# Title: Loss of NFIX transcription factor biases postnatal neural stem/progenitor cells towards oligodendrogenesis.

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**Running Title: NFIX suppresses NSC commitment to oligodendrogenesis**

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**Abstract**

Murine postnatal neural stem cells (NSCs) give rise to either neurons, astrocytes or oligodendrocytes, however our knowledge of the genes that control this lineage-specification is incomplete. Here we show that Nuclear Factor I X (NFIX), a transcription factor known to regulate NSC quiescence, also suppresses oligodendrogenesis (ODG) from NSCs. Immunostaining reveals little or no expression of NFIX in oligodendrocyte (OL)-lineage cells both *in vivo* and *in vitro*. Loss of NFIX from subventricular zone NSCs results in enhanced ODG both *in vivo* and *in vitro*, while forced expression of NFIX blocks NSC differentiation into OLs *in vitro*. RNA-seq analysis shows that genes previously shown to be differentially expressed in OL progenitors are significantly enriched in RNA from *Nfix*$^{-/-}$ vs. wild type NSCs. These data indicate that NFIX influences the lineage-specification of postnatal subventricular zone NSCs, specifically suppressing ODG.

## Introduction

Nuclear Factor I (NFI) transcription factors (TFs) regulate the development of many organ systems [1-8]. In vertebrates, 4 alternatively spliced NFI genes (*Nfia*, *Nfib*, *Nfic* and *Nfix*) encode proteins that form homo- or hetero-dimers and function as site-specific TFs [7]. All NFI proteins appear to bind to the same DNA recognition motif [7], and either activate or repress gene expression depending on the promoter and cell type [7,9]. Previously we reported that *Nfix*-knockout mice had an expanded cerebral cortex, excess PAX6+ progenitor cells in the subventricular zone (SVZ), fewer subgranular zone (SGZ) neural progenitor cells, and delayed neurogenesis in the hippocampus [10,11]. These findings indicate a role for NFIX in regulating neural stem cells (NSCs) and their differentiation. In addition, we reported that NFIX regulates NSC quiescence *in vitro* [12]. While ChIP-seq analysis has shown that NFIs bind to some genes that regulate the differentiation of NSCs (e.g. Mash1) [12,13], the role of NFIX in oligodendrogenesis (ODG) has not been well studied.

Oligodendrocytes (OLs) are one of two main glial types [14-16]. They myelinate axons of neurons to both protect them and promote signal conduction [17,18]. OL formation begins around birth in mice and peaks at postnatal day 14 (P14) [14,19,20]. Murine OLs are derived mostly from preexisting OL progenitor cells (OPCs) present in multiple locations in the brain [14,21]. However, some OLs are derived from NSCs in the SVZ rather than from existing OPCs [14,21,22]. Indeed, NSC-derived OLs can play a major role in remyelination after brain injury or induced demyelination [23,24], suggesting the potential for NSC-based therapy for brain injury and demyelination diseases. However, the TFs that regulate OL formation from NSCs are only partially defined. Here we show that NFIX expression decreases as NSCs undergo ODG and that this down-regulation appears essential for normal NSC-derived OL formation. This suggests an important role for NFIX in the lineage-specification of NSCs in postnatal mouse brain.

## Material and Methods

***Nfix$^{-/-}$* and *Nfix* iKO mice.** Germline *Nfix$^{-/-}$* mice were generated as described previously [11] and were analysed as C57Bl/6/129 F1 hybrid animals. This avoided the hydrocephalus seen in inbred C57Bl/6 *Nfix$^{-/-}$* mice. NestinCreERT2/R26R-EYFP/*Nfix$^{+/+}$* and NestinCreERT2/R26R-EYFP/*Nfix$^{flox/- \text{ or } flox}$* (iKO) mice were maintained on a C57Bl/6 background and were generated by crossing the appropriate progeny of *Nfix$^{+/+}$*, *Nfix$^{flox/-}$* or *Nfix$^{flox/flox}$* and NestinCreERT2/R26R-EYFP mice (provided by Dr. Amelia J. Eisch [25,26]). Mice were genotyped by PCR and sequences of the primers are available upon request. 180 mg/kg tamoxifen (Sigma, T-5648) in sunflower oil was administered by daily intraperitoneal injection for 4 days into 4-week old NestinCreER$^{T2}$/R26R-EYFP/*Nfix$^{+/+}$* and NestinCreERT2/R26R-EYFP/*Nfix$^{flox/-}$* (or *Nfix$^{flox/flox}$*) mice [25]. All protocols were approved by the IACUC at Roswell Park Cancer Institute.

**Tissue preparation and immunofluorescence.** Animals were perfused with 4% PFA and brains were dissected and post-fixed in 4% PFA overnight at 4°C. Serial coronal sections (40-45 μm) through the dentate gyrus were collected and every 6th section was used for staining. Primary antibodies are listed in Suppl. Table 1. Free floating or slide mounted staining was performed as described previously [5]. Images were taken with a Zeiss Observer Z1 with ApoTome 2. For WT and *Nfix* iKO brains, every 6$^{th}$ section starting from Bregma 1.18-0.02 mm was taken for SVZ staining.  P12 was chosen as the time to analyse NFIX expression in the DG as it was the latest postnatal time prior to the frank development of hydrocephalus in *Nfix$^{-/-}$* animals.

**Cell culture and staining.** Brains were dissected at postnatal day 10 (P10) and a 2 mm coronal slice containing the SVZ was dissociated with 0.05% Trypsin. Cells were seeded onto wells or coverslips at $2X10^5$ cells/$cm^2$. For monolayer cultures, wells/coverslips were coated with 0.001% poly l-lysine (Sigma, P8920) and 10 μg/ml laminin (Sigma, L2020) before seeding [27]. Proliferation medium consisted of DMEM/F12 (Gibco), B27 (1:50), 2 mM L-Glutamine, 20 ng/ml human EGF and 20 ng/ml human FGF2 [28,29]. For differentiation, medium was replaced with medium lacking growth factors [28,29]. Neurospheres and monolayer-cultured cells were fixed with 4% PFA and stained with antibodies (see Suppl. Table 1). For O4 staining, live neurospheres or monolayer cells were incubated with primary antibody at 37°C for 1 hour, and then fixed with 4% PFA. Total cell number was assessed by DAPI staining. For quantification of the neurosphere assay, neurospheres with at least 10 TUJ1+ or O4+ cells were counted as TUJ1+ or O4+ neurospheres, respectively. For classifying NFIX expression levels, the average intensity of NFIX staining in each nucleus (area defined by DAPI staining) was quantified using ImageJ. Nuclei with an average intensity value above half the maximum intensity value in the same view were classified as NFIX-high with the remainder being NFI-low or NFIX negative.  P10 was chosen for cell isolation to maximize the number of postnatal NSCs available, which begins to decrease after P10.

**Electroporation of *Nfix*$^{-/-}$ cultured NSCs.** Primary *Nfix*$^{-/-}$ NSCs were expanded for 10 days and electroporated with pCAGGSs plasmids expressing NFIX2-IRES-GFP or IRES-GFP as described previously [12]. Cultures were detached using Accutase and counted using a Nexcelom cell counter. $2X10^6$ cells were mixed with 4 μg plasmid DNA and electroporation was performed with a Nucleofector II (Lonza VAPG-1004 kit, Program A-33). Cells were seeded in medium containing growth factors on coated coverslipped 24 well plates and shifted to differentiation medium after 24 hrs. Cells were fixed and stained on differentiation day 0, 2 and 4 (D0, D2 and D4) or proliferation day 1, 3 and 5 (Pro1, Pro3 and Pro5).

**Brain RNA extraction and RT-qPCR.** Brains minus olfactory bulbs and cerebella were dissected, RNA was extracted with TRIzol reagent and cDNA generated by random hexamer-primed cDNA synthesis (iScript, Bio-rad). Transcript levels were assessed by quantitative PCR (qPCR) (Bio-Rad iCycler) using SYBR Green detection as described previously [5]. β2-microglobulin transcript levels were used to normalize expression levels. All primers are listed in Suppl. Table 2.

**RNA-seq and ROC analysis.** RNA was harvested from proliferating WT and *Nfix*$^{-/-}$ monolayer cells and used for RNA-seq analysis on an Illumina HiSeq2000 with 50 bp single-end sequencing. Data were analysed using Tophat 2.0.7 and Cufflinks 1.3.0 with the mm9 UCSC annotation file [12,30]. Primers used for qPCR are shown in Suppl. Table 2. Analysis was performed with DAVID [31] on GO Fat, Kegg and Panther Pathways with cutoffs of $log_2FC$ (fold change) >1.5 and $p<0.05$. The top 10 up or down-regulated clusters using gene function classification are shown. Data were deposited in the Gene Expression Omnibus (#GSE65337). The RNA-seq list from Cufflinks was sorted (high to low) by $Log_2FC$ of FPKM values (*Nfix*$^{-/-}$/WT). This list was compared to gene lists from known OPC gene sets to generate ROC curves. Mouse cell-type specific gene lists were generated by differential gene expression analysis utilizing profiles of

OPCs (PDGF$\alpha$R$^+$), and OLs (GalC$^+$ & MOG$^+$), astrocytes (S100B$^+$) and neuronal populations [32]. Cell-type specific gene lists were generated by comparison against all other cell types using a linear model and regulated genes identified using >5 fold change (FC) and 1% false discover rate (FDR) cut-offs. The gene list of human fetal CD140a$^+$ OPCs was generated by comparison against the profile of CD140a$^-$ cells (>3FC, 5%FDR) [33]. The gene list of human adult A2B5$^+$ OPCs (from subcortical white matter) was generated by comparison with unsorted white matter and the profiles of sorted microglia (CD11b$^+$) and astrocytes (GLT1$^+$) (>3FC and 5% FDR) [34].

## Results

### NFIX is expressed in most neural stem and progenitor cells in postnatal DG and SVZ but not in SOX10+ OPCs.

Previously we showed that NFIX is expressed in both the SVZ and DG [10,11], the two main niches for NSCs in adult mice. To assess NFX expression in NSCs and their progeny in the DG, we performed immunostaining on WT postnatal day 12 (P12) DG sections with markers that distinguish the cell types present, as described previously [25,35] (Suppl. Fig. 1). NFIX was expressed in ~65% of NSCs (GFAP+S100B-) (Suppl. Fig. 1A and 1A', white arrows, quantified in Suppl. Fig. 1E), most transit amplifying progenitors (Ki67+DCX-) (Suppl. Fig. 1B and 1B', white arrows), neuroblasts (Ki67+DCX+) (Suppl. Fig. 1B and 1B", yellow arrows) and immature neurons (Ki67-DCX+) (Suppl. Fig. 1B and 1B'", cyan arrows). While most mature neurons were NFIX negative (Suppl. Fig. 1C and 1C', yellow arrowheads), ~1/4 expressed NFIX (Suppl. Fig. 1C and 1C", yellow arrows) and few mature astrocytes (GFAP+S100B+) (Suppl. Fig. 1A and 1A'", yellow arrowheads) expressed NFIX. SOX10 is a marker of committed OPCs, and essentially no OLs or OPCs (SOX10+) (Suppl. Fig. 1D and 1D', yellow arrowheads) expressed NFIX. In summary, NFIX was expressed in most NSCs and some of their progeny but not in OLs or OPCs in postnatal DG. This is consistent with previous data in postnatal SVZ [35], indicating a role for NFIX in NSCs at both locations. In addition, the absence of NFIX expression in SOX10+ cells in both DG (Suppl. Fig. 1D&E) and SVZ (0/48, Suppl. Fig. 2A-A' and [35]) showed that NFIX expression is normally down-regulated when NSC progeny commit to the OL-lineage.

We next assessed NFIX expression in OL-lineage cells in other regions of the postnatal brain. In P12 corpus callosum (CC), NFIX was expressed in most astrocytes (S100B+) but not in SOX10+ OL-lineage cells (0/50, Suppl. Fig. 2B-C). In the cortex, NFIX expression was seen in most neurons (NEUN+) and a few astrocytes (S100B+) but not in SOX10+ OL-lineage cells (0/71, Suppl. Fig. 2D-E). These data indicate that NFIX expression is suppressed in OL-lineage cells in multiple regions of the postnatal mouse brain.

**NFIX expression is lost when NSCs generate OL-lineage cells *in vitro*.**

To assess NFIX expression during NSC lineage-determination *in vitro*, we generated SVZ-derived primary neural stem and progenitor cells from P10 WT brains. The cells were induced to differentiate into multiple lineages by removal of growth factors for 4 days [36] and stained for NFIX and differentiation markers. All presumptive astrocytes showed strong NFIX expression (GFAP+, Fig. 1A-B) while only 16% of neurons strongly expressed NFIX (TUJ1+, Fig. C-D). Consistent with our *in vivo* data, no mature OLs (0/285) were NFIX+ (O4+, Fig. 1E-F), indicating loss of NFIX expression during ODG from NSCs.

To ask when NFIX expression is lost during ODG *in vitro*, we stained cells that had been differentiated for 4 days for markers representing various stages of ODG: OLIG2, expressed in NSCs and very early OPC stages; SOX10, expressed at a later OPC stage and in mature OLs; and MBP, expressed only in myelinating OLs. While ~90% of OLIG2- cells were NFIX+, only ~10% of OLIG2+ cells were NFIX+ (Fig. 1G-H). In addition, while ~80% of SOX10- cells were NFIX+, no (0/580) SOX10+ cells were NFIX+ (Fig. 1I-J). Similarly, no MBP+ cells expressed NFIX (Fig. 1K-L). These data show the loss of NFIX expression in all OL-lineage cells beginning at the early OPC state. This is consistent with our *in vivo* IHC data showing no SOX10+/NFIX+ cells in either SVZ or DG ([35] and Suppl. Figs. 1-2).

**Loss of NFIX promotes ODG from NSCs *in vitro.***

NFIX expression is high in proliferating NSCs but very low or absent in cells undergoing ODG, suggesting that NFIX expression may be incompatible with ODG. But is the loss of NFIX expression a cause or an effect of ODG? To address this, we assessed the lineage-specification pattern of P10 WT and *Nfix*$^{-/-}$ SVZ-derived NSCs. >95% of both WT and *Nfix*$^{-/-}$ proliferating NSCs were Nestin+ (data not shown), indicating a uniform high percentage of NSCs in each population. After withdrawal of growth factors for 4 days there was an ~4 fold higher percentage of O4+ cells in *Nfix*$^{-/-}$ vs. WT cultures (Fig. 2A-C). In contrast, the percentage of TUJ1+ and GFAP+ cells was similar in both (Fig. 2D&H, respectively). The lack of a statistically significant decrease in the percentage of TUJ1+ and GFAP+ cells is likely due to the relatively low percentage of O4+ cells present in both populations.  Consistent with the increased percentage of O4+ cells, *Nfix*$^{-/-}$ cultures also showed a significantly higher percentage of SOX10+ (Fig. 2E-G) cells vs. WT cultures.

To further assess the lineage-specification properties of *Nfix*$^{-/-}$ NSCs, we generated neurospheres from WT and *Nfix*$^{-/-}$ SVZ and assessed the cell types generated upon growth factor withdrawal. Consistent with the data from monolayer cultures, a significantly higher percentage of *Nfix*$^{-/-}$ neurospheres contained O4+ cells compared to WT neurospheres (Suppl. Fig. 3F) while the fraction of GFAP+ (not shown) and TUJ1+ neurospheres (Suppl. Fig. 3E) did not differ between *Nfix*$^{-/-}$ and WT cultures. These data suggest that the absence of *Nfix* biases NSCs to choose the OL-lineage.

**Forced expression of NFIX blocks ODG of NSCs *in vitro***

To further assess the role of NFIX in ODG, we induced expression of NFIX in *Nfix*$^{-/-}$ primary cultured NSCs. Electroporation of a control IRES-GFP vector had no observable effect on differentiation vs. non electroporated cells (Suppl. Fig. 4A). Electroporation of *Nfix*$^{-/-}$ NSCs with an NFIX-IRES-GFP expression vector resulted in a significant change in the distribution of cell types generated compared to that seen with the control vector (Fig. 3). The percentage of SOX10+ and O4+ cells was reduced in GFP+ cells of NFIX-IRES-GFP-electroporated cultures vs. GFP+ cells from IRES-GFP cultures (Fig. 3C-D). In addition, a reduced percentage of GFP+ cells in NFIX-IRES-GFP-electroporated cultures showed SOX10+ and O4+ staining vs. GFP- cells in the same cultures (Suppl. Fig. 4B-C). These data support a cell-autonomous role for NFIX in suppressing ODG from NSCs.

In this expression system, NFIX is translated from the first ATG 3' of the transcription start site while GFP is expressed from a downstream internal ribosome entry site (IRES) on the same transcript. Surprisingly, we saw that in the NFIX-GFP electroporated cells all NFIX+ cells were GFP+, but not all GFP+ cells expressed the same level of NFIX. Some GFP+ cells had very strong NFIX expression, some showed weaker NFIX expression and some appeared NFIX negative (NFIX-) (Fig. 3A-A'). We therefore quantified the fraction of OLs from cells expressing high or low levels of NFIX (NFIX-high and NFIX-low) in NFIX-electroporated cultures. In both populations, and particularly in NFIX-high cells, there was a decrease in the percentage of SOX10+ cells compared to the NFIX- cells in the same cultures (Fig. 3G, see Fig. 3B for example of mutually exclusive SOX10 and NFIX expression). Dual O4/NFIX staining showed that almost none of the NFIX+ cells differentiated into O4+ cells (Fig. 3H). These data indicate that forced expression of NFIX appears sufficient to suppress ODG from NSCs *in vitro*.

When we assessed the percentage of GFP+ cells in other cell lineages, we noted a significant decrease in the percentage of TUJ1+ cells from NFIX-IRES-GFP-expressing cells compared to IRES-GFP cells (Fig. 3E). Thus forced expression of NFIX can also repress neurogenesis. Consistent with the observed decrease in ODG and neurogenesis, the percentage of cells expressing GFAP was increased in NFIX-expressing vs. control cells (Fig. 3F). To further test for a cell-autonomous effect of NFIX on differentiation, we compared NFIX+ and NFIX- cells in the NFIX-IRES-GFP-electroporated cultures. Consistent with the above data, cells expressing NFIX showed reduced neuronal and increased astrocyte marker expression vs. NFIX- cells in the same cultures (Fig. 3I-J). Forced expression of NFIX also appeared to reduce the proliferation of NSCs as shown by a 6-9 fold decrease in Ki67 staining (Suppl. Fig. 4D). These data are consistent with our previous data showing forced expression of NFIX promoted quiescence of the NS5 NSC cell line [12].

**Loss of NFIX increases ODG marker expression *in vivo*.**

To determine the role of NFIX in ODG *in vivo,* we first measured the transcript levels of OL and OPC markers in WT and *Nfix*$^{-/-}$ littermate brains from P6 to P10. At P6, the transcript levels of *Olig2*, *Sox10* and *Mbp* were similar in WT and *Nfix*$^{-/-}$ brains (Fig. 4A-C). However, by P8 both the early ODG markers (*Olig2* and *Sox10*) and the late marker *Mbp* were elevated in *Nfix*$^{-/-}$ brains vs. WT littermate controls (Fig. 4A-C, respectively). At P10, the transcript levels of all 3 ODG markers were also elevated in the *Nfix*$^{-/-}$ brains, suggesting precocious ODG in *Nfix*$^{-/-}$ mice *in vivo*.

We did not measure marker transcript levels at later stages of development, as germline *Nfix*$^{-/-}$ mice develop severe hydrocephalus from P12 and do not survive weaning. Therefore, to test whether NFIX affects ODG from adult NSCs, we generated 4 week old Nestin-CreER$^{T2}$/R26R-EYFP/*Nfix*$^{flox/-}$ (*Nfix* inducible knock-out (iKO)) mice and lineage-traced the Nestin+ NSCs *in vivo* using EYFP as a marker (Fig. 5A). Brains were harvested at 1 month, 2 months and 3 months after tamoxifen injection (1M, 2M and 3M, red arrows in Fig. 5B). One month after tamoxifen injection, ~20% of EYFP+ cells in the CC of *Nfix* iKO mice were co-stained with OLIG2, while very few EYFP+ cells in the CC of NestinCreER$^{T2}$/R26-EYFP/ *Nfix*$^{+/+}$ (*Nfix*$^{+/+}$) mice were OLIG2+ (Fig. 5D). This difference increased at 2-months and 3-months after injection (Fig. 5D, see 5C for example). At 3 months, 60% of the EYFP+ cells expressed OLIG2 in the CC of *Nfix* iKO mice while almost no EYFP/OLIG2+ cells were present in the *Nfix*$^{+/+}$ CC. Most of the OLIG2-EYFP+ cells in the *Nfix*$^{+/+}$ CC were S100B+ astrocytes (data not shown). These data indicate that Nestin-Cre-mediated loss of NFIX appears to bias adult NSC lineage-determination towards the OL lineage *in vivo*. In addition, since only a fraction of Nestin+ NSCs were subject to loss of NFIX in a WT background, these data indicate that NFIX likely suppresses postnatal ODG of NSCs in a cell-autonomous manner.

