid circles, respectively.

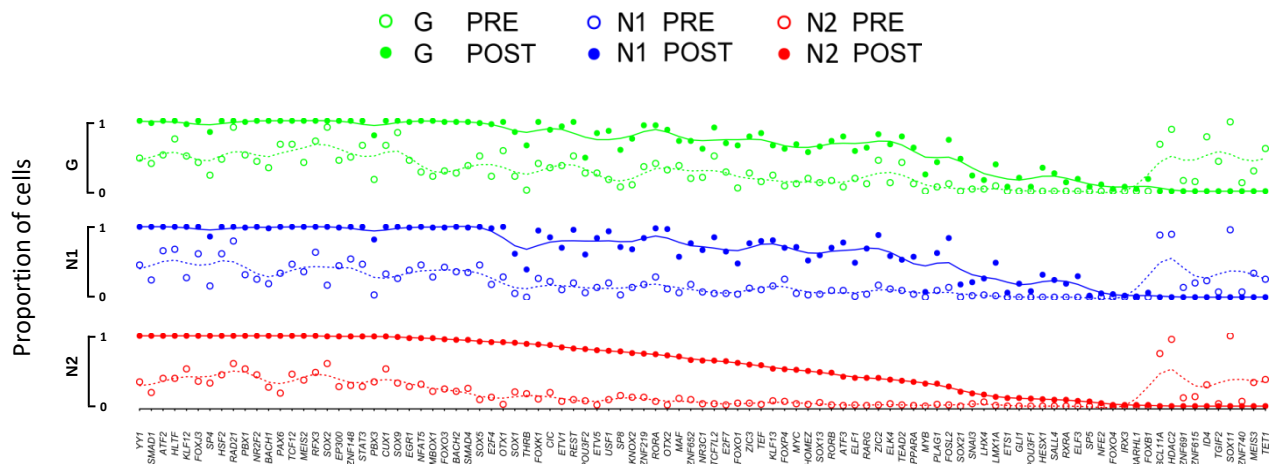
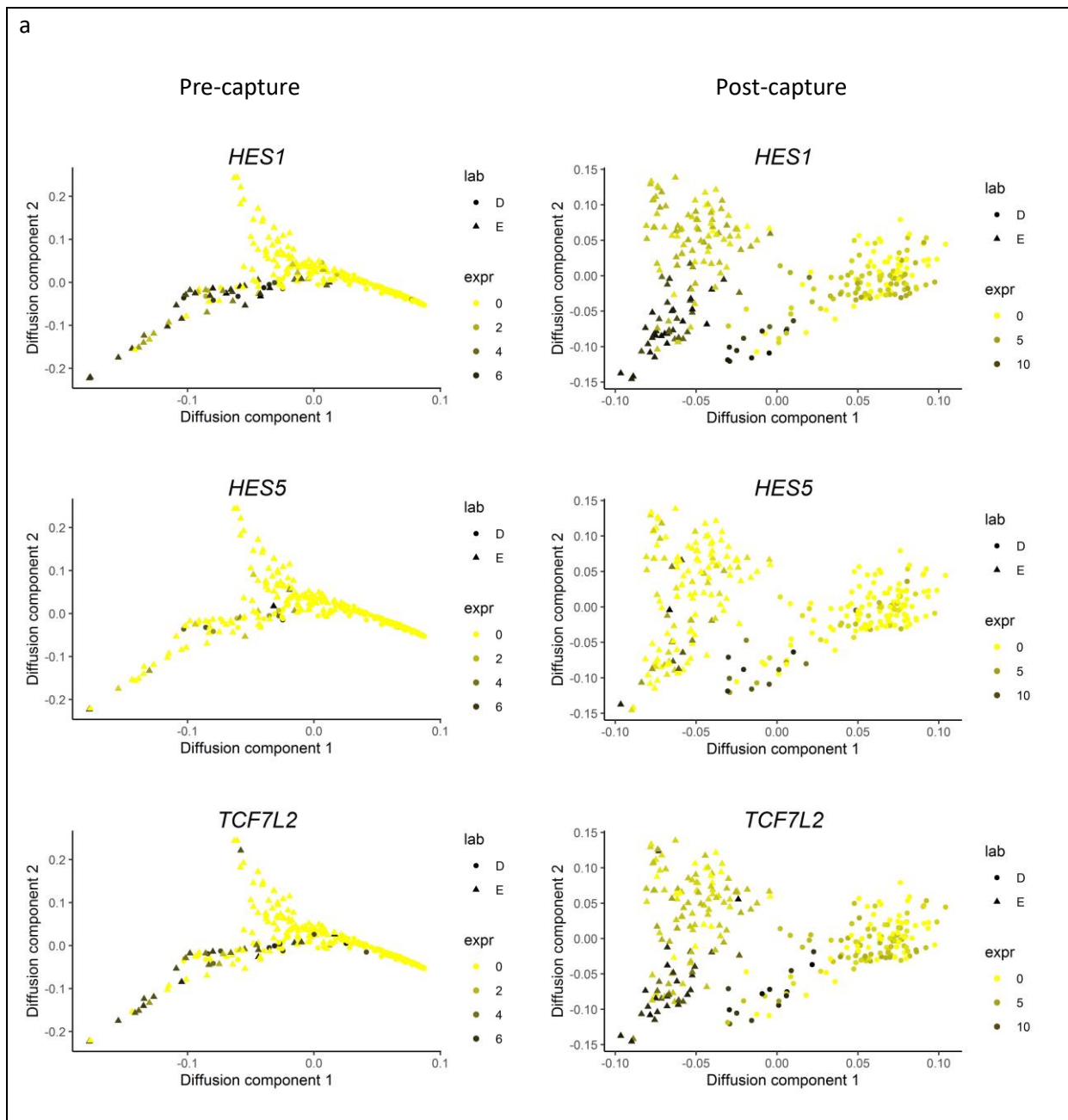
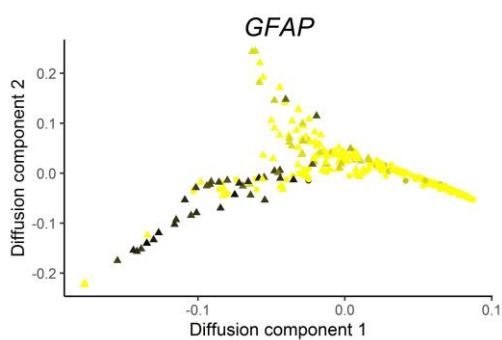
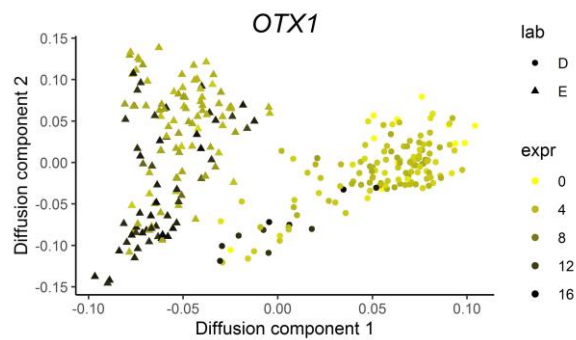
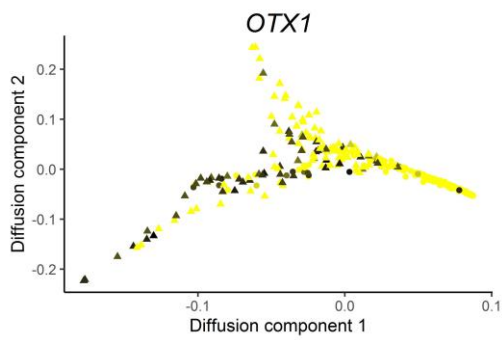
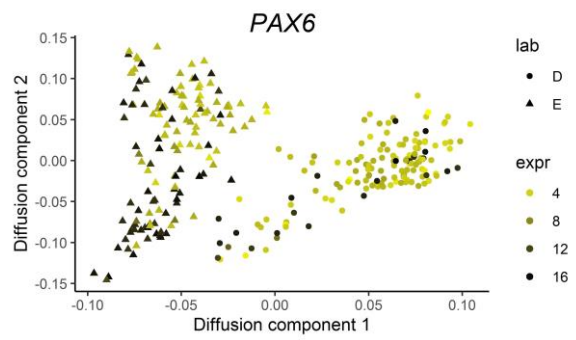
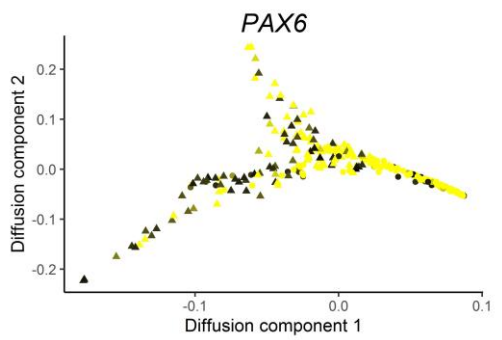
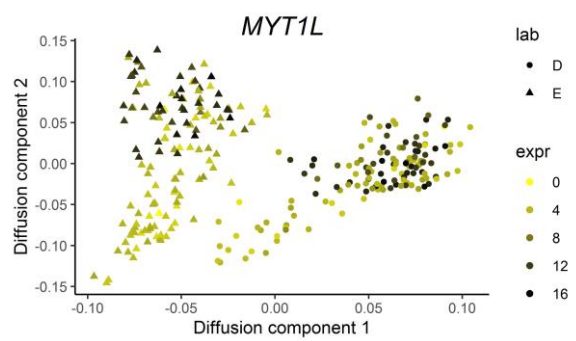
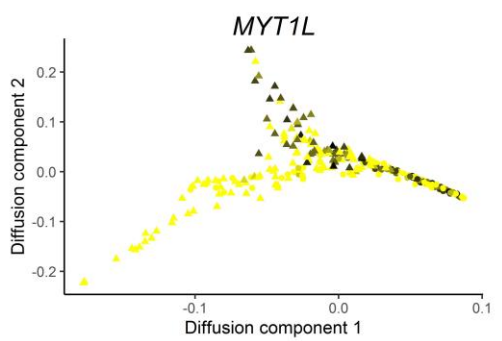
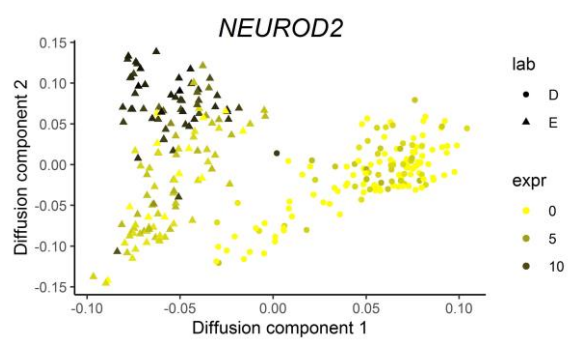
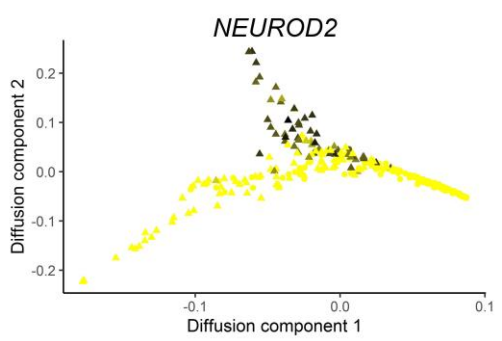


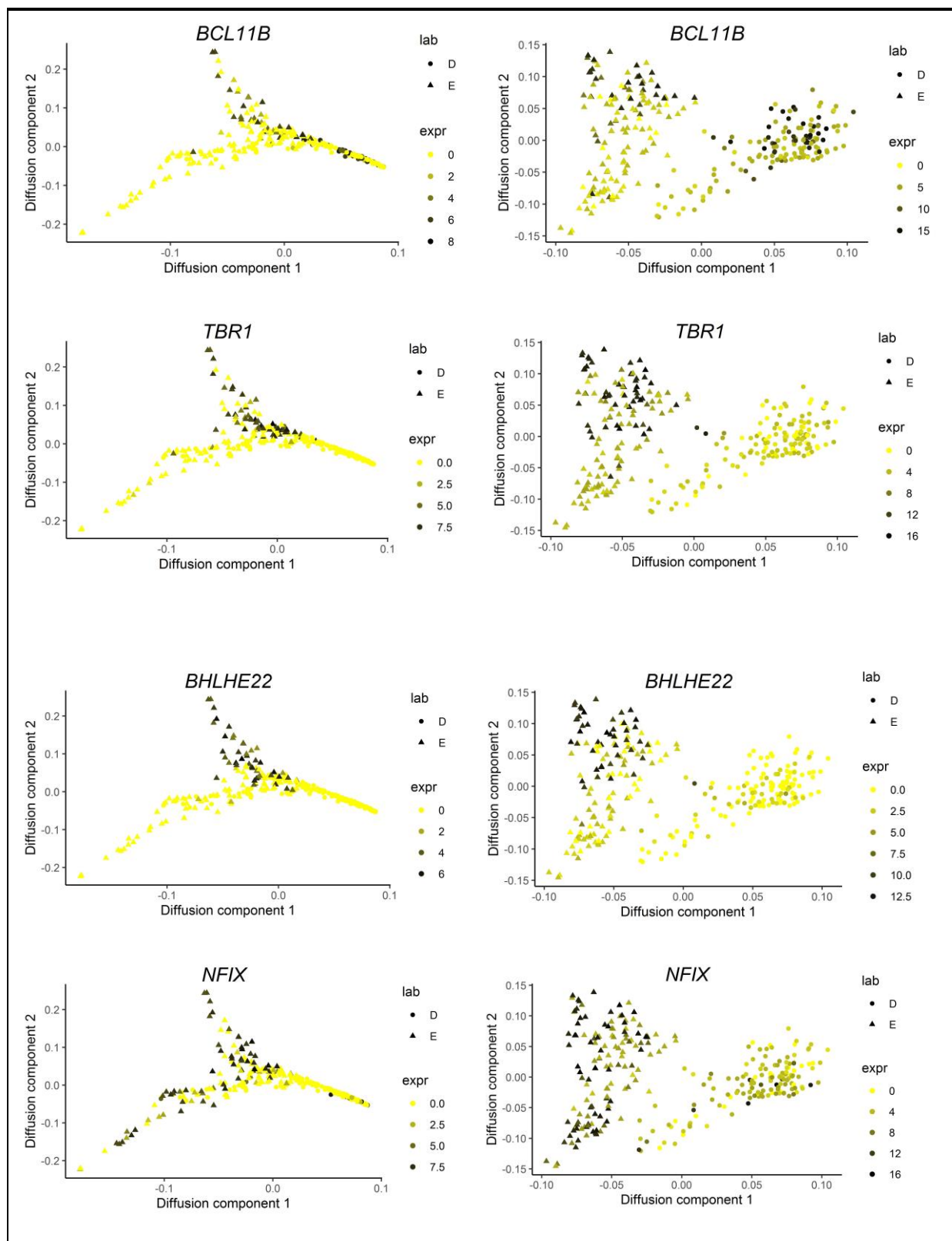
Figure S5. Expression of pre- and post-capture TFs in pseudotime space. **a** and **b** indicate TFs differentially expressed between clusters (a) or labs (b). **a** includes TF with clear maturation kinetics, such as *GFAP*, *HES1*, *HES5*, *PAX6*, *NR2E1*, *TCF7L2*, *OTX1*, corresponding to a radial glial proliferative stage and TFs of early stage of neuronal maturation (*NEUROD2*, *TBR1*, *BCL11B*, *BHLHE22*, *NFIX*). **b** shows some of TFs, which were differentially expressed between labs D and E and potentially involved in the developmental switch between N1 and N2. The expression was calculated as log2 of counts after adding 1.

