

Supplementary Information

Pokhilko A., et al. Targeted single cell sequencing of transcription factors facilitates biological insights from human cell experimental models

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.

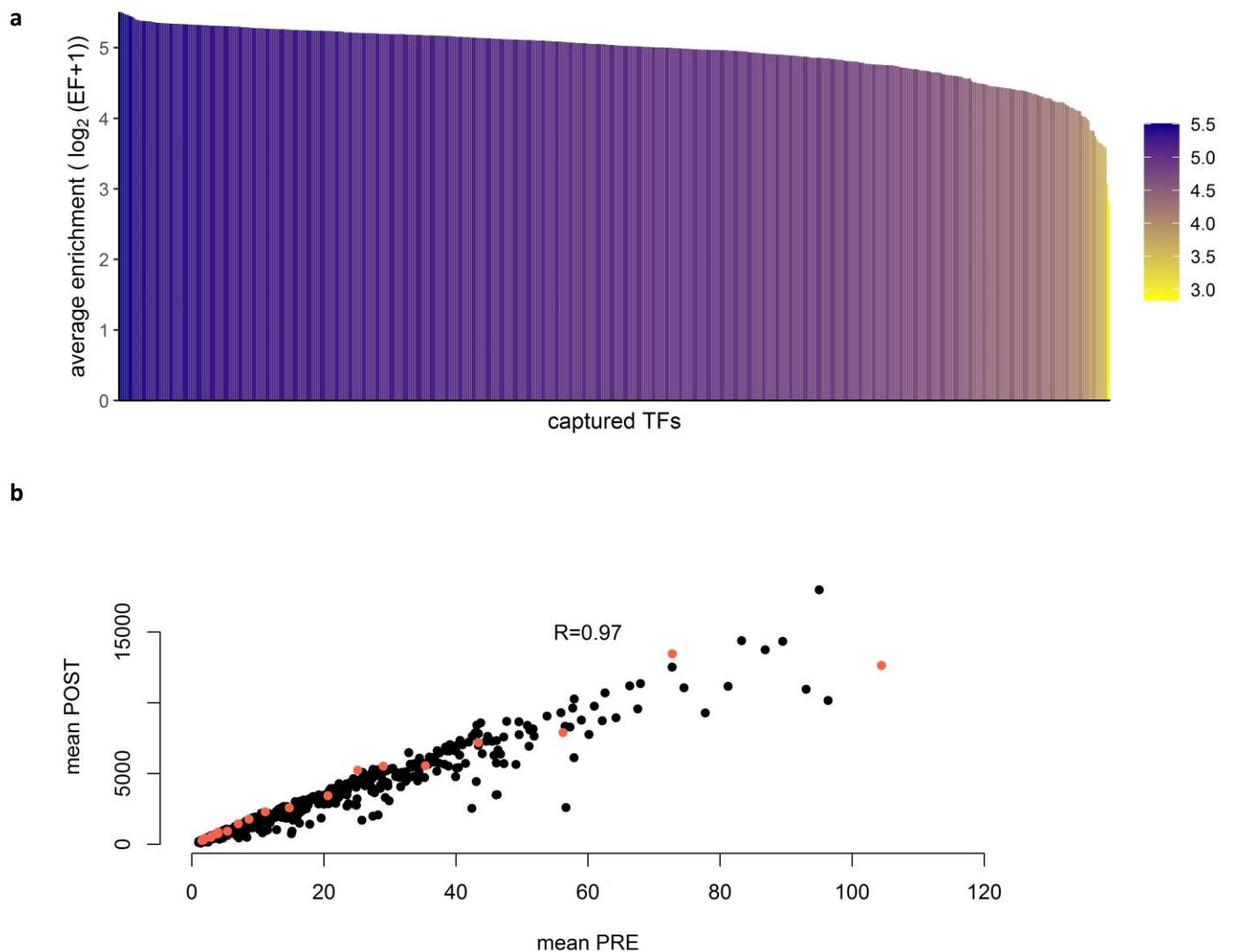
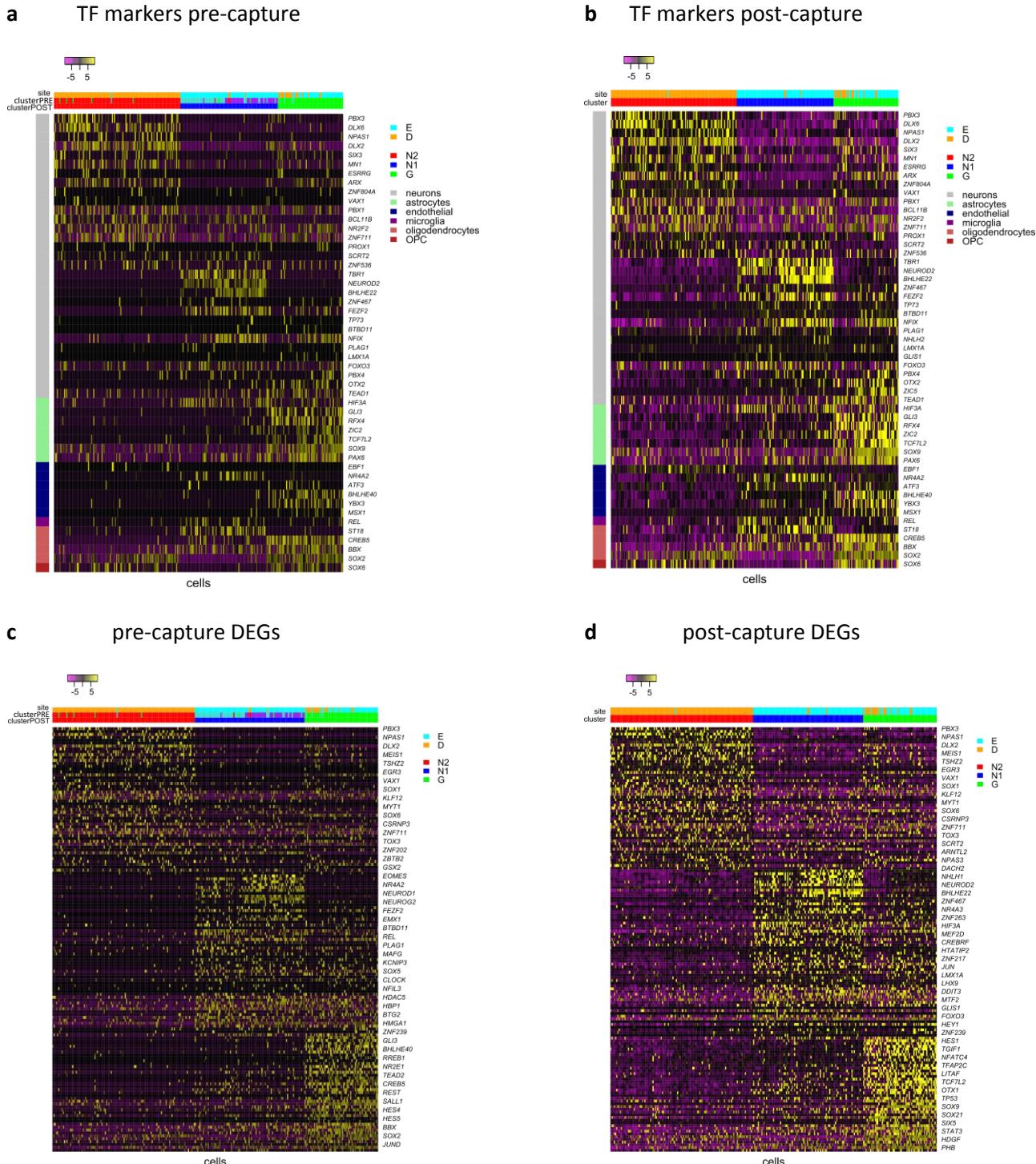


Figure S2. Characterization of cell clusters in pre- and post-capture libraries. **a,b**, Heat maps of cell type TF markers, which were differentially expressed post-capture (b), and their pre-capture expression (a). **c,d**, Heat maps of TF DEGs, which were differentially expressed post-capture (d,e) 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).