**Loss of NFIX from NSCs increases expression of OPC-specific genes**

Both our *in vivo* and *in vitro* data indicate a role for NFIX in suppressing NSC progression into the OL-lineage. To assess possible mechanisms of this suppression and examine transcriptome changes in the absence of *Nfix*, RNA-seq was performed on proliferating WT and *Nfix*$^{-/-}$ primary culture NSCs. The quality of these data were tested by qPCR, which confirmed a subset of transcripts whose expression was changed in *Nfix*$^{-/-}$ NSCs (Suppl. Fig. 5). GO analysis using DAVID showed that the most significantly down-regulated gene sets in *Nfix*$^{-/-}$ NSCs were related to cell attachment and proliferation (Fig. 6C-D), consistent with our previous microarray data on the NS5 cell line expressing a dominant repressor form of NFI [12]. In addition, genes whose expression is increased or decreased in *Nfix*$^{-/-}$ NSCs are enriched for NFI binding sites within 50kb of their TSS as assessed from previous NFI ChIP-seq data in NS5 cells (Fig. 6A) [12]. These data suggest that NFIX may directly regulate a large fraction of these genes in NSCs.

We next asked whether the expression of genes associated with early stages of ODG were enriched in the *Nfix*$^{-/-}$ cultured NSC compared to WT controls. When the set of genes differentially expressed in *Nfix*$^{-/-}$ vs. WT NSCs was compared with gene sets differentially expressed in mouse OPCs [32] using Receiver Operating Characteristic (ROC) analysis [37-39], a significant enrichment of PDGF$\alpha$R+ OPC enriched transcripts was seen in *Nfix*$^{-/-}$ cultured NSCs ($p = 4.27e-18$) (Fig. 6E). Similarly, human fetal and adult OPC-enriched transcripts were also significantly enriched in *Nfix*$^{-/-}$ cultured NSCs (Fig. 6F-G) [33,34]. This suggests that NFIX may directly regulate OPC-specific gene expression and subsequently repress ODG from NSCs. In contrast, two mature OL-enriched gene sets did not show an apparent enrichment in *Nfix*$^{-/-}$ cultured NSCs (Suppl. Fig. 6), suggesting NFIX may regulate early stage but not late stage ODG.

## Discussion

Here we show that cells within the OL-lineage have little or no NFIX expression compared to other NSC-derived cell lineages (Fig. 1 and Suppl. Figs. 1-3). Loss of NFIX from NSCs resulted in increased ODG both *in vivo* and *in vitro* (Figs. 2, 4-5). In addition, forced expression of NFIX appears sufficient to suppress ODG from cultured *Nfix*$^{-/-}$ NSCs *in vitro* (Fig. 3). Gene expression analysis showed increased expression of OPC-specific genes in *Nfix*$^{-/-}$ versus WT cultured NSCs, suggesting that NFIX expression in NSCs is inversely correlated with the expression of OPC markers (Fig. 6E-G). These data are consistent with the model that NFIX directly suppresses the generation of OPCs from NSCs.

### NFIX is expressed in most NSCs in postnatal DG and SVZ.

It is of interest that the expression patterns of NFIX differed between NSCs of the SVZ and DG. While almost all SVZ NSCs are NFIX+ [35], only ~half of DG NSCs are NFIX+. While similar markers are expressed in NSCs of both regions (e.g., Nestin, GFAP, GLAST, etc.), the functional properties of NSCs in the two regions differ. For example, only SVZ NSCs normally generate postnatal OPCs and OLs *in vivo* [19,40], although both SVZ and DG NSCs differentiate into OLs *in vitro* [41,42]. Differences between NSCs in the SVZ and DG are believed due, at least in part, to distinct extracellular signalling within the two niches [14,43]. It is possible that the extracellular environment in the SVZ may better promote NSC proliferation and ODG than does the DG. Once the NSCs differentiate into mature astrocytes or neurons that migrate to new locations *in vivo*, signals in the new environment may act to reduce NFIX expression.

This would be consistent with our finding that NFIX expression was observed in only a fraction of mature neurons in the SVZ and DG ([35] and Supp. Fig. 1E).

**NFIX regulates early stages of ODG.**

Our data indicate that NFIX biases NSC lineage commitment away from ODG. The lack of NFIX expression in both SOX10+ cells *in vivo* and *in vitro* and OLIG2+ cells *in vitro*, indicates that that NFIX expression is down-regulated at an early step of ODG. In addition, our ROC analysis showed the enrichment of OPC-enriched genes but not OL-enriched genes in *Nfix*$^{-/-}$ NSCs, supporting the model that NFIX may repress an early stage of ODG from NSCs. Consistent with this model, our qPCR analysis showed a significant increase in the levels of *Olig2*, *Sox10* and *Mbp* transcripts in *Nfix*$^{-/-}$ vs. WT brains (Fig. 4). The magnitude of this difference was similar for both early (*Olig2*) and late (*Mbp*) markers of ODG, although the timing of the changes differed.  These data are consistent with the germline loss of NFIX promoting precocious ODG, presumably from NSCs.

**Forced expression of NFIX blocks ODG of NSCs.**

Both monolayer and neurosphere assays indicated that loss of NFIX increases ODG from NSCs. However, loss of NFIX is not sufficient to induce ODG, as only a small fraction of NSCs became OLs upon complete loss of NFIX. Therefore we asked whether loss of NFIX is necessary for ODG from cultured NSCs. In our electroporation system, while all NFIX+ cells were GFP+, the GFP+ cells showed a range of NFIX expression (NFIX-high, NFIX-low and NFIX- cells). When we analysed the NFIX-high and NFIX-low cells separately, we found that almost none of the NFIX-high cells were

SOX10+ cells, while ~5% of NFIX-low cells were SOX10+ (Fig. 3F). These data suggest that there may be a dose-dependence of NFIX on suppression of the OL-lineage which likely relates to the observed timing of the drop of NFIX expression during NSC ODG.

It was unexpected to find a decrease in TUJ1+ cells from NFIX-IRES-GFP-electroporated cells compared to controls, as enhanced neurogenesis was not seen in differentiated *Nfix*$^{-/-}$ NSC monolayer or neurosphere cultures. However, these data are consistent with the low fraction of neurons that express high levels of NFIX both *in vivo* and *in vitro*. One possibility is that the effect of NFIX on neurogenesis depends on the precise level of NFIX. In our electroporated cells we estimate that NFIX transcript levels may be as much as 5 fold above the endogenous levels seen in NSCs (data not shown). Thus, while forced expression of NFIX reduces neurogenesis from NSCs, it is possible that endogenous levels of NFIX may not affect neurogenesis. Alternatively, different functions have been reported for alternatively spliced products of the same *Nfi* gene [44]. Thus it is possible that the *Nfix2* isoform we expressed in NSCs represses neurogenesis, while other isoforms of *Nfix* may not. Further studies are needed to test for specific roles of different *Nfix* isoforms in neurogenesis, astrogenesis and ODG.

**_In vivo_ lineage-tracing indicates cell-autonomous regulation on NSC ODG by NFIX.**

Our DAVID analysis of genes down-regulated in *Nfix*$^{-/-}$ cultured NSCs suggests that the gene set regulated was related to cell external stimuli. There are a number of growth factors/hormones that are critical for induction of ODG from NSCs and OPC survival, including thyroid hormone (TH), FGF-2, BDNF, IGF-1 and PDGF [45-52]. However, our RNA-seq data indicated that none of these signalling molecules were affected by loss of NFIX. The level of FGF-5 transcript was decreased in *Nfix*$^{-/-}$ NSCs, however addition of FGF-5 (10 ng/ml) to proliferation and differentiation medium did not affect ODG of NSCs (data not shown). Thus, we have no evidence that apparent suppression of NSC ODG by NFIX is related to secreted signalling molecules.

To test whether NFIX suppresses ODG cell-autonomously *in vivo*, we generated *Nfix* iKO mice and performed lineage-tracing of Nestin+ cells. OPCs produced from adult NSCs in the SVZ normally migrate primarily to the CC [14,21,23,53]. Here we found that *Nfix*$^{-/-}$ NSCs generated a much higher percentage of OLIG2+/EYFP+ OPCs in the CC than did *Nfix*$^{+/+}$ NSCs. These data are consistent with cell-autonomous regulation of ODG by NFIX. However, no OLIG2+/EYFP+ cells were detected in the DG in either *Nfix*$^{+/+}$ or *Nfix* iKO mice (data not shown). These data suggest that NSCs in the SVZ and DG differ in their response to loss of NFIX. Determining whether this difference is cell-intrinsic, or due to the environment of the respective stem cell niches, requires further examination.

Nestin is often used as a NSC marker both *in vivo* and *in vitro* [26,54]. However recent studies have shown some heterogeneity of NSCs *in vivo*, with Nestin marking only a substantial fraction of the NSCs [55,56]. Thus our *in vivo* data indicate only that NFIX appears to suppress ODG from the Nestin+ fraction of SVZ NSCs. To address how well the Nestin-CreERT2 deletion of NFIX reflects the entire NSC population, additional lineage tracing studies using other Cre-expression systems including GLAST-CreERT2 and GFAP-CreERT2 are needed.

**Possible mechanisms of NFIX regulation of ODG**

There are at least 3 simple models for how NFIX may affect the lineage-determination of NSCs. First, it is possible that NFIX alone directly or indirectly regulates one or a few key TFs essential for NSCs to progress towards ODG. Second, NFIX alone may directly or indirectly regulate a complex network of TFs and signaling molecules that influences commitment to the OL lineage. Third, NFIX may interact specifically with other NFI family members, including NFIA, to regulate either key factors or networks of factors essential for NSC ODG. Each of these models is at least partially consistent with our data, but some are better supported than others.

Previous studies have shown that enforced expression of OLIG2 or SOX10 in NSCs can promote ODG [57,58]. However, our RNA-seq data show no major changes in the transcript levels of these key TFs in *Nfix*$^{-/-}$ NSCs. In contrast, *Rfx4* is involved in human ODG and oligodendroglial tumor formation [34,58,59] and its expression was increased ~2.8 fold in *Nfix*$^{-/-}$ cultured NSCs. In addition, several other TFs whose transcript levels are weakly altered by loss of NFIX (Fig. 6B) may influence ODG. Knockdown studies on these individual TFs will be necessary to test this model.

The “Network Model” is most consistent with our RNA-seq data. Our ROC analysis showed that a large number of genes differentially expressed in OPCs were also differentially regulated in *Nfix*$^{-/-}$ vs. WT NSC cultures *in vitro*. This correlation of gene expression was seen despite the fact that no SOX10+ cells were detected in proliferating *Nfix*$^{-/-}$ NSCs (data not shown). This co-enrichment of gene sets in mouse and human OPCs and *Nfix*$^{-/-}$ NSCs is the strongest evidence of pre-existing bias in proliferating *Nfix*$^{-/-}$ NSCs towards the OL lineage. However, it is unclear mechanistically how a change in a set of genes related to ODG can bias a cell populations towards differentiation into the OL lineage, and yet result in only a small fraction of the cells going down this specific lineage *in vitro*.

Previous studies showed increased ODG in postnatal *Nfia*$^{-/-}$ spinal cord and brain [60-62], suggesting that NFIA can also suppress ODG. In addition, NFIA appears to directly suppress neurogenesis and/or promote astrogenesis [63]. Here we show that loss of *Nfix* increases ODG and that forced NFIX expression suppresses ODG and neurogenesis but promotes astrogenesis. There are at least 3 ways that NFIX and NFIA might function together to regulate ODG, A) NFIX may regulate NFIA expression, B) NFIX may hetero-dimerize with NFIA, or C) NFIX may bind to the same regulatory sites and/or interact with the same ODG mediators as does NFIA. However, our RNA-seq data showed that *Nfia* transcripts were increased only ~1.3 fold in *Nfix*$^{-/-}$ NSCs vs. WT controls (Fig. 6B), while no changes were seen in *Nfib* and *Nfic* levels. Since all NFIs bind to similar DNA sequences and have similar DNA-binding and dimerization domains [7,64], NFIX may regulate ODG by modulating the same signalling pathway genes and/or by antagonizing the function(s) of the same TFs (e.g. SOX10, OLIG2) as does NFIA [60-62]. However, while both NFIX and NFIA suppress ODG, their mechanisms of action may be distinct. For example, NFIX appears to regulate an early stage of ODG (from NSC to OPC), while NFIA affects multiple stages of ODG [61,62]. Thus it will be important in future studies to determine common vs. unique targets of NFIX and other NFIs in NSCs and OPCs.

Mutations in the human homolog of *Nfix* are seen in the Marshall-Smith and Sotos-like syndromes [65-67] which exhibit delayed brain development, suggesting that NFIX plays important roles in both mouse and human. Moreover, NFIX and other NFIs have been identified as putative oncogenes or tumour suppressor genes in genetic models of meduloblastoma [68] and glioblastoma [69], and OPCs have been implicated as the cell of origin of glioblastomas [70,71]. Thus, a better understanding of the mechanism by which NFIX regulates NSC ODG may lead to improved therapies for brain injury, demyelinating diseases, developmental syndromes and brain tumors.

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**Author Disclosure Statement:**

The authors have no conflicts of interest to disclose.

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## Figure Legends

Gronostajski, RM Fig. 1 top

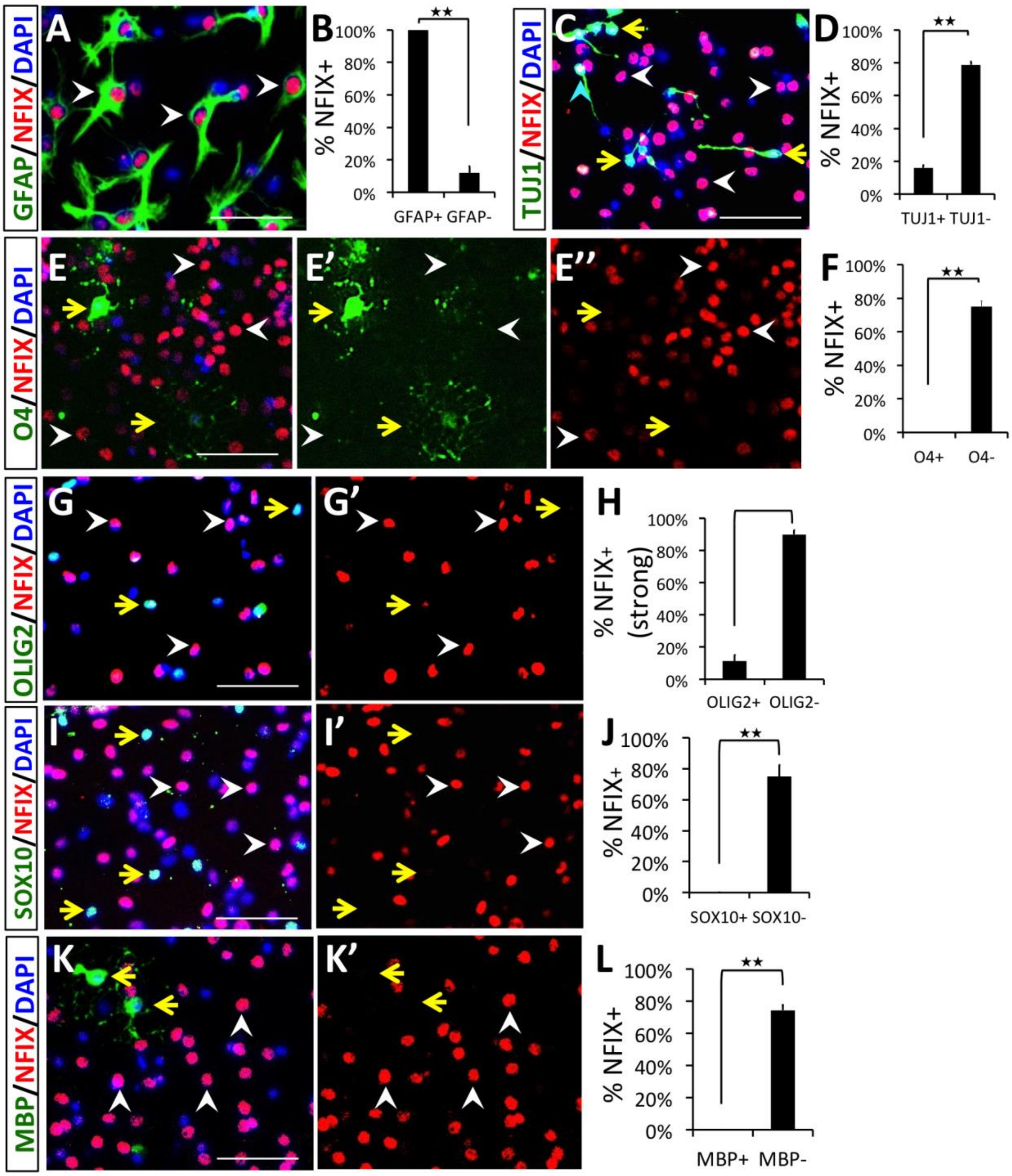



**Fig. 1. Expression of NFIX in differentiated lineages of cultured NSCs *in vitro*.**

WT NSCs were cultured in differentiation conditions for 4 days and stained for differentiation markers and NFIX. A) All GFAP+ (green cytoplasm) astrocytes express

NFIX (purple nuclei, white arrowheads). C) Most TUJ1+ neurons (green cytoplasm) show no NFIX staining (cyan nuclei, yellow arrows), while some TUJ1+ cells are NFIX+ (white nuclei, cyan arrowhead) Most TUJ1- cells are NFIX+ (purple nuclei, white arrowheads). E-E") O4+ OLs (green nuclei and cytoplasm) are NFIX- (blue nuclei in E, yellow arrows), while most O4- cells are NFIX+ (purple nuclei, white arrowheads). E' & E") O4 and NFIX channels, respectively from E. G, I and K) NFIX (red) and DAPI (blue) combined with OLIG2 (green, G), SOX10 (green, I), or MBP (green, K), respectively. Most OLIG2+ cells, all SOX10+ and all MBP+ cells are uniformly NFIX- (cyan nuclei, yellow arrows in G, I & K). Most OLIG2-, SOX10- and MBP- cells are NFIX+ (purple nuclei, white arrowheads in G, I & K). G', I' & K') NFIX staining (red) channels from G, I & K, respectively. B, D, F, J & L) Quantification of the percentage of NFIX+ cells that are GFAP+ vs. GFAP-, TUJ1+ vs. TUJ1-, O4+ vs. O4-,OLIG2+ vs. OLIG2-, SOX10+ vs. SOX10- and MBP+ vs. MBP-, respectively. H) Quantification of the percentage of OLIG2+ vs. OLIG2- cells that stained strongly for NFIX. Student's t-test was performed. n=3, > 300 cells per sample were analyzed (Scale bars: 50 μm). ⋆⋆$p < 0.001$.

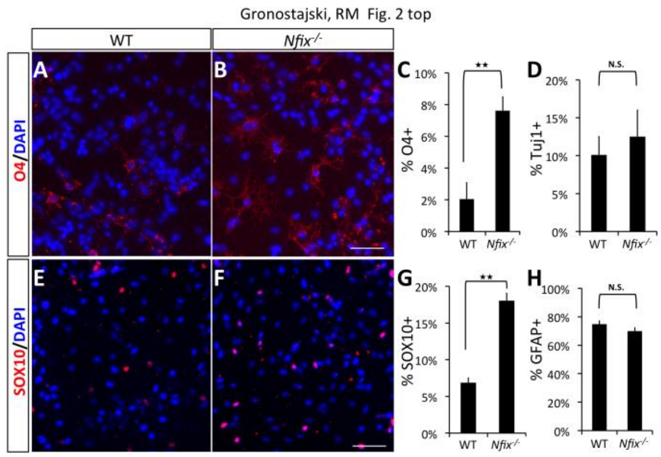



**Fig. 2. *Nfix$^{-/-}$* NSCs generate a higher percentage of OL-lineage cells than do WT NSCs.**

Primary WT and *Nfix$^{-/-}$* NSCs were cultured in differentiation conditions for 4 days and stained with anti-O4 (red, A & B) or anti-SOX10 antibodies (red, E & F) and counterstained with DAPI (blue, A, B, E & F). C, D, G & H) Quantification of the percentage of O4+, TUJ1+, SOX10+ and GFAP+ cells in WT and *Nfix$^{-/-}$* monolayer cultures, respectively. For C, n=7, > 5000 cells per sample were analyzed. For D, G & H, n=3, > 500 cells per sample were analyzed. Scale bars are 50μm. Student's t-test was applied. ⋆⋆*p* < 0.005. N.S., not significant.