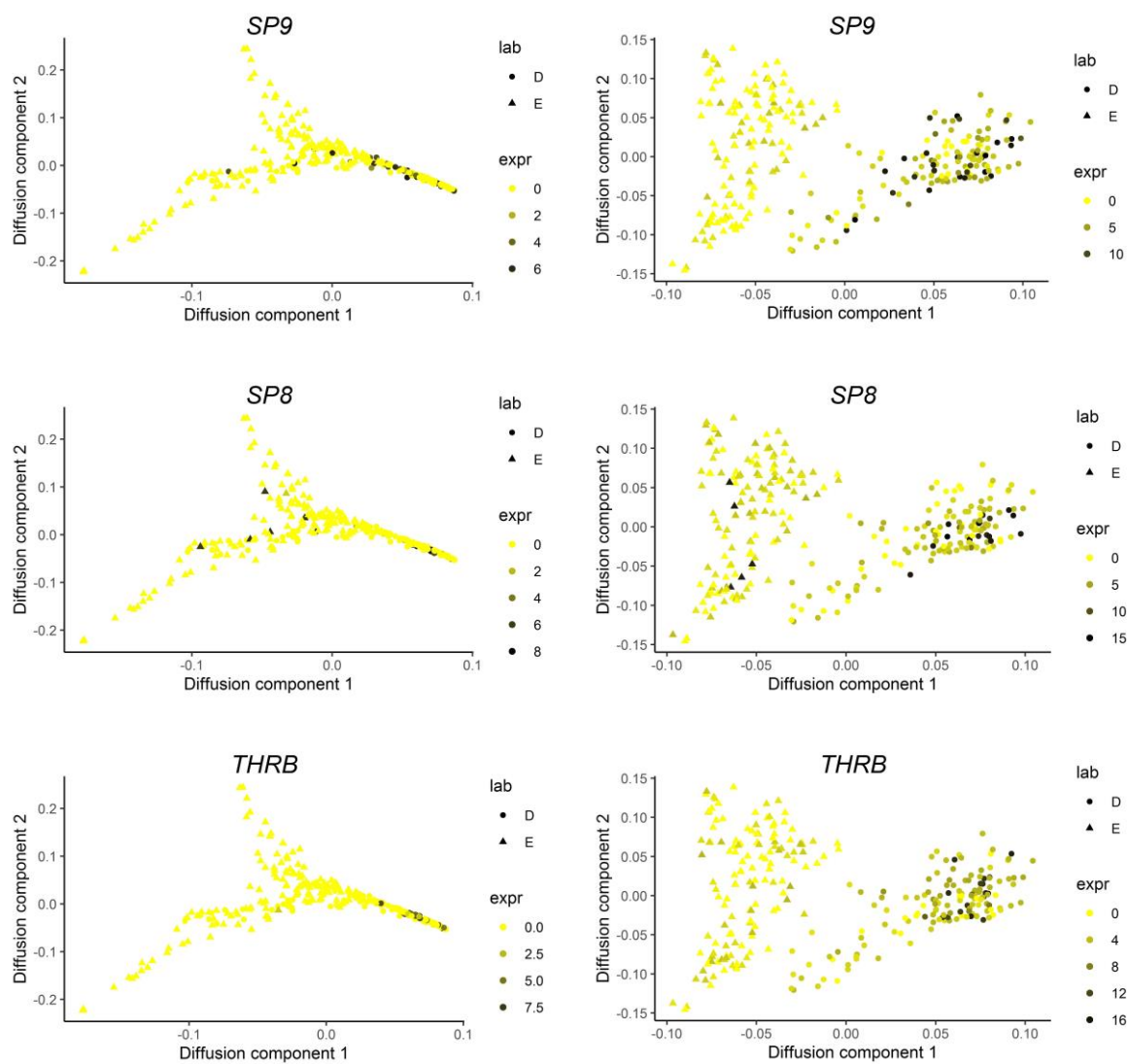




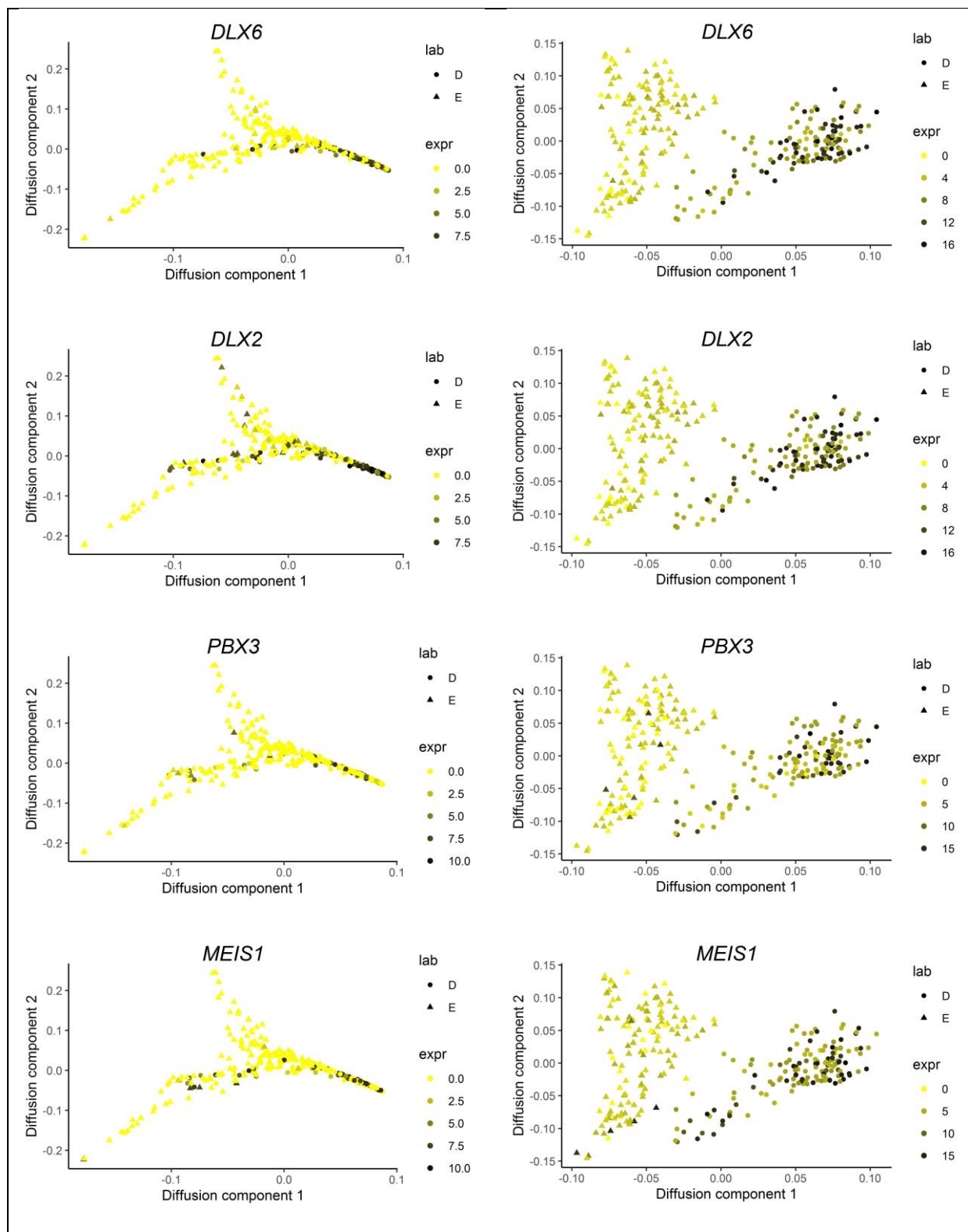
NA (RGC marker, not TF)

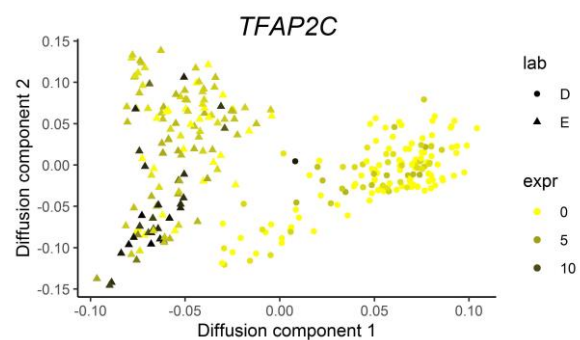
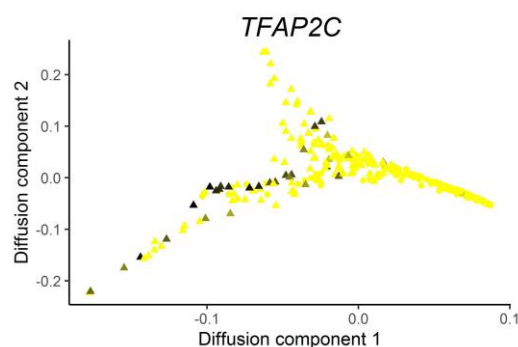
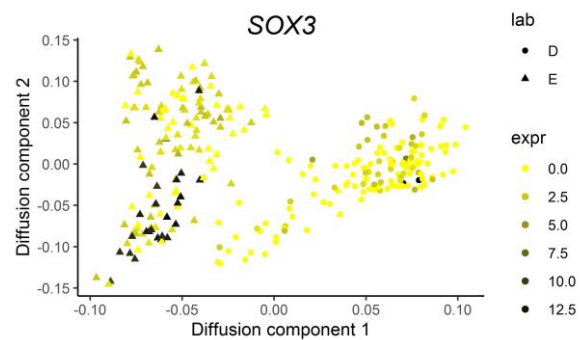
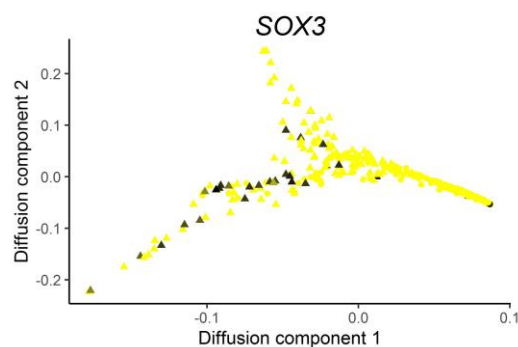
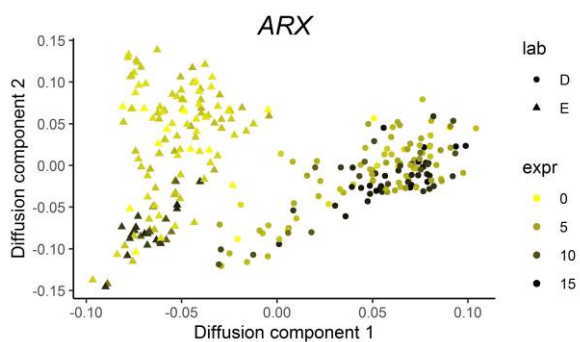
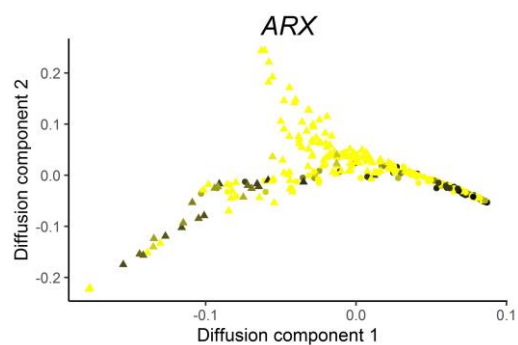
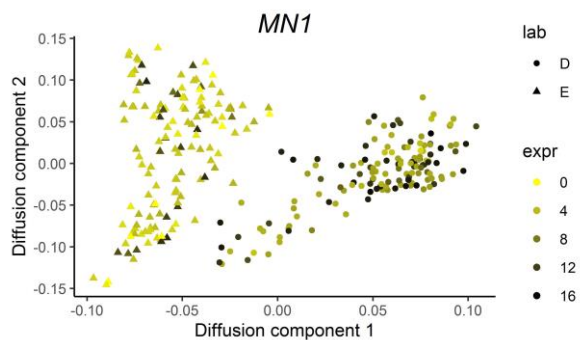
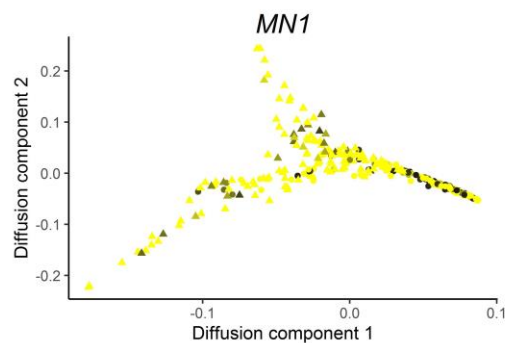