E

post-capture DEGs

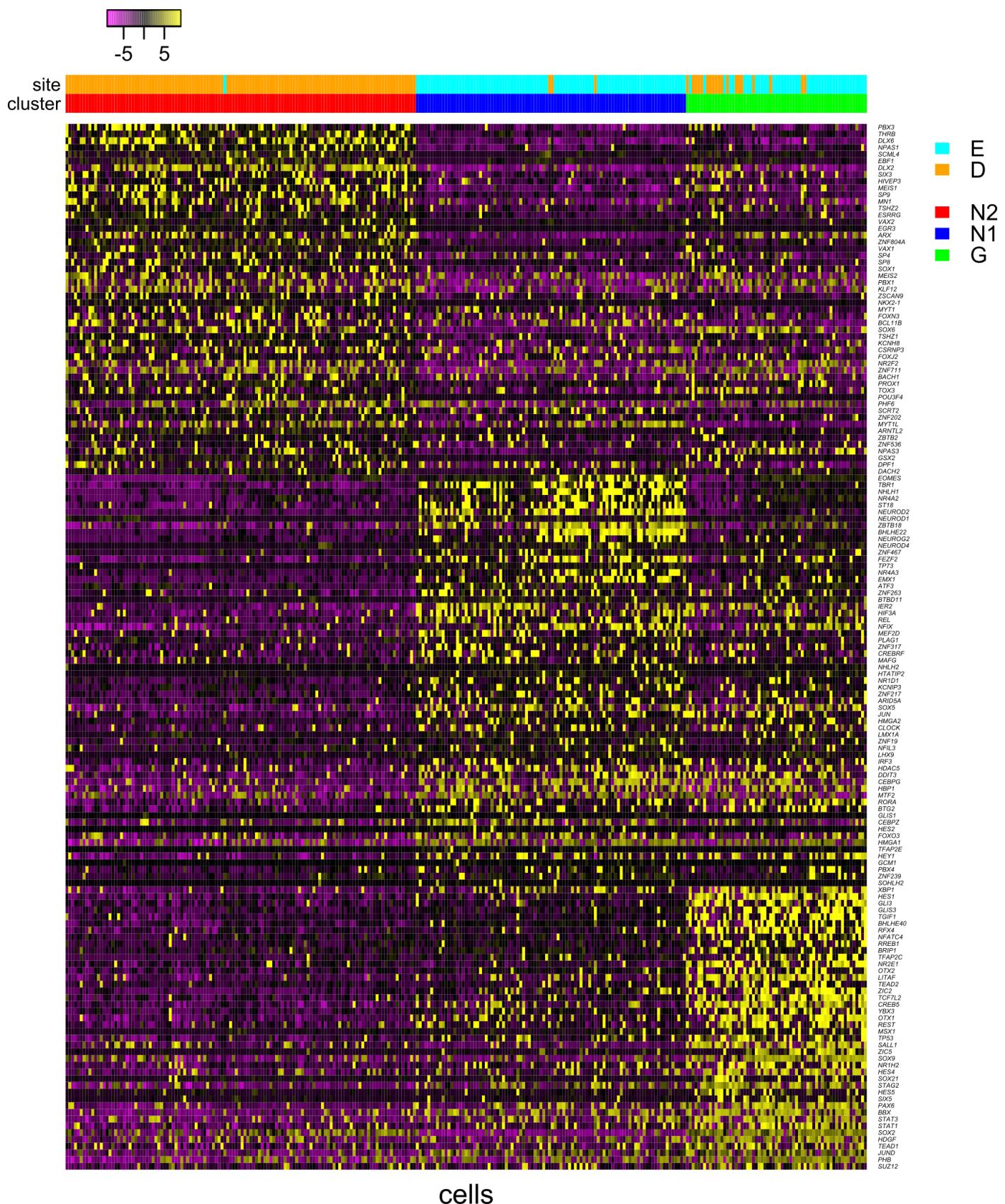
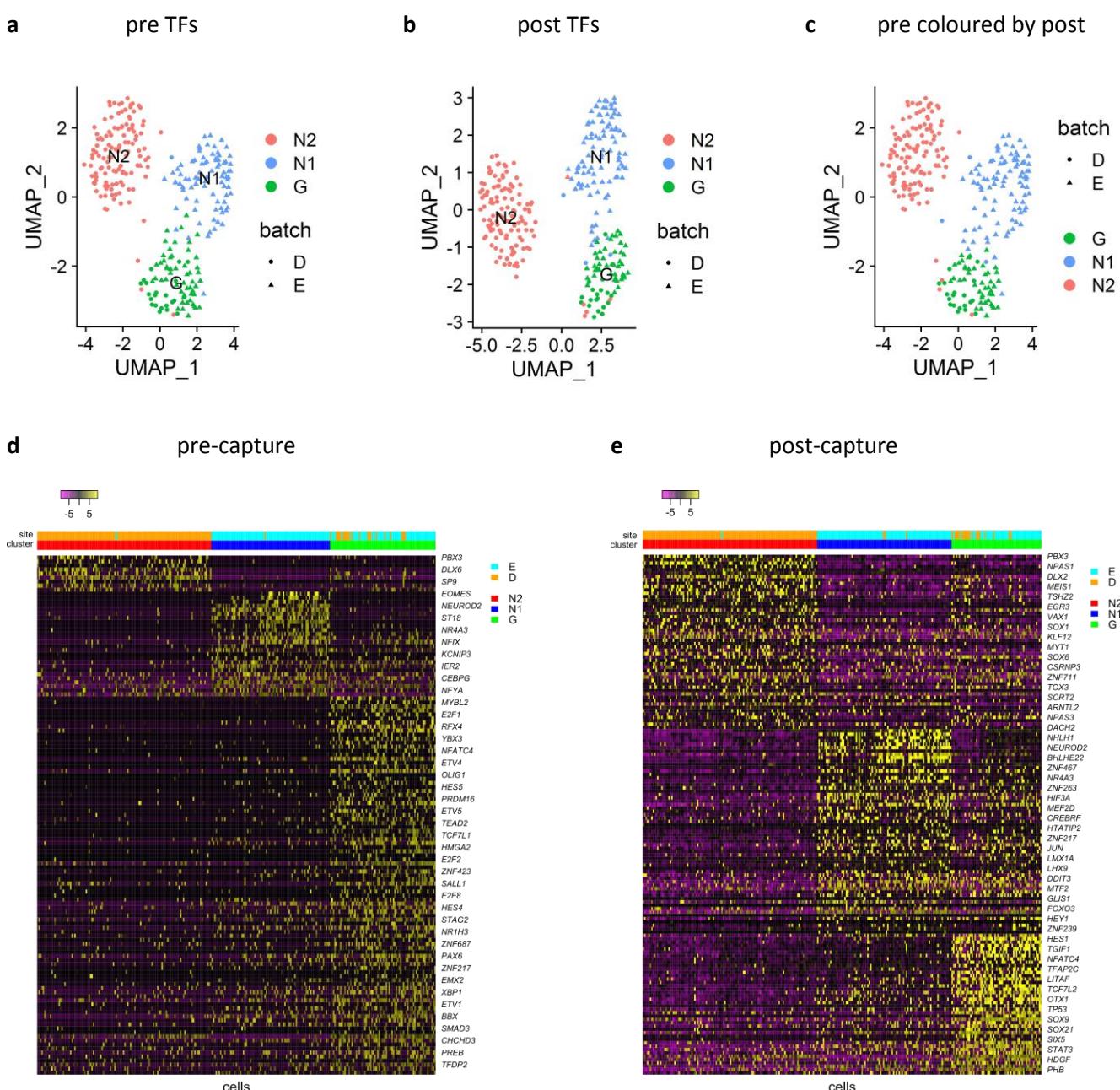


Figure S3. Comparison of the clustering of pre- and post-capture TFs. The clustering and differential expression were performed in Seurat using pre- and post-capture expression of the captured TFs. **a,b,c**, Umaps of cell clusters using 585 pre-capture (a) or 731 post-capture TFs (b). **c** Clustering 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

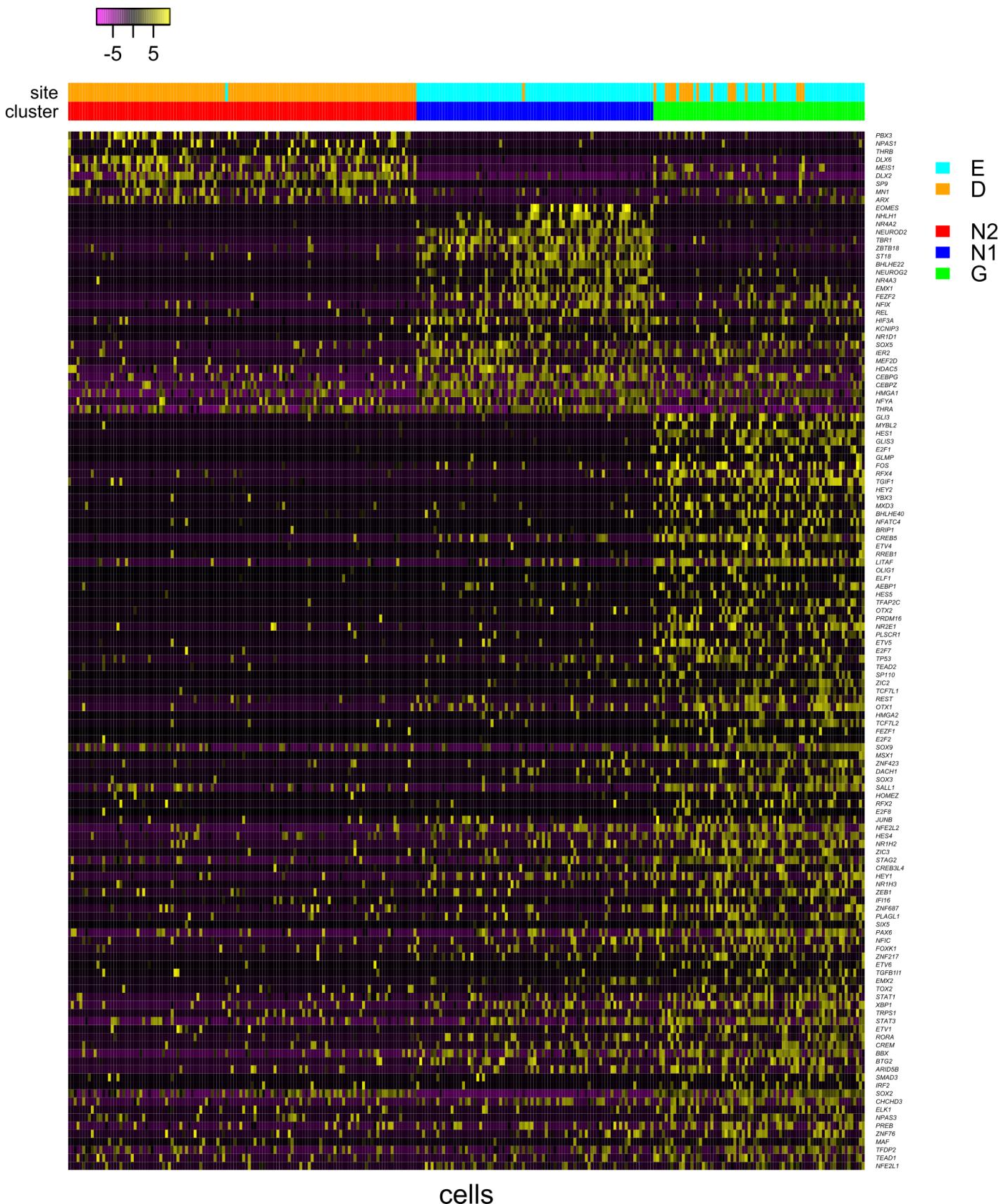


Figure S4. Numbers of cells expressing key TFs of the early differentiation stages from (Inoue et al. 2019) in each of 3 groups of cells (N1, N2 and G). The lab D N2 neurons, G cells and lab E N1 neurons were defined by clusters 1, 2 and 3+4 for pre-capture and by clusters N2, G and N1 for post-capture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