Gronostajski, RM Fig. 3 top

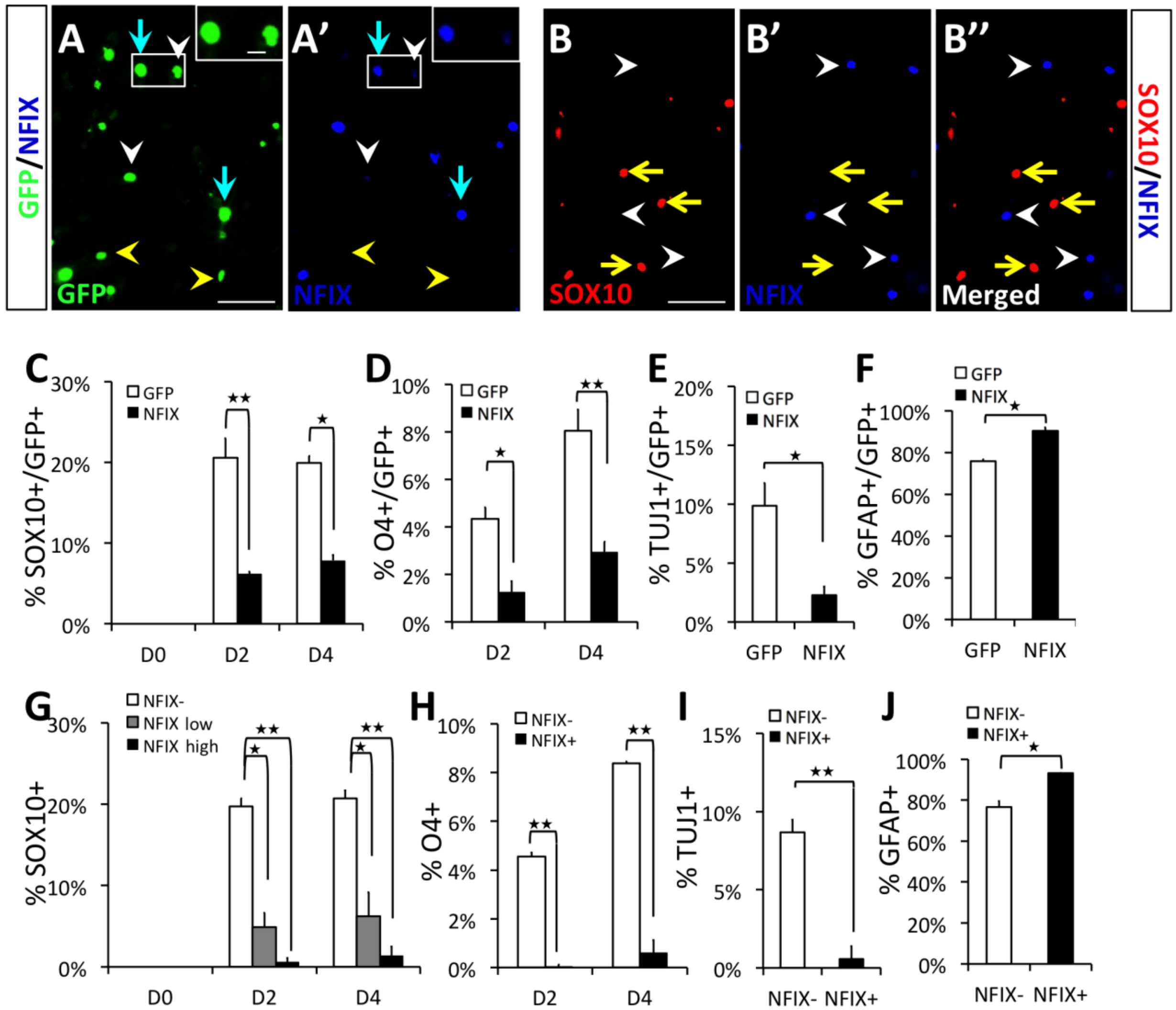



**Fig. 3. Forced expression of NFIX in *Nfix*$^{-/-}$ NSCs represses ODG.**

Proliferating *Nfix*$^{-/-}$ NSCs were electroporated with either control IRES-GFP (GFP) or NFIX-IRES-GFP (NFIX) vectors, placed in differentiation conditions for 0 (D0), 2 (D2) or 4 (D4) days and stained for GFP, NFIX and the indicated markers. A-A') Cells expressing the NFIX-IRES-GFP vector stained for GFP (A, green) and NFIX (A', blue) after 4 days of differentiation. Note that some GFP+ cells showed strong NFIX staining (NFIX-high, cyan arrows), some showed weaker staining (NFIX-low, white arrowheads) and some were NFIX- (yellow arrowheads). The boxes in the upper right quadrant of each panel are magnified views of the small white boxes. B-B'') Cells expressing the NFIX-IRES-GFP vector after 4 days of differentiation were stained for SOX10 (B, red, yellow arrows) and NFIX (B', blue, white arrowheads). B'' shows a merged image showing mutually exclusive SOX10 (yellow arrows) and NFIX (white arrowheads) expression. C, D, E & F) The percentage of GFP+ cells that differentiated into SOX10+, O4+, TUJ1+ and GFAP+ cells in cultures expressing the control GFP vector (white bars) or the NFIX-IRES-GFP vector (black bars), respectively. G) In NFIX-IRES-GFP expressing cultures a lower percentage of NFIX-high cells (black bars) and NFIX-low cells (gray bars) differentiate into SOX10+ cells compared to NFIX- cells (white bars) in the same cultures. H, I & J) The percentage of NFIX+ cells (black bars) vs. NFIX- cells (white bars) that differentiated into O4+, TUJ1+ and GFAP+ cells, respectively, in NFIX-IRES-GFP expressing cultures. n=3, > 2000 cells/sample were analyzed for SOX10 staining, > 500 cells/sample for other staining. Scale bars in A and B = 50μm, in magnified box in A = 10μm. Student's t-test was applied. ⋆$p < 0.05$, ⋆⋆$p < 0.005$.

Gronostajski, RM Fig. 4 top

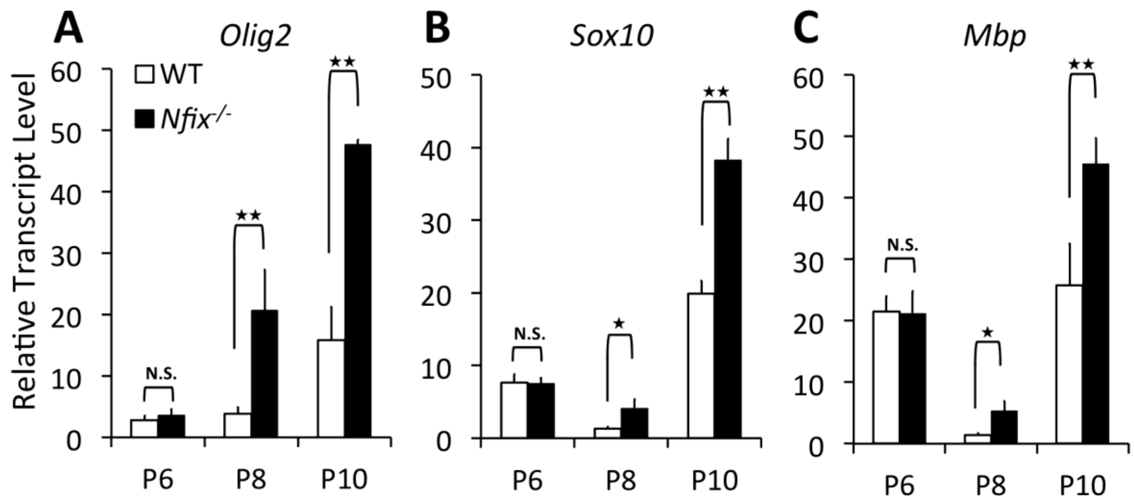



**Fig. 4. *Nfix*$^{-/-}$ brains have increased transcript levels of OPC and OL marker genes.** Brains of WT and *Nfix*$^{-/-}$ mice were dissected at postnatal days 6 (P6), 8 (P8) or 10 (P10), the olfactory bulbs and cerebella were removed and RNA was prepared and subjected to reverse transcription. A-C) qPCR analysis of relative transcript levels of *Olig2* (A), *Sox10* (B) and *Mbp* (C) in WT (white bars) and *Nfix*$^{-/-}$ (black bars) brains. Note significantly increased expression of *Olig2*, *Sox10* and *Mbp* at both P8 and P10 in *Nfix*$^{-/-}$ brains. n=3. p-value determined by t-test. ⋆$p < 0.01$, ⋆⋆$p < 0.05$. N.S., not significant.

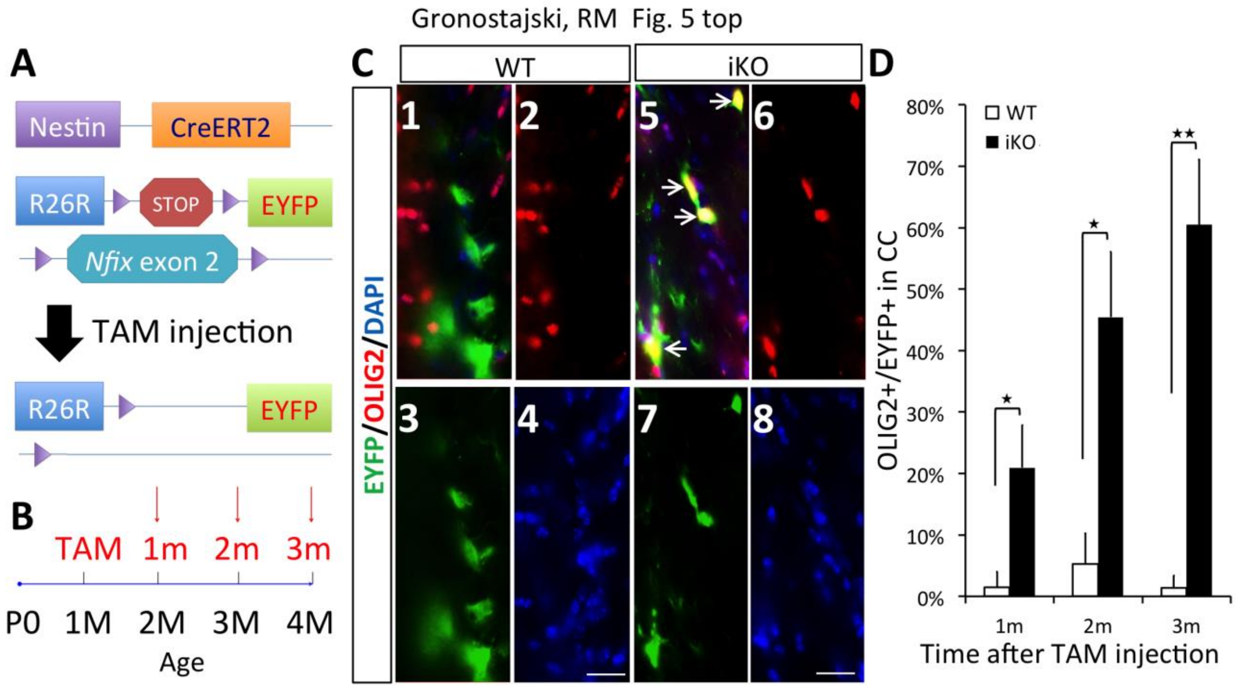



**Fig. 5. Deletion of *Nfix in vivo* results in increased commitment of SVZ-derived NSCs into OL-lineage cells in the corpus callosum.**

Mice containing Nestin-CreERT2 and Rosa26 flox-stopped EYFP alleles that were either *Nfix*$^{+/+}$ (WT) or homozygous for a floxed *Nfix* allele (iKO) were injected with tamoxifen at 1 month of age and sacrificed at 1, 2 and 3 months of after injection (1m-3m, respectively). Brains were fixed and stained for OLIG2, EYFP and DAPI. A) Diagram showing recombination in Nestin+ cells in *Nfix* iKO mice after tamoxifen (TAM) injection yielding *Nfix*$^{-}$ allele and active EYFP reporter. B) Diagram of time course for TAM-induced deletion of NFIX in Nestin+ cells in 1 month old *Nfix* iKO mice and control mice. C) EYFP (green), OLIG2 (red) and DAPI (blue) staining of WT and *Nfix* iKO CC 2-month after TAM injection. C1&5) Combined EYFP, OLIG2 and DAPI staining. White arrows in C5 show co-staining of EYFP and Olig2 in iKO brains. Far fewer of such double-positive cells were detected in WT brains (C1). C2 & C6 show OLIG2 staining alone, C3 & C7 show EYFP staining alone and C4 & C8 show DAPI staining alone. Scale bar in C4 & C8 = 50 μm. D) Quantification showing a higher percentage of OLIG2+/EYFP+ cells in *Nfix* iKO (black bars) vs. WT CC (white bars) at 1-3 months post injection. T-test, n=3. ⋆$p < 0.05$, ⋆⋆$p < 0.01$.

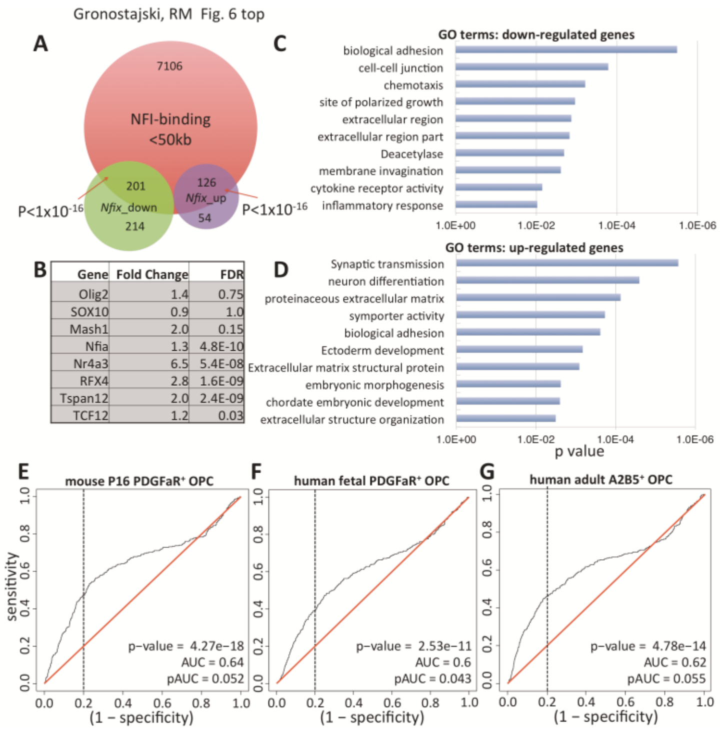
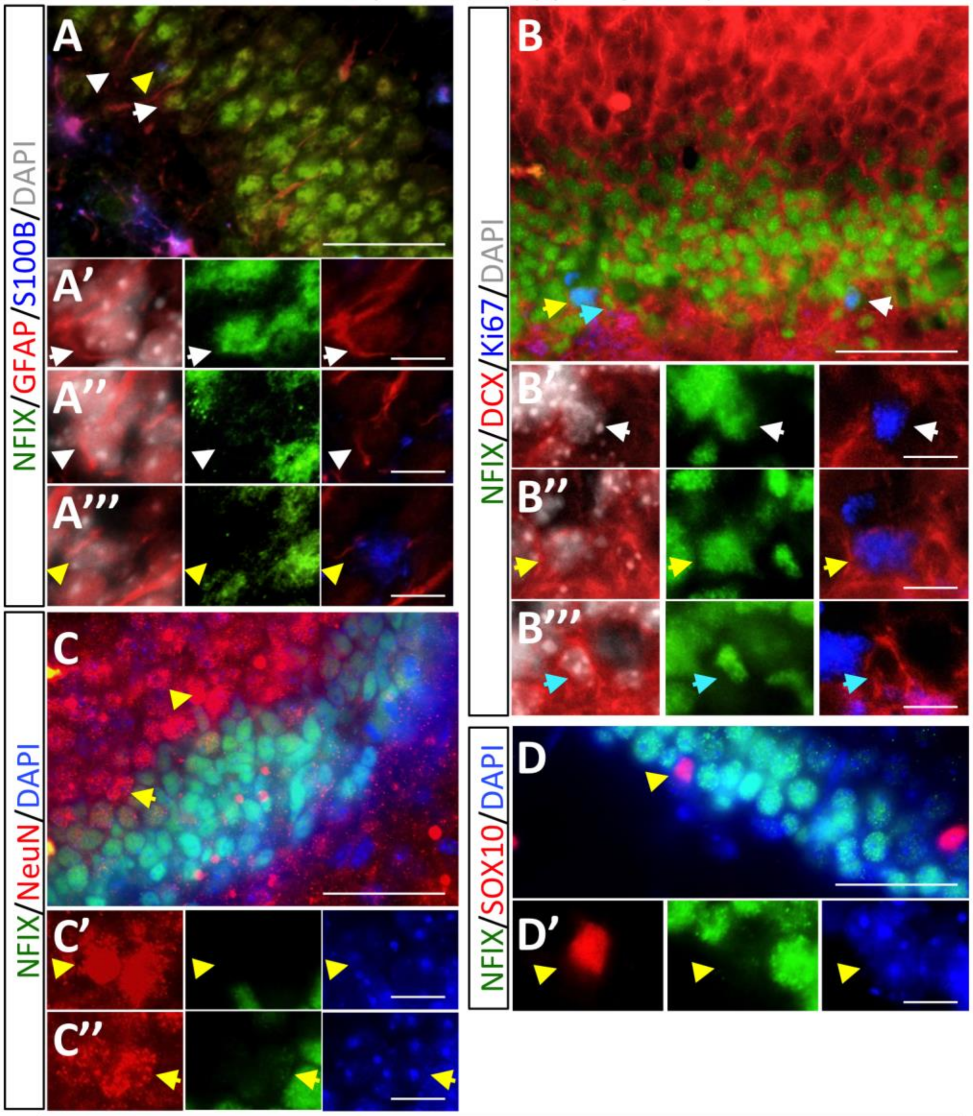



**Fig. 6. Genes differentially expressed in *Nfix*$^{-/-}$ NSCs show enrichment in specific GO terms, NFI binding sites and genes differentially expressed in OPCs.**

WT and *Nfix*$^{-/-}$ NSCs were cultured for 10 days then harvested and RNA was prepared and subjected to RNA-seq analysis. A) Venn diagram showing that genes up-regulated and down-regulated upon loss of NFIX are significantly enriched for NFI-binding sites identified previously by ChIP-seq on the NS5 cell line [12]. B) List of ODG-related transcription factors and their expression fold change and False Discovery Rate (FDR) in *Nfix*$^{-/-}$ vs. WT NSCs from RNA-seq data. FDR < 5% is considered significant. C & D) GO classes of genes down-regulated and up-regulated in *Nfix*$^{-/-}$ cultured NSCs compared to WT controls, respectively. E-G) The rank order of genes differentially expressed in *Nfix*$^{-/-}$ vs. WT NSCs was compared to lists of OPC-differentially expressed genes in three human and mouse data sets using Receiver Operator Characteristic (ROC) analysis. ROC curves show that genes differentially expressed in mouse P16

PDGFαR$^+$ OPCs (E)[32], human fetal PDGFαR$^+$ OPCs (F)[34] and human adult A2B5$^+$ OPCs (G)[33] were also differentially expressed in *Nfix*$^{-/-}$ cultured NSCs vs. WT NSCs. Deviation of the line above the diagonal indicates co-enrichment of the same set of genes in the two populations. AUC is Area Under Curve, pAUC is the area under the curve from 0-0.2 and is positive at values >0.02, $p$-values of <0.05 are statistically significant.

Gronostajski, RM Suppl. Fig. 1 top

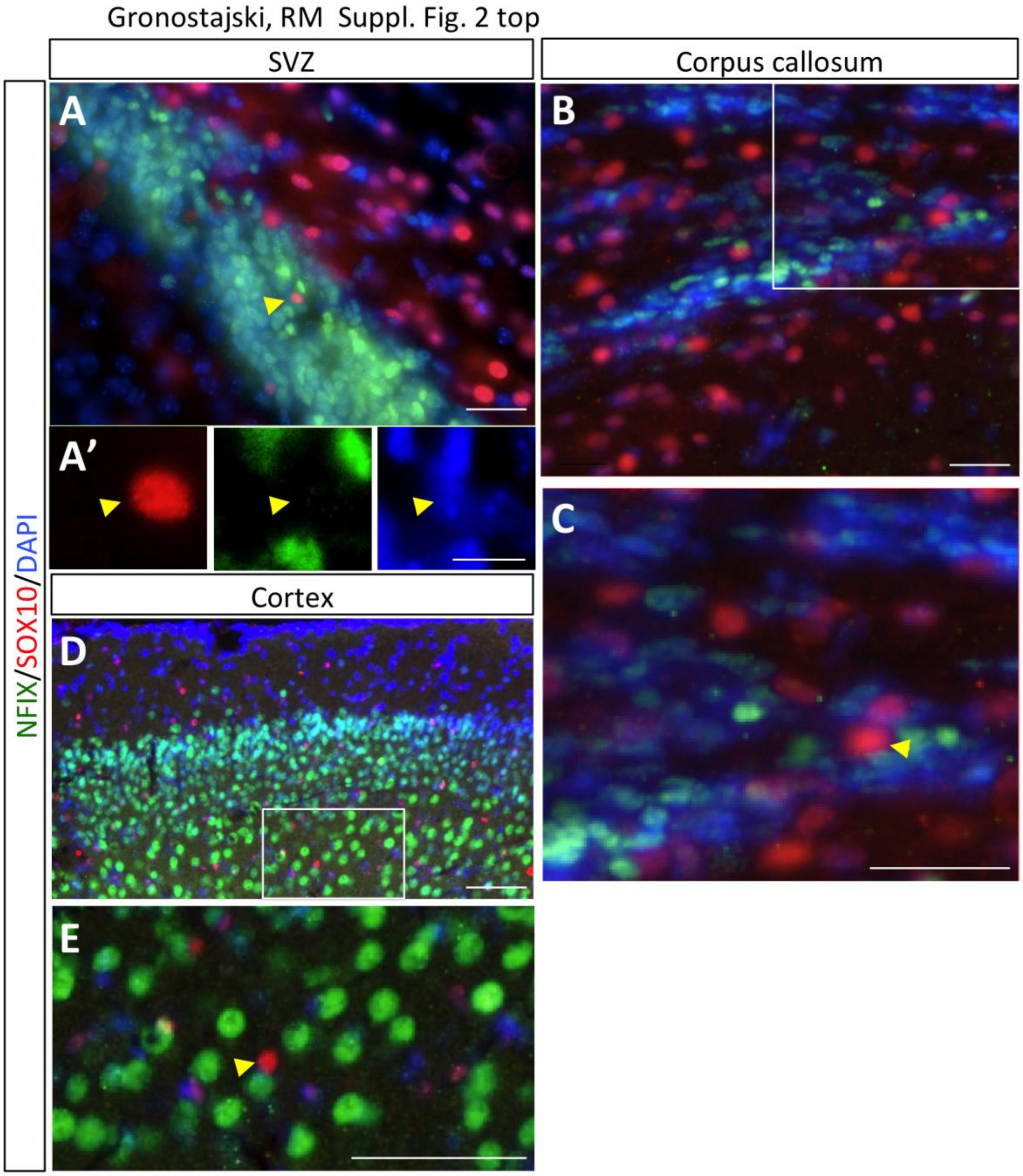



**E**

| Cell type | Markers | NFIX+/Tested | % NFIX+ |
|---|---|---|---|
| Neural stem cell | GFAP+S100B- | 46/71 | 65% |
| Mature astrocyte | GFAP+S100B+ | 5/93 | 5% |
| Transient amplifying progenitor | Ki67+DCX- | 72/74 | 98% |
| Neuroblast | Ki67+DCX+ | 90/91 | 99% |
| Immature neuron | Ki67-DCX+ | 74/74 | 100% |
| Mature neuron | NeuN+ | 23/90 | 26% |
| Oligodendrocyte and progenitor | SOX10+ | 0/53 | 0% |