b





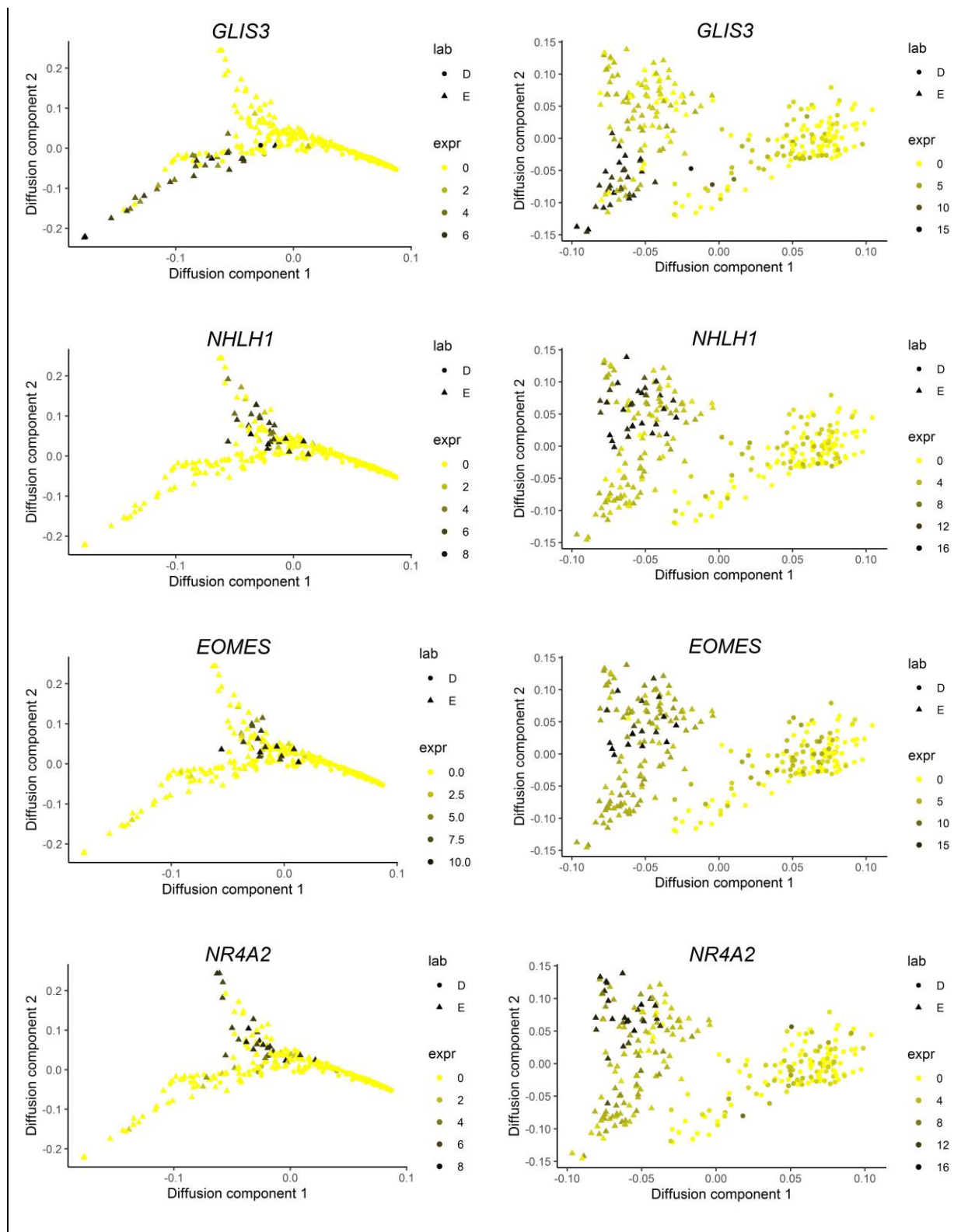


Figure S6. Volcano plots of TFs differentially expressed between Lab E and Lab D cells. **a**, Pre-capture TF DEGs between N1 and N2 neurons (based on expression of 585 targeted TFs). **b**, post-capture TF DEGs between G cells from lab D and lab E. Significant TF DEGs are labelled (FDR ≤ 0.05 , natural log fold changes ≥ 0.5).

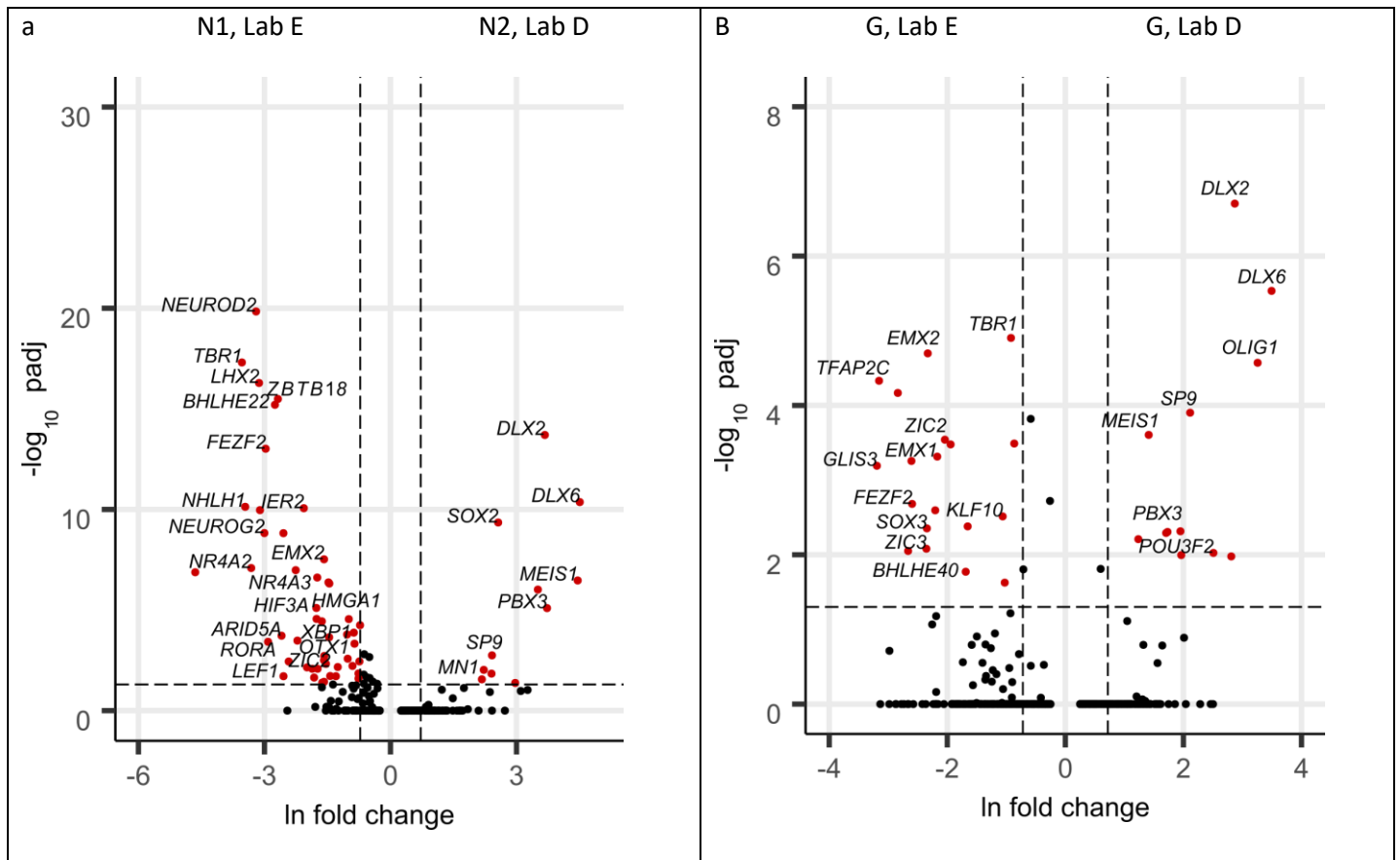


Figure S7. Analysis of GRN TFs related to retinoic acid (RA) signalling. **a**, Co-expression subnetwork of the GRN of Fig. 4b, including TF PPIs involved in retinoic acid signalling. The network was built using TFs belonging to *RARA*, *RXRRA* and *CEBPB* terms of TF PPI of cluster N2 (Fig. 4e, Table S2). The TF PPIs are marked with orange borders and they are plotted together with the neighbours on the GRN of Fig. 4b. The network genes are coloured as indicated in the legend. Thicker edges show direct connections between the TF PPIs and GRN genes. Orange and blue colour of the edges correspond to positive and negative correlation, respectively. Noticeably, many of N2 DEGs (e.g., *DLX2*, *DLX6*) are negatively correlated to RA TFs (e.g., *RORA*, *NR1H2*, *ZNF423*). **b**, Heatmaps of post-capture log2 expression of the TFs from RA-related TF PPIs. The cells from different labs are ordered by pseudotime.

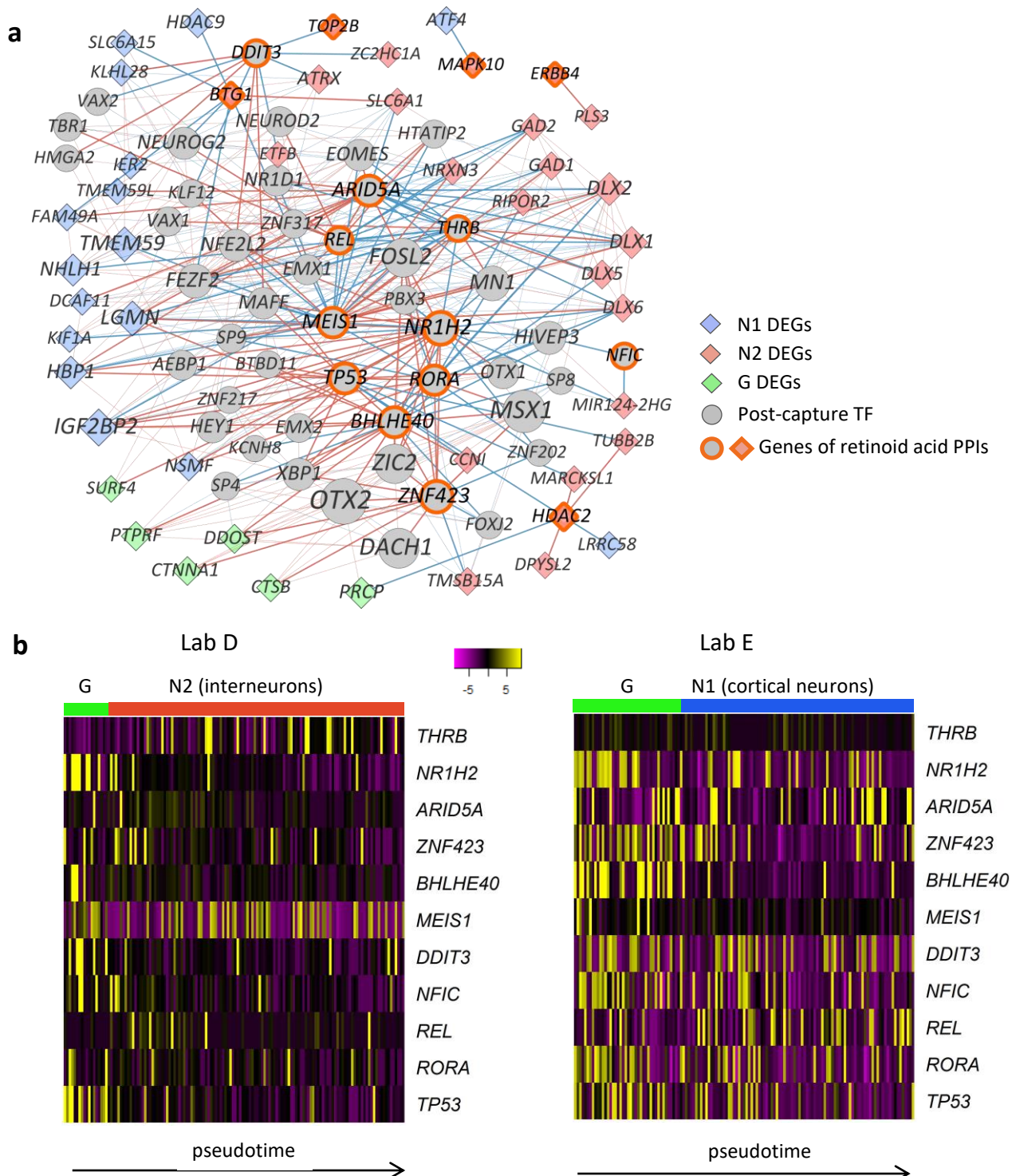


Figure S8. Validation of scCapture-seq with intestinal stromal cells from UC patients. Capture-Seq improves the quality of scRNA-seq libraries and enriches for targeted TFs. **a**, Linear correlation between the pre- and post-capture averaged expression (raw counts) of 530 common TFs, expressed both pre- and post-capture. ERCC spike-ins are shown in red. **b**, Post-capture enrichment of the captured TFs detected pre-capture. For each gene the enrichment was calculated a ratio between the average CPMs in the post- and pre-capture libraries, plotted in log2 scale after adding a pseudocount of 1 (Curion et al. 2020). **c**, Increase in the number of TFs detected per cell post-capture. **d**, UMAPs of pre - (left) and post- (middle) captured clusters show 2 cellular clusters. UMAPs were constructed using Seurat package (Stuart et al. 2019). The right panel shows post-capture cells coloured by pre-capture clusters. **e**, **f**. Feature plots of differentially expressed TFs pre- (e) and post- (f) capture in low-dimensional space, using Seurat package on ln-transformed expression values