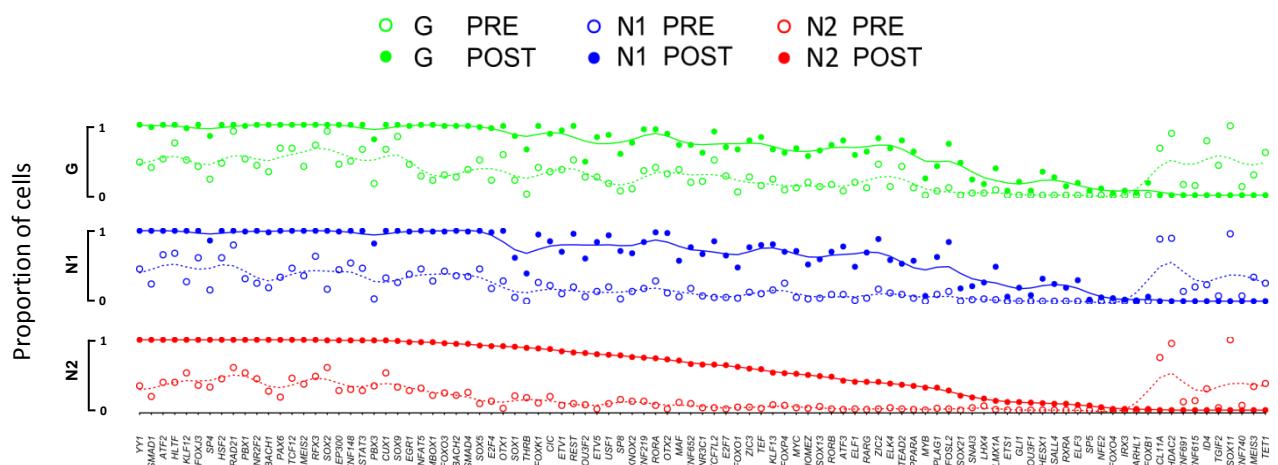
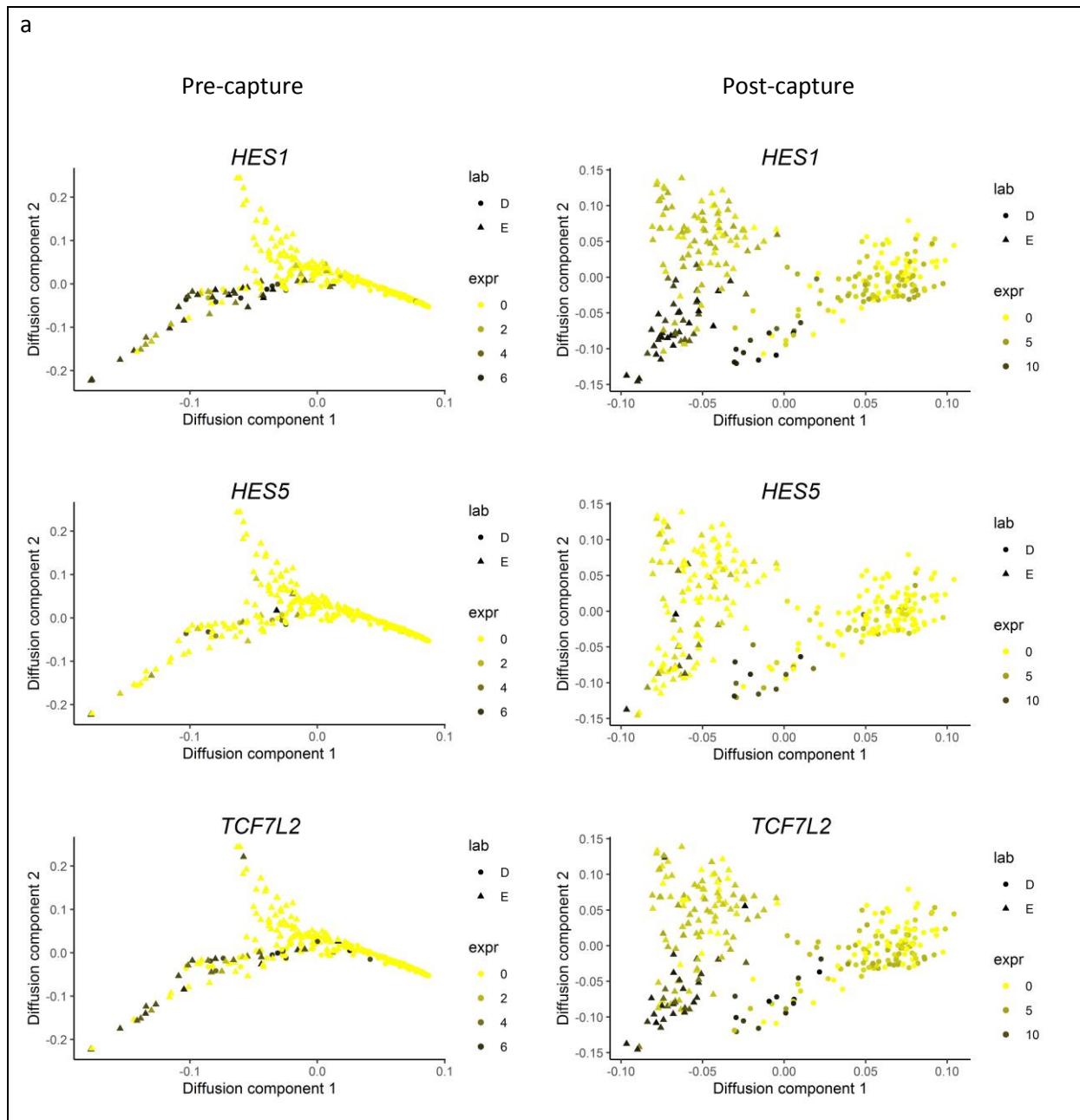
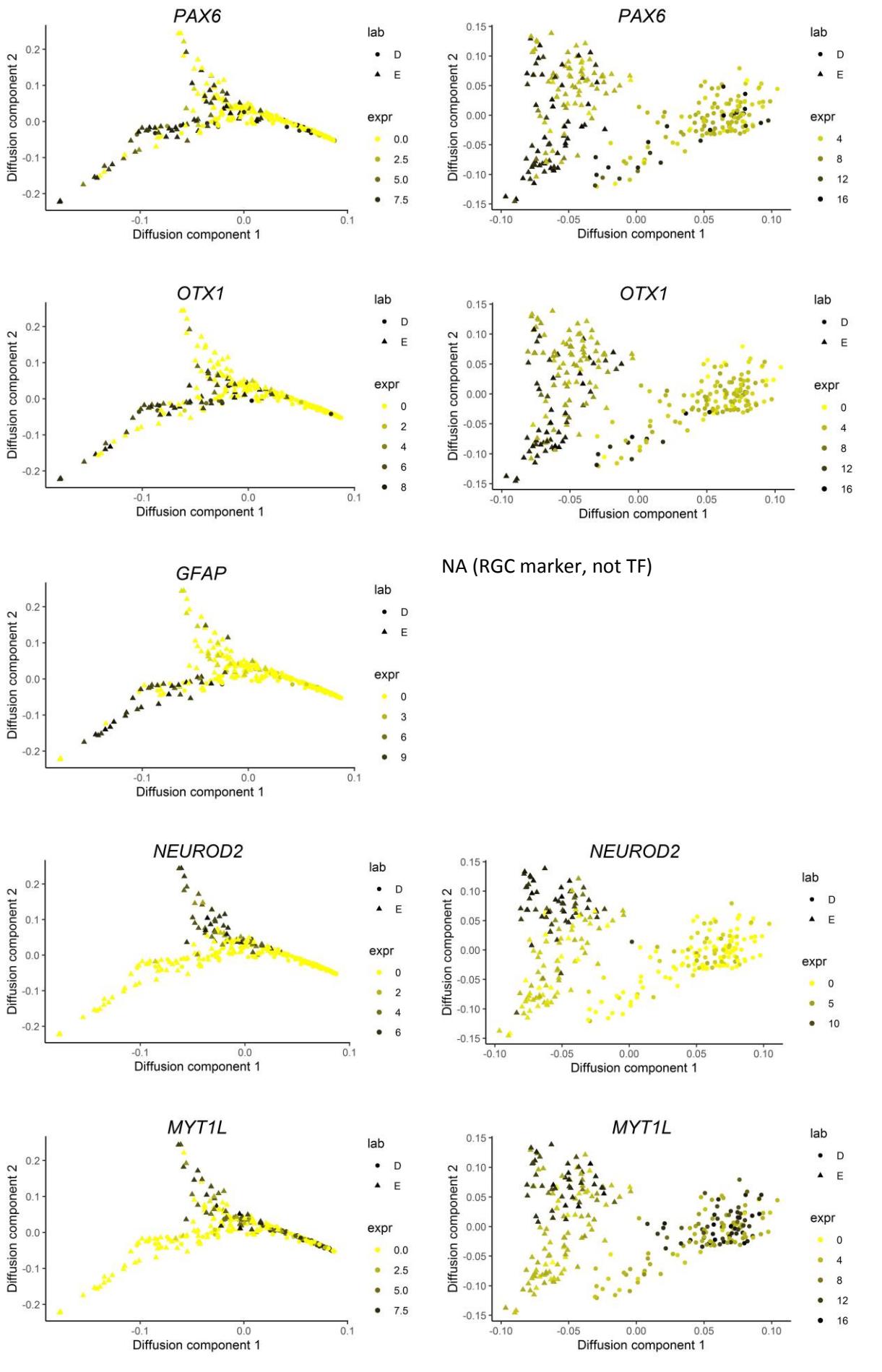