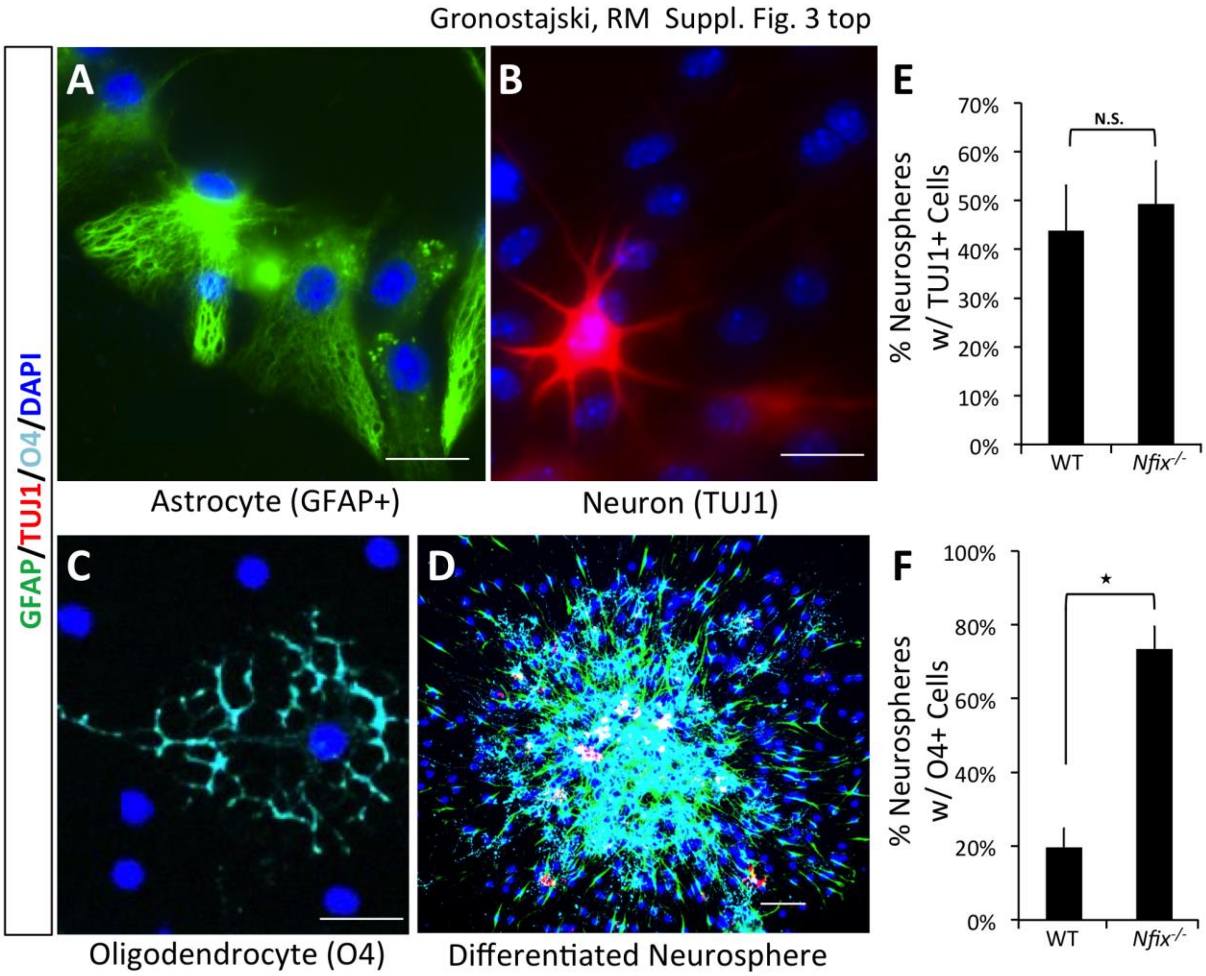
**Supplemental Fig. 1. NFIX is expressed in most neural stem and progenitor cells, few mature astrocytes and neurons, and no OLs or OPCs in postnatal DG.**

Postnatal day 12 brains were fixed, sectioned and the DG was stained for the indicated markers. A-A’”) Panel A is a merged overview showing NFIX (green), GFAP (red) S100B (blue) and DAPI (white) staining and panels. White arrow shows an NFIX+, GFAP+, S100B- NSC, shown in greater detail in A'. White arrowhead shows an NFIX-, GFAP+, S100B- NSC, shown in greater detail in A''. Yellow arrowhead shows a NFIX-, GFAP+, S100B+ mature astrocyte, shown in greater detail in A'''. Individual cells were identified by analysis of Z-stacks of confocal images. The expanded panels A’-A’” show, left: GFAP (red)+DAPI (white), center: NFIX (green), right: GFAP (red)+S100B (blue). NFIX is expressed in most NSCs (GFAP+S100B-, white arrow in A and A’, 46/71), but few mature astrocytes (GFAP+S100B+, yellow arrowhead in A and A’’’, 5/93) in the DG. Some NSCs are NFIX- (GFAP+S100B-, white arrowhead in A and A”). B-B’”) Panel B is a merged overview showing NFIX (green) DCX (red), Ki67 (blue) and DAPI (white) staining and panels B’-B’” are expanded regions denoted by the arrows in B-B’”. The three expanded panels in B’-B’” show the following, left: DCX (red)+DAPI (white), center: NFIX (green), right: DCX (red)+Ki67 (blue). NFIX is expressed in most transitory amplifying cells (Ki67+DCX-, white arrow in B and B’, 72/74), neuroblasts (Ki67+DCX+, yellow arrow in B and B”, 90/91) and all immature neurons (Ki67-DCX+, cyan arrow in B and B’’’, 74/74). C-C”) Panel C is a merged overview and panels C’ & C” are expanded regions denoted by the arrows in C-C”. The three expanded panels in C’ & C” show the following, left: NeuN (red), center: NFIX (green), right: DAPI (blue). Mature neurons (NEUN+) show either no (yellow arrowhead in C and C’, 23/90) or very weak (yellow arrow in C and C”) NFIX expression. D-D’) Panel D is a merged overview of the expanded region shown in D’ showing staining for NFIX (green), SOX10 (red) and DAPI (blue). The three expanded panels in D’ show the following, left: SOX10 (red), center: NFIX (green), right: DAPI (blue). No SOX10+ (red) OLs or OPCs express NFIX (yellow arrowhead in D and D', purple nuclei, 0/53). Cyan nuclei in D are NFIX+ and DAPI+ but SOX10-. E) Quantification of cells of P12 DG stained for NFIX and the indicated markers of neural stem cells, astrocytes, transient amplifying progenitors, neuroblasts, immature neurons, mature neurons and OLs/OPCs. n=3. Scale bars are 50μm in A, B, C & D and 10μm in other panels.




**Supplemental Fig. 2. NFIX is not expressed in SOX10+ cells in postnatal SVZ, CC or cortex.**

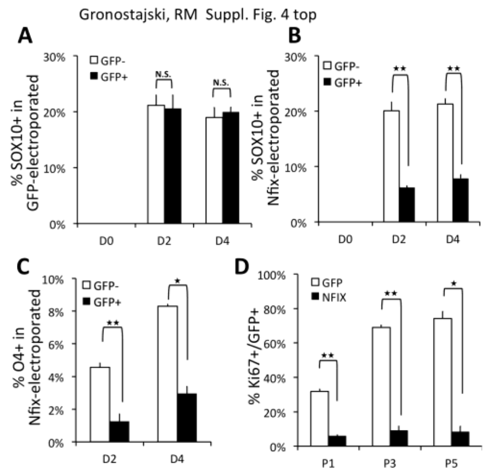
Postnatal day 12 brains were fixed, sectioned and the SVZ (A-A'), CC (B-C) and cortex (D-E) were triple-stained for NFIX (green), SOX10 (red) and total DNA (DAPI, blue). The three panels of A' are an expanded region denoted by the yellow arrowhead in A and showing the following, left: SOX10 (red), center: NFIX (green) and right: DAPI (blue) staining. Yellow arrowhead in A' shows SOX10+, NFIX- nucleus. B & D) Overview of NFIX (green)/SOX10 (red) /DAPI (blue) triple-staining in the CC and cortex, respectively. C & E are expanded views of the white squares shown in B & D, respectively. NFIX is not expressed in SOX10+ cells in postnatal CC (C yellow arrowhead, purple nuclei) or cortex (E, yellow arrowhead, purple nuclei). All SOX10+ cells are NFIX-. Scale bars are 10μm in A’ and 50μm in other panels.




**Supplemental Fig. 3. A higher percentage of differentiated neurospheres from *Nfix*$^{-/-}$ brains contain OLs than do neurospheres from WT brains.**

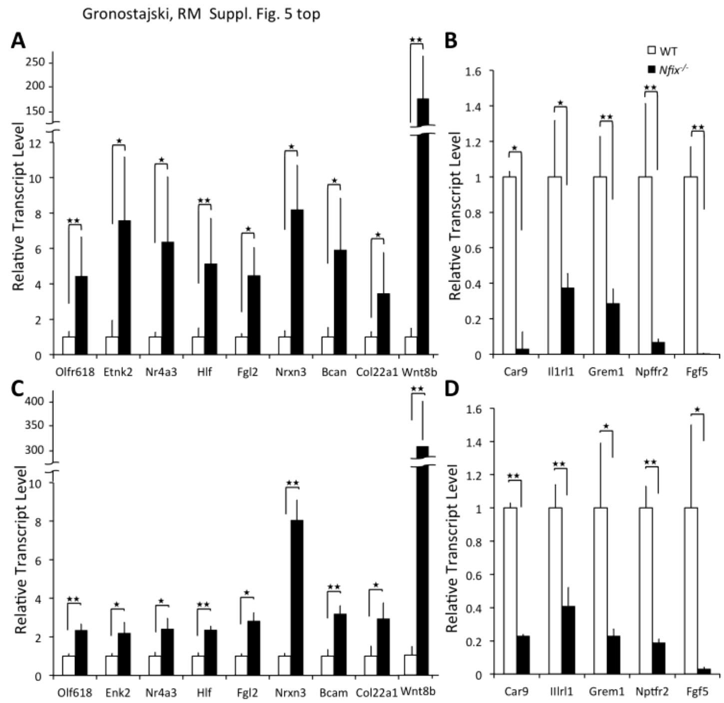
WT and *Nfix*$^{-/-}$ P10 brains were dissected and neurospheres were expanded and placed in differentiation condition for 4 days. A-C) Examples of GFAP (green), Tuj1 (red) and O4 (cyan) expressing cells at the edge of neurospheres labeling astrocytes, neurons and OLs, respectively. D) A differentiated neurosphere containing all 3 cell types. Scale bars are 100μm in D and 20μm in other panels). E) Quantification of the percentage of neurospheres containing O4+ cells from WT vs. *Nfix*$^{-/-}$ brains. F) Quantification of the percentage of neurospheres containing TUJ1+ cells between WT vs. *Nfix*$^{-/-}$ brains.

Neurospheres with >10 TUJ1+ or O4+ cells were counted as TUJ1+ or O4+ neurospheres, respectively. n=4, >100 neurospheres per sample were analyzed by student t-test. ⋆$p < 0.05$. N.S., not significant.



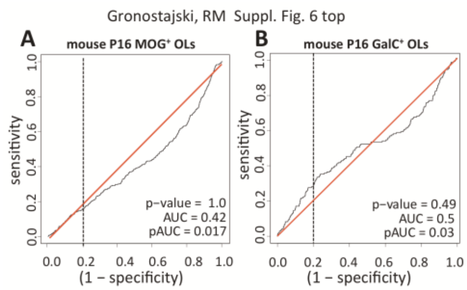

**Supplemental Fig. 4. Forced expression of NFIX represses ODG and proliferation of NSCs while expression of GFP has no effect on these processes.**

A-C) Proliferating *Nfix*$^{-/-}$ NSCs were electroporated with either a control IRES-GFP vector (GFP) or an NFIX-IRES-GFP vector expressing both GFP and NFIX (NFIX) then placed in differentiation conditions for 0 (D0), 2 (D2) or 4 (D4) days and stained for SOX10 (A & B) or O4 (C). A) No difference was seen in the percentage of SOX10+ cells between GFP- (white bars) and GFP+ (black bars) cells in cultures electroporated with the control GFP vector. B & C) A significantly higher percentage of GFP- cells (white bars) differentiate into SOX10+ (B) or O4+ cells (C) compared to GFP+ cells (black bars) in NFIX-IRES-GFP-electroporated cultures. D) Proliferating *Nfix*$^{-/-}$ NSCs were electroporated with either a control IRES-GFP vector (GFP) or an NFIX-IRES-GFP vector expressing both GFP and NFIX (NFIX) and maintained in proliferation conditions for 1 (P1), 3 (P3) or 5 (P5) days and stained for the proliferation marker Ki67. Ki67 staining is reduced in NFIX-IRES-GFP-electroporated cells (black bars) vs. IRES-GFP-electroporated cells (white bars). n=3, > 500 cells per sample were analyzed. Comparison was done by student t-test. ⋆$p < 0.05$, ⋆⋆$p < 0.005$. N.S., not significant.




**Supplemental Fig. 5. QPCR validation of expression levels of genes showing significant change by RNA-seq.**

A & B) QPCR verification of transcript levels of 9/9 of genes shown to be up-regulated (A) and 5/5 of genes shown to be down-regulated (B) by RNA-seq using the same samples as used in the RNA-seq analysis. C & D) QPCR verification of transcript levels in 9/9 of genes shown to be up-regulated (C) and 5/5 of genes shown to be down-regulated (D) in RNA-seq data but using independent RNA samples from NSCs derived from inbred C57Bl/6 WT and *Nfix*$^{-/-}$ mice. T-test, n=3. ⋆$p < 0.05$, ⋆⋆$p < 0.01$.




**Supplemental Fig. 6. Genes differentially expressed in OLs vs. whole brain are not differentially expressed in *Nfix*$^{-/-}$ vs. WT RNA-seq data.**

A & B) ROC curves showing that genes differentially expressed in mouse MOG$^{+}$ (A) and GalC$^{+}$ (B) OLs in P16 mouse forebrain are not differentially expressed in *Nfix*$^{-/-}$ vs. WT NSCs. The RNA-seq list from Cufflinks was first sorted from high to low by the Log2 FC (fold change) value. The list was then compared to the sorted gene lists from known OL gene sets to generate ROC curves.

**Supplemental Table 1. List of antibodies.**

**Supplemental Table 2. List of qPCR primer sets.** F for forward, R for reverse.

**Supplemental Table 3. List of all genes showing significant fold change in expression between *Nfix*$^{-/-}$ vs. WT NSCs based on Cuffdiff result from RNA-seq analysis.** FDR (False Discovery Rate, q_value) < 5% considered significant.

| Antigen | Host | Isoform | Company | Catalog # | Dilution |
|---|---|---|---|---|---|
| NFIX | rabbit | IgG | Abcam | ab101341 | 1:500 |
| NFIX | rabbit | IgG | Thermo Scientific | PA5-30897 | 1:500 |
| Ki67 | mouse | IgG1 | BD Biosciences | 550609 | 1:200 |
| Nestin | mouse | IgG1 | BD Biosciences | 556309 | 1:400 |
| GFAP | chicken | IgY | Abcam | ab4674 | 1:200 |
| S100b | mouse | IgG1 | Sigma-Aldrich | SAB1402349 | 1:1000 |
| DCX | goat | IgG | Santa Cruz Biotechnology | sc-8066 | 1:400 |
| Tuj1 | mouse | IgG2a | Covance | MMS-435P | 1:600 |
| SOX10 | goat | IgG | Santa Cruz Biotechnology | sc-17342 | 1:100 |
| O4 | mouse | IgM | R&D Systems | MAB1326 | 1:100 |
| EYFP | rabbit | IgG | Life Technologies | A11122 | 1:400 |
| EYFP | chicken | IgY | Aves Labs | GFP-1020 | 1:1000 |
| NeuN | mouse | IgG1 | EMD Millipore | MAB377 | 1:10 |
| NeuN | chicken | IgY | Aves Labs | NUN | 1:20 |
| MBP | chicken | IgY | Aves Labs | MBP | 1:500 |
| Olig2 | mouse | IgG2a | EMD Millipore | MABN50 | 1:600 |

| | |
|---|---|
| MBP-F | CCCAAGATGAAAACCCAGTAG |
| MBP-R | CCCTTGTGAGCCGATTTATAG |
| SOX10-F | CAGGCGGCACGCAGAAAGCTA |
| SOX10-R | CCCTGGGCTGCCTTCCCGTT |
| PDGFRa-F | TCACCATTTCTGTCCACGAG |
| PDGFRa-R | GCCCGGATCAGCTTTAATTTG |
| Olig2-F | CTCCGCAGCGAGCACCTCAA |
| Olig2-R | TCGGCGTGGACGAGGACACA |
| Zim1-F | CCCAGATTAAGTTTGTTCCCTG |
| Zim1-R | GCTGGTTTGCTGTCTGATC |
| Fgf5-F | GCTCGGAACATAGCAGTTTC |
| Fgf5-R | TCCTCGTATTCCTACAATCCC |
| Bmp6-F | CTTCAGACTACAACGGCAG |
| Bmp6-R | CAAGGTCTGTACAATGGCG |
| Bcl2l1-F | GAAAGCGTAGACAAGGAGATG |
| Bcl2l1-R | CCGTAGAGATCCACAAAAGTG |
| En2-F | ACTCGGACAGCTCTCAAG |
| En2-R | CCGCTTGTCCTCTTTGTTAG |
| Sox7-F | GGACAAGAGTTCGGAAAGC |
| Sox7-R | TCATCCACATAGGGTCTCTTC |
| Olfr618-F | GGAGGAACATCATTCGTCACTC |
| Olfr618-R | CGTCGAGCATTTTGAGACGGG |
| Etnk2-F | CGGGAGAATGAGGTCAGAAAC |
| Etnk2-R | TGGATGGTGTGAATCTTAGCC |
| Nr4a3-F | CATCATCTGGGGAAGGCACA |
| Nr4a3-FR | CATCGGTTTCGGCGTCTCT |
| Hlf-F | TTTGACCCTCGCAAACGGA |
| Hlf-R | CATGTTGTTCTTTCTGCGCCT |
| Fgl2-F | ACGCTCCATCTGGTAAATATGA |
| Fgl2-R | CTAGCACGTAGTGGTCGGAA |
| Nrxn3-F | TCTTCCTTGCTTTTCTCCCC |
| Nrxn3-R | GTCTACCTCTTCCCCTGTTTG |
| Bcan-F | CACACGAAGGAGTTGGGAG |
| Bcan-R | GGTTCCAGTTTTCATAGAGCAG |
| Col22a1-F | CAGGAAACCCAGGAGAAAGAG |
| Col22a1-R | TTTGCCTTCTGTCCCCTC |
| Ccl20-F | TCTGCTCTTCCTTGCTTTGG |
| Ccl20-R | TTCATCGGCCATCTGTCTTG |
| Gldn-F | AGAGACTTTTGGGACTTGGATG |
| Gldn-R | TGGAAATAATGTGGGAGGTGG |
| Car9-F | TGCAGGAGAGCCCAGAAGAA |
| Car9-R | AACACAGTCCAGATGACCCC |
| Il1rl1-F | CACACCATAAGGCTGAGAAGG |

Stem Cells and Development
Loss of NFIX transcription factor biases postnatal neural stem/progenitor cells towards oligodendrogenesis. (doi: 10.1089/scd.2015.0136)
This article has been peer-reviewed and accepted for publication, but has yet to undergo copyediting and proof correction. The final published version may differ from this proof.