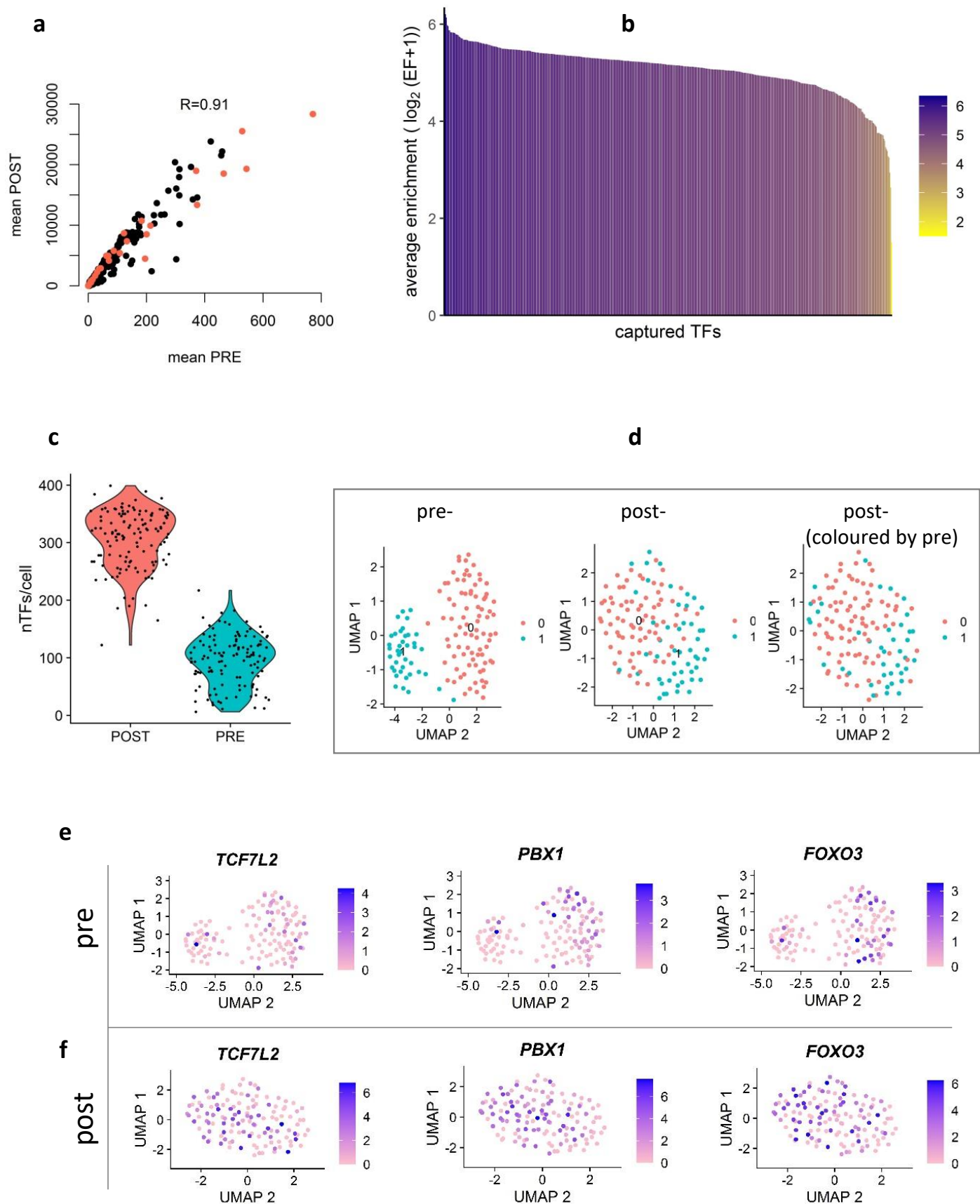


Figure S9. Validation of scCapture-seq with NG capture in iPSC cortical neurons. **a**, Linear correlation between the pre- and post-capture averaged expression (raw counts) of 71 common NGs, expressed both pre- and post-capture. ERCC spike-ins are shown in red. **b**, Post-capture enrichment of the common NGs. **c**, Increase in the number of TFs detected per cell post-capture. **d**, UMAPs of pre - (left) and post- (middle) captured clusters, as well as post-capture cells coloured by pre-capture clusters (right). The clustering was performed on all (pre-capture) or targeted (post-capture) expressed transcripts. **e**, Heatmap of post-capture NG DEGs. **f**. Typical feature plots of NG DEGs.

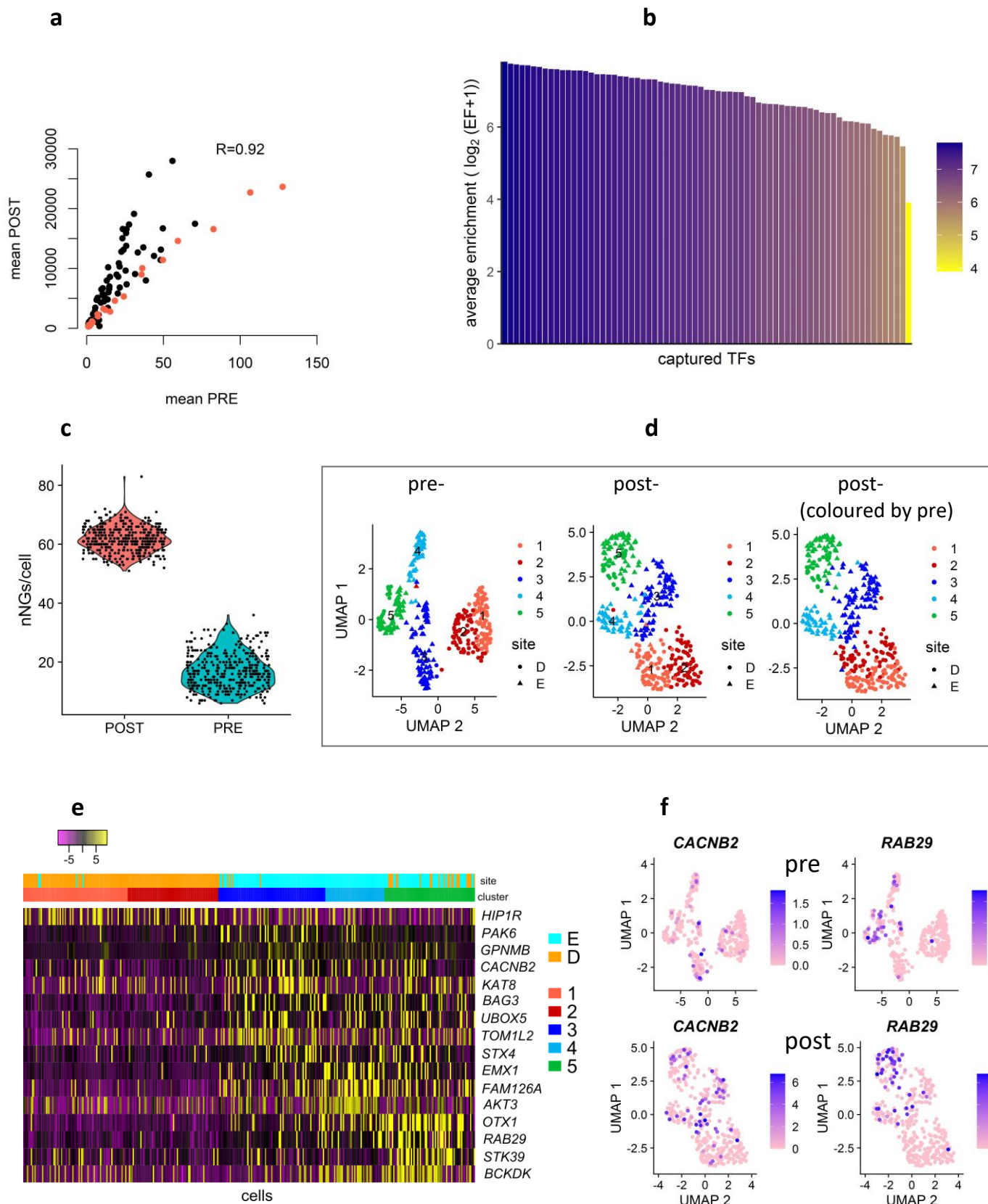


Figure S10. Characterization of cell clusters in pre-capture libraries of iPSC-derived cultures of cortical neurons used for NG capture. Heat map shows cell type marker DEGs. The expression is log-normalized and centred.

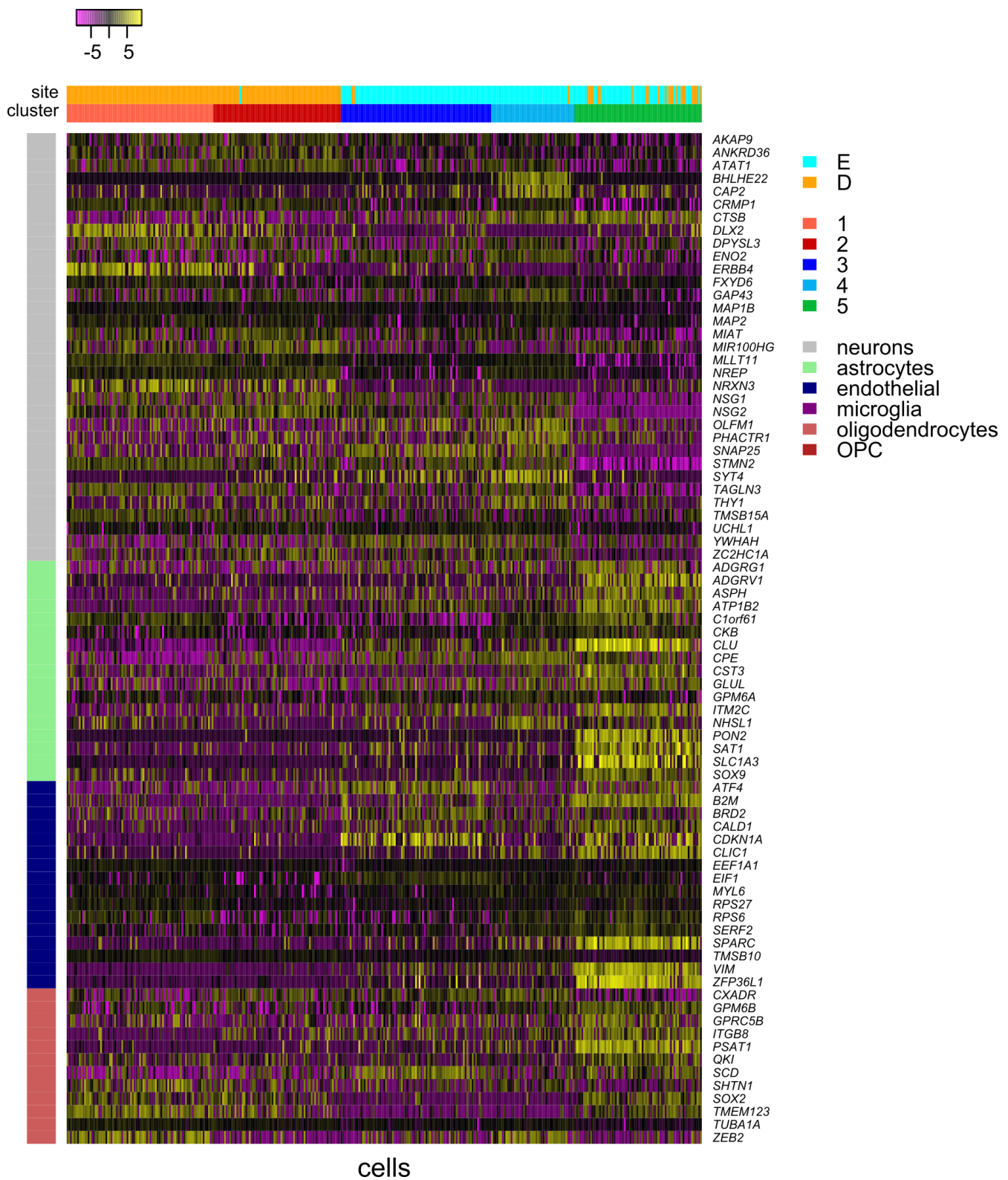


Figure S11. Comparison of read mapping between neuronal and gut libraries generated using SMART-seq2 or 10x Genomics sequencing. The mapping is shown for *SP1* gene expressed in both cell types. The figure was generated using UCSC genomic browser, for typical pre and post TF capture libraries of neuronal and gut cell, as indicated. There was comparable increase of read numbers post-capture, with more even coverage of 3' and 5' ends in the SMART-seq2 neuronal libraries.