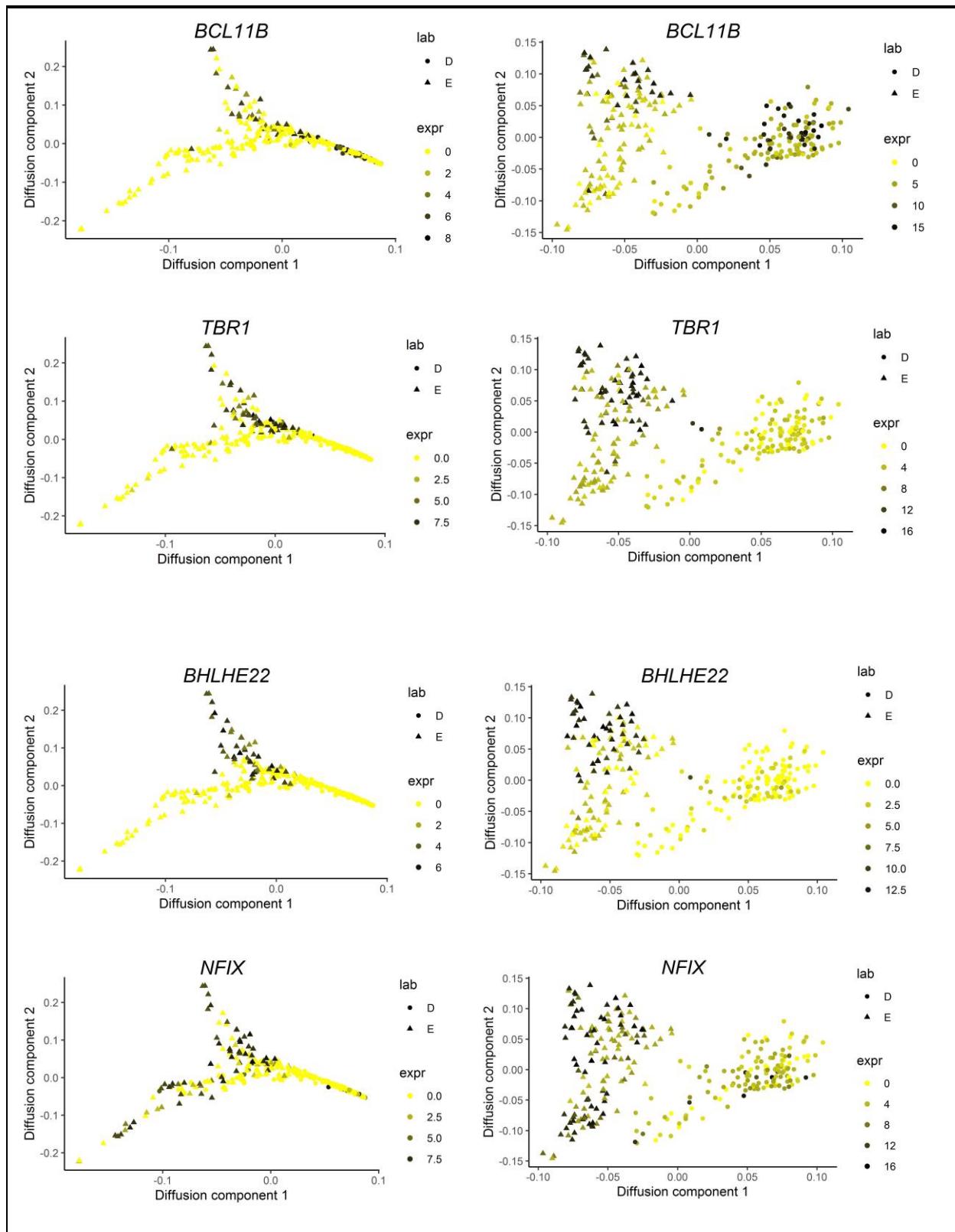
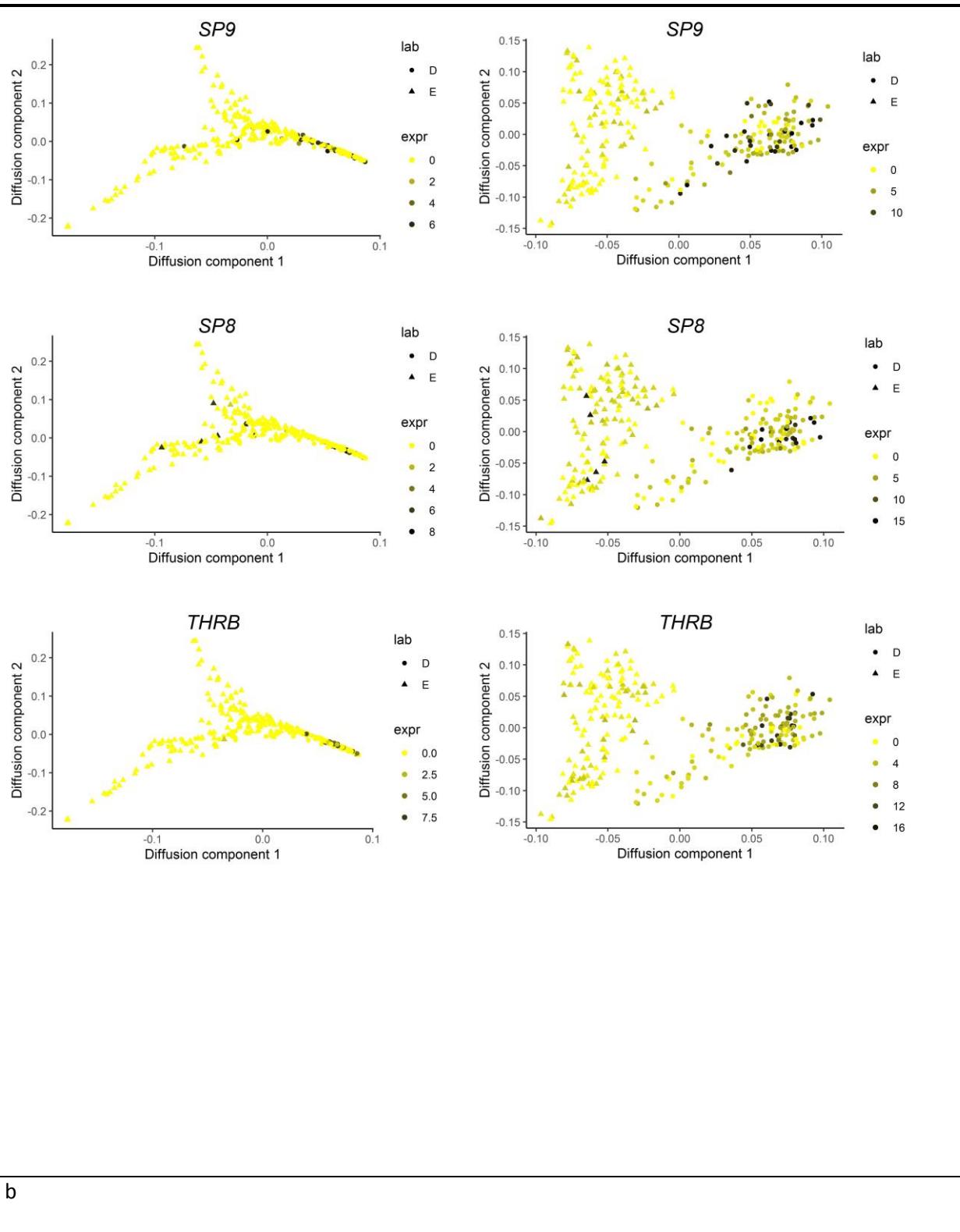