| | |
|---|---|
| Il1rl1-R | TCGTTCCGGGTTTTGTAAGG |
| Gzme-F | TTGTCTCCTTTGCTCTCCTTC |
| Gzme-R | GCCTCCACAGTATCTCCTATTAC |
| Npffr2-F | TGGCGGTTCTTTCTCATCCTC |
| Npffr2-R | TGAGTCCCATTTCTCGCTCA |
| Wnt8b-F | CCGTGTGCGTTCTTCTAGTC |
| Wnt8b-R | CAACGGTCCCAAGCAAACTG |
| Neurog2-F | CTGGAGCCGCGTAGGATG |
| Neurog2-R | CCTCGTCCTCCTCCTCGT |
| Crb3-F | CACAAATAGCACAACTCAACCC |
| Crb3-R | ATGAGCAGAAACAGTCCCAC |
| Nhedc2-F | TCCTGATGGTGTGTTTCGCT |
| Nhedc2-R | GCTTCTCTCCGTGGGATCTT |

| gene_id | gene | locus | sample_1 | sample_2 | status | value_1 | value_2 | log2(fold_change) | test_stat | p_value | q_value | significant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENSMUSG00000018927 | Ccl6 | chr11:83395557-83437195 | WT | KO | OK | 87.6346 | 3.07538 | -4.83266 | 13.7994 | 0 | 0 | yes |
| ENSMUSG00000047501 | Cldn4 | chr5:135420995-135422804 | WT | KO | OK | 4.62784 | 0.232125 | -4.31737 | 5.74647 | 9.11E-09 | 1.07E-06 | yes |
| ENSMUSG00000068428 | Gm606 | chr16:26957321-26990060 | WT | KO | OK | 4.80372 | 0.25105 | -4.2581 | 8.05861 | 6.66E-16 | 2.68E-13 | yes |
| ENSMUSG00000023906 | Cldn6 | chr17:23816331-23819413 | WT | KO | OK | 1.04614 | 0.0547416 | -4.25629 | 3.09304 | 0.00198116 | 0.0452969 | yes |
| ENSMUSG00000061808 | Ttr | chr18:20716574-20832825 | WT | KO | OK | 99.8897 | 5.61666 | -4.15255 | 8.37119 | 0 | 0 | yes |
| ENSMUSG00000017002 | Slpi | chr2:164179805-164214831 | WT | KO | OK | 11.8006 | 0.688123 | -4.10005 | 6.22559 | 4.80E-10 | 7.49E-08 | yes |
| ENSMUSG00000049382 | Krt8 | chr15:101827141-101834773 | WT | KO | OK | 7.2322 | 0.427967 | -4.07886 | 6.31535 | 2.70E-10 | 4.42E-08 | yes |
| ENSMUSG00000005800 | Mmp8 | chr9:7558428-7568486 | WT | KO | OK | 1.57797 | 0.0949919 | -4.05412 | 4.77648 | 1.78E-06 | 0.00012466 | yes |
| ENSMUSG00000023043 | Krt18 | chr15:101858646-101862457 | WT | KO | OK | 13.2529 | 0.941022 | -3.81594 | 6.58213 | 4.64E-11 | 9.05E-09 | yes |
| ENSMUSG00000041380 | Htr2c | chrX:143397055-143631820 | WT | KO | OK | 0.375176 | 0.0268206 | -3.80615 | 3.06622 | 0.00216787 | 0.0485377 | yes |
| ENSMUSG00000025481 | 1190003J15Rik | chr7:148020916-148023865 | WT | KO | OK | 4.70672 | 0.369746 | -3.67012 | 4.76584 | 1.88E-06 | 0.00013073 | yes |
| ENSMUSG00000027399 | Il1a | chr2:129123105-129135708 | WT | KO | OK | 1.26332 | 0.0992853 | -3.66949 | 3.94113 | 8.11E-05 | 0.00346217 | yes |
| ENSMUSG00000046352 | Gjb2 | chr14:57717436-57723539 | WT | KO | OK | 0.819769 | 0.0715671 | -3.51785 | 3.57078 | 0.00035593 | 0.0116016 | yes |
| ENSMUSG00000017723 | Wfdc2 | chr2:164387912-164394010 | WT | KO | OK | 25.102 | 2.58275 | -3.28082 | 7.82157 | 5.11E-15 | 1.83E-12 | yes |
| ENSMUSG00000079293 | Clec7a | chr6:129411610-129422790 | WT | KO | OK | 5.22456 | 0.560638 | -3.22017 | 5.37405 | 7.70E-08 | 7.46E-06 | yes |
| ENSMUSG00000029646 | Cdx2 | chr5:148112475-148118825 | WT | KO | OK | 1.01242 | 0.109913 | -3.20337 | 3.63358 | 0.00027951 | 0.0096142 | yes |
| ENSMUSG00000029337 | Fgf5 | chr5:98683202-98706049 | WT | KO | OK | 0.866058 | 0.105872 | -3.03214 | 3.70439 | 0.0002119 | 0.00779331 | yes |
| ENSMUSG00000022157 | Mcpt8 | chr14:56701002-56704053 | WT | KO | OK | 8.43875 | 1.04574 | -3.01251 | 4.83171 | 1.35E-06 | 9.88E-05 | yes |
| ENSMUSG00000063011 | Msln | chr17:25885558-25891272 | WT | KO | OK | 9.7836 | 1.23443 | -2.98652 | 5.57223 | 2.51E-08 | 2.69E-06 | yes |
| ENSMUSG00000031927 | 1700012B09Rik | chr9:14562643-14575474 | WT | KO | OK | 5.15727 | 0.662376 | -2.96089 | 4.06284 | 4.85E-05 | 0.00221953 | yes |
| ENSMUSG00000035528 | Npffr2 | chr5:89956453-90012765 | WT | KO | OK | 1.04615 | 0.138 | -2.92234 | 3.33177 | 0.00086297 | 0.024378 | yes |
| ENSMUSG00000026981 | Il1rn | chr2:24192372-24207014 | WT | KO | OK | 7.36616 | 0.973964 | -2.91897 | 6.81047 | 9.73E-12 | 2.05E-09 | yes |
| ENSMUSG00000029843 | Slc13a4 | chr6:35217956-35258131 | WT | KO | OK | 0.709552 | 0.0943754 | -2.91043 | 3.63603 | 0.00027687 | 0.009548 | yes |
| ENSMUSG00000002289 | Angptl4 | chr17:33910701-33918520 | WT | KO | OK | 2.66351 | 0.359188 | -2.89052 | 4.62629 | 3.72E-06 | 0.00023763 | yes |
| ENSMUSG00000015354 | Pcolce2 | chr9:95519329-95598515 | WT | KO | OK | 20.7323 | 2.87783 | -2.84882 | 6.49783 | 8.15E-11 | 1.46E-08 | yes |
| ENSMUSG00000029082 | Bst1 | chr5:44135854-44234510 | WT | KO | OK | 3.92759 | 0.549049 | -2.83864 | 3.77796 | 0.00015812 | 0.005964 | yes |
| ENSMUSG00000041607 | Mbp | chr18:82644537-82755029 | WT | KO | OK | 6.26881 | 0.884212 | -2.82573 | 7.36684 | 1.75E-13 | 5.40E-11 | yes |
| ENSMUSG00000053117 | E330013P04Rik | chr19:60220591-60238163 | WT | KO | OK | 1.40635 | 0.206432 | -2.76821 | 3.66032 | 0.00025191 | 0.00882464 | yes |
| ENSMUSG00000061048 | Cdh3 | chr8:109034790-109080808 | WT | KO | OK | 0.543296 | 0.0797859 | -2.76753 | 3.30344 | 0.00095506 | 0.0263576 | yes |
| ENSMUSG00000049493 | Pls1 | chr9:95653060-95745730 | WT | KO | OK | 6.90254 | 1.06834 | -2.69175 | 4.83716 | 1.32E-06 | 9.66E-05 | yes |
| ENSMUSG00000025804 | Ccr1 | chr9:123876958-123883525 | WT | KO | OK | 0.72956 | 0.118902 | -2.61726 | 3.22813 | 0.001246 | 0.0325544 | yes |
| ENSMUSG00000030109 | Slc6a12 | chr6:121293093-121315793 | WT | KO | OK | 7.83295 | 1.27992 | -2.6135 | 6.17495 | 6.62E-10 | 1.00E-07 | yes |
| ENSMUSG00000074227 | Spint2 | chr7:30041349-30066996 | WT | KO | OK | 19.8168 | 3.26894 | -2.59983 | 6.91323 | 4.74E-12 | 1.10E-09 | yes |
| ENSMUSG00000028238 | Atp6v0d2 | chr4:19803987-19849752 | WT | KO | OK | 2.76503 | 0.458162 | -2.59337 | 3.13387 | 0.00172518 | 0.0412707 | yes |
| ENSMUSG00000027827 | Kcnab1 | chr3:64913305-65182145 | WT | KO | OK | 2.78197 | 0.464285 | -2.58303 | 6.6414 | 3.11E-11 | 6.25E-09 | yes |
| ENSMUSG00000058743 | Kcnj14 | chr7:53071836-53080117 | WT | KO | OK | 1.24096 | 0.207995 | -2.57683 | 3.68803 | 0.000226 | 0.0081538 | yes |
| ENSMUSG00000022949 | Clic6 | chr16:92478987-92541488 | WT | KO | OK | 4.61433 | 0.782686 | -2.55962 | 4.33074 | 1.49E-05 | 0.00078298 | yes |
| ENSMUSG00000001497 | Pax9 | chr12:57790904-58298459 | WT | KO | OK | 0.64204 | 0.1096 | -2.55042 | 3.4443 | 0.00057254 | 0.0172373 | yes |
| ENSMUSG00000012889 | Podnl1 | chr8:86649887-86656426 | WT | KO | OK | 1.69634 | 0.290099 | -2.54781 | 5.38475 | 7.25E-08 | 7.13E-06 | yes |
| ENSMUSG00000052396 | Mogat2 | chr7:106367593-106387129 | WT | KO | OK | 1.36209 | 0.238375 | -2.51452 | 3.2205 | 0.00127966 | 0.0331189 | yes |
| ENSMUSG00000033633 | Clec18a | chr8:113593397-113605988 | WT | KO | OK | 1.02333 | 0.182249 | -2.48929 | 3.10787 | 0.00188441 | 0.0437401 | yes |
| ENSMUSG00000091444 | AL607127.1 | chr11:96325906-96620791 | WT | KO | OK | 6.15837 | 1.16977 | -2.39633 | 6.34237 | 2.26E-10 | 3.75E-08 | yes |
| ENSMUSG00000025504 | Eps8l2 | chr7:148524778-148551009 | WT | KO | OK | 5.10162 | 0.978393 | -2.38247 | 3.97185 | 7.13E-05 | 0.00310454 | yes |
| ENSMUSG00000004885 | Crabp2 | chr3:87752587-87757298 | WT | KO | OK | 4.4557 | 0.866866 | -2.36177 | 3.62749 | 0.00028619 | 0.00976799 | yes |
| ENSMUSG00000026686 | Lmx1a | chr1:169619369-169778872 | WT | KO | OK | 1.15101 | 0.225946 | -2.34885 | 3.37608 | 0.00073526 | 0.021411 | yes |
| ENSMUSG00000063767 | S100a7a | chr3:90458223-90462052 | WT | KO | OK | 6.3489 | 1.24794 | -2.34695 | 3.66754 | 0.0002449 | 0.00864757 | yes |
| ENSMUSG00000026327 | Serpinb11 | chr1:109258505-109277052 | WT | KO | OK | 2.03891 | 0.403202 | -2.33822 | 3.73382 | 0.0001886 | 0.00705347 | yes |
| ENSMUSG00000028217 | Cdh17 | chr4:11685293-11745042 | WT | KO | OK | 1.31778 | 0.260729 | -2.33749 | 3.60369 | 0.00031373 | 0.0105991 | yes |
| ENSMUSG00000022156 | Gzme | chr14:56736455-56739468 | WT | KO | OK | 2.51894 | 0.499075 | -2.33549 | 3.13867 | 0.00169714 | 0.0408015 | yes |
| ENSMUSG00000074934 | Grem1 | chr2:113586320-113598803 | WT | KO | OK | 37.2428 | 7.58396 | -2.29594 | 6.57443 | 4.88E-11 | 9.40E-09 | yes |
| ENSMUSG00000020836 | Coro6 | chr11:77275912-77283986 | WT | KO | OK | 4.22048 | 0.867791 | -2.28199 | 4.07149 | 4.67E-05 | 0.00215349 | yes |
| ENSMUSG00000071713 | Csf2rb | chr15:78156419-78184277 | WT | KO | OK | 1.47266 | 0.312796 | -2.23513 | 3.81795 | 0.00013457 | 0.00522402 | yes |
| ENSMUSG00000039419 | Cntnap2 | chr6:45010059-47251368 | WT | KO | OK | 29.3235 | 6.31661 | -2.21483 | 6.1918 | 5.95E-10 | 9.18E-08 | yes |
| ENSMUSG00000032128 | Robo3 | chr9:37223253-37240760 | WT | KO | OK | 2.34071 | 0.505664 | -2.2107 | 3.56538 | 0.00036333 | 0.0117656 | yes |
| ENSMUSG00000016283 | H2-M2 | chr17:37617795-37620497 | WT | KO | OK | 5.18381 | 1.13629 | -2.18968 | 5.81214 | 6.17E-09 | 7.58E-07 | yes |
| ENSMUSG00000026069 | Il1rl1 | chr1:40496620-40522241 | WT | KO | OK | 1.86095 | 0.409387 | -2.1845 | 6.11219 | 9.83E-10 | 1.43E-07 | yes |
| ENSMUSG00000028463 | Car9 | chr4:43517299-43526601 | WT | KO | OK | 14.1786 | 3.13715 | -2.17619 | 6.15948 | 7.30E-10 | 1.09E-07 | yes |
| ENSMUSG00000027460 | Angpt4 | chr2:151736942-151771073 | WT | KO | OK | 3.41353 | 0.755903 | -2.17499 | 3.86635 | 0.00011048 | 0.00441813 | yes |
| ENSMUSG00000032346 | Ooep | chr9:78223915-78226532 | WT | KO | OK | 1.79108 | 0.39934 | -2.16514 | 3.09115 | 0.00199385 | 0.0454827 | yes |
| ENSMUSG00000026166 | Ccl20 | chr1:83113340-83115742 | WT | KO | OK | 3.40215 | 0.764216 | -2.15439 | 3.10886 | 0.00187813 | 0.0436707 | yes |
| ENSMUSG00000069792 | Gm11428 | chr11:83517492-83519770 | WT | KO | OK | 18.8325 | 4.24812 | -2.14833 | 4.02685 | 5.65E-05 | 0.00252701 | yes |
| ENSMUSG00000070780 | Rbm47 | chr5:66407787-66566183 | WT | KO | OK | 1.96499 | 0.446623 | -2.1374 | 3.21189 | 0.00131867 | 0.033734 | yes |
| ENSMUSG00000050359 | Sprr1a | chr3:92287876-92289816 | WT | KO | OK | 17.4405 | 4.01275 | -2.11978 | 4.10832 | 3.99E-05 | 0.00188312 | yes |
| ENSMUSG00000056054 | S100a8 | chr3:90472992-90473956 | WT | KO | OK | 18.9103 | 4.38345 | -2.10904 | 3.62952 | 0.00028394 | 0.00971631 | yes |
| ENSMUSG00000060988 | Galnt13 | chr2:54288727-54970720 | WT | KO | OK | 3.11901 | 0.726426 | -2.1022 | 3.90609 | 9.38E-05 | 0.00387981 | yes |
| ENSMUSG00000038963 | Slco4a1 | chr2:180190949-180209572 | WT | KO | OK | 3.75825 | 0.880546 | -2.09359 | 4.65178 | 3.29E-06 | 0.00021523 | yes |
| ENSMUSG00000044433 | 2310057J16Rik | chr8:3587449-3621316 | WT | KO | OK | 0.631517 | 0.149633 | -2.0774 | 3.25847 | 0.00112013 | 0.0297441 | yes |
| ENSMUSG00000030789 | Itgax | chr7:135273060-135294171 | WT | KO | OK | 1.37089 | 0.331659 | -2.04734 | 3.29613 | 0.00098027 | 0.0268905 | yes |
| ENSMUSG00000038295 | Atg9b | chr5:23870627-23897961 | WT | KO | OK | 2.1592 | 0.5291 | -2.02888 | 3.48789 | 0.00048685 | 0.0150325 | yes |
| ENSMUSG00000033453 | Adamts15 | chr9:30706739-30730037 | WT | KO | OK | 6.57522 | 1.61733 | -2.02342 | 4.14711 | 3.37E-05 | 0.0016256 | yes |
| ENSMUSG00000024164 | C3 | chr17:57343396-57367559 | WT | KO | OK | 2.97804 | 0.733478 | -2.02154 | 4.15366 | 3.27E-05 | 0.00159714 | yes |
| ENSMUSG00000075602 | Ly6a | chr15:74825307-74828064 | WT | KO | OK | 6.7271 | 1.70279 | -1.98209 | 3.15862 | 0.00158516 | 0.0386169 | yes |
| ENSMUSG00000000982 | Ccl3 | chr11:83461345-83462857 | WT | KO | OK | 14.852 | 3.77567 | -1.97585 | 3.69504 | 0.00021985 | 0.00801915 | yes |
| ENSMUSG00000033854 | Kcnk10 | chr12:99672203-99816150 | WT | KO | OK | 4.20757 | 1.09259 | -1.94524 | 5.70769 | 1.15E-08 | 1.32E-06 | yes |
| ENSMUSG00000001943 | Vsig2 | chr9:37346839-37351790 | WT | KO | OK | 3.32763 | 0.871137 | -1.93352 | 4.08309 | 4.44E-05 | 0.00206309 | yes |
| ENSMUSG00000018470 | Kcnab3 | chr11:69139759-69146544 | WT | KO | OK | 3.51739 | 0.926681 | -1.92436 | 4.21242 | 2.53E-05 | 0.00126108 | yes |
| ENSMUSG00000046167 | Gldn | chr9:54116384-54189593 | WT | KO | OK | 1.88367 | 0.505031 | -1.8991 | 3.5942 | 0.00032538 | 0.010937 | yes |
| ENSMUSG00000022296 | Baalc | chr15:38656627-38837731 | WT | KO | OK | 6.53307 | 1.75561 | -1.89579 | 4.44198 | 8.91E-06 | 0.00050792 | yes |
| ENSMUSG00000016349 | Eef1a2 | chr2:180882357-180891720 | WT | KO | OK | 1.02751 | 0.276491 | -1.89385 | 3.30409 | 0.00095286 | 0.0263564 | yes |
| ENSMUSG00000019122 | Ccl9 | chr11:83386420-83392138 | WT | KO | OK | 24.7733 | 6.68472 | -1.88985 | 4.34909 | 1.37E-05 | 0.00073481 | yes |
| ENSMUSG00000027840 | Wnt2b | chr3:104747722-104764627 | WT | KO | OK | 2.4826 | 0.673369 | -1.88238 | 3.22485 | 0.0012604 | 0.0327481 | yes |
| ENSMUSG00000034570 | Inpp5j | chr11:3388229-3404824 | WT | KO | OK | 0.710389 | 0.193474 | -1.87647 | 3.4295 | 0.0006047 | 0.0181231 | yes |
| ENSMUSG00000046623 | Gjb4 | chr4:127028329-127031325 | WT | KO | OK | 3.21248 | 0.875949 | -1.87477 | 3.22767 | 0.00124804 | 0.0325544 | yes |
| ENSMUSG00000028328 | Tmod1 | chr4:46051806-46209183 | WT | KO | OK | 20.5531 | 5.61908 | -1.87095 | 5.64083 | 1.69E-08 | 1.89E-06 | yes |
| ENSMUSG00000047443 | Fam132b | chr1:93263006-93270793 | WT | KO | OK | 4.23346 | 1.17029 | -1.85498 | 3.37081 | 0.00074946 | 0.0216284 | yes |
| ENSMUSG00000026822 | Lcn2 | chr2:32240152-32243317 | WT | KO | OK | 43.2769 | 12.198 | -1.82695 | 4.23162 | 2.32E-05 | 0.0011713 | yes |
| ENSMUSG00000039813 | Tbc1d2 | chr4:46617261-46663081 | WT | KO | OK | 7.85918 | 2.26145 | -1.79713 | 4.32147 | 1.55E-05 | 0.00080699 | yes |
| ENSMUSG00000000627 | Sema4f | chr6:82861878-82889763 | WT | KO | OK | 4.13951 | 1.19438 | -1.7932 | 3.12375 | 0.0017856 | 0.0422592 | yes |