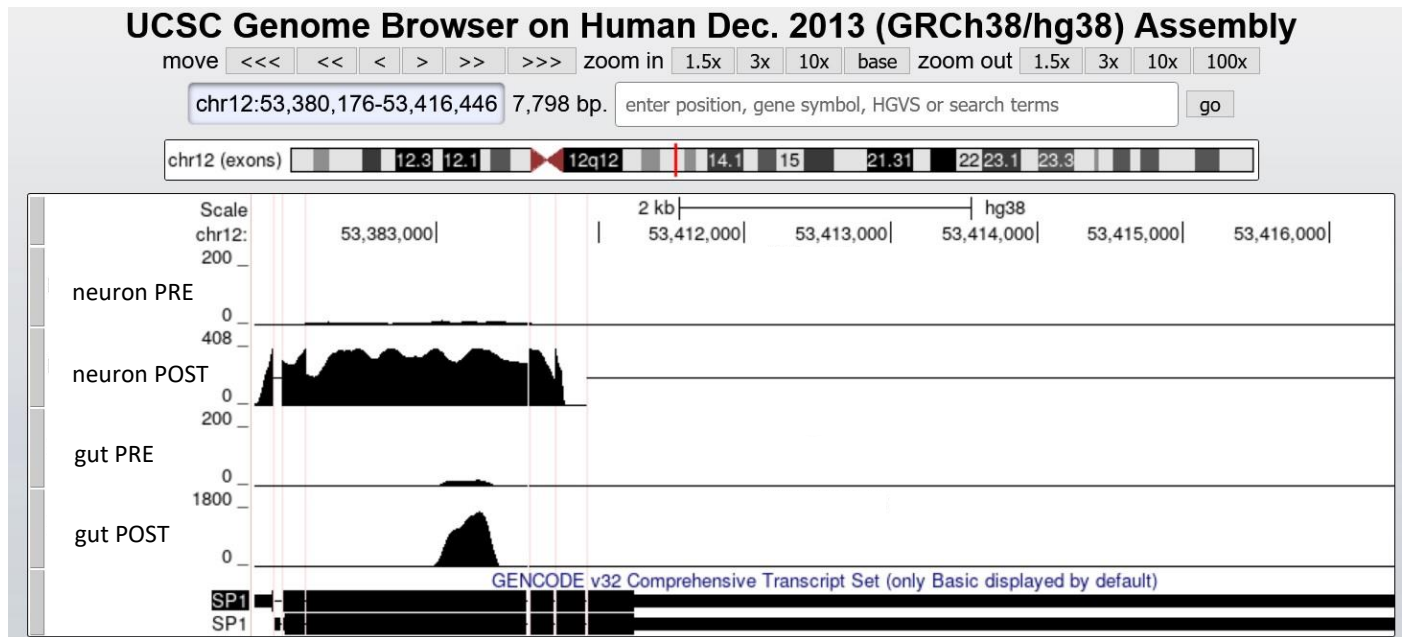


Table S1. GRN TFs with their targets. The targets are predicted based on neuron and astrocyte networks of (Marbach et al. 2016); or based on BrainSpan and BrainCloud datasets (Colantuoni et al. 2011; Lachmann et al. 2016). The table consists of 2 parts, marked by thick borders: first part corresponds to pre-capture GRN and second part corresponds to post-capture imputed GRN

TF	targets Marbach neurons pre-capture	targets Marbach astrocytes pre-capture	targets BrainSpan, BrainCloud
<i>BBX</i>	-	<i>CREB5, NRCAM</i>	<i>GNPDA1, SLC25A1</i>
<i>BHLHE22</i>	-	-	<i>KDM5B, CXADR, SLC6A15, IFITM2, MTSS1, GRHPR, LGALS3BP, GFAP, DPYSL3, FAM126A, CTSA, BCL11A, DLX2, DOK5</i>
<i>CEBPG</i>	<i>SALL1, NTRK2, GNG3, NRCAM, BCL11A</i>	<i>SALL1, NRCAM, NTRK2</i>	<i>GAD2</i>
<i>CEBPZ</i>	-	-	<i>GNG3, ARL6IP6, OTX1</i>
<i>CREB5</i>	<i>SOX2, PAX6, CTNNA1, NFIX, CDK6, DLX6, NKAIN4, BCAN, TMEM59L</i>	<i>PAX6, SOX2, DLX6, CTNNA1, CDK6, NFIX, CREB5</i>	<i>TP53I13, ARF1, CDK6, TMEM98</i>
<i>DLX2</i>	<i>FEZF2, KLHDC8A, SALL1, NRCAM, ELAVL4, LIX1, NTRK3, COL4A6</i>	<i>FEZF2, NRCAM, KLHDC8A, MAPK10, LIX1, SALL1, COL4A6</i>	<i>MGST1, ZNF704, RNASEH2A, BHLHE22, MCM4, SLC9A3R1, CXADR, SLC6A15, ATAT1, IFITM2, DUT, BTG1, GRN, ZNF608, LGALS3BP, GFAP, DPYSL3, AKAP9, SNCB, TOP2B, VPS52, TMEM35A, DLX1, NINJ1, SCRG1, TSPAN6, DOK5</i>
<i>DLX6</i>	<i>KLHDC8A, SALL1, NTRK3</i>	<i>KLHDC8A, SALL1</i>	-
<i>FEZF2</i>	-	-	<i>MGST1, RNASEH2A, SEMA4D, PCNA, STAT3</i>
<i>HES1</i>	-	-	<i>LTBP1, PLCE1, GMNN, MAPK10, GPC4, CNN3, TNC, OTX1, PDPN</i>

<i>HES4</i>	-	-	<i>PEPD, YIF1A, TUBA1B</i>
<i>IER2</i>	-	-	<i>PDE2A, ZWINT</i>
<i>LHX2</i>	<i>GAD2, TBR1, NRXN3, SYT4, LIX1, NHLH1, SALL1</i>	<i>TBR1, NRXN3, SEL1L3, LIX1, SYT4, SALL1</i>	<i>TP53I11, STOML2</i>
<i>LITAF</i>	-	-	<i>RNASEH2A, RAB6A, PGM2L1, LTBP1, TP53I13, ADGRV1, NOTCH2, NR2E1, GNG5, SALL1, PSME1, PTBP1</i>
<i>MYT1L</i>	-	-	<i>PHGDH, PAK5, SLC9A3R1, LRIG1, CXADR, TIMP1, SOX2, HSDL2, NPC2, GRHPR, MLC1, PDE1A, SLC39A1, NINJ1, NELL2, AIF1L, NKAIN4, CHL1, DOK5</i>
<i>NEUROD2</i>	<i>ZBTB18</i>	<i>ZBTB18</i>	<i>ATAT1, MTSS1, GNG3, SNAP25, BTG1, PPT1, MAPK10, NES, SNCB, BCL11A</i>
<i>NFIX</i>	-	-	<i>POLE3, OTX1</i>
<i>NHLH1</i>	<i>NES, DNAJB5, CTNNA2, BCAN, SOX2, SLC1A2, PPP2R5B, SLC9A3R1, STAT3, TCF4, TNC, ID3, PDPN</i>	<i>NES, DNAJB5, BCAN, SOX2, SEL1L3, SLC1A2, CTNNA2, TNC, LTBP1, STAT3, PDPN</i>	<i>LRRC55, GINS2, TYMS</i>
<i>NR2E1</i>	<i>SEMA6D, NEUROD2, TCF4, NR2E1, RCN1, FAM49A, SALL1, DLX1, NLGN1, SEL1L3, MLC1, PSAT1, DLX2</i>	<i>SEMA6D, NR2E1, NLGN1, TCF4, RCN1, SALL1, MLC1, PSAT1, FAM49A</i>	<i>LITAF, SOX9, ADGRV1, MEGF10, NOTCH2, PLCE1, SALL1, BMP7, GPC4, GRIA3, SH3GL2</i>
<i>OTX1</i>	<i>GAD2, BHLHE22, ELAVL4, TCF4, ATF4</i>	<i>TCF4, BHLHE22</i>	<i>NFIX, HES1, CEBPZ</i>
<i>PAX6</i>	<i>ELAVL4, NFIB, BHLHE22, SALL1, HOPX</i>	<i>ZEB2, NFIB, SEL1L3, BHLHE22, SALL1, FAM49A,</i>	<i>NDP, PLCE1, GINS2, TYMS, CNN3, SH3GL2</i>

		<i>HOPX</i>	
<i>PREB</i>	-	-	<i>SRRM2, SAMD8, ATP1A3</i>
<i>REST</i>	<i>NDP, GAD2, SYT4, CELF3, CTNNA2, ATP1A3, BCAN, HOPX, MEGF10, DLX6, TCF4</i>	<i>NDP, GAD2, HOPX, MEGF10, CELF3, CTNNA2</i>	-
<i>RFX4</i>	<i>ATP1A3, MYT1L, PHACTR1, MYO10, KIF1A, CTNNA2, RFX4, FAM49A, MSN, CDK4, ITGB8, PDIA6, FAM107A, PDCD4, PON2, IQGAP2, STOML2, CXADR, DLX2, DNAJB5, KNTC1, PTTG1, BTG1, SQLE, ATRX</i>	<i>MYO10, KIF1A, PDIA6, RFX4, CTNNA2, STOML2, PDCD4, FAM107A, PHACTR1, ITGB8, FAM49A, CXADR, DLX2, KNTC1, IQGAP2, BSG, SQLE, MSMO1, CDK4</i>	<i>SND1, LRIG1, RCN1, PSAT1, ASNS, PDZRN3, PON2, DCXR, MLC1, BMP7, S1PR1, BCHE, SCRG1, PLPP3, NKAIN4, SLC1A3</i>
<i>SALL1</i>	-	-	<i>LITAF, MEGF10, NOTCH2, NR2E1, MYO10, PSME1, HAT1, COL4A5, SH3GL2</i>
<i>SOX2</i>	<i>RFX4, SRRM4, SALL1, SLC1A2, DNAJB5</i>	<i>RFX4, SALL1, SLC1A2</i>	<i>PHGDH, MYT1L, TIMP1, LGALS3BP, MPV17, RHOC, FAM49A</i>
<i>SOX9</i>	<i>NEUROD2, GAD2, MEGF10, CELF3, SALL1, SLC1A2, DLX6, PPP2R2B, DLX5, RFX4</i>	<i>NEUROD2, SALL1, PPP2R2B, SLC1A2, CELF3</i>	<i>LTBP1, NOTCH2, NR2E1, BMP7, TNC</i>
<i>ST18</i>	-	-	<i>YTHDC1, PDCD4, ARF1, PDZRN3, SEZ6L2, CDK6, SPINT2, CLIP3, ATP6V0B</i>
<i>STAT1</i>	<i>FEZF2</i>	<i>FEZF2</i>	<i>ZNF704, RNASEH2A, HOPX, KLHL28, PON2, PCNA, SAMD8, S1PR1, MCM2</i>
<i>STAT3</i>	<i>CTNNA1, LIX1</i>	<i>LIX1, CTNNA1</i>	<i>MGST1, MCM7, RNASEH2A, SEMA4D, NPTXR, CTNNA2, PCNA, MLC1, FEZF2, GRIA3</i>

<i>TBR1</i>	<i>ZEB2</i>	-	<i>MGST1, NRXN3, ATP1A2, SLC9A3R1, LRIG1, CXADR, HSDL2, TPP1, KLHL28, ETFB, PON2, MLC1, CTSA, NINJ1, NKAIN4, HMGCS1</i>
<i>TP53</i>	<i>ZNF608</i>	-	-
<i>XBP1</i>	<i>NR2E1, SOX2, PAX6, CTNNA1, TMEM59L, NFIX, NKAIN4, TUBB2B</i>	<i>NR2E1, PAX6, SOX2, CTNNA1, TUBB2B, CREB5</i>	-
<i>ZBTB18</i>	<i>CELF3, SOX2, DOK6, NRXN3, LTBP1, CHGB, ZEB2, NRCAM</i>	<i>SOX2, NRXN3, LTBP1</i>	-
<i>ZEB1</i>	<i>NHLH1, KLHDC8A, LRRN1</i>	<i>KLHDC8A, NHLH1, LRRN1, SRP68</i>	<i>SFRP1, SLC37A4, NPTXR, NUP107, CDO1, PDE2A, NMT1, DNAJB5, TSPAN6, FDFT1, ID4</i>

<i>TF</i>	<i>targets Marbach neurons post-capture</i>	<i>targets Marbach astrocytes post-capture</i>	<i>targets BrainSpan, BrainCloud post-capture</i>
<i>AEBP1</i>	-	-	<i>TIMP1, DNAJB5</i>
<i>ARID5A</i>	<i>SALL1</i>	<i>SALL1</i>	-
<i>ARX</i>	<i>SP8, TBR1, EOMES, GPM6A, ZIC5, ZIC2, ZBTB20, GPM6B, FABP7, ASPH</i>	<i>SP8, EOMES, TBR1, GPM6A, ZIC5, SEL1L3, ZIC2, ZBTB20, GPM6B, NRCAM</i>	<i>FAM49A, PDPN</i>
<i>BACH1</i>	<i>BCL11B, BCL11A, BTBD11, GRHPR, DNAJB5, MPV17, GDAP1L1, ENO2, GLIS3</i>	<i>GFAP, DNAJB5, GLIS3, BTBD11, MPV17</i>	<i>ZNF704, SMC4, TUBB4A, GFAP, IQGAP2</i>
<i>BBX</i>	<i>BCL11B</i>	<i>CREB5, NRCAM</i>	<i>PDE1C, GNPDA1, SLC25A1</i>
<i>BCL11B</i>	-	-	<i>MGST1, MCM7, RNASEH2A, SFRP1, MYT1, NUSAP1, NPTXR, HSDL2, SMC4, ITM2C,</i>

			NES, STAT3, FEZF2, PGM1, BCL11A, GDAP1L1, SERPINE2, MCM2, ZNF217, POU3F3, AIF1L, GRIA3, DOK5
BHLHE22	ZBTB20	ZBTB20	KDM5B, MN1, CXADR, KLF12, SLC6A15, IFITM2, MTSS1, GRHPR, LGALS3BP, GFAP, DDIT3, FAM126A, CTSA, PGM1, BCL11A, TECR, DLX2, DOK5
BHLHE40	ZIC1	ZIC1	MGST1, ATF4, SEMA4D, PAFAH1B3, FEZF2, NEK6, GDAP1L1
BTG2	-	-	TOB1, LITAF, GFPT1
CEBPG	SALL1, NTRK2, GNG3, NRCAM, BCL11A, HEY1, GPM6B	SALL1, NRCAM, NTRK2, GPM6B	GLMP, GAD2
CEBPZ	-	-	GNG3, ZNF433, ARL6IP6, OTX1
CREB5	SOX2, CTNNA1, NFIX, SOX6, DLX6, NKAIN4, BCAN, ZNF711, TMEM59L	SOX2, DLX6, CTNNA1, NFIX, ZNF711, CREB5	TP53I13, KCNH8, ARF1, TMEM98, CDC42
DDIT3	-	-	KDM5B, SLC1A2, SRP68, BHLHE22, CENPF, B9D1, DCC, CXADR, SLC6A15, NPTXR, PDCD4, NCSTN, ETFB, CD9, PPT1, LGALS3BP, CDO1, VPS52, CTSA, BCL11A, NINJ1, RHOC, DOK5
DLX2	FEZF2, EMX2, KLHDC8A, ERBB4, GPM6A, SALL1, NRCAM, ELAVL4, LIX1, NTRK3, COL4A6	FEZF2, NRCAM, KLHDC8A, MAPK10, THRA, LIX1, SALL1, ERBB4, GPM6A, COL4A6, NR1D1	MGST1, ZNF704, ADGRG1, RNASEH2A, BHLHE22, SLC9A3R1, MN1, CXADR, SLC6A15, ATAT1, IFITM2, DUT, BTG1, GRN, LGALS3BP, GFAP, AKAP9, NR1H2, SNCB, TOP2B, VPS52, TMEM35A, PGM1,