Figure S5. Expression of pre- and post-capture TFs in pseudotime space. **a** and **b** indicate TFs differentially expressed between clusters (a) or labs (b). a includes TF with clear maturation kinetics, such as *GFAP*, *HES1*, *HES5*, *PAX6*, *NR2E1*, *TCF7L2*, *OTX1*, corresponding to a radial glial proliferative stage and TFs of early stage of neuronal maturation (*NEUROD2*, *TBR1*, *BCL11B*, *BHLHE22*, *NFI*). 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.

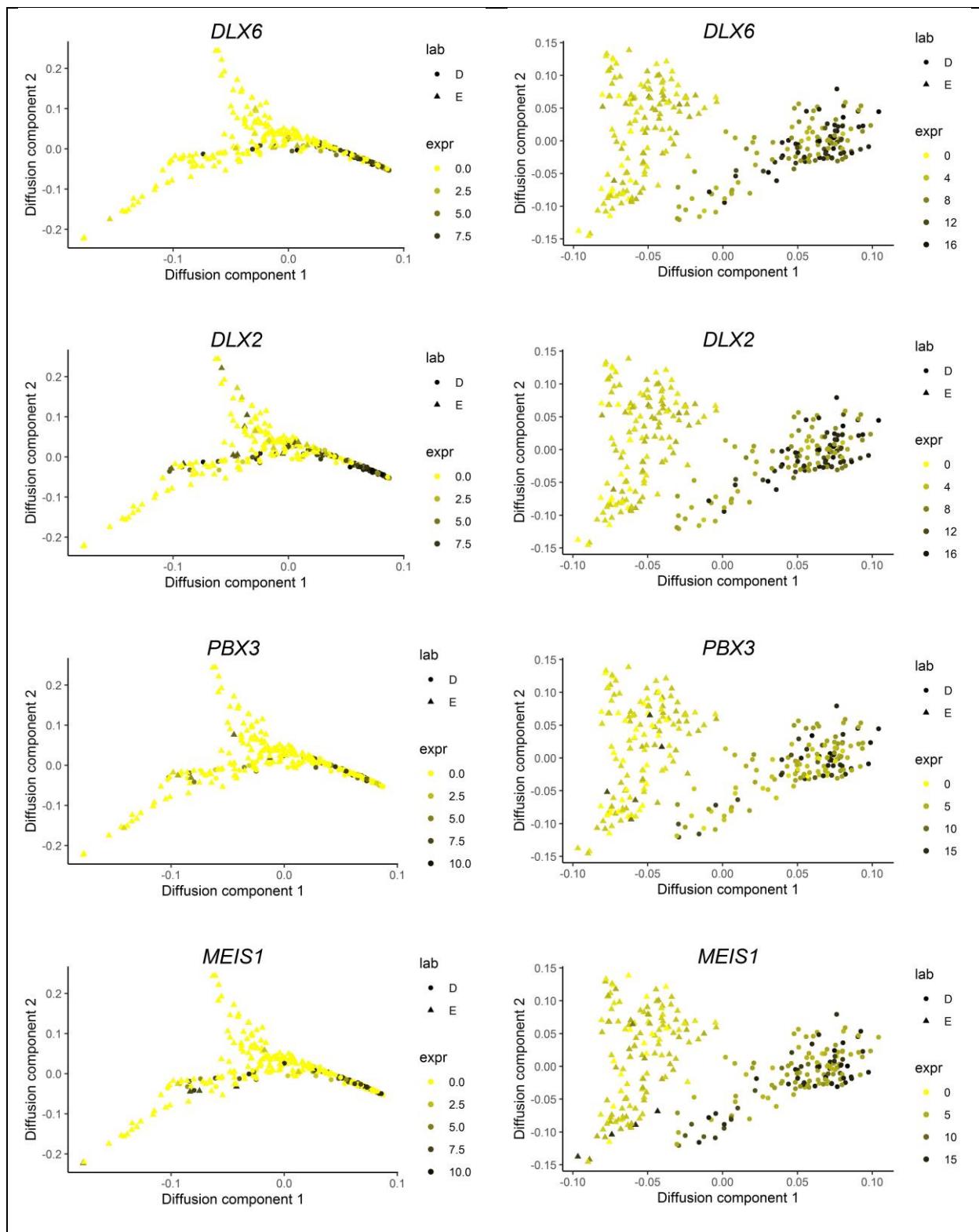


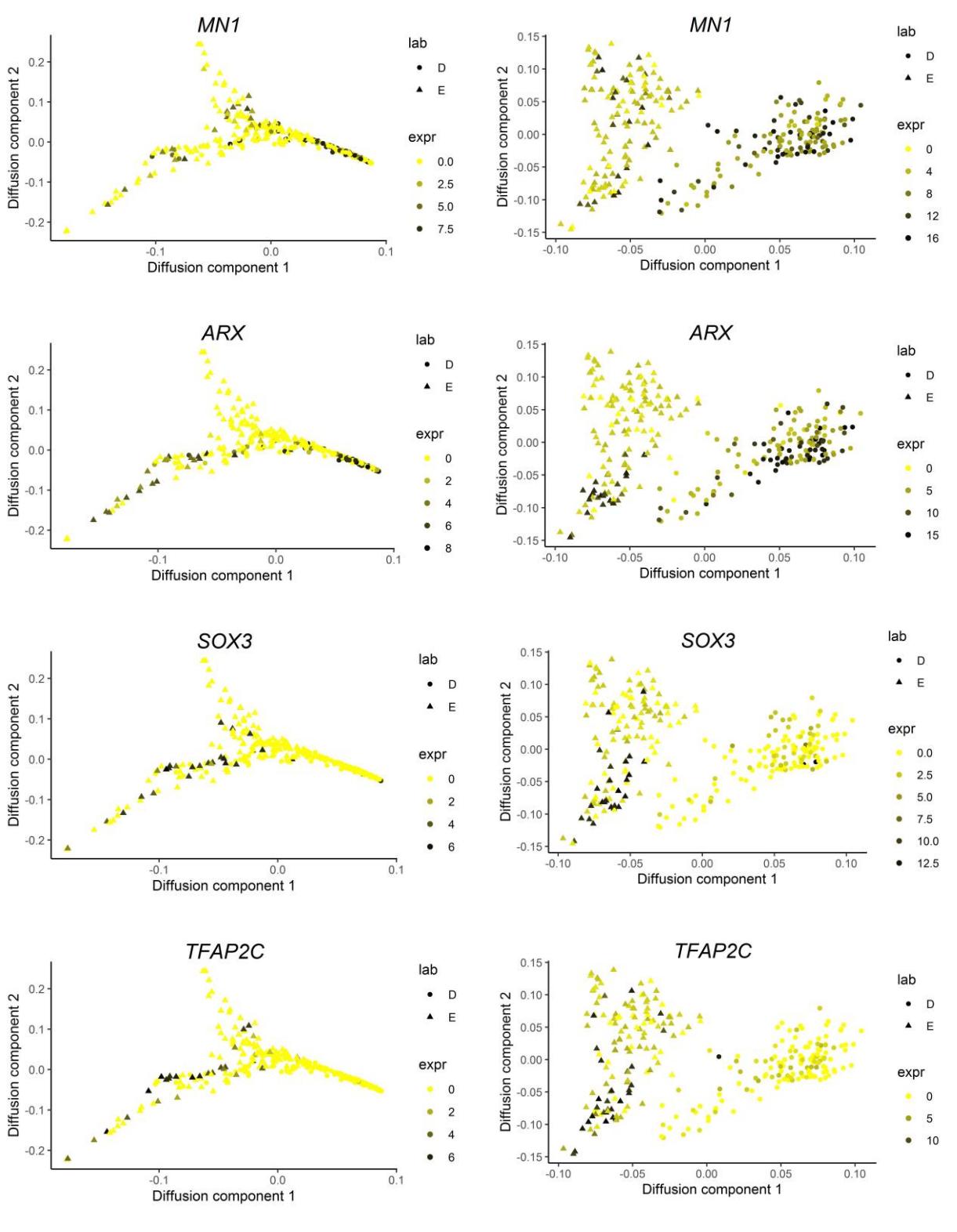






b





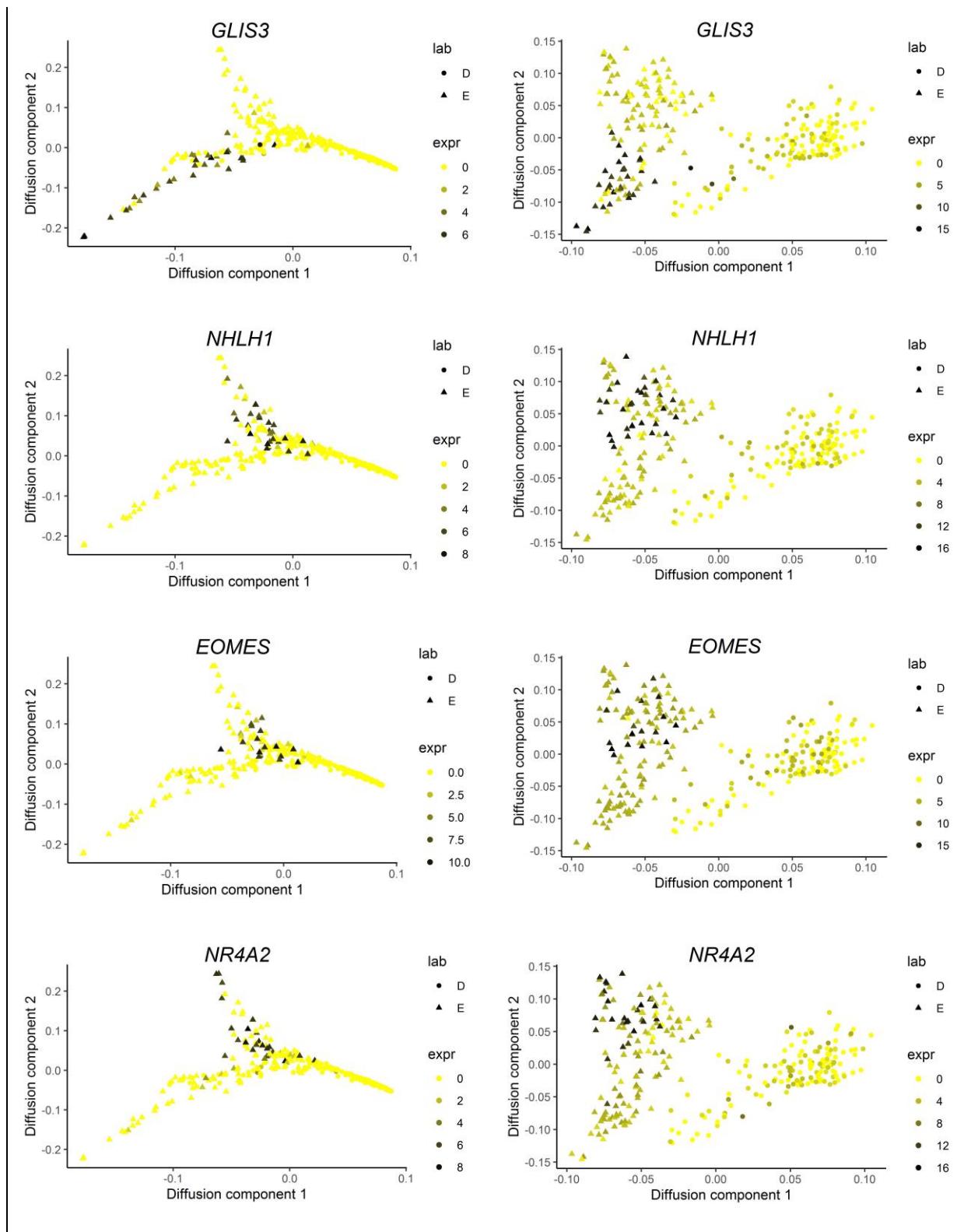


Figure S6. Volcano plots of TFs differentially expressed between Lab E and Lab D cells. **a**, Pre-capture TF DEGs between N1 and N2 neurons (based on expression of 585 targeted TFs). **b**, post-capture TF DEGs between G cells from lab D and lab E. Significant TF DEGs are labelled (FDR ≤ 0.05 , natural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

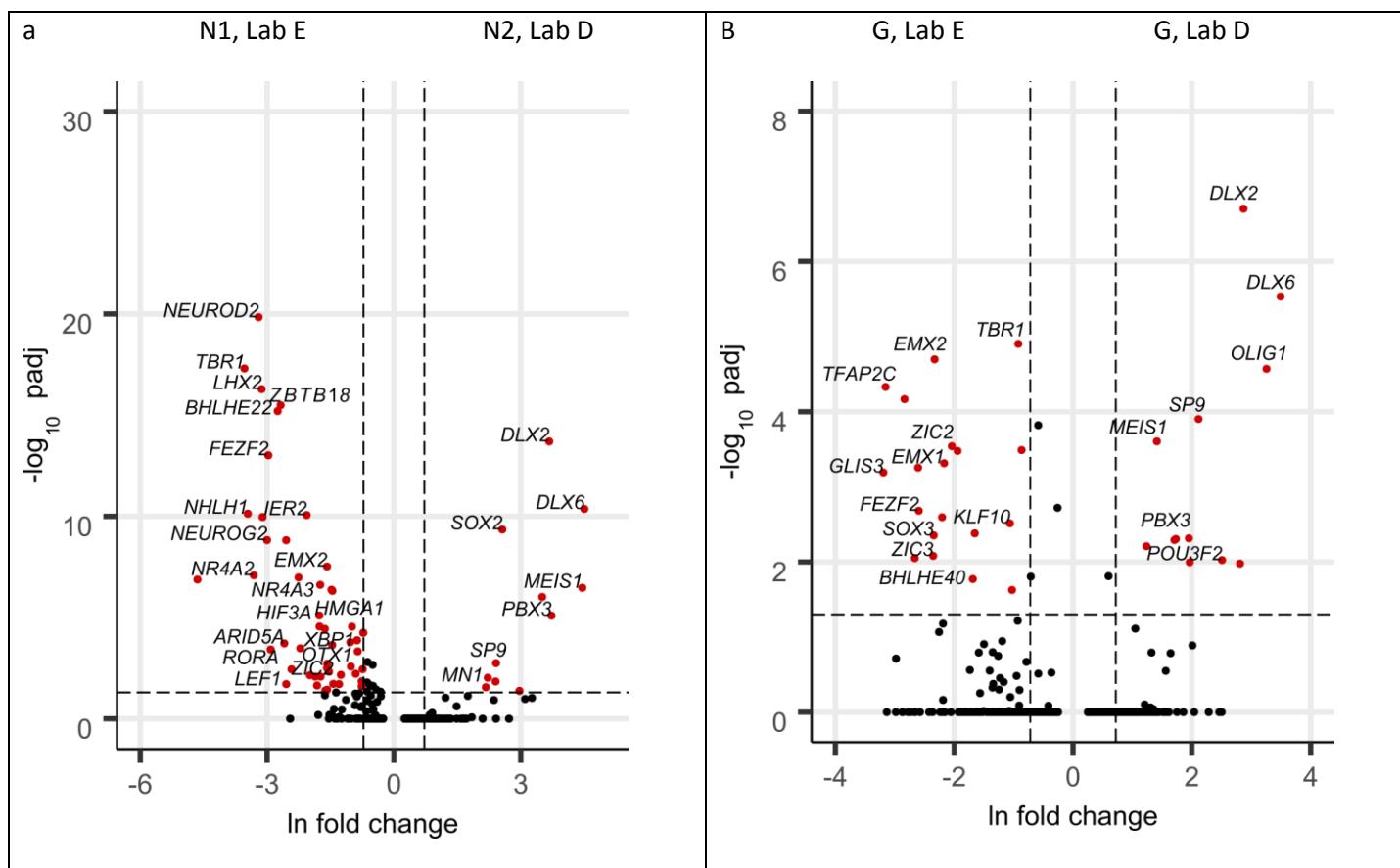


Figure S7. Analysis of GRN TFs related to retinoic acid (RA) signalling. **a**, Co-expression subnetwork of the GRN of Fig. 4b, including TF PPIs involved in retinoic acid signalling. The network was built using TFs belonging to *RARA*, *RXRA* and *CEBPB* terms of TF PPI of cluster N2 (Fig. 4e, Table 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.