Stem Cells and Development
Loss of NFIX transcription factor biases postnatal neural stem/progenitor cells towards oligodendrogenesis. (doi: 10.1089/scd.2015.0136)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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENSMUSG00000044811 | AF251705 | chr11:114858034-114863194 | WT | KO | OK | 3.2349 | 0.935154 | -1.79045 | 4.81568 | 1.47E-06 | 0.00010472 | yes |
| ENSMUSG00000058624 | Gda | chr19:21465796-21547935 | WT | KO | OK | 1.82167 | 0.52693 | -1.78958 | 4.71251 | 2.45E-06 | 0.00016407 | yes |
| ENSMUSG00000054409 | Tmem74 | chr15:43698240-43701575 | WT | KO | OK | 4.14896 | 1.20111 | -1.78838 | 3.16168 | 0.00156862 | 0.0383547 | yes |
| ENSMUSG00000047230 | Cldn2 | chrX:136335366-136345925 | WT | KO | OK | 3.94039 | 1.16323 | -1.7602 | 3.79039 | 0.00015041 | 0.00570842 | yes |
| ENSMUSG00000071714 | Csf2rb2 | chr15:78112946-78136052 | WT | KO | OK | 0.885584 | 0.26183 | -1.758 | 3.06501 | 0.00217663 | 0.0486517 | yes |
| ENSMUSG00000054162 | Spock3 | chr8:65429805-65835900 | WT | KO | OK | 2.14759 | 0.636063 | -1.75548 | 4.7613 | 1.92E-06 | 0.00013232 | yes |
| ENSMUSG00000081169 | Gm12551 | chr4:86272978-86277155 | WT | KO | OK | 13.4133 | 3.97534 | -1.75452 | 3.27719 | 0.00104846 | 0.0283044 | yes |
| ENSMUSG00000062393 | Dgkk | chrX:6356431-6525489 | WT | KO | OK | 1.39557 | 0.414637 | -1.75093 | 3.61498 | 0.00030038 | 0.0102069 | yes |
| ENSMUSG00000045777 | 6330512M04Rik | chr7:149511741-149573943 | WT | KO | OK | 9.17269 | 2.73561 | -1.74548 | 5.60156 | 2.12E-08 | 2.31E-06 | yes |
| ENSMUSG00000026579 | F5 | chr1:166045394-166150408 | WT | KO | OK | 1.82855 | 0.549462 | -1.73461 | 3.4227 | 0.00062003 | 0.0185408 | yes |
| ENSMUSG00000041552 | Ptchd1 | chrX:152007997-152058357 | WT | KO | OK | 2.93594 | 0.885626 | -1.72905 | 4.32016 | 1.56E-05 | 0.00080864 | yes |
| ENSMUSG00000053519 | Kcnip1 | chr11:33529338-33998554 | WT | KO | OK | 15.9895 | 4.84178 | -1.72351 | 6.90738 | 4.94E-12 | 1.13E-09 | yes |
| ENSMUSG00000019851 | Perp | chr10:18564876-18576879 | WT | KO | OK | 34.8677 | 10.5727 | -1.72155 | 4.44288 | 8.88E-06 | 0.00050792 | yes |
| ENSMUSG00000026259 | Ngef | chr1:89373408-89494420 | WT | KO | OK | 14.3792 | 4.3745 | -1.71679 | 5.19338 | 2.07E-07 | 1.82E-05 | yes |
| ENSMUSG00000051279 | Gdf6 | chr4:9771518-9789492 | WT | KO | OK | 5.60416 | 1.71322 | -1.70979 | 3.6903 | 0.00022399 | 0.0081477 | yes |
| ENSMUSG00000025350 | Rdh5 | chr10:128350648-128361091 | WT | KO | OK | 12.7418 | 3.9242 | -1.6991 | 4.96411 | 6.90E-07 | 5.52E-05 | yes |
| ENSMUSG00000022367 | Has2 | chr15:56497181-56609954 | WT | KO | OK | 4.0992 | 1.26549 | -1.69564 | 3.54287 | 0.0003958 | 0.012602 | yes |
| ENSMUSG00000022512 | Cldn1 | chr16:26356727-26371927 | WT | KO | OK | 11.2196 | 3.49712 | -1.68178 | 3.88014 | 0.0001044 | 0.00421306 | yes |
| ENSMUSG00000023886 | Smoc2 | chr17:14416512-14541797 | WT | KO | OK | 16.0396 | 5.00247 | -1.68092 | 7.55838 | 4.09E-14 | 1.29E-11 | yes |
| ENSMUSG00000027338 | Prnd | chr2:131735663-131781866 | WT | KO | OK | 4.90347 | 1.54248 | -1.66855 | 8.39368 | 0 | 0 | yes |
| ENSMUSG00000021895 | Arhgef3 | chr14:28051224-28217090 | WT | KO | OK | 3.56409 | 1.12253 | -1.66678 | 4.45972 | 8.21E-06 | 0.00047689 | yes |
| ENSMUSG00000034161 | Scx | chr15:76210690-76307699 | WT | KO | OK | 7.18107 | 2.2798 | -1.65529 | 3.11289 | 0.00185263 | 0.0432568 | yes |
| ENSMUSG00000042115 | Klhdc8a | chr1:134195202-134203934 | WT | KO | OK | 19.5198 | 6.32508 | -1.62578 | 4.44036 | 8.98E-06 | 0.00050956 | yes |
| ENSMUSG00000083689 | Gm14094 | chr2:133025346-133025956 | WT | KO | OK | 21.007 | 6.82434 | -1.62211 | 3.09289 | 0.00198219 | 0.0452969 | yes |
| ENSMUSG00000023571 | Fam132a | chr4:155336426-155340738 | WT | KO | OK | 19.0369 | 6.25334 | -1.6061 | 5.75703 | 8.56E-09 | 1.01E-06 | yes |
| ENSMUSG00000014158 | Trpv4 | chr5:115072160-115108430 | WT | KO | OK | 1.47805 | 0.486696 | -1.6026 | 3.68642 | 0.00022743 | 0.00816449 | yes |
| ENSMUSG00000027221 | Chst1 | chr2:92439863-92455407 | WT | KO | OK | 11.1904 | 3.69799 | -1.59745 | 3.67829 | 0.00023481 | 0.00835794 | yes |
| ENSMUSG00000089922 | 3110039M20Rik | chr12:50483679-50508333 | WT | KO | OK | 7.70947 | 2.54952 | -1.59641 | 3.18479 | 0.00144859 | 0.0363573 | yes |
| ENSMUSG00000042988 | Notum | chr11:120507344-120523129 | WT | KO | OK | 14.675 | 4.8977 | -1.58319 | 5.63765 | 1.72E-08 | 1.91E-06 | yes |
| ENSMUSG00000036136 | Fam110c | chr12:31758832-31764802 | WT | KO | OK | 6.18934 | 2.0718 | -1.5789 | 3.3574 | 0.0007868 | 0.0225137 | yes |
| ENSMUSG00000039070 | Cpa4 | chr6:30518368-30542418 | WT | KO | OK | 7.73759 | 2.61193 | -1.56677 | 3.41241 | 0.00064391 | 0.0191258 | yes |
| ENSMUSG00000030144 | Clec4d | chr6:123212124-123225286 | WT | KO | OK | 15.4692 | 5.28351 | -1.54983 | 3.30863 | 0.00093752 | 0.0261501 | yes |
| ENSMUSG00000004609 | Cd33 | chr7:50782825-50788541 | WT | KO | OK | 2.24751 | 0.774098 | -1.53774 | 3.68385 | 0.00022974 | 0.0082156 | yes |
| ENSMUSG00000000290 | Itgb2 | chr10:76992996-77028453 | WT | KO | OK | 9.6745 | 3.35392 | -1.52834 | 4.40654 | 1.05E-05 | 0.00058349 | yes |
| ENSMUSG00000000792 | Slc5a5 | chr8:73406787-73416656 | WT | KO | OK | 13.5192 | 4.69956 | -1.52441 | 3.40513 | 0.00066132 | 0.0195553 | yes |
| ENSMUSG00000027684 | Mecom | chr3:29850235-30039345 | WT | KO | OK | 0.95303 | 0.334811 | -1.50918 | 3.66381 | 0.00024849 | 0.00873686 | yes |
| ENSMUSG00000038642 | Ctss | chr3:95330707-95360325 | WT | KO | OK | 48.169 | 16.96 | -1.50597 | 3.8615 | 0.00011269 | 0.00449316 | yes |
| ENSMUSG00000030798 | Cd37 | chr7:52471122-52494485 | WT | KO | OK | 3.48563 | 1.2402 | -1.49085 | 3.4355 | 0.00059146 | 0.0177665 | yes |
| ENSMUSG00000039518 | Cdsn | chr17:35689072-35694125 | WT | KO | OK | 10.6401 | 3.82354 | -1.47653 | 3.45225 | 0.00055593 | 0.0168519 | yes |
| ENSMUSG00000044583 | Tlr7 | chrX:163742860-163768490 | WT | KO | OK | 1.70605 | 0.615897 | -1.4699 | 3.49164 | 0.00048006 | 0.0148573 | yes |
| ENSMUSG00000032679 | Cd59a | chr2:103935957-103955511 | WT | KO | OK | 23.4832 | 8.57336 | -1.45369 | 5.89036 | 3.85E-09 | 4.97E-07 | yes |
| ENSMUSG00000045083 | Lingo2 | chr4:35653895-36898780 | WT | KO | OK | 3.32032 | 1.22277 | -1.44117 | 5.31464 | 1.07E-07 | 1.01E-05 | yes |
| ENSMUSG00000030653 | Pde2a | chr7:108570211-108661340 | WT | KO | OK | 32.3007 | 11.9482 | -1.43477 | 9.36112 | 0 | 0 | yes |
| ENSMUSG00000020435 | Osbp2 | chr11:3603733-3763906 | WT | KO | OK | 6.08862 | 2.30363 | -1.40221 | 4.4789 | 7.50E-06 | 0.00043884 | yes |
| ENSMUSG00000052270 | Fpr2 | chr17:18024787-18108641 | WT | KO | OK | 2.13506 | 0.80909 | -1.3999 | 3.07886 | 0.00207792 | 0.0467989 | yes |
| ENSMUSG00000032261 | Sh3bgrl2 | chr9:83441933-83532408 | WT | KO | OK | 10.6641 | 4.07955 | -1.38628 | 3.37026 | 0.00075097 | 0.0216284 | yes |
| ENSMUSG00000041309 | Nkx6-2 | chr7:146575007-146768696 | WT | KO | OK | 22.2435 | 8.56614 | -1.37667 | 6.00817 | 1.88E-09 | 2.62E-07 | yes |
| ENSMUSG00000062444 | Ap3b2 | chr7:88605284-88638811 | WT | KO | OK | 5.25595 | 2.02464 | -1.37629 | 4.84057 | 1.29E-06 | 9.60E-05 | yes |
| ENSMUSG00000028539 | Artn | chr4:117598766-117602368 | WT | KO | OK | 6.77063 | 2.60952 | -1.3755 | 3.89373 | 9.87E-05 | 0.00402042 | yes |
| ENSMUSG00000020950 | Foxg1 | chr12:50483679-50508333 | WT | KO | OK | 25.3215 | 9.79785 | -1.36983 | 5.17485 | 2.28E-07 | 1.99E-05 | yes |
| ENSMUSG00000038147 | Cd84 | chr1:173769827-173820849 | WT | KO | OK | 3.8023 | 1.48887 | -1.35265 | 3.12557 | 0.00177464 | 0.0420747 | yes |
| ENSMUSG00000026068 | Il18rap | chr1:40572206-40608550 | WT | KO | OK | 6.63669 | 2.60098 | -1.35141 | 3.82702 | 0.00012971 | 0.00506719 | yes |
| ENSMUSG00000074657 | Kif5a | chr10:126662754-126700136 | WT | KO | OK | 1.82516 | 0.720337 | -1.34128 | 5.93054 | 3.02E-09 | 4.09E-07 | yes |
| ENSMUSG00000020911 | Krt19 | chr11:100002123-100009979 | WT | KO | OK | 4.83629 | 1.91629 | -1.33558 | 3.72092 | 0.0001985 | 0.0074029 | yes |
| ENSMUSG00000020357 | Flt4 | chr11:49422764-49466241 | WT | KO | OK | 5.8965 | 2.34997 | -1.32722 | 3.25969 | 0.00111533 | 0.0296759 | yes |
| ENSMUSG00000025044 | Msr1 | chr8:40667053-40728032 | WT | KO | OK | 6.83904 | 2.73729 | -1.32104 | 4.72242 | 2.33E-06 | 0.00015881 | yes |
| ENSMUSG00000022099 | Epb4.9 | chr14:71001069-71035785 | WT | KO | OK | 2.14115 | 0.866589 | -1.30497 | 3.57664 | 0.00034804 | 0.0114845 | yes |
| ENSMUSG00000022415 | Syngr1 | chr15:79921763-79949931 | WT | KO | OK | 20.8387 | 8.4465 | -1.30284 | 4.09761 | 4.17E-05 | 0.00195843 | yes |
| ENSMUSG00000026475 | Rgs16 | chr1:155587478-155592598 | WT | KO | OK | 99.6383 | 41.1741 | -1.27496 | 3.71737 | 0.00020131 | 0.00745998 | yes |
| ENSMUSG00000001827 | Folr1 | chr7:109006844-109019302 | WT | KO | OK | 11.2263 | 4.64361 | -1.27357 | 4.03221 | 5.53E-05 | 0.00247841 | yes |
| ENSMUSG00000068457 | Uty | chrY:433303-582202 | WT | KO | OK | 5.4127 | 2.26741 | -1.2553 | 5.94122 | 2.83E-09 | 3.87E-07 | yes |
| ENSMUSG00000039126 | Prune2 | chr19:17030607-17298422 | WT | KO | OK | 15.9241 | 6.72537 | -1.24353 | 5.63473 | 1.75E-08 | 1.92E-06 | yes |
| ENSMUSG00000025185 | Loxl4 | chr19:42668471-42687303 | WT | KO | OK | 5.96991 | 2.55665 | -1.22345 | 3.10213 | 0.00192136 | 0.0442112 | yes |
| ENSMUSG00000032060 | Cryab | chr9:50560862-50564738 | WT | KO | OK | 467.505 | 200.584 | -1.22078 | 4.71506 | 2.42E-06 | 0.00016369 | yes |
| ENSMUSG00000030748 | Il4ra | chr7:132695784-132722986 | WT | KO | OK | 35.0455 | 15.1866 | -1.20643 | 6.17458 | 6.63E-10 | 1.00E-07 | yes |
| ENSMUSG00000041774 | Ydjc | chr16:17139156-17202742 | WT | KO | OK | 4.67841 | 2.03851 | -1.1985 | 3.30617 | 0.00094579 | 0.0262704 | yes |
| ENSMUSG00000041362 | 4930506M07Rik | chr19:59047847-59150559 | WT | KO | OK | 3.93698 | 1.71555 | -1.19842 | 5.67865 | 1.36E-08 | 1.53E-06 | yes |
| ENSMUSG00000029304 | Spp1 | chr5:104864136-104870069 | WT | KO | OK | 977.174 | 429 | -1.18764 | 6.90423 | 5.05E-12 | 1.14E-09 | yes |
| ENSMUSG00000001020 | S100a4 | chr3:90407691-90409967 | WT | KO | OK | 1631.69 | 718.941 | -1.18243 | 7.79037 | 6.66E-15 | 2.33E-12 | yes |
| ENSMUSG00000040640 | Erc2 | chr14:28435613-29291721 | WT | KO | OK | 4.05144 | 1.79235 | -1.17658 | 3.1726 | 0.00151079 | 0.0373533 | yes |
| ENSMUSG00000045672 | Col27a1 | chr4:62875037-62996025 | WT | KO | OK | 3.23936 | 1.43311 | -1.17656 | 4.19546 | 2.72E-05 | 0.00135414 | yes |
| ENSMUSG00000020333 | Acsl6 | chr11:54117299-54178258 | WT | KO | OK | 28.4826 | 12.6028 | -1.17634 | 8.99812 | 0 | 0 | yes |
| ENSMUSG00000036854 | Hspb6 | chr7:31324152-31344857 | WT | KO | OK | 42.0771 | 18.7738 | -1.16432 | 4.85849 | 1.18E-06 | 8.92E-05 | yes |
| ENSMUSG00000046318 | Ccbe1 | chr18:66204955-66479261 | WT | KO | OK | 4.15822 | 1.86395 | -1.1576 | 3.8251 | 0.00013072 | 0.00508964 | yes |
| ENSMUSG00000022505 | Emp2 | chr16:10281841-10314061 | WT | KO | OK | 117.547 | 52.6954 | -1.15749 | 5.72325 | 1.05E-08 | 1.22E-06 | yes |
| ENSMUSG00000015340 | Cybb | chrX:9012377-9064897 | WT | KO | OK | 15.2595 | 6.84239 | -1.15713 | 3.82691 | 0.00012976 | 0.00506719 | yes |
| ENSMUSG00000015850 | Adamtsl4 | chr3:95480123-95491840 | WT | KO | OK | 26.2195 | 11.7885 | -1.15326 | 3.92096 | 8.82E-05 | 0.00370567 | yes |
| ENSMUSG00000034765 | Dusp5 | chr19:53603598-53616921 | WT | KO | OK | 33.0894 | 14.8823 | -1.15277 | 3.24611 | 0.00116992 | 0.0308196 | yes |
| ENSMUSG00000028583 | Pdpn | chr4:142857333-142889467 | WT | KO | OK | 201.299 | 91.2393 | -1.14161 | 8.06788 | 6.66E-16 | 2.68E-13 | yes |
| ENSMUSG00000032271 | Nnmt | chr9:48399981-48413258 | WT | KO | OK | 16.5242 | 7.49496 | -1.14059 | 5.14933 | 2.61E-07 | 2.25E-05 | yes |
| ENSMUSG00000085128 | Gm2115 | chr7:91677484-91726847 | WT | KO | OK | 47.8205 | 21.7587 | -1.13604 | 3.20005 | 0.00137402 | 0.0348811 | yes |
| ENSMUSG00000046618 | Olfml2a | chr2:38787497-38819273 | WT | KO | OK | 2.64489 | 1.20351 | -1.13596 | 3.35523 | 0.00079299 | 0.0226284 | yes |
| ENSMUSG00000007888 | Crlf1 | chr8:73017056-73027980 | WT | KO | OK | 116.655 | 53.2883 | -1.13036 | 6.23831 | 4.42E-10 | 6.99E-08 | yes |
| ENSMUSG00000036356 | Csgalnact1 | chr8:70880679-71259045 | WT | KO | OK | 14.1702 | 6.47625 | -1.12963 | 4.00117 | 6.30E-05 | 0.00278956 | yes |
| ENSMUSG00000038235 | F11r | chr1:173367665-173394734 | WT | KO | OK | 20.2696 | 9.33954 | -1.11789 | 4.2712 | 1.94E-05 | 0.00099666 | yes |
| ENSMUSG00000029135 | Fosl2 | chr5:32438844-32460204 | WT | KO | OK | 28.7777 | 13.3069 | -1.11277 | 3.1924 | 0.00141095 | 0.0354794 | yes |
| ENSMUSG00000054520 | Sh3bp2 | chr5:34868486-34906274 | WT | KO | OK | 4.70933 | 2.1791 | -1.11179 | 3.57034 | 0.00035652 | 0.0116016 | yes |
| ENSMUSG00000027913 | Crct1 | chr3:92818126-92819609 | WT | KO | OK | 35.8299 | 16.6299 | -1.10738 | 4.14773 | 3.36E-05 | 0.0016256 | yes |
| ENSMUSG00000025586 | Cpeb1 | chr7:88491911-88600351 | WT | KO | OK | 26.9445 | 12.539 | -1.10357 | 4.97775 | 6.43E-07 | 5.21E-05 | yes |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENSMUSG00000043687 | 1190005I06Rik | chr8:123132501-123158392 | WT | KO | OK | 11.9442 | 5.59974 | -1.09288 | 3.36762 | 0.00075821 | 0.0217894 | yes |
| ENSMUSG00000026494 | Kif26b | chr1:180459255-180862986 | WT | KO | OK | 2.90106 | 1.36299 | -1.0898 | 5.27805 | 1.31E-07 | 1.20E-05 | yes |
| ENSMUSG00000030256 | Bhlhe41 | chr6:145806762-145814078 | WT | KO | OK | 17.0021 | 8.01574 | -1.0848 | 3.66355 | 0.00024874 | 0.00873686 | yes |
| ENSMUSG00000051043 | Gprc5c | chr11:114712465-114733931 | WT | KO | OK | 8.8053 | 4.18594 | -1.07282 | 3.38193 | 0.00071978 | 0.0210961 | yes |
| ENSMUSG00000028581 | Laptm5 | chr4:130469039-130492056 | WT | KO | OK | 16.8981 | 8.04739 | -1.07027 | 4.05912 | 4.93E-05 | 0.00224739 | yes |
| ENSMUSG00000029162 | Khk | chr5:31223928-31233619 | WT | KO | OK | 10.1899 | 4.85956 | -1.06824 | 3.51726 | 0.00043603 | 0.0137337 | yes |
| ENSMUSG00000045573 | Penk | chr4:4060677-4115850 | WT | KO | OK | 13.8025 | 6.63835 | -1.05604 | 3.48498 | 0.00049217 | 0.0151261 | yes |
| ENSMUSG00000042622 | Maff | chr15:79177970-79189502 | WT | KO | OK | 55.1037 | 26.7665 | -1.04172 | 3.59774 | 0.00032099 | 0.0108167 | yes |
| ENSMUSG00000017417 | Plxdc1 | chr11:97784551-97847758 | WT | KO | OK | 1.51451 | 0.738451 | -1.03628 | 3.79935 | 0.00014508 | 0.00557462 | yes |
| ENSMUSG00000023905 | Tnfrsf12a | chr17:23805580-23814416 | WT | KO | OK | 236.93 | 116.112 | -1.02895 | 3.09042 | 0.00199871 | 0.0454827 | yes |
| ENSMUSG00000020774 | Aspa | chr11:73118493-73140309 | WT | KO | OK | 7.72168 | 3.81979 | -1.01542 | 3.19601 | 0.00139344 | 0.0352395 | yes |