			<i>GDAP1L1, DLX1, NINJ1, SCRG1, SP8, TSPAN6, DOK5</i>
<i>DLX6</i>	<i>EMX2, KLHDC8A, SALL1, NTRK3</i>	<i>KLHDC8A, THRA, SALL1</i>	-
<i>DPF1</i>	-	-	<i>AKAP12, SDCBP, LTA4H</i>
<i>E2F2</i>	<i>KIF1A</i>	<i>KIF1A</i>	<i>KDM5B, PLP1, KNTC1, RNASEH2A, CENPF, SFRP1, NUSAP1, DUT, TMSB15A, TUBB4A, HMGA2, CD9, CDCA7, PPT1, GLI3, GRN, ZNF433, ITM2C, AKAP9, SNCB, IQGAP2, ARL6IP6, MCM2, POU3F3, EOMES, ID4</i>
<i>E2F8</i>	-	<i>OTX2</i>	<i>NRXN1, ASPH, CDKN2D</i>
<i>EBF1</i>	<i>LHX2, SCRT2, DOK6, SLC1A2, NEUROG2, ZBTB20, BCAN, C1orf61</i>	<i>THRA, LHX2, NRXN3, ZBTB20</i>	<i>GFAP</i>
<i>EMX1</i>	<i>FEZF2, NRXN3, MYT1, GPM6B, LIX1, EMX2, ZBTB20, ELMO1</i>	<i>FEZF2, NRXN3, GPM6B, LIX1, EMX2, ELMO1</i>	-
<i>EMX2</i>	<i>FEZF2, CREB5, MYT1, ZBTB20, NRXN3, LIX1, GPM6B, EMX2, KLF7, NFIX</i>	<i>FEZF2, NRXN3, SEL1L3, LIX1, GPM6B, EMX2, ZBTB20, MYT1, NFIX</i>	-
<i>EOMES</i>	<i>GPM6A, NRCAM, NRXN3</i>	<i>GPM6A, NRCAM</i>	<i>KDM5B, PLP1, CENPF, SFRP1, MYT1, NUSAP1, SLC6A15, MTSS1, SCRT2, SMC4, CDCA7, GLI3, E2F2, COL4A6, NES, MLC1, GAD2, IQGAP2, ZNF217, POU3F3, SCRG1, SP8, TSPAN6</i>
<i>FEZF2</i>	-	-	<i>MGST1, RNASEH2A, SEMA4D, RAI14, EMX1, BCL11B, HIST1H4C, PCNA, STAT3,</i>

			<i>BHLHE40, NEUROG2</i>
<i>FOXJ2</i>	<i>VSTM2A, GPM6A, ZIC1, KLHDC8A, OTX2, BCL11B, SOX6, FAM49A, NFIX, TNC, ELMO1, MAPK10, NTRK2, RFX4</i>	<i>THRA, OTX2, ZIC1, ZIC2, DCAF11, KLHDC8A, NFIX, ZIC5, SOX6, BBX</i>	-
<i>GLI3</i>	-	-	<i>CENPF, SFRP1, NUSAP1, SMC4, CDCA7, E2F2, COL4A6, AKAP9, ARL6IP6, ZNF217, EOMES, SP8</i>
<i>GLIS3</i>	-	-	<i>WDR34</i>
<i>HBP1</i>	<i>GPM6A, FAT1, PDE1C</i>	<i>GPM6A, FAT1</i>	-
<i>HES1</i>	-	-	<i>LTBP1, EMX2, PLCE1, RAI14, GMNN, MAPK10, GPC4, CNN3, TNC, OTX1, PDPN</i>
<i>HES4</i>	-	-	<i>PEPD, YIF1A, TUBA1B</i>
<i>HEY2</i>	<i>NFIX</i>	-	<i>TOB1, HOPX, PSAT1, S1PR1, ALDH9A1, SLC1A3</i>
<i>HMGA1</i>	<i>NR2E1, MYT1L</i>	<i>NR2E1</i>	<i>HOPX, ID3</i>
<i>HMGA2</i>	-	-	<i>BTBD11, NUSAP1, GINS2, TGIF1, RAI14, E2F2, ITM2C, SNCB, VPS52, SPINT2, GAD2, SLC6A1</i>
<i>HSF1</i>	<i>VSTM2A, HOPX, OTX2, SOX6, ELAVL4, ASPH, CTNNA1, CRYAB, RFX4, PPP2R2B, SRRM4, ZIC1, FAT1</i>	<i>OTX2, HOPX, SOX6, CRYAB, ZIC1, FAT1</i>	-
<i>IER2</i>	-	-	<i>NRP2, ZWINT</i>
<i>IRF3</i>	<i>SP8, OTX2, NRCAM, TCF7L2,</i>	<i>SP8, OTX2, NRCAM, NFIX</i>	<i>CENPF, MN1, TUBB4A, GRN, ABHD4,</i>

	CD200, NFIX, AMPH		LGALS3BP, GFAP, CPXM1, AKAP9, SNCB, ATRX, TMEM35A, ATP1B2, IQGAP2, GLIPR2, BSG
KLF12	NSMF, CELF3, ERBB4, ZBTB20, TSPAN3, NR1H2, STAG2, BMP7, VAX1, PAFAH1B3, KIT, HEY2	NSMF, ZBTB20, BMP7, CELF3, KIT, PAFAH1B3	BHLHE22, CRYAB, CCDC88A, SLC6A15, DUT, SMC4, BTG1, GFAP, IFI6, SNCB, FAM126A, SMARCC2, PHF6, PGM1, POU3F3, CCNL1, BSG
LEF1	TBR1, LEF1, ARX, DLX5, DLX6, RFX4, NRXN1, SOX2, SOX6, KCNH8, ZIC2, TUBB4A, THRB, NFIX, NELL2, HEY1, MT3, BTG1, DACH1	MEST, TBR1, ARX, ZIC2, ZIC5, RFX4, NRXN1, SOX2, PIM3, DLX5, KCNH8, LEF1, HMGA2, DACH1	YTHDC1, SLC6A15, MTSS1, BTG1, NES, CCNL1
LHX2	GAD2, TBR1, NRXN3, LIX1, GPM6B, EMX2, BCL11B, ASPH, NHLH1, SALL1, ELMO1	TBR1, NRXN3, SEL1L3, GPM6B, LIX1, EMX2, SALL1	TP53I11, FABP7, STOML2, SLC25A5
LITAF	-	-	RNASEH2A, RAB6A, LTBP1, TP53I13, NRXN1, ADGRV1, NOTCH2, NR2E1, THRA, GNG5, BTG2, SALL1, PSME1, PTBP1, ECI2, PAICS
MAFF	OTX2, BHLHE22, LHX2, TUBB4A	OTX2, BHLHE22, LHX2	GTPBP4
MAFG	OTX2, BHLHE22, TUBB4A, PDE1C	OTX2, BHLHE22	ELMO1, NUP107
MEIS1	FEZF2, GFAP, GPM6A, DNAJB5, ERBB4, BTBD17, NLGN1	FEZF2, NLGN1, GFAP, DNAJB5, GPM6A	STAG2, TMEM98
MN1	-	-	KDM5B, PLP1, SLC1A2, BHLHE22, PEPD,

			<i>SLC6A15, NPTXR, HSDL2, MTSS1, DUT, TMSB15A, HDAC2, ELAVL4, LGALS3BP, GFAP, ITM2C, AKAP9, SNCB, FAM126A, TOP2B, CTSA, SPINT2, PHF6, PGM1, BCL11A, NINJ1, DLX2, IRF3, DOK5</i>
<i>MSX1</i>	<i>SP8, EOMES, TBR1, DLX6, GPM6A, DLX5, PHF6, ZIC5, HOPX, ZBTB20, BHLHE22, SOX2, ASPH, ZIC2, GPM6B, DLX1, BCL11B, EMX2, DLX2, FAM49A</i>	<i>EOMES, SP8, GPM6A, TBR1, HOPX, ZBTB20, ZIC5, GPM6B, ZIC2, SOX2, BHLHE22</i>	-
<i>MYBL2</i>	<i>MLC1, NDP</i>	<i>NDP, MLC1</i>	<i>SLC9A3R1, KCNH8, MTSS1, PKIA, AIF1L, SLC1A3, DOK5</i>
<i>MYT1</i>	-	-	<i>MCM7, CAP2, SFRP1, H2AFX, SMC4, BCL11B, NES, TMEM98, SERPINE2, MCM2, POU3F3, EOMES</i>
<i>MYT1L</i>	-	-	<i>RREB1, PHGDH, SLC9A3R1, LRIG1, CXADR, TIMP1, SOX2, HSDL2, NPC2, PKIA, ASPH, GRHPR, MLC1, PDE1A, DPYSL2, NINJ1, NELL2, AIF1L, NKAIN4, DOK5</i>
<i>NEUROD2</i>	<i>ZBTB20, ZBTB18, GLIS3</i>	<i>ZBTB20, ZBTB18</i>	<i>ATAT1, MTSS1, SCRT2, GNG3, SNAP25, RAI14, BTG1, PPT1, MAPK10, NES, SNCB, BCL11A</i>
<i>NEUROG2</i>	<i>ZBTB20</i>	<i>ZBTB20</i>	<i>MGST1, RNASEH2A, SEMA4D, NUSAP1, MSMO1, FABP7, DUT, NUP107, TMSB15A, TPP1, CD9, CDCA7, GRN, AKAP9, FAM126A, PAFAH1B3, FEZF2, TMEM35A, SPINT2,</i>

			<i>PHF6, NEK6, GDAP1L1, NINJ1, DCLK2, POU3F3, NELL2, SP8, TSPAN6, FDFT1</i>
<i>NFE2L2</i>	<i>BTBD17, GNG3, NTRK2, CRYAB, MAPK10, ZBTB20, HSP90AB1, GPX3, PLCE1, PLBD2, CA12, THSD7A</i>	<i>NTRK2, CRYAB, PLCE1, GNG3, CA12, NRXN3, UBC</i>	<i>TOB1, PSAT1, PON2, ANP32E, S1PR1</i>
<i>NFIC</i>	<i>NEUROD2, RCN1, PPP2R2B, FAM49A, SALL1, FABP7, NHLH1, PSAT1, MYO10, CHD2, MLC1, NDP, NTRK2</i>	<i>THRA, RCN1, PPP2R2B, SALL1, PSAT1, HMGA2, MLC1, CHD2</i>	<i>TMSB15A, PKIA, AIF1L</i>
<i>NFIX</i>	-	-	<i>OTX1, ANKRD36C</i>
<i>NHLH1</i>	<i>NES, DNAJB5, BCAN, SOX2, SLC1A2, FAT1, PPP2R5B, SLC9A3R1, STAT3, TNC, ID3, PDPN</i>	<i>NES, DNAJB5, FAT1, BCAN, SOX2, SEL1L3, SLC1A2, TNC, LTBP1, STAT3, PDPN</i>	<i>GIN52, TYMS</i>
<i>NPAS3</i>	-	-	<i>SAE1</i>
<i>NR1H2</i>	-	-	<i>ADGRG1, SLC9A3R1, B9D1, ZNF711, ZNF517, CXADR, C1orf61, SLC6A15, IFITM2, DUT, TPP1, PKIA, LGALS3BP, GFAP, IFI6, MPV17, FAM126A, PAFAH1B3, CTSA, PGM1, BCKDK, TECR, VAX2, NINJ1, DLX2, AIF1L, DOK5, BSG</i>
<i>NR2E1</i>	<i>NEUROD2, NR2E1, RCN1, FAM49A, SALL1, DLX1, NLGN1, SEL1L3, MLC1, PSAT1, ASPH, DLX2</i>	<i>THRA, NR2E1, NLGN1, RCN1, SALL1, MLC1, HMGA2, PSAT1, FAM49A</i>	<i>LITAF, SOX9, EMX2, ADGRV1, MEGF10, NOTCH2, PLCE1, ACAA2, SALL1, BMP7, GPC4, GRIA3, SH3GL2</i>

NR2F2	KLHDC8A, ID3	KLHDC8A	-
NR4A3	-	-	DOK6
OTX1	GAD2, BHLHE22, ELAVL4, ATF4	BHLHE22	TRMT112, EMX2, NFIX, HES1, CEBPZ
OTX2	BHLHE22, NELL2, ELAVL4, BTG1, PON2	ZIC2, BHLHE22, BTG1, NELL2	RREB1, PEPD, SOX2, TMEM147
PBX1	SCRT2, ZBTB18, GPM6A, DLX1, NDP, DLX2, BHLHE22, NRCAM	NRCAM, GPM6A, ZBTB18, SCRT2, NDP, HES1, BHLHE22	-
PBX3	-	-	TUBB6
PHF6	-	-	MN1, NUSAP1, KLF12, NPTXR, DUT, NUP107, TMSB15A, SMC4, ELAVL4, BTG1, CDCA7, ATP6V0E2, ZNF433, GFAP, AKAP9, SNCB, ENO2, SPINT2, PGM1, NEUROG2, ATP6V0B, DOK5
POU3F3	FEZF2, NHLH1, GPM6A, HIVEP3, NEUROG2, RFX4, SCRT2, SOX6, NRCAM, ZBTB18, NRXN3, SLC1A2, NPAS3, ZBTB20, NLGN1, ZIC1, GPM6B, DLX1, MN1, HDAC9, GFAP	FEZF2, HIVEP3, NEUROG2, NLGN1, NHLH1, NRCAM, NRXN3, RFX4, ZIC1, SOX6, ZBTB20, GPM6B, NPAS3, SLC1A2, DLX1, ZBTB18, SEL1L3, DACH1, LGALS3BP	ZNF704, CAP2, RNASEH2A, SFRP1, SEMA4D, MYT1, NUSAP1, KLF12, NPTXR, NUP107, SMC4, LGMN, TPP1, BTG1, E2F2, BCL11B, NES, SNCB, FAM126A, CTSA, NEK6, PGM1, MCM2, EOMES, NEUROG2
PREB	-	-	ATP1A3
REL	GPM6A, BHLHE22, RFX4, ZEB1, TNC, DARS	GPM6A, BHLHE22, RFX4	-
REST	NDP, GAD2, CELF3, NRXN1,	NDP, GAD2, NEUROG2,	C1orf61