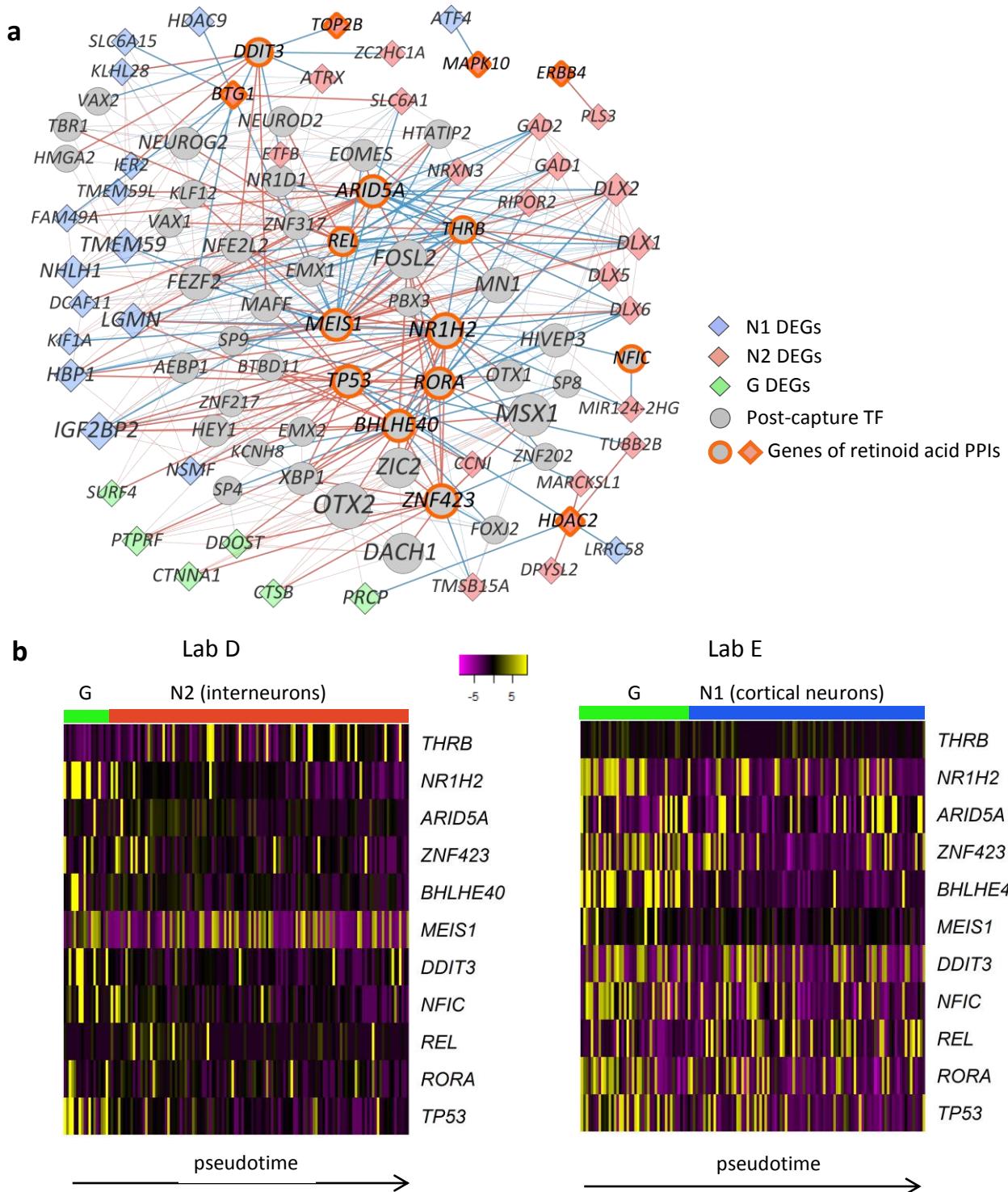


Figure S8. Validation of scCapture-seq with intestinal stromal cells from UC patients. Capture-Seq improves the quality of scRNA-seq libraries and enriches for targeted TFs. **a**, Linear correlation between the pre- and post-capture averaged expression (raw counts) of 530 common TFs, expressed both 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

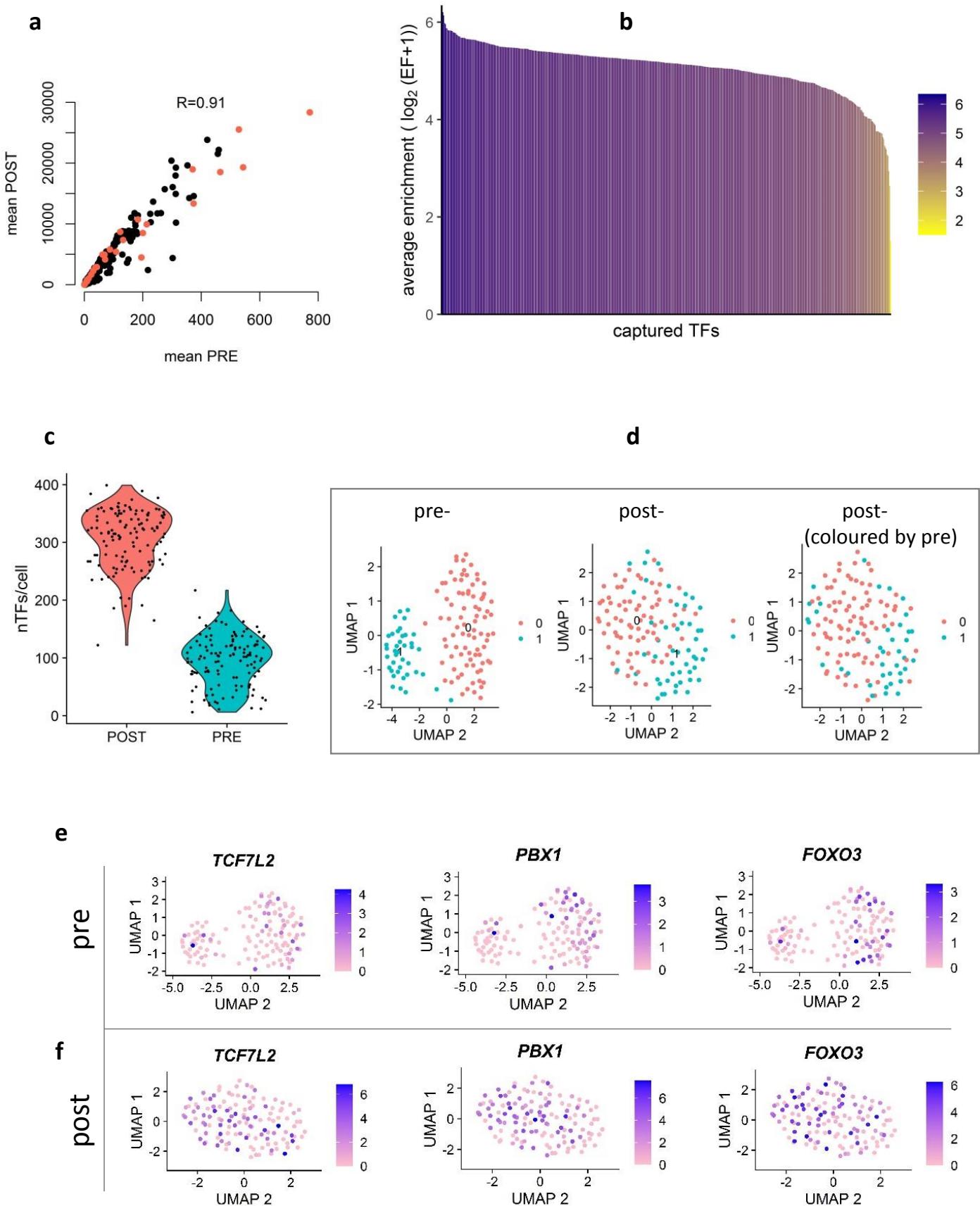


Figure S9. Validation of scCapture-seq with NG capture in iPSC cortical neurons. **a**, Linear correlation between the pre- and post-capture averaged expression (raw counts) of 71 common NGs, expressed both pre- and post-capture. ERCC spike-ins are shown in red. **b**, Post-capture enrichment of the 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.

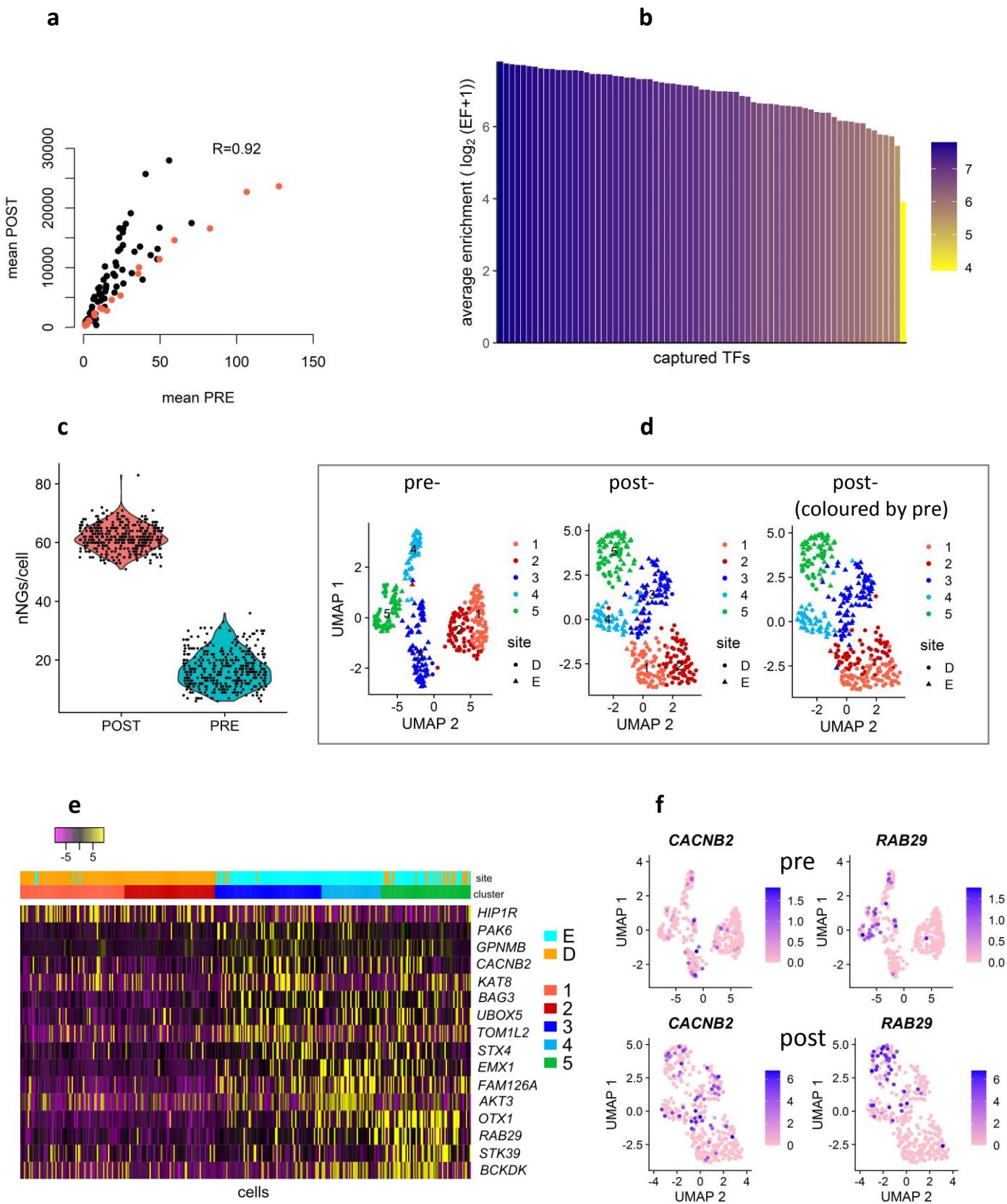


Figure S10. Characterization of cell clusters in pre-capture libraries of iPSC-derived cultures of cortical neurons used for NG capture. Heat map shows cell type marker DEGs. The expression is log-normalized and centred.