| ENSMUSG00000026921 | Egfl7 | chr2:26435533-26459937 | WT | KO | OK | 9.65527 | 4.79167 | -1.01079 | 3.15428 | 0.00160893 | 0.0389813 | yes |
| ENSMUSG00000022661 | Cd200 | chr16:45382247-45409166 | WT | KO | OK | 18.1149 | 9.02176 | -1.0057 | 4.55374 | 5.27E-06 | 0.00032097 | yes |
| ENSMUSG00000041189 | Chrnb1 | chr11:69597537-69609445 | WT | KO | OK | 9.59271 | 4.81131 | -0.995508 | 3.17527 | 0.00149699 | 0.0371504 | yes |
| ENSMUSG00000059824 | Dbp | chr7:52960457-52976205 | WT | KO | OK | 20.6263 | 10.3782 | -0.990928 | 6.00919 | 1.86E-09 | 2.62E-07 | yes |
| ENSMUSG00000054855 | Rnd1 | chr15:98493851-98507892 | WT | KO | OK | 15.1995 | 7.7236 | -0.976677 | 4.18212 | 2.89E-05 | 0.00142542 | yes |
| ENSMUSG00000029762 | Akr1b8 | chr6:34304118-34318463 | WT | KO | OK | 48.1462 | 24.6591 | -0.965302 | 4.17798 | 2.94E-05 | 0.00144628 | yes |
| ENSMUSG00000022223 | Sdr39u1 | chr14:56516122-56519069 | WT | KO | OK | 10.2404 | 5.28542 | -0.954176 | 3.55698 | 0.00037514 | 0.0120307 | yes |
| ENSMUSG00000016194 | Hsd11b1 | chr1:195029232-195090248 | WT | KO | OK | 4.72053 | 2.43652 | -0.954125 | 3.57457 | 0.0003508 | 0.0115003 | yes |
| ENSMUSG00000018339 | Gpx3 | chr11:54715954-54723879 | WT | KO | OK | 25.3538 | 13.1508 | -0.947049 | 3.95112 | 7.78E-05 | 0.00334223 | yes |
| ENSMUSG00000018821 | Avpi1 | chr19:42197762-42203549 | WT | KO | OK | 41.7058 | 21.6542 | -0.9456 | 3.29428 | 0.00098674 | 0.0270124 | yes |
| ENSMUSG00000030353 | Tead4 | chr6:128174305-128250841 | WT | KO | OK | 5.84163 | 3.04652 | -0.939209 | 3.37604 | 0.00073536 | 0.021411 | yes |
| ENSMUSG00000080316 | Ncrna00085 | chr17:17967682-17979973 | WT | KO | OK | 24.7856 | 12.9996 | -0.931033 | 4.01054 | 6.06E-05 | 0.00269001 | yes |
| ENSMUSG00000024424 | Ttc39c | chr18:12758434-12895559 | WT | KO | OK | 7.35862 | 3.86179 | -0.930167 | 4.97813 | 6.42E-07 | 5.21E-05 | yes |
| ENSMUSG00000062210 | Tnfaip8 | chr18:50139080-50266827 | WT | KO | OK | 44.3542 | 23.4289 | -0.920784 | 7.73841 | 9.99E-15 | 3.40E-12 | yes |
| ENSMUSG00000028671 | Gale | chr4:135519641-135524093 | WT | KO | OK | 41.4905 | 21.9514 | -0.918464 | 5.79756 | 6.73E-09 | 8.20E-07 | yes |
| ENSMUSG00000000253 | Gmpr | chr13:45602812-45641751 | WT | KO | OK | 19.0761 | 10.0952 | -0.918102 | 5.07837 | 3.81E-07 | 3.20E-05 | yes |
| ENSMUSG00000085148 | 2210403K04Rik | chr11:75275040-75284401 | WT | KO | OK | 41.1303 | 21.9358 | -0.906913 | 3.06276 | 0.00219305 | 0.0489363 | yes |
| ENSMUSG00000030688 | Stard10 | chr7:108465632-108494826 | WT | KO | OK | 18.5068 | 9.87252 | -0.906568 | 3.57349 | 0.00035226 | 0.0115196 | yes |
| ENSMUSG00000037946 | Fgd3 | chr13:49356922-49415680 | WT | KO | OK | 18.0534 | 9.63446 | -0.905992 | 4.23299 | 2.31E-05 | 0.00116862 | yes |
| ENSMUSG00000001946 | Esam | chr9:37335662-37345904 | WT | KO | OK | 36.9179 | 19.7598 | -0.901752 | 3.85052 | 0.00011787 | 0.00465758 | yes |
| ENSMUSG00000000915 | Hip1r | chr5:124423636-124453223 | WT | KO | OK | 17.6423 | 9.48486 | -0.895341 | 3.68631 | 0.00022753 | 0.00816449 | yes |
| ENSMUSG00000004558 | Ndrg2 | chr14:52524945-52533163 | WT | KO | OK | 35.2776 | 18.9847 | -0.893911 | 3.10325 | 0.00191408 | 0.044205 | yes |
| ENSMUSG00000032657 | Fam189b | chr3:88987064-88993217 | WT | KO | OK | 45.4474 | 24.485 | -0.892302 | 6.39416 | 1.61E-10 | 2.75E-08 | yes |
| ENSMUSG00000046727 | 0610010O12Rik | chr18:36505272-36562634 | WT | KO | OK | 73.6338 | 40.2186 | -0.872505 | 4.14752 | 3.36E-05 | 0.0016256 | yes |
| ENSMUSG00000029552 | Tes | chr6:17015009-17121833 | WT | KO | OK | 63.4797 | 34.6992 | -0.871392 | 4.12399 | 3.72E-05 | 0.00177198 | yes |
| ENSMUSG00000074024 | 4632427E13Rik | chr7:99886167-99889978 | WT | KO | OK | 1.39967 | 0.770048 | -0.862064 | 4.29092 | 1.78E-05 | 0.00091568 | yes |
| ENSMUSG00000007655 | Cav1 | chr6:17147750-17335604 | WT | KO | OK | 404.922 | 222.828 | -0.861711 | 6.84484 | 7.66E-12 | 1.67E-09 | yes |
| ENSMUSG00000028789 | Adc | chr4:128607476-128639686 | WT | KO | OK | 35.9553 | 19.9418 | -0.850404 | 5.50502 | 3.69E-08 | 3.74E-06 | yes |
| ENSMUSG00000021477 | Ctsl | chr13:64464521-64471614 | WT | KO | OK | 406.902 | 225.952 | -0.848667 | 3.85896 | 0.00011387 | 0.00452648 | yes |
| ENSMUSG00000026972 | Arrdc1 | chr2:24780871-24790772 | WT | KO | OK | 18.5532 | 10.3296 | -0.844883 | 4.39063 | 1.13E-05 | 0.00062009 | yes |
| ENSMUSG00000001507 | Itga3 | chr11:94905787-94938115 | WT | KO | OK | 154.956 | 86.6759 | -0.838153 | 4.50654 | 6.59E-06 | 0.00038883 | yes |
| ENSMUSG00000031488 | Rab11fip1 | chr8:28249244-28285120 | WT | KO | OK | 3.04528 | 1.70435 | -0.837353 | 3.18352 | 0.00145498 | 0.0364194 | yes |
| ENSMUSG00000039081 | Zfp503 | chr14:22803183-22808823 | WT | KO | OK | 13.9402 | 7.97092 | -0.806434 | 6.48864 | 8.66E-11 | 1.53E-08 | yes |
| ENSMUSG00000025473 | Adam8 | chr7:147136294-147178461 | WT | KO | OK | 13.3572 | 7.64983 | -0.804115 | 3.92957 | 8.51E-05 | 0.00359819 | yes |
| ENSMUSG00000022952 | Runx1 | chr16:92601711-92826311 | WT | KO | OK | 11.9235 | 6.84675 | -0.800312 | 3.19393 | 0.0014035 | 0.0354264 | yes |
| ENSMUSG00000027864 | Ptgfrn | chr3:100844154-100914201 | WT | KO | OK | 48.15 | 27.6562 | -0.799931 | 5.19496 | 2.05E-07 | 1.81E-05 | yes |
| ENSMUSG00000030268 | Bcat1 | chr6:144942354-145024704 | WT | KO | OK | 30.5339 | 17.5493 | -0.798995 | 4.99809 | 5.79E-07 | 4.75E-05 | yes |
| ENSMUSG00000036872 | Abcc12 | chr8:89006158-89104585 | WT | KO | OK | 14.2195 | 8.18782 | -0.796322 | 4.67475 | 2.94E-06 | 0.00019538 | yes |
| ENSMUSG00000026623 | Lpgat1 | chr1:193541712-193608134 | WT | KO | OK | 19.0707 | 11.0455 | -0.7879 | 3.38544 | 0.00071065 | 0.0208745 | yes |
| ENSMUSG00000024830 | Rps6kb2 | chr19:4154605-4163354 | WT | KO | OK | 33.4044 | 19.4056 | -0.783567 | 5.29953 | 1.16E-07 | 1.08E-05 | yes |
| ENSMUSG00000026456 | Cyb5r1 | chr1:136302357-136308313 | WT | KO | OK | 31.0055 | 18.0349 | -0.781734 | 3.48279 | 0.00049622 | 0.0152156 | yes |
| ENSMUSG00000024924 | Vldlr | chr19:27290973-27328721 | WT | KO | OK | 20.2232 | 11.7694 | -0.780971 | 4.63458 | 3.58E-06 | 0.00023052 | yes |
| ENSMUSG00000032334 | Loxl1 | chr9:58135529-58161019 | WT | KO | OK | 100.081 | 58.5454 | -0.773542 | 5.43946 | 5.34E-08 | 5.38E-06 | yes |
| ENSMUSG00000057421 | Las1l | chrX:93130673-93152301 | WT | KO | OK | 40.3885 | 23.7462 | -0.766244 | 3.07862 | 0.00207964 | 0.0467989 | yes |
| ENSMUSG00000019810 | Fuca2 | chr10:13219345-13238841 | WT | KO | OK | 39.7049 | 23.3817 | -0.763938 | 3.57558 | 0.00034946 | 0.0114845 | yes |
| ENSMUSG00000031816 | Mthfsd | chr8:123618911-123632292 | WT | KO | OK | 46.4952 | 27.3881 | -0.763532 | 5.34681 | 8.95E-08 | 8.49E-06 | yes |
| ENSMUSG00000010067 | Rassf1 | chr9:107453885-107470746 | WT | KO | OK | 46.623 | 27.5221 | -0.760451 | 5.04153 | 4.62E-07 | 3.81E-05 | yes |
| ENSMUSG00000027238 | Frmd5 | chr2:121371264-121632823 | WT | KO | OK | 4.53423 | 2.68772 | -0.754474 | 3.31643 | 0.00091176 | 0.0255389 | yes |
| ENSMUSG00000041959 | S100a10 | chr3:93359001-93368565 | WT | KO | OK | 911.151 | 540.677 | -0.752924 | 8.03193 | 8.88E-16 | 3.47E-13 | yes |
| ENSMUSG00000025408 | Ddit3 | chr10:126727829-126748842 | WT | KO | OK | 16.4435 | 9.77636 | -0.750148 | 4.03271 | 5.51E-05 | 0.00247841 | yes |
| ENSMUSG00000008305 | Tle1 | chr4:71778175-71861953 | WT | KO | OK | 28.0217 | 16.68 | -0.74843 | 12.3236 | 0 | 0 | yes |
| ENSMUSG00000025533 | Asl | chr5:130487127-130501002 | WT | KO | OK | 43.4905 | 26.2939 | -0.725971 | 3.47827 | 0.00050465 | 0.0154384 | yes |
| ENSMUSG00000024981 | Acsl5 | chr19:55327858-55390522 | WT | KO | OK | 26.7892 | 16.198 | -0.725836 | 3.63667 | 0.00027619 | 0.009548 | yes |
| ENSMUSG00000062906 | Hdac10 | chr15:88953732-88959130 | WT | KO | OK | 8.45458 | 5.11317 | -0.725514 | 5.56369 | 2.64E-08 | 2.81E-06 | yes |
| ENSMUSG00000007122 | Casq1 | chr1:174140024-174150026 | WT | KO | OK | 10.9438 | 6.6545 | -0.717715 | 3.68869 | 0.00022541 | 0.0081538 | yes |
| ENSMUSG00000006335 | Tfpt | chr7:3571925-3581531 | WT | KO | OK | 28.8123 | 17.5985 | -0.711231 | 4.85702 | 1.19E-06 | 8.94E-05 | yes |
| ENSMUSG00000069833 | Ahnak | chr19:9063749-9151409 | WT | KO | OK | 68.461 | 41.8893 | -0.708702 | 4.57778 | 4.70E-06 | 0.00028886 | yes |
| ENSMUSG00000001288 | Rarg | chr15:102065368-102087948 | WT | KO | OK | 16.1084 | 9.85629 | -0.708696 | 3.30487 | 0.00095022 | 0.0263383 | yes |
| ENSMUSG00000055737 | Ghr | chr15:3267759-3533492 | WT | KO | OK | 38.5677 | 23.6752 | -0.704015 | 4.55134 | 5.33E-06 | 0.00032316 | yes |
| ENSMUSG00000018819 | Lsp1 | chr7:149646713-149701914 | WT | KO | OK | 23.888 | 14.6773 | -0.702698 | 3.90534 | 9.41E-05 | 0.00387981 | yes |
| ENSMUSG00000034412 | Tbc1d10a | chr11:4086791-4115508 | WT | KO | OK | 41.1273 | 25.316 | -0.700048 | 5.58341 | 2.36E-08 | 2.55E-06 | yes |
| ENSMUSG00000040511 | Pvr | chr7:20488926-20512956 | WT | KO | OK | 36.3674 | 22.3988 | -0.699223 | 3.2915 | 0.00099654 | 0.0271685 | yes |
| ENSMUSG00000034040 | Wbscr17 | chr5:131347951-131783948 | WT | KO | OK | 8.76666 | 5.40674 | -0.69727 | 4.40901 | 1.04E-05 | 0.00057931 | yes |
| ENSMUSG00000032489 | Kif9 | chr9:110379461-110427683 | WT | KO | OK | 1.34518 | 0.831665 | -0.693722 | 3.10547 | 0.00189978 | 0.0440198 | yes |
| ENSMUSG00000033852 | Pla2g4b | chr2:119853218-119868769 | WT | KO | OK | 10.9424 | 6.77686 | -0.691247 | 3.80008 | 0.00014465 | 0.00557462 | yes |
| ENSMUSG00000028601 | Echdc2 | chr4:107838041-107851913 | WT | KO | OK | 11.8607 | 7.37041 | -0.686375 | 3.87486 | 0.00010669 | 0.00429238 | yes |
| ENSMUSG00000030839 | Sergef | chr7:53698537-53895177 | WT | KO | OK | 15.2026 | 9.4504 | -0.685874 | 4.12106 | 3.77E-05 | 0.00178828 | yes |
| ENSMUSG00000022550 | Adck5 | chr15:76406787-76438021 | WT | KO | OK | 18.9061 | 11.8405 | -0.675117 | 3.61123 | 0.00030475 | 0.010322 | yes |
| ENSMUSG00000026825 | Dnm1 | chr2:32163990-32237458 | WT | KO | OK | 25.332 | 16.0297 | -0.660217 | 3.97249 | 7.11E-05 | 0.00310454 | yes |
| ENSMUSG00000075706 | Gpx4 | chr10:79509910-79519184 | WT | KO | OK | 522.234 | 331.224 | -0.656886 | 3.26903 | 0.00107915 | 0.0289452 | yes |
| ENSMUSG00000058586 | Serhl | chr15:82919935-82953231 | WT | KO | OK | 64.4863 | 40.9542 | -0.654981 | 5.70497 | 1.16E-08 | 1.33E-06 | yes |
| ENSMUSG00000018585 | Atox1 | chr11:55260142-55274741 | WT | KO | OK | 147.646 | 93.818 | -0.654202 | 3.32155 | 0.00089518 | 0.0251803 | yes |
| ENSMUSG00000024725 | Ostf1 | chr19:18653817-18706279 | WT | KO | OK | 41.5656 | 26.4465 | -0.652314 | 3.28588 | 0.00101663 | 0.0275466 | yes |
| ENSMUSG00000048772 | Tmem53 | chr4:116885937-116941187 | WT | KO | OK | 8.56941 | 5.45422 | -0.651822 | 3.119 | 0.00181468 | 0.0427189 | yes |
| ENSMUSG00000025138 | Sirt7 | chr11:120479685-120494914 | WT | KO | OK | 32.0979 | 20.4815 | -0.648157 | 7.2666 | 3.69E-13 | 1.04E-10 | yes |
| ENSMUSG00000030409 | Dmpk | chr7:19669197-19679170 | WT | KO | OK | 112.631 | 72.4112 | -0.637325 | 5.70326 | 1.18E-08 | 1.33E-06 | yes |
| ENSMUSG00000005087 | Cd44 | chr2:102651297-102741822 | WT | KO | OK | 225.26 | 145.059 | -0.634958 | 12.2535 | 0 | 0 | yes |
| ENSMUSG00000026730 | Pter | chr2:12845667-12925080 | WT | KO | OK | 41.4993 | 26.8071 | -0.630472 | 3.79829 | 0.0001457 | 0.00557462 | yes |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENSMUSG00000002332 | Dhrs1 | chr14:56357856-56364527 | WT | KO | OK | 268.116 | 173.423 | -0.628561 | 3.19244 | 0.00141075 | 0.0354794 | yes |
| ENSMUSG00000033955 | Tnks1bp1 | chr2:84888178-84913205 | WT | KO | OK | 104.072 | 67.5599 | -0.623341 | 3.4494 | 0.00056183 | 0.016992 | yes |
| ENSMUSG00000040990 | Sh3kbp1 | chrX:156065203-156416001 | WT | KO | OK | 26.6217 | 17.3377 | -0.618694 | 7.051 | 1.78E-12 | 4.62E-10 | yes |
| ENSMUSG00000024501 | Dpysl3 | chr18:43480632-43597940 | WT | KO | OK | 237.516 | 154.814 | -0.617484 | 5.51643 | 3.46E-08 | 3.56E-06 | yes |
| ENSMUSG00000013539 | D16H22S680E | chr16:18300917-18348196 | WT | KO | OK | 16.5714 | 10.8309 | -0.613547 | 3.37511 | 0.00073785 | 0.0214364 | yes |
| ENSMUSG00000089917 | Uckl1 | chr2:181303853-181390365 | WT | KO | OK | 36.0576 | 23.6436 | -0.608852 | 4.4152 | 1.01E-05 | 0.00056657 | yes |
| ENSMUSG00000024862 | Klc2 | chr19:5107745-5118560 | WT | KO | OK | 25.8465 | 16.9587 | -0.607941 | 4.848 | 1.25E-06 | 9.30E-05 | yes |
| ENSMUSG00000036073 | Galt | chr4:41647020-41721120 | WT | KO | OK | 11.8053 | 7.78 | -0.601592 | 4.66273 | 3.12E-06 | 0.0002051 | yes |
| ENSMUSG00000042359 | Osbpl6 | chr2:76244564-76438704 | WT | KO | OK | 17.3928 | 11.4723 | -0.600327 | 4.54732 | 5.43E-06 | 0.0003279 | yes |
| ENSMUSG00000022558 | Heatr7a | chr15:76210690-76307699 | WT | KO | OK | 42.8969 | 28.3162 | -0.599248 | 3.89747 | 9.72E-05 | 0.00397094 | yes |
| ENSMUSG00000005125 | Ndrg1 | chr15:66760882-66844601 | WT | KO | OK | 41.3673 | 27.3278 | -0.59812 | 3.16493 | 0.00155118 | 0.0381389 | yes |
| ENSMUSG00000032332 | Col12a1 | chr9:79446797-79566638 | WT | KO | OK | 52.8526 | 34.9152 | -0.59812 | 3.79865 | 0.00014549 | 0.00557462 | yes |
| ENSMUSG00000022656 | Pvrl3 | chr16:46387818-46498638 | WT | KO | OK | 86.7111 | 57.5905 | -0.590387 | 6.54207 | 6.07E-11 | 1.15E-08 | yes |
| ENSMUSG00000028266 | Lmo4 | chr3:143851010-143868219 | WT | KO | OK | 165.325 | 110.192 | -0.585284 | 9.14021 | 0 | 0 | yes |
| ENSMUSG00000032925 | Itgbl1 | chr14:124059192-124374840 | WT | KO | OK | 9.30083 | 6.20512 | -0.583902 | 3.50092 | 0.00046366 | 0.0144359 | yes |
| ENSMUSG00000038172 | Ttc39b | chr4:82866203-82970159 | WT | KO | OK | 19.6796 | 13.1821 | -0.578119 | 4.25757 | 2.07E-05 | 0.00105533 | yes |
| ENSMUSG00000032300 | 1700017B05Rik | chr9:57100128-57110406 | WT | KO | OK | 15.2734 | 10.2712 | -0.57242 | 4.22464 | 2.39E-05 | 0.00119908 | yes |
| ENSMUSG00000026547 | Tagln2 | chr1:174430177-174437511 | WT | KO | OK | 353.113 | 237.617 | -0.571491 | 5.23529 | 1.65E-07 | 1.48E-05 | yes |
| ENSMUSG00000001524 | Gtf2h4 | chr17:35804682-35810684 | WT | KO | OK | 24.3987 | 16.4441 | -0.569231 | 4.44587 | 8.75E-06 | 0.00050313 | yes |
| ENSMUSG00000029009 | Mthfr | chr4:147413185-147433660 | WT | KO | OK | 19.9662 | 13.4688 | -0.567937 | 3.528 | 0.00041872 | 0.0132998 | yes |
| ENSMUSG00000024664 | Fads3 | chr19:10116037-10134161 | WT | KO | OK | 61.4149 | 41.4615 | -0.566817 | 4.45682 | 8.32E-06 | 0.0004802 | yes |
| ENSMUSG00000041801 | Phlda3 | chr1:137662695-137665713 | WT | KO | OK | 167.631 | 113.693 | -0.56014 | 3.16381 | 0.00155719 | 0.0381453 | yes |