	<i>PDE1C, NEUROG2, ATP1A3, BCAN, HOPX, MEGF10, DLX6</i>	<i>HOPX, MEGF10, CELF3, PDE1C</i>	
<i>RFX4</i>	<i>ATP1A3, MYT1, MYT1L, ELMO1, MYO10, KIF1A, RFX4, FAM49A, ZIC2, MSN, CDK4, ITGB8, FAT1, FAM107A, PDCD4, PON2, ID2, IQGAP2, STOML2, CXADR, NFIC, DLX2, PDE1C, CCNL1, DNAJB5, KNTC1, NR2F2, MN1, PTTG1, BTG1, SQLE, ATRX</i>	<i>ZIC2, ZIC5, MYO10, KIF1A, RFX4, FAT1, STOML2, PDCD4, FAM107A, ID2, ITGB8, ELMO1, FAM49A, CXADR, DLX2, KNTC1, E2F8, IQGAP2, NR2F2, MN1, BSG, SQLE, TECR, MSMO1, CDK4</i>	<i>LRIG1, RCN1, PSAT1, PDZRN3, PON2, DCXR, MLC1, BMP7, S1PR1, ALDH9A1, SCRG1, PLPP3, NKAIN4, SLC1A3</i>
<i>RORA</i>	<i>NEUROD2, SLC1A3, ELAVL4, BCL11B, CREB5, DACH1, ERBB4, GFAP, HDAC9, DNAJB5, KLHDC8A, PDCD4</i>	<i>SLC1A3, NEUROD2, GFAP, DACH1, HDAC9, ZBTB20</i>	<i>BTBD11, NRXN3, LRIG1, NARF, GAD2, SERPINE2, SLC6A1, GPM6B, GAD1</i>
<i>RREB1</i>	<i>NHLH1, CTNNA1, GAD2, ARX, SCRT2, TBR1, EMX2, OTX1, DCC, ERBB4, FEZF2, OTX2, LRRC3B, BHLHE22, RFX4, SRRM4, COL11A1, EMX1, VAX1</i>	<i>OTX2, ARX, EMX2, CTNNA1, FEZF2, NHLH1, CCNI, SEL1L3, LRRC3B, RFX4, TBR1, BHLHE22</i>	<i>MYT1L, OTX2</i>
<i>SALL1</i>	-	-	<i>LITAF, MEGF10, NOTCH2, NR2E1, MYO10, LTA4H, PSME1, HAT1, COL4A5, SH3GL2</i>
<i>SCRT2</i>	<i>SOX2</i>	<i>SOX2</i>	<i>SLC1A2, ATP1A2, SFRP1, ATAT1, TPP1, SRRM4, RAI14, CD9, ITM2C, IFI6, NEUROD2, NES, NRP2, GAD2, SLC6A1,</i>

			<i>AIF1L, SCRG1, EOMES, CLIP3, DAP, BSG</i>
<i>SMAD5</i>	-	-	<i>SFRP1, PLCE1, CDKN2D, GMNN, MAPK10, TMEM98, GPC4, ARL6IP6</i>
<i>SOX1</i>	<i>EOMES, OTX2, DLX1, VAX1</i>	<i>OTX2, EOMES, SEL1L3, VAX1</i>	-
<i>SOX2</i>	<i>RFX4, SRRM4, SP8, SALL1, SOX6, SLC1A2, DNAJB5, NRXN1</i>	<i>RFX4, SP8, SALL1, SLC1A2</i>	<i>ADGRG1, PHGDH, MYT1L, TIMP1, LGALS3BP, MPV17, RHOC, FAM49A, OTX2</i>
<i>SOX9</i>	<i>C1orf61, NEUROD2, GAD2, MEGF10, CELF3, SALL1, SLC1A2, OTX2, DLX6, PPP2R2B, DLX5, RFX4, HDAC9</i>	<i>C1orf61, OTX2, NEUROD2, SALL1, PPP2R2B, SLC1A2, CELF3</i>	<i>LTBP1, NOTCH2, NR2E1, BMP7, TNC, PAICS</i>
<i>SP4</i>	<i>NHLH1, KCNH8, BCL11B, COL11A1, VSTM2A, SRRM4, CELF3, SALL1, RFX4, KLHDC8A, ZIC2, DCC, ZBTB20, SLC1A2, ATP1A3, BMP7, ERBB4, TUBB4A, NR1H2, NR2F2, FEZF2, ZIC5, DACH1, NR4A3, NELL2, SNCB, RAB6A, CDKN1A, SH3GL2, ID4, NCSTN, REL, NTRK2, COL4A6, ISYNA1, KIT, PAFAH1B3, HEY2, FTL, GGNBP2, IQGAP2, TUBB2B, KLF12, MAPK10, DPYSL2, THRB, SP8, ID2, ATP1B2,</i>	<i>COL11A1, NHLH1, ZIC2, ZBTB20, SALL1, KLHDC8A, RFX4, ZIC5, NR2F2, FEZF2, DACH1, BMP7, KCNH8, CREB5, NR4A3, NCSTN, CLIC1, DCC, KIT, CELF3, COL4A6, TMEM59L, ID4, ISYNA1, SRRM4, PAFAH1B3, FTL, ID2, INSIG1, RAB6A, CDKN1A, SLC1A2, MAPK10, SNCB, TUBB2B, HMGA1, MN1, PPP2R5B, DPYSL2, TCF7L2, PEPD, ATP1B2, HEY2, MAFF, GLIS3, IER2, MTCH2, TRMT112, GGNBP2,</i>	<i>ZNF711, DCC, KLHL28, DCXR, CTSA</i>

	CA12, CDKN2D, NES, LIG1, TCF7L2, HMGN2, POLR2G, MN1, NPAS3, ZC2HC1A, GLIS3, GAS2L3, ABHD4, ACAA2, C1orf61, CYP51A1, HSDL2	GAS2L3, GPM6B, SP8, HMGN2, NES, CDK4, SLC9A3R1, ABHD4, ID3, BCL11B, NOTCH2, SH3GL2, CYP51A1, DCAF11, ACAA2, NTRK2, POLR2G, TECR, KNTC1, ERBB4, BTBD11, FAM126A, MPV17, BCKDK, LIG1	
SP8	NHLH1, DCC, OTX2, ARX, RFX4, CELF3, BCL11B, COL11A1, NLGN1, KCNH8, KIT, ZBTB20, ERBB4, GNG3, GPM6A, GPM6B, COL4A6, PCLO, VAX1, NPAS3, RORA	OTX2, ARX, ZBTB20, COL11A1, RFX4, DCC, GPM6A, GPM6B, NR2F2, KIT, COL4A6, CELF3, GNG3	SLC1A2, CENPF, MTSS1, BTG1, CD9, GLI3, GRN, AKAP9, CDO1, PAFAH1B3, GAD2, NINJ1, DLX2, SCRG1, EOMES, NEUROG2, TSPAN6, FDFT1
ST18	-	-	YTHDC1, PDCD4, ARF1, PDZRN3, SEZ6L2, SPINT2, CLIP3, ATP6V0B
STAT3	CTNNA1, ELMO1, LIX1, HEY1	ELMO1, LIX1, CTNNA1	MGST1, MCM7, RNASEH2A, SEMA4D, NPTXR, BCL11B, PCNA, MLC1, FEZF2, GDAP1L1, GRIA3
TBR1	GPM6A, SOX6	GPM6A	MGST1, NRXN3, ATP1A2, SLC9A3R1, LRIG1, CXADR, HSDL2, TPP1, KLHL28, ETFB, PON2, MLC1, CTSA, GDAP1L1, NINJ1, NKAIN4, HMGCS1
TCF7L1	H2AFX, NRXN1, SOX6, ZIC2, TUBB4A, PDE1C, NRCAM, BTG1, GRIA3, GPM6A,	ZIC2, ZIC5, NRCAM, NRXN1, NCSTN, GRIA3, BTG1	GMNN

	<i>IFRD1, NCSTN</i>		
<i>TCF7L2</i>	<i>ARX, DLX5, NRXN1, DLX6, SOX2, ZIC2, ARID5A, TUBB4A, IFRD1, NRCAM, MYT1, NRXN3, NELL2, GPM6B, PSME1</i>	<i>ZIC2, MEST, ZIC5, ARX, NRXN1, SOX2, NRXN3, GPM6B, DLX5</i>	<i>RCN1, NOTCH2, NARF</i>
<i>TEAD2</i>	-	-	<i>BEX2, PPP2R5B, GFAP</i>
<i>TGIF1</i>	<i>GPM6B, BTBD17, DNAJB5, CPE, PTN</i>	<i>GPM6B, HEY2, DNAJB5</i>	<i>NUSAP1, HMGA2, PLCE1, VIM, ZNF433, LTA4H, MAPK10, CNN3, PTBP1, TUBB6</i>
<i>THRA</i>	-	-	<i>RAB6A, LITAF, CDKN2D, PTBP1</i>
<i>THRB</i>	-	-	<i>KCNH8, PCLO, TMEM98, ZWINT, DAP</i>
<i>TP53</i>	<i>KCNH8</i>	-	-
<i>VAX1</i>	<i>SP8, FEZF2, TBR1, NRXN3, LIX1, ERBB4</i>	<i>FEZF2, SP8, NRXN3, TBR1, LIX1, LGALS3BP, ZBTB20, ERBB4</i>	-
<i>VAX2</i>	<i>SP8, ZIC5, ZIC2, ELAVL4, GPM6B, PPP2R2B, RORA</i>	<i>SP8, SEL1L3, ZIC5, ZIC2, GPM6B, ELAVL4, RORA</i>	<i>CXADR, MSMO1, PKIA, TUBA1B, NR1H2, PAFAH1B3, NINJ1, AIF1L, MCUB, DOK5</i>
<i>XBP1</i>	<i>NR2E1, SOX2, CTNNA1, TMEM59L, NFIX, NKAIN4, TUBB2B, GPM6B</i>	<i>NR2E1, SOX2, CTNNA1, TUBB2B, GPM6B, CREB5</i>	-
<i>ZBTB18</i>	<i>CELF3, SLC6A1, SOX2, DOK6, NRXN3, LTBP1, CPXM1, NRCAM, ID2</i>	<i>SOX2, NRXN3, ID2, LTBP1</i>	-
<i>ZBTB20</i>	-	-	<i>MCM7, SFRP1, YTHDC1, TMEM98, ZNF217</i>
<i>ZEB1</i>	<i>NHLH1, KLHDC8A, GPM6B, LRRN1</i>	<i>KLHDC8A, NHLH1, GPM6B, LRRN1, SRP68</i>	<i>SFRP1, NPTXR, NUP107, CDO1, NMT1, DNAJB5, TSPAN6, FDFT1, TPGS2, ID4</i>

<i>ZIC1</i>	<i>SCRT2, ELMO1, DLX5, ZIC5</i>	<i>DLX5, TNC</i>	<i>ZIC2</i>
<i>ZIC2</i>	-	-	<i>ZIC1</i>
<i>ZNF217</i>	-	-	<i>MCM7, B9D1, SFRP1, YTHDC1, NUSAP1, SLC6A15, HSDL2, RAI14, GLI3, BCL11B, ZBTB20, IQGAP2, BCL11A, MCM2, AIF1L, EOMES, ATP6V0B</i>
<i>ZNF423</i>	<i>FEZF2</i>	<i>FEZF2</i>	-
<i>ZNF433</i>	-	-	<i>KNTC1, TGIF1, E2F2, PHF6, CEBPZ</i>
<i>ZNF517</i>	-	-	<i>CENPF, DCC, NUSAP1, CPXM1, AKAP9, NR1H2, VPS52, PGM1</i>
<i>ZNF711</i>	-	-	<i>SLC1A2, ZNF704, ATP1A2, RNASEH2A, SLC9A3R1, RBM25, DCC, ATAT1, DUT, BTG1, SP4, AKAP9, NR1H2, FAM126A, CDO1, MLC1, PAFAH1B3, ATP1B2, NEK6, PGM1, HMGCS1, DOK5</i>

Table S2. Top annotated TF PPIs of the cluster subnetworks of GRNs. The Table correspond to Fig. 4e. The enriched genes for each cell group and each TF PPI are shown for pre-captured and post-capture imputed GRNs