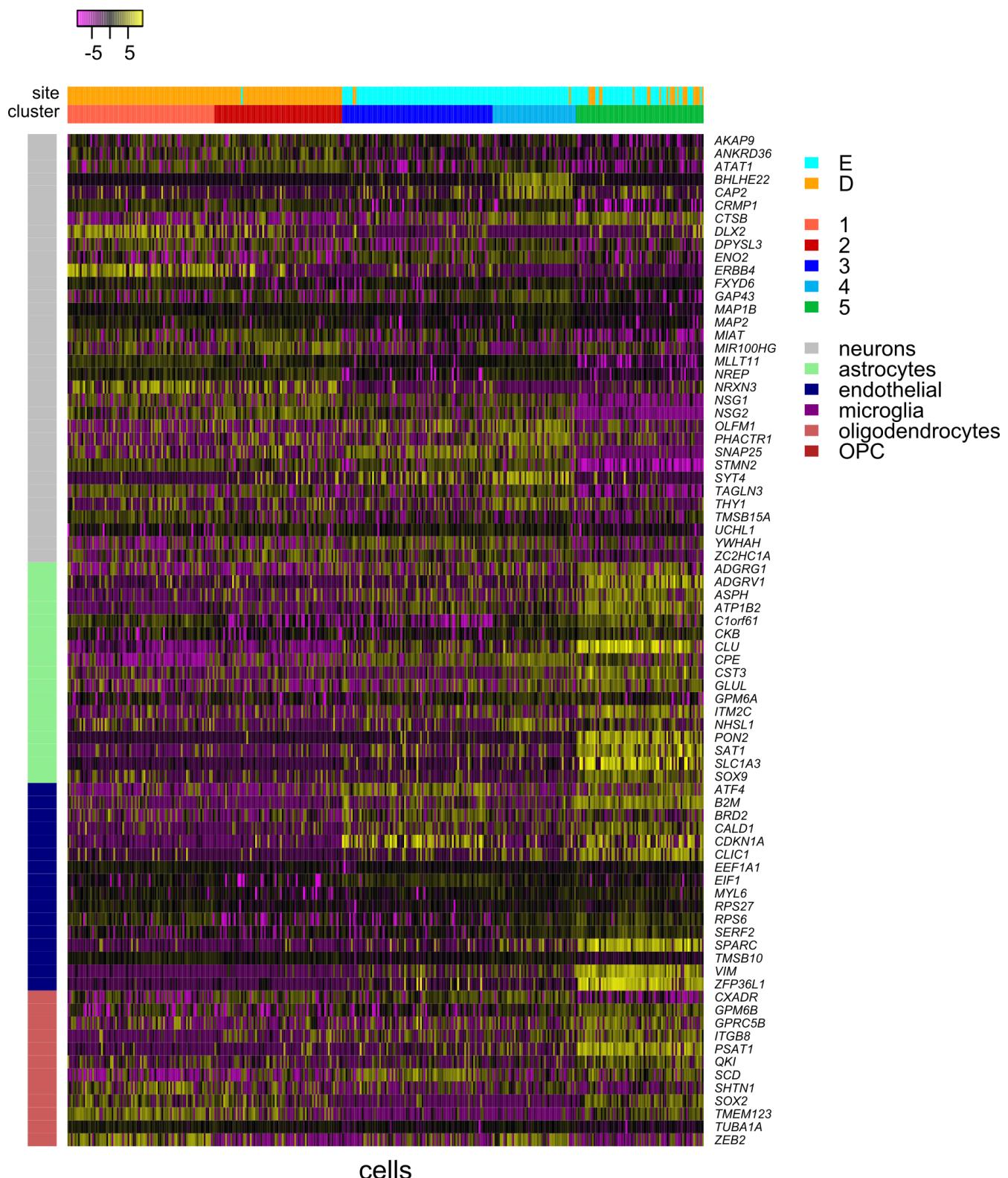


Figure S11. Comparison of read mapping between neuronal and gut libraries generated using SMART-seq2 or 10x Genomics sequencing. The mapping is shown for *SP1* gene expressed in both cell types. The figure was generated using UCSC genomic browser, for typical pre and post TF capture libraries of neuronal 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.

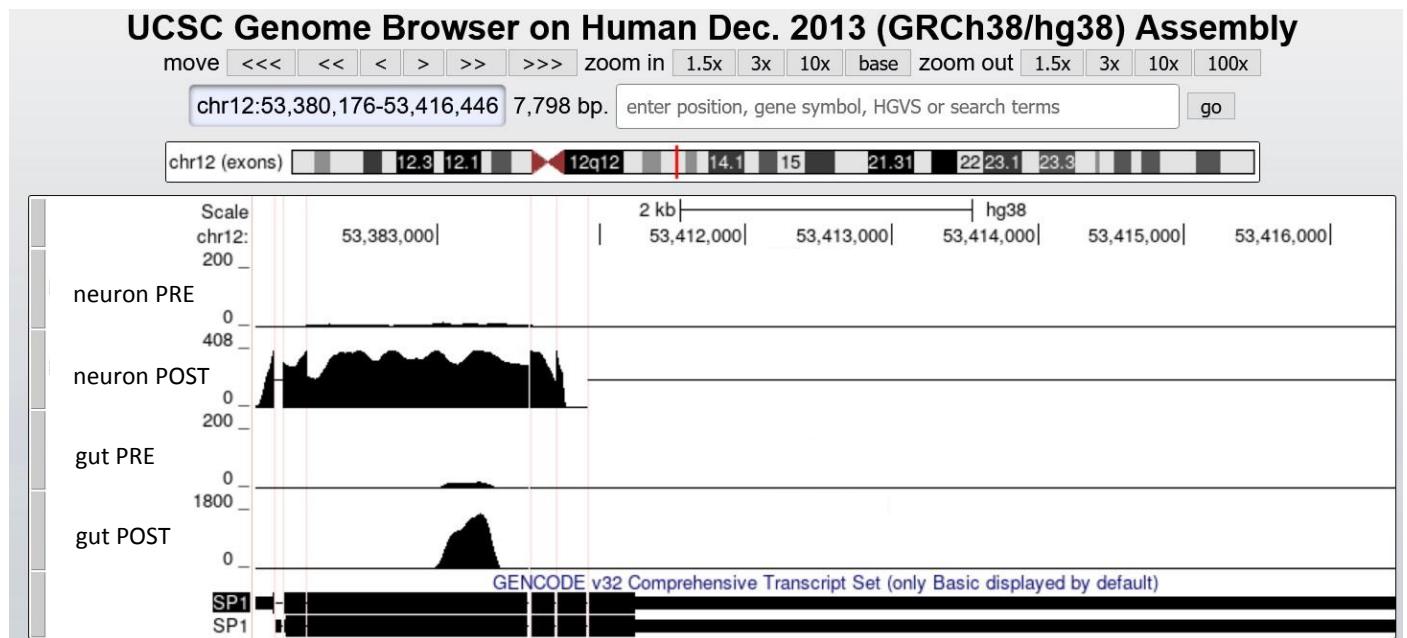


Table S1. GRN TFs with their targets. The targets are predicted based on neuron and astrocyte networks of (Marbach et al. 2016); or based on BrainSpan and BrainCloud datasets (Colantuoni et al. 2011; Lachmann et al. 2016). The table consists of 2 parts, marked by thick borders: first part corresponds 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, CTS, 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, PDIA6, RFX4, RFX4, FAM49A, MSN, CDK4, ITGB8, PDIA6, FAM107A, 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, ATP6VOB</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>

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

			<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>

	<i>CD200</i> , <i>NFIX</i> , <i>AMPH</i>		<i>LGALS3BP</i> , <i>GFAP</i> , <i>CPXM1</i> , <i>AKAP9</i> , <i>SNCB</i> , <i>ATRX</i> , <i>TMEM35A</i> , <i>ATP1B2</i> , <i>IQGAP2</i> , <i>GLIPR2</i> , <i>BSG</i>
<i>KLF12</i>	<i>NSMF</i> , <i>CELF3</i> , <i>ERBB4</i> , <i>ZBTB20</i> , <i>TSPAN3</i> , <i>NR1H2</i> , <i>STAG2</i> , <i>BMP7</i> , <i>VAX1</i> , <i>PAFAH1B3</i> , <i>KIT</i> , <i>HEY2</i>	<i>NSMF</i> , <i>ZBTB20</i> , <i>BMP7</i> , <i>CELF3</i> , <i>KIT</i> , <i>PAFAH1B3</i>	<i>BHLHE22</i> , <i>CRYAB</i> , <i>CCDC88A</i> , <i>SLC6A15</i> , <i>DUT</i> , <i>SMC4</i> , <i>BTG1</i> , <i>GFAP</i> , <i>IFI6</i> , <i>SNCB</i> , <i>FAM126A</i> , <i>SMARCC2</i> , <i>PHF6</i> , <i>PGM1</i> , <i>POU3F3</i> , <i>CCNL1</i> , <i>BSG</i>
<i>LEF1</i>	<i>TBR1</i> , <i>LEF1</i> , <i>ARX</i> , <i>DLX5</i> , <i>DLX6</i> , <i>RFX4</i> , <i>NRXN1</i> , <i>SOX2</i> , <i>SOX6</i> , <i>KCNH8</i> , <i>ZIC2</i> , <i>TUBB4A</i> , <i>THR8</i> , <i>NFIX</i> , <i>NELL2</i> , <i>HEY1</i> , <i>MT3</i> , <i>BTG1</i> , <i>DACH1</i>	<i>MEST</i> , <i>TBR1</i> , <i>ARX</i> , <i>ZIC2</i> , <i>ZIC5</i> , <i>RFX4</i> , <i>NRXN1</i> , <i>SOX2</i> , <i>PIM3</i> , <i>DLX5</i> , <i>KCNH8</i> , <i>LEF1</i> , <i>HMGA2</i> , <i>DACH1</i>	<i>YTHDC1</i> , <i>SLC6A15</i> , <i>MTSS1</i> , <i>BTG1</i> , <i>NES</i> , <i>CCNL1</i>
<i>LHX2</i>	<i>GAD2</i> , <i>TBR1</i> , <i>NRXN3</i> , <i>LIX1</i> , <i>GPM6B</i> , <i>EMX2</i> , <i>BCL11B</i> , <i>ASPH</i> , <i>NHLH1</i> , <i>SALL1</i> , <i>ELMO1</i>	<i>TBR1</i> , <i>NRXN3</i> , <i>SEL1L3</i> , <i>GPM6B</i> , <i>LIX1</i> , <i>EMX2</i> , <i>SALL1</i>	<i>TP53I11</i> , <i>FABP7</i> , <i>STOML2</i> , <i>SLC25A5</i>
<i>LITAF</i>	-	-	<i>RNASEH2A</i> , <i>RAB6A</i> , <i>LTBP1</i> , <i>TP53I13</i> , <i>NRXN1</i> , <i>ADGRV1</i> , <i>NOTCH2</i> , <i>NR2E1</i> , <i>THRA</i> , <i>GNG5</i> , <i>BTG2</i> , <i>SALL1</i> , <i>PSME1</i> , <i>PTBP1</i> , <i>ECI2</i> , <i>PAICS</i>
<i>MAFF</i>	<i>OTX2</i> , <i>BHLHE22</i> , <i>LHX2</i> , <i>TUBB4A</i>	<i>OTX2</i> , <i>BHLHE22</i> , <i>LHX2</i>	<i>GTPBP4</i>
<i>MAFG</i>	<i>OTX2</i> , <i>BHLHE22</i> , <i>TUBB4A</i> , <i>PDE1C</i>	<i>OTX2</i> , <i>BHLHE22</i>	<i>ELMO1</i> , <i>NUP107</i>
<i>MEIS1</i>	<i>FEZF2</i> , <i>GFAP</i> , <i>GPM6A</i> , <i>DNAJB5</i> , <i>ERBB4</i> , <i>BTBD17</i> , <i>NLGN1</i>	<i>FEZF2</i> , <i>NLGN1</i> , <i>GFAP</i> , <i>DNAJB5</i> , <i>GPM6A</i>	<i>STAG2</i> , <i>TMEM98</i>
<i>MN1</i>	-	-	<i>KDM5B</i> , <i>PLP1</i> , <i>SLC1A2</i> , <i>BHLHE22</i> , <i>PEPD</i> ,