TF	Padj pre-capture	PPI genes pre-capture	Padj post-capture	PPI genes post-capture	Cell type
<i>AR</i>	2.67E-01	<i>ATRX; TP53</i>	4.51E-02	<i>ATRX; ARID5A; REL; PHB; TP53</i>	N2
<i>ATF3</i>	6.52E-02	<i>HDAC2; TP53</i>	1.65E-02	<i>HDAC2; DDIT3; TP53</i>	N2
<i>BACH1</i>	2.22E-01	<i>TP53</i>	8.09E-03	<i>MAFF; TP53; NFE2L2</i>	N2
<i>CEBPB</i>	1.79E-01	<i>MAPK10; TP53</i>	2.02E-05	<i>MAPK10; MEIS1; DDIT3; NFIC; BHLHE40; REL; RORA; TP53</i>	N2
<i>E2F1</i>	4.17E-02	<i>HDAC2; CHL1; TP53</i>	2.09E-02	<i>HDAC2; LEF1; PHB; TP53</i>	N2
<i>EP300</i>	4.89E-01	<i>HDAC2; TP53</i>	1.63E-02	<i>MN1; HDAC2; DDIT3; LEF1; REL; RORA; TP53; FOSL2</i>	N2
<i>ESR1</i>	1.79E-01	<i>YWHAЕ; TOP2B; HDAC2; YWHAZ; TP53</i>	3.79E-02	<i>YWHAЕ; TOP2B; HDAC2; THRB; SMARCC2; LEF1; ARID5A; PHB; YWHAZ; TP53</i>	N2
<i>FOS</i>	2.20E-01	<i>HDAC2; TUBB2B</i>	2.06E-02	<i>TUBB2B; HDAC2; DDIT3; FOSL2; NFE2L2</i>	N2
<i>HNF4G</i>	1.92E-01	<i>DLX5</i>	2.04E-02	<i>EMX1; DLX5</i>	N2
<i>JUN</i>	4.30E-02	<i>MAPK10; HDAC2; CHL1; GAD1</i>	3.21E-03	<i>MAPK10; HDAC2; DDIT3; GAD1; LEF1; FOSL2; NFE2L2</i>	N2
<i>JUND</i>	2.46E-01	<i>MAPK10</i>	1.70E-03	<i>MAPK10; DDIT3; FOSL2; NFE2L2</i>	N2
<i>KLF4</i>	3.98E-02	<i>HDAC2; TP53</i>	4.80E-02	<i>HDAC2; TP53</i>	N2
<i>MAFK</i>	2.97E-02	<i>HDAC2; TP53</i>	2.42E-03	<i>HDAC2; TP53; NFE2L2</i>	N2
<i>NFATC1</i>	9.05E-03	<i>MAPK10; HDAC2; YWHAZ</i>	2.48E-03	<i>MAPK10; HDAC2; REL; YWHAZ</i>	N2
<i>NFE2</i>	3.34E-01	<i>DLX5</i>	7.60E-03	<i>DLX5; MAFF; AEBP1; NFE2L2</i>	N2
<i>NFKB1</i>	2.52E-01	<i>HDAC2; TUBB2B</i>	3.99E-02	<i>TUBB2B; HDAC2; REL; PLS3;</i>	N2

				HMGA2	
NR3C1	4.23E-02	MAPK10; HDAC2; TUBB2B; TP53	3.26E-02	MAPK10; TUBB2B; HDAC2; MAFF; TP53	N2
RARA	2.11E-02	MAPK10; TOP2B; HDAC2; BTG1	1.11E-05	MAPK10; TOP2B; HDAC2; BTG1; THRB; ERBB4; NR1H2; ARID5A; ZNF423	N2
RCOR1	2.46E-01	HDAC2	1.43E-02	HDAC2; REST; SMARCC2	N2
RNF2	2.05E-01	HDAC2; TP53	4.56E-02	HDAC2; REST; PHB; TP53	N2
RXRA	4.92E-01	MAPK10	1.64E-03	MAPK10; THRB; NR1H2; BHLHE40; ARID5A; ZNF423	N2
SMAD3	1.00E+00	TP53	4.26E-02	SMARCC2; HEY1; NFIC; LEF1; HMGA2; TP53	N2
SP1	2.59E-01	HDAC2; TP53	4.28E-02	HDAC2; REST; SMARCC2; REL; TP53	N2
SP3	4.77E-02	HDAC2; TP53	1.05E-02	HDAC2; REST; TP53	N2
TP53	1.77E-01	MAPK10; TOP2B; HDAC2; YWHAZ	8.28E-03	CDC42; MAPK10; TOP2B; HDAC2; THRB; ERBB4; BHLHE40; PHB; YWHAZ; PAFAH1B3	N2
YY1	1.73E-01	HDAC2; TP53	2.00E-02	HDAC2; NR1H2; TP53; NFE2L2	N2
ZBTB7A	3.80E-02	HDAC2; TP53	4.59E-02	HDAC2; TP53	N2
ATF2	4.65E-09	AHCY; PCNA; TPM4; H2AFY; GSTP1; ANXA5; H2AFX; RHOC; HSPD1; HADHB; LDHB; GANAB; BSG; CALU; VIM; P4HB; PFN1; CLIC1; CREB5	5.65E-08	AHCY; PCNA; TPM4; H2AFY; GSTP1; ANXA5; H2AFX; PHB; RHOC; DDOST; HSPD1; HADHB; BSG; CALU; VIM; P4HB; PFN1; CLIC1; CREB5	RGC
ESR1	2.30E-03	XBP1; DUT; GSN; PARP1; H2AFY;	8.66E-04	RPN2; TECR; LEF1; PHB; HMGB1;	RGC

		STAT3; H2AFX; HMGB1; HSPD1; HADHB; PDLIM1; SLC9A3R1; PTBP1; TUBA1B; GANAB; RFX4; HNRNPA2B1; FLNA; PHGDH; RBBP7; P4HB; PFN1; TP53; CLIC1		HSPD1; PDLIM1; SLC9A3R1; PTBP1; TUBA1B; FLNA; PHGDH; RBBP7; CLIC1; XBP1; DUT; TCF7L1; GSN; PARP1; H2AFY; H2AFX; DDOST; HADHB; RFX4; HNRNPA2B1; P4HB; PFN1; SLC25A5	
GLI1	3.13E-01	XBP1; CDK4	3.59E-02	XBP1; ZIC2; CDK4; ZIC1	RGC
MYC	3.09E-04	SLC25A1; RNH1; MCM7; CDCA7L; IQGAP2; SMC4; SMC2; HSPD1; PTBP1; TUBA1B; TUBB6; GANAB; FLNA; AASS; RRM1; STAT1; H2AFZ; HADHB; RCN1; CDK6; FANCD2; CDK4; PRC1; PPT1; MCM3; MCM4; TPP1; TP53	1.01E-02	SLC25A1; RNH1; RPN2; MCM7; CDCA7L; LEF1; IQGAP2; SMC4; SMC2; HSPD1; PTBP1; TUBA1B; TUBB6; FLNA; RRM1; H2AFZ; HADHB; RCN1; STAG2; FANCD2; CDK4; PRC1; PPT1; MCM3; TPP1; NFE2L2	RGC
NRF1	3.65E-01	PARP1	9.22E-03	PARP1; MAFF; NFE2L2	RGC
SMAD2	2.70E-02	TUBA1B; ZEB1; CDK4; FLNA; SOX9; SRI; TP53; LITAF; RHOA; GFAP; HSPD1; SOD1	3.19E-03	TGIF1; LEF1; SRI; LITAF; GLI3; RHOA; GFAP; HSPD1; SOD1; TUBA1B; ZEB1; CDK4; ANP32E; FLNA; SOX9; SLC25A5	RGC
SOX2	2.66E-02	SALL1; ZEB1; PAX6; RBBP7; SAE1	3.69E-02	TCF7L1; SALL1; ZEB1; RBBP7; SAE1	RGC
SP1	2.40E-02	TUBA1B; REST; PARP1; TPM4; CDK4; STAT3; S1PR1; NR2E1; VIM; TP53	3.55E-02	TUBA1B; BCL11B; PARP1; TPM4; CDK4; SP4; S1PR1; MSX1; NR2E1; VIM	RGC
TCF3	8.40E-02	SLC9A3R1; PCNA; CDK4; RFX4; PON2; ID4; ID3; RBBP7	1.20E-02	EEF1B2; SLC9A3R1; PCNA; RPN2; CDK4; RFX4; ID2; PON2; ID4; ID3;	RGC

				<i>RBBP7</i>	
<i>AR</i>	0.088684	<i>KDM5B; DCC; UBC; TCF4; KIF1A; ENO2; CALM1</i>	0.048663	<i>KDM5B; BTG2; DCC; UBC; ARID5A; KIF1A; ENO2; CALM1</i>	N1
<i>ATF3</i>	0.092944	<i>HSP90AB1; CEBPG; UBC; ATF4</i>	0.000486	<i>HSP90AB1; DDIT3; CEBPG; UBC; HSF1; ATF4</i>	N1
<i>BACH1</i>	0.155689	<i>ARF1; UBC</i>	0.00079	<i>ARF1; MAFG; UBC; MAFF; NFE2L2</i>	N1
<i>CEBPB</i>	0.085313	<i>UBC; CEBPG; POLE3; CAMK2G; ATF4</i>	0.00297	<i>MEIS1; DDIT3; UBC; CEBPG; HSF1; RORA; HDAC9; ATF4</i>	N1
<i>EP300</i>	0.284725	<i>CDKN1A; NPM1; UBC; HBP1; TCF4; ATF4</i>	0.04952	<i>MN1; XBP1; CDKN1A; THRA; IRF3; DDIT3; UBC; HBP1; RORA; ATF4; FOSL2</i>	N1
<i>ESR1</i>	0.10725	<i>SRRM2; MTCH2; ARF1; CDKN1A; NPM1; HSP90AB1; ASNS; GNL3; UBC; HNRNPC; KIF1A; CALM1; SPTAN1</i>	0.049891	<i>XBP1; ARF1; CDKN1A; MTCH2; HSP90AB1; THRB; THRA; ARID5A; HDAC9; GTPBP4; GNL3; FKBP1A; UBC; COX2; HNRNPC; KIF1A; CALM1</i>	N1
<i>FOS</i>	0.20152	<i>NTRK3; UBC; CEBPG; ATF4</i>	0.015839	<i>XBP1; DDIT3; NTRK3; UBC; CEBPG; ATF4; FOSL2; NFE2L2</i>	N1
<i>JUN</i>	0.060426	<i>CDKN1A; PPP2R2B; NTRK3; UBC; VRK1; AMPH; TCF4; ATF4</i>	0.001459	<i>CDKN1A; DACH1; PPP2R2B; DDIT3; NTRK3; UBC; AMPH; HDAC9; ATF4; FOSL2; NFE2L2</i>	N1
<i>JUNB</i>	0.087772	<i>NPM1; UBC; ATF4</i>	0.021055	<i>MAFG; UBC; FOSL2; ATF4</i>	N1
<i>JUND</i>	0.411506	<i>UBC</i>	0.016146	<i>DDIT3; UBC; FOSL2; NFE2L2</i>	N1
<i>LMO2</i>	0.079107	<i>KDM5B; NHLH1; UBC</i>	0.015845	<i>KDM5B; BEX2; NHLH1; UBC</i>	N1
<i>MAFK</i>	0.285892	<i>UBC</i>	0.001669	<i>NR4A3; UBC; BACH1; NFE2L2</i>	N1
<i>MEF2A</i>	0.391665	<i>NFIX</i>	0.04559	<i>NFIX; THRA; HDAC9</i>	N1

<i>NFE2L2</i>	0.10928	<i>CDKN1A; UBC; ATF4</i>	0.000282	<i>CDKN1A; DDIT3; MAFG; UBC; MAFF; BACH1; ATF4</i>	N1
<i>NRF1</i>	0.216054	<i>UBC</i>	0.003623	<i>MAFF; UBC; NFE2L2</i>	N1
<i>PPARG</i>	0.188598	<i>HSP90AB1; UBC; KIF1A</i>	0.046737	<i>HSP90AB1; UBC; MAFF; KIF1A; NFE2L2</i>	N1
<i>RXRA</i>	0.404191	<i>UBC; KIF1A</i>	0.0303	<i>THRB; THRA; NR1H2; UBC; ARID5A; KIF1A</i>	N1
<i>TCF3</i>	0.074468	<i>SOX2; NPM1; NHLH1; UBC; TCF4; CALM1; MRPL44</i>	0.034499	<i>SOX2; NHLH1; UBC; AEBP1; CALM1; NEUROG2; MRPL44; RAI14</i>	N1
<i>TP53</i>	0.129674	<i>CDKN1A; NPM1; HSP90AB1; PPP2R2B; IFRD1; UBC; NMT1; VRK1; CEBPZ; GNL3</i>	0.036786	<i>BTG2; CDKN1A; HSP90AB1; THRB; IFRD1; BACH1; HDAC9; GTPBP4; GNL3; PPP2R2B; UBC; NMT1; ANXA7; CEBPZ</i>	N1
<i>YY1</i>	0.377623	<i>NPM1; UBC</i>	0.049365	<i>FKBP1A; NR1H2; UBC; PHC3; NFE2L2</i>	N1
<i>ZNF217</i>	0.077087	<i>KDM5B; UBC</i>	0.049583	<i>KDM5B; UBC</i>	N1

Table S3. Comparison of the significance of TF-based cell type identification in pre- and post-capture datasets. For each cell type, the sets of targeted TF marker DEGs (based on TF clustering of 585 pre- or 731 post-capture TFs, Fig. S3) was compared to the full sets of TF markers in the reference datasets using a hypergeometric test. P values of hypergeometric test show enrichment of the pre- and post-capture DEGs with targeted TF markers.

cell type	pre-capture P value	post-capture P value
neurons	0.015	$1.2 \cdot 10^{-10}$
astrocytes	$< 2.2 \cdot 10^{-16}$	$3.5 \cdot 10^{-7}$
oligodendrocytes	$6.1 \cdot 10^{-4}$	0.0015
endothelial cells	0.019	0.0016

Table S4. Targeted TFs, which are differentially expressed between different cell populations of intestinal stromal cells from UC patients. The analysis was done using Seurat package in R and standard Seurat outputs are shown for pre- and post-capture, as indicated. logFC are averaged natural log fold changes in a gene expression in cluster 1 relative to cluster 0; pct.1 and pct.2 are relative number of cells expressing the gene in clusters 1 and 0, respectively.

	logFC POST	pct.1 POST	pct.2 POST	Padj POST	logFC PRE	pct.1 PRE	pct.2 PRE	Padj PRE
<i>TCF7L2</i>	-0.58	0.92	0.987	0.0038	0.59	0.2	0.471	1
<i>PBX1</i>	-1.74	1	0.96	0.0096	-0.19	0.175	0.612	0.37
<i>TCF21</i>	-2.78	0.84	0.907	0.053	-0.49	0.05	0.306	1
<i>NFATC4</i>	-2.11	0.62	0.84	0.072	-0.42	0.1	0.247	1
<i>FOXO3</i>	-0.71	1	0.987	0.077	-0.72	0.225	0.529	1

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