			<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>
MSX1	<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>	-
MYBL2	<i>MLC1, NDP</i>	<i>NDP, MLC1</i>	<i>SLC9A3R1, KCNH8, MTSS1, PKIA, AIF1L, SLC1A3, DOK5</i>
MYT1	-	-	<i>MCM7, CAP2, SFRP1, H2AFX, SMC4, BCL11B, NES, TMEM98, SERPINE2, MCM2, POU3F3, EOMES</i>
MYT1L	-	-	<i>RREB1, PHGDH, SLC9A3R1, LRIG1, CXADR, TIMP1, SOX2, HSDL2, NPC2, PKIA, ASPH, GRHPR, MLC1, PDE1A, DPYSL2, NINJ1, NELL2, AIF1L, NKAIN4, DOK5</i>
NEUROD2	<i>ZBTB20, ZBTB18, GLIS3</i>	<i>ZBTB20, ZBTB18</i>	<i>ATAT1, MTSS1, SCRT2, GNG3, SNAP25, RAI14, BTG1, PPT1, MAPK10, NES, SNCB, BCL11A</i>
NEUROG2	<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>
NFE2L2	<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>
NFIC	<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>
NFIX	-	-	<i>OTX1, ANKRD36C</i>
NHLH1	<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>GINS2, TYMS</i>
NPAS3	-	-	<i>SAE1</i>
NR1H2	-	-	<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>
NR2E1	<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, ACMA2, SALL1, BMP7, GPC4, GRIA3, SH3GL2</i>

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

	<i>PDE1C, NEUROG2, ATP1A3, BCAN, HOPX, MEGF10, DLX6</i>	<i>HOPX, MEGF10, CELF3, PDE1C</i>	
RFX4	<i>ATP1A3, MYT1, MYT1L, ELMO1, MYO10, KIF1A, RFX4, FAM49A, ZIC2, MSN, CDK4, ITGB8, FAT1, FAM107A, PDCD4, PON2, ID2, IQGAP2, STOML2, CCNL1, DNAJB5, 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, CXADR, NFIC, DLX2, PDE1C, TECR, MSMO1, CDK4</i>	<i>LRIG1, RCN1, PSAT1, PDZRN3, PON2, DCXR, MLC1, BMP7, S1PR1, ALDH9A1, SCRG1, PLPP3, NKA/N4, SLC1A3</i>
RORA	<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>
RREB1	<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>
SALL1	-	-	<i>LITAF, MEGF10, NOTCH2, NR2E1, MYO10, LTA4H, PSME1, HAT1, COL4A5, SH3GL2</i>
SCRT2	<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, 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, THRIB, 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>

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

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

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

		<i>STAT3; H2AFX; HMGB1; HSPD1; HADHB; PDLIM1; SLC9A3R1; PTBP1; TUBA1B; GANAB; RFX4; HNRNPA2B1; FLNA; PHGDH; RBBP7; P4HB; PFN1; TP53; CLIC1</i>		<i>HSPD1; PDLIM1; SLC9A3R1; PTBP1; TUBA1B; FLNA; PHGDH; RBBP7; CLIC1; XBP1; DUT; TCF7L1; GSN; PARP1; H2AFY; H2AFX; DDOST; HADHB; RFX4; HNRNPA2B1; P4HB; PFN1; SLC25A5</i>	
<i>GLI1</i>	3.13E-01	<i>XBP1; CDK4</i>	3.59E-02	<i>XBP1; ZIC2; CDK4; ZIC1</i>	RGC
<i>MYC</i>	3.09E-04	<i>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</i>	1.01E-02	<i>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</i>	RGC
<i>NRF1</i>	3.65E-01	<i>PARP1</i>	9.22E-03	<i>PARP1; MAFF; NFE2L2</i>	RGC
<i>SMAD2</i>	2.70E-02	<i>TUBA1B; ZEB1; CDK4; FLNA; SOX9; SRI; TP53; LITAF; RHOA; GFAP; HSPD1; SOD1</i>	3.19E-03	<i>TGIF1; LEF1; SRI; LITAF; GLI3; RHOA; GFAP; HSPD1; SOD1; TUBA1B; ZEB1; CDK4; ANP32E; FLNA; SOX9; SLC25A5</i>	RGC
<i>SOX2</i>	2.66E-02	<i>SALL1; ZEB1; PAX6; RBBP7; SAE1</i>	3.69E-02	<i>TCF7L1; SALL1; ZEB1; RBBP7; SAE1</i>	RGC
<i>SP1</i>	2.40E-02	<i>TUBA1B; REST; PARP1; TPM4; CDK4; STAT3; S1PR1; NR2E1; VIM; TP53</i>	3.55E-02	<i>TUBA1B; BCL11B; PARP1; TPM4; CDK4; SP4; S1PR1; MSX1; NR2E1; VIM</i>	RGC
<i>TCF3</i>	8.40E-02	<i>SLC9A3R1; PCNA; CDK4; RFX4; PON2; ID4; ID3; RBBP7</i>	1.20E-02	<i>EEF1B2; SLC9A3R1; PCNA; RPN2; CDK4; RFX4; ID2; PON2; ID4; ID3;</i>	RGC

				<i>RBBP7</i>	
AR	0.088684	<i>KDM5B; DCC; UBC; TCF4; KIF1A; ENO2; CALM1</i>	0.048663	<i>KDM5B; BTG2; DCC; UBC; ARID5A; KIF1A; ENO2; CALM1</i>	N1
ATF3	0.092944	<i>HSP90AB1; CEBPG; UBC; ATF4</i>	0.000486	<i>HSP90AB1; DDIT3; CEBPG; UBC; HSF1; ATF4</i>	N1
BACH1	0.155689	<i>ARF1; UBC</i>	0.00079	<i>ARF1; MAFG; UBC; MAFF; NFE2L2</i>	N1
CEBPB	0.085313	<i>UBC; CEBPG; POLE3; CAMK2G; ATF4</i>	0.00297	<i>MEIS1; DDIT3; UBC; CEBPG; HSF1; RORA; HDAC9; ATF4</i>	N1
EP300	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
ESR1	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; THRΒ; THRA; ARID5A; HDAC9; GTPBP4; GNL3; FKBP1A; UBC; COX2; HNRNPC; KIF1A; CALM1</i>	N1
FOS	0.20152	<i>NTRK3; UBC; CEBPG; ATF4</i>	0.015839	<i>XBP1; DDIT3; NTRK3; UBC; CEBPG; ATF4; FOSL2; NFE2L2</i>	N1
JUN	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
JUNB	0.087772	<i>NPM1; UBC; ATF4</i>	0.021055	<i>MAFG; UBC; FOSL2; ATF4</i>	N1
JUND	0.411506	<i>UBC</i>	0.016146	<i>DDIT3; UBC; FOSL2; NFE2L2</i>	N1
LMO2	0.079107	<i>KDM5B; NHLH1; UBC</i>	0.015845	<i>KDM5B; BEX2; NHLH1; UBC</i>	N1
MAFK	0.285892	<i>UBC</i>	0.001669	<i>NR4A3; UBC; BACH1; NFE2L2</i>	N1
MEF2A	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>THR8; 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; THR8; 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

References

- Colantuoni C, Lipska BK, Ye T, Hyde TM, Tao R, Leek JT, Colantuoni EA, Elkahloun AG, Herman MM, Weinberger DR et al. 2011. Temporal dynamics and genetic control of transcription in the human prefrontal cortex. *Nature* **478**(7370): 519-523.
- Curion F, Handel AE, Attar M, Gallone G, Bowden R, Cader MZ, Clark MB. 2020. Targeted RNA sequencing enhances gene expression profiling of ultra-low input samples. *RNA biology*: 1-13.
- Inoue F, Kreimer A, Ashuach T, Ahituv N, Yosef N. 2019. Identification and Massively Parallel Characterization of Regulatory Elements Driving Neural Induction. *Cell stem cell* **25**(5): 713-727 e710.
- Lachmann A, Giorgi FM, Lopez G, Califano A. 2016. ARACNe-AP: gene network reverse engineering through adaptive partitioning inference of mutual information. *Bioinformatics* **32**(14): 2233-2235.
- Marbach D, Lamarter D, Quon G, Kellis M, Kutalik Z, Bergmann S. 2016. Tissue-specific regulatory circuits reveal variable modular perturbations across complex diseases. *Nature methods* **13**(4): 366-370.
- Stuart T, Butler A, Hoffman P, Hafemeister C, Papalexi E, Mauck WM, 3rd, Hao Y, Stoeckius M, Smibert P, Satija R. 2019. Comprehensive Integration of Single-Cell Data. *Cell* **177**(7): 1888-1902 e1821.