| ENSMUSG00000072812 | Ahnak2 | chr12:114010404-114040868 | WT | KO | OK | 33.7477 | 22.953 | -0.55611 | 3.65422 | 0.00025796 | 0.00898052 | yes |
| ENSMUSG00000038400 | Pmepa1 | chr2:173049958-173102034 | WT | KO | OK | 70.2696 | 47.8005 | -0.555876 | 6.51378 | 7.33E-11 | 1.35E-08 | yes |
| ENSMUSG00000043421 | 2310016C08Rik | chr6:29222487-29225446 | WT | KO | OK | 15.6149 | 10.6442 | -0.552864 | 3.26076 | 0.00111115 | 0.0296239 | yes |
| ENSMUSG00000033379 | Atp6v0b | chr4:117556225-117559938 | WT | KO | OK | 192.368 | 131.134 | -0.552824 | 7.59439 | 3.09E-14 | 9.99E-12 | yes |
| ENSMUSG00000024937 | Ehbp1l1 | chr19:5707375-5726317 | WT | KO | OK | 14.9923 | 10.2243 | -0.552219 | 4.62703 | 3.71E-06 | 0.00023763 | yes |
| ENSMUSG00000008855 | Hdac5 | chr11:102055745-102091480 | WT | KO | OK | 55.3465 | 37.8106 | -0.5497 | 4.34054 | 1.42E-05 | 0.00075788 | yes |
| ENSMUSG00000039382 | Wdr45 | chrX:7291458-7305327 | WT | KO | OK | 25.6858 | 17.5546 | -0.549119 | 4.30014 | 1.71E-05 | 0.00088181 | yes |
| ENSMUSG00000051736 | 1700025K23Rik | chr10:38838609-38853720 | WT | KO | OK | 9.64175 | 6.59309 | -0.54834 | 3.95959 | 7.51E-05 | 0.00324703 | yes |
| ENSMUSG00000036097 | Fam178a | chr19:45005608-45058277 | WT | KO | OK | 19.3229 | 13.2324 | -0.54624 | 7.85875 | 3.77E-15 | 1.39E-12 | yes |
| ENSMUSG00000023088 | Abcc1 | chr16:14361650-14475830 | WT | KO | OK | 35.9958 | 24.7084 | -0.542825 | 8.59894 | 0 | 0 | yes |
| ENSMUSG00000029869 | Ephb6 | chr6:41555480-41570508 | WT | KO | OK | 37.6295 | 25.8564 | -0.541345 | 3.41952 | 0.00062731 | 0.0187164 | yes |
| ENSMUSG00000037419 | Endod1 | chr9:14158433-14185951 | WT | KO | OK | 17.6189 | 12.139 | -0.537481 | 3.50542 | 0.00045588 | 0.0142753 | yes |
| ENSMUSG00000020744 | Slc25a19 | chr11:115475491-115489595 | WT | KO | OK | 15.9143 | 10.972 | -0.536493 | 3.32462 | 0.00088538 | 0.0249578 | yes |
| ENSMUSG00000020388 | Pdlim4 | chr11:53868429-53882516 | WT | KO | OK | 122.084 | 84.5327 | -0.530295 | 3.57751 | 0.00034688 | 0.0114845 | yes |
| ENSMUSG00000015745 | Plekho1 | chr3:95792351-95799924 | WT | KO | OK | 47.2492 | 32.8919 | -0.522559 | 3.2668 | 0.0010877 | 0.0291156 | yes |
| ENSMUSG00000066640 | Fbxl18 | chr5:143628624-143657100 | WT | KO | OK | 6.8362 | 4.78589 | -0.514406 | 3.12209 | 0.00179571 | 0.0423474 | yes |
| ENSMUSG00000032763 | Ilvbl | chr10:78037244-78047243 | WT | KO | OK | 24.4808 | 17.1766 | -0.511205 | 3.62993 | 0.0002835 | 0.00971631 | yes |
| ENSMUSG00000040183 | Ankrd6 | chr4:32891009-33037816 | WT | KO | OK | 15.1602 | 10.6495 | -0.5095 | 3.08099 | 0.00206316 | 0.0467449 | yes |
| ENSMUSG00000047843 | Bri3 | chr5:145002558-145207626 | WT | KO | OK | 52.7496 | 37.0643 | -0.509128 | 3.55735 | 0.00037462 | 0.0120307 | yes |
| ENSMUSG00000029752 | Asns | chr6:7625168-7643254 | WT | KO | OK | 60.8948 | 42.8332 | -0.507588 | 3.71686 | 0.00020171 | 0.00745998 | yes |
| ENSMUSG00000009291 | Pttg1ip | chr10:77044464-77061477 | WT | KO | OK | 300.981 | 211.981 | -0.505738 | 3.90046 | 9.60E-05 | 0.00394658 | yes |
| ENSMUSG00000051232 | Tmem199 | chr11:78320556-78325674 | WT | KO | OK | 28.367 | 20.0264 | -0.502307 | 3.22305 | 0.00126833 | 0.0328899 | yes |
| ENSMUSG00000036820 | Amdhd2 | chr17:24292799-24300733 | WT | KO | OK | 27.3038 | 19.3677 | -0.495453 | 3.11573 | 0.00183489 | 0.0430629 | yes |
| ENSMUSG00000015790 | Surf1 | chr2:26768902-26789448 | WT | KO | OK | 52.4663 | 37.2694 | -0.4934 | 4.38794 | 1.14E-05 | 0.00062522 | yes |
| ENSMUSG00000026199 | Ankzf1 | chr1:75188708-75207353 | WT | KO | OK | 6.76738 | 4.81512 | -0.491026 | 3.64476 | 0.00026765 | 0.00927818 | yes |
| ENSMUSG00000044117 | 2900011O08Rik | chr16:13981794-14101593 | WT | KO | OK | 19.4605 | 13.8493 | -0.49074 | 3.30914 | 0.00093585 | 0.0261501 | yes |
| ENSMUSG00000034751 | Mast4 | chr13:103483637-104124577 | WT | KO | OK | 14.066 | 10.028 | -0.488188 | 3.12935 | 0.00175192 | 0.0417599 | yes |
| ENSMUSG00000042675 | Ypel3 | chr7:133920468-133924028 | WT | KO | OK | 28.727 | 20.4992 | -0.486839 | 3.1507 | 0.00162878 | 0.0393187 | yes |
| ENSMUSG00000044864 | Ankrd50 | chr3:38348182-38383766 | WT | KO | OK | 64.3422 | 45.9503 | -0.485689 | 3.20417 | 0.00135451 | 0.0345178 | yes |
| ENSMUSG00000018820 | Zfyve27 | chr19:42238440-42269080 | WT | KO | OK | 22.9659 | 16.4192 | -0.484111 | 3.75272 | 0.00017493 | 0.0065608 | yes |
| ENSMUSG00000049327 | Setd8 | chr5:124889938-124912317 | WT | KO | OK | 114.321 | 81.7607 | -0.483611 | 5.38261 | 7.34E-08 | 7.17E-06 | yes |
| ENSMUSG00000002963 | Pnkp | chr7:52112508-52118295 | WT | KO | OK | 45.0241 | 32.2183 | -0.482817 | 5.89271 | 3.80E-09 | 4.97E-07 | yes |
| ENSMUSG00000007659 | Bcl2l1 | chr2:152593051-152657464 | WT | KO | OK | 98.1839 | 70.2735 | -0.482505 | 4.80057 | 1.58E-06 | 0.00011114 | yes |
| ENSMUSG00000068329 | Htra2 | chr6:82984166-83007674 | WT | KO | OK | 48.4604 | 34.7653 | -0.479157 | 7.06536 | 1.60E-12 | 4.25E-10 | yes |
| ENSMUSG00000034205 | Loxl2 | chr14:69955207-70166920 | WT | KO | OK | 204.277 | 146.843 | -0.476251 | 3.78963 | 0.00015087 | 0.00570842 | yes |
| ENSMUSG00000033021 | Gmppa | chr1:75432504-75439754 | WT | KO | OK | 57.6833 | 41.5734 | -0.472495 | 5.91512 | 3.32E-09 | 4.45E-07 | yes |
| ENSMUSG00000005514 | Por | chr5:136145902-136211196 | WT | KO | OK | 131.751 | 95.0123 | -0.471631 | 10.3295 | 0 | 0 | yes |
| ENSMUSG00000053291 | Rab4b | chr7:27953442-27966176 | WT | KO | OK | 56.0433 | 40.4364 | -0.470885 | 5.07256 | 3.93E-07 | 3.28E-05 | yes |
| ENSMUSG00000037012 | Hk1 | chr10:61731602-61842656 | WT | KO | OK | 93.6208 | 67.6058 | -0.469682 | 8.68477 | 0 | 0 | yes |
| ENSMUSG00000029578 | Wipi2 | chr5:143105495-143146542 | WT | KO | OK | 41.2687 | 29.8497 | -0.467333 | 5.15629 | 2.52E-07 | 2.19E-05 | yes |
| ENSMUSG00000058835 | Abi1 | chr2:22750840-22895761 | WT | KO | OK | 89.3264 | 65.183 | -0.45459 | 10.115 | 0 | 0 | yes |
| ENSMUSG00000025875 | Tspan17 | chr13:54890737-54898137 | WT | KO | OK | 43.4351 | 31.7466 | -0.452259 | 3.2715 | 0.00106977 | 0.0287516 | yes |
| ENSMUSG00000063506 | Arhgap22 | chr14:34027211-34183329 | WT | KO | OK | 74.4435 | 54.4352 | -0.451607 | 3.29696 | 0.00097738 | 0.0268668 | yes |
| ENSMUSG00000029108 | Pcdh7 | chr5:58109259-58520590 | WT | KO | OK | 29.1094 | 21.3234 | -0.449047 | 4.81089 | 1.50E-06 | 0.00010668 | yes |
| ENSMUSG00000032604 | Qars | chr9:108410335-108418272 | WT | KO | OK | 113.88 | 83.4328 | -0.448821 | 4.13916 | 3.49E-05 | 0.00167079 | yes |
| ENSMUSG00000053819 | Camk2d | chr3:126299219-126547972 | WT | KO | OK | 106.733 | 78.2376 | -0.448072 | 3.21846 | 0.0012888 | 0.0331964 | yes |
| ENSMUSG00000029598 | Plbd2 | chr5:120926539-120953634 | WT | KO | OK | 72.1967 | 52.928 | -0.447902 | 4.05571 | 5.00E-05 | 0.00226487 | yes |
| ENSMUSG00000028822 | Tmem50a | chr4:134453763-134470939 | WT | KO | OK | 89.3573 | 65.5912 | -0.446084 | 4.61805 | 3.87E-06 | 0.00024466 | yes |
| ENSMUSG00000005501 | Usp40 | chr1:89841695-89905126 | WT | KO | OK | 12.5011 | 9.18835 | -0.444176 | 3.77151 | 0.00016227 | 0.00610308 | yes |
| ENSMUSG00000022711 | Pmm2 | chr16:8633976-8657624 | WT | KO | OK | 47.084 | 34.6445 | -0.442609 | 4.41473 | 1.01E-05 | 0.00056657 | yes |
| ENSMUSG00000015126 | 0610007P22Rik | chr17:25377114-25393309 | WT | KO | OK | 24.6329 | 18.1567 | -0.440085 | 3.07535 | 0.00210253 | 0.0472341 | yes |
| ENSMUSG00000027472 | Pdrg1 | chr2:152834625-152841163 | WT | KO | OK | 131.081 | 97.1209 | -0.432606 | 3.33755 | 0.0008452 | 0.0239779 | yes |
| ENSMUSG00000019558 | Slc6a8 | chrX:70918488-70927841 | WT | KO | OK | 80.3468 | 59.5948 | -0.431053 | 6.4239 | 1.33E-10 | 2.29E-08 | yes |
| ENSMUSG00000032531 | Amotl2 | chr9:102619001-102635748 | WT | KO | OK | 127.985 | 95.024 | -0.429612 | 9.82406 | 0 | 0 | yes |
| ENSMUSG00000024012 | Mtch1 | chr17:29469016-29484849 | WT | KO | OK | 463.141 | 344.032 | -0.428906 | 6.83821 | 8.02E-12 | 1.72E-09 | yes |
| ENSMUSG00000021268 | Meg3 | chr12:110779210-110809936 | WT | KO | OK | 107.655 | 80.1534 | -0.425582 | 3.71154 | 0.00020601 | 0.00759758 | yes |
| ENSMUSG00000071708 | Sms | chrX:153881786-153930219 | WT | KO | OK | 66.8514 | 49.8322 | -0.423879 | 3.51696 | 0.00043652 | 0.0137337 | yes |
| ENSMUSG00000029581 | Fscn1 | chr5:143722021-143734864 | WT | KO | OK | 678.331 | 506.232 | -0.422191 | 3.90646 | 9.37E-05 | 0.00387981 | yes |
| ENSMUSG00000026767 | Fam188a | chr2:12268889-12341096 | WT | KO | OK | 94.7773 | 70.812 | -0.420547 | 4.45923 | 8.23E-06 | 0.00047689 | yes |
| ENSMUSG00000037351 | Actr1b | chr1:36756046-36771267 | WT | KO | OK | 178.065 | 133.251 | -0.418254 | 3.89961 | 9.63E-05 | 0.00394813 | yes |
| ENSMUSG00000024909 | Efemp2 | chr19:5473972-5481853 | WT | KO | OK | 428.386 | 321.624 | -0.413534 | 7.32498 | 2.39E-13 | 6.90E-11 | yes |
| ENSMUSG00000018848 | Rars | chr11:35621882-35648008 | WT | KO | OK | 101.315 | 76.1843 | -0.411286 | 3.52117 | 0.00042964 | 0.0135818 | yes |
| ENSMUSG00000003199 | Mpnd | chr17:56145133-56176058 | WT | KO | OK | 108.112 | 81.6414 | -0.405157 | 3.57614 | 0.00034871 | 0.0114845 | yes |
| ENSMUSG00000028464 | Tpm2 | chr4:43527582-43536637 | WT | KO | OK | 241.381 | 182.716 | -0.401709 | 3.21822 | 0.0012899 | 0.0331964 | yes |
| ENSMUSG00000027309 | 4930402H24Rik | chr2:130531935-130732142 | WT | KO | OK | 60.9717 | 46.1723 | -0.401113 | 3.35237 | 0.00080123 | 0.0227793 | yes |
| ENSMUSG00000030815 | Phkg2 | chr7:134716853-134732109 | WT | KO | OK | 28.7135 | 21.8405 | -0.394719 | 4.38609 | 1.15E-05 | 0.00062797 | yes |
| ENSMUSG00000013921 | Clip3 | chr7:31076690-31093386 | WT | KO | OK | 185.683 | 141.345 | -0.393629 | 3.93214 | 8.42E-05 | 0.00357128 | yes |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENSMUSG00000020263 | Appl2 | chr10:83062777-83111483 | WT | KO | OK | 55.9475 | 42.6275 | -0.392291 | 3.69578 | 0.00021922 | 0.00801797 | yes |
| ENSMUSG00000066406 | Akap13 | chr7:82600419-82899495 | WT | KO | OK | 15.0458 | 11.4676 | -0.391795 | 3.06902 | 0.00214762 | 0.0481654 | yes |
| ENSMUSG00000038845 | Phb | chr11:95528270-95542087 | WT | KO | OK | 71.207 | 54.5397 | -0.384711 | 3.27414 | 0.00105986 | 0.0285431 | yes |
| ENSMUSG00000078440 | Dohh | chr10:80847172-80854305 | WT | KO | OK | 49.2153 | 37.7039 | -0.384394 | 3.37948 | 0.00072623 | 0.0212382 | yes |
| ENSMUSG00000017760 | Ctsa | chr2:164656231-164683211 | WT | KO | OK | 169.767 | 130.403 | -0.380582 | 5.22989 | 1.70E-07 | 1.51E-05 | yes |
| ENSMUSG00000030269 | Mtmr14 | chr6:113187836-113231386 | WT | KO | OK | 24.5972 | 18.8963 | -0.38039 | 3.07904 | 0.00207668 | 0.0467989 | yes |
| ENSMUSG00000037902 | Sirpa | chr2:129418570-129457964 | WT | KO | OK | 97.9785 | 75.3529 | -0.378802 | 4.76316 | 1.91E-06 | 0.00013179 | yes |
| ENSMUSG00000068917 | Clk2 | chr3:88968716-88980843 | WT | KO | OK | 34.5297 | 26.6318 | -0.374688 | 4.24916 | 2.15E-05 | 0.00109153 | yes |
| ENSMUSG00000019087 | Atp6ap1 | chrX:71542435-71550060 | WT | KO | OK | 317.989 | 245.654 | -0.37235 | 4.33081 | 1.49E-05 | 0.00078298 | yes |
| ENSMUSG00000033788 | Dysf | chr6:83958583-84161054 | WT | KO | OK | 29.7216 | 22.9649 | -0.372083 | 3.25096 | 0.00115017 | 0.0304201 | yes |
| ENSMUSG00000039137 | Whrn | chr4:63075943-63157025 | WT | KO | OK | 14.4245 | 11.1489 | -0.371611 | 5.39018 | 7.04E-08 | 6.97E-06 | yes |
| ENSMUSG00000015714 | Lass2 | chr3:95111593-95161124 | WT | KO | OK | 191.232 | 148.455 | -0.365294 | 5.55174 | 2.83E-08 | 2.98E-06 | yes |
| ENSMUSG00000023846 | Riok2 | chr17:17511295-17532267 | WT | KO | OK | 19.7238 | 15.323 | -0.364237 | 3.58682 | 0.00033474 | 0.0111666 | yes |
| ENSMUSG00000039640 | Mrpl12 | chr11:120345926-120350379 | WT | KO | OK | 75.6579 | 58.8029 | -0.363604 | 3.28746 | 0.00101097 | 0.0275055 | yes |
| ENSMUSG00000027131 | Tmem85 | chr2:112105981-112254397 | WT | KO | OK | 75.0376 | 58.3498 | -0.362884 | 3.15211 | 0.00162098 | 0.0392017 | yes |
| ENSMUSG00000005575 | Ube2m | chr7:13620586-13623622 | WT | KO | OK | 210.539 | 163.718 | -0.362876 | 5.14009 | 2.75E-07 | 2.35E-05 | yes |
| ENSMUSG00000020232 | Hmg20b | chr10:80808792-80813225 | WT | KO | OK | 95.4495 | 74.2521 | -0.362306 | 6.44379 | 1.17E-10 | 2.04E-08 | yes |
| ENSMUSG00000030750 | Nsmce1 | chr7:132611153-132635110 | WT | KO | OK | 50.8816 | 39.6162 | -0.361052 | 3.33433 | 0.00085506 | 0.024206 | yes |
| ENSMUSG00000039069 | Gtpbp5 | chr2:179805292-179820607 | WT | KO | OK | 7.71044 | 6.00945 | -0.359579 | 4.08338 | 4.44E-05 | 0.00206309 | yes |
| ENSMUSG00000024146 | Cript | chr17:87424889-87435150 | WT | KO | OK | 42.9166 | 33.47 | -0.358669 | 4.60707 | 4.08E-06 | 0.00025561 | yes |
| ENSMUSG00000006024 | Napa | chr7:16683806-16703324 | WT | KO | OK | 190.878 | 148.893 | -0.358377 | 3.57576 | 0.00034921 | 0.0114845 | yes |
| ENSMUSG00000028898 | Trnau1ap | chr4:131867677-131885453 | WT | KO | OK | 33.8051 | 26.5323 | -0.349487 | 3.20286 | 0.0013607 | 0.0346093 | yes |
| ENSMUSG00000024799 | Tm7sf2 | chr19:6062820-6084944 | WT | KO | OK | 61.1915 | 48.0546 | -0.348657 | 7.33964 | 2.14E-13 | 6.47E-11 | yes |
| ENSMUSG00000026254 | Eif4e2 | chr1:89110488-89137063 | WT | KO | OK | 107.519 | 84.5619 | -0.346506 | 3.59093 | 0.0003295 | 0.0110196 | yes |
| ENSMUSG00000060279 | Ap2a1 | chr7:52151448-52184866 | WT | KO | OK | 154.253 | 121.485 | -0.344517 | 6.50685 | 7.67E-11 | 1.40E-08 | yes |
| ENSMUSG00000004846 | Plod3 | chr5:137458033-137472518 | WT | KO | OK | 118.472 | 93.3158 | -0.344349 | 4.82793 | 1.38E-06 | 0.0001001 | yes |
| ENSMUSG00000038615 | Nfe2l1 | chr11:96678727-96691282 | WT | KO | OK | 233.315 | 184.992 | -0.334818 | 7.33636 | 2.19E-13 | 6.47E-11 | yes |
| ENSMUSG00000060938 | Rpl26 | chr11:68715084-68720491 | WT | KO | OK | 280.328 | 223.226 | -0.328609 | 5.51313 | 3.53E-08 | 3.60E-06 | yes |
| ENSMUSG00000005262 | Ufd1l | chr16:18780539-18835354 | WT | KO | OK | 75.2461 | 60.021 | -0.326149 | 4.34469 | 1.39E-05 | 0.00074669 | yes |
| ENSMUSG00000022553 | Maf1 | chr15:76181723-76184810 | WT | KO | OK | 62.3768 | 49.7916 | -0.325108 | 4.3291 | 1.50E-05 | 0.0007857 | yes |
| ENSMUSG00000001630 | Stk38l | chr6:146673516-146727334 | WT | KO | OK | 8.65731 | 6.91087 | -0.325051 | 3.27708 | 0.00104887 | 0.0283044 | yes |
| ENSMUSG00000074247 | Dda1 | chr8:73993097-74009966 | WT | KO | OK | 84.3804 | 67.4119 | -0.323905 | 3.32097 | 0.00089706 | 0.0251803 | yes |
| ENSMUSG00000061689 | Dlgap4 | chr2:156439440-156590099 | WT | KO | OK | 92.2658 | 74.056 | -0.317179 | 3.50262 | 0.00046071 | 0.0143925 | yes |
| ENSMUSG00000026927 | Sdccag3 | chr2:26237045-26244836 | WT | KO | OK | 65.0943 | 52.3958 | -0.31308 | 3.5846 | 0.00033759 | 0.0112335 | yes |
| ENSMUSG00000028101 | Pias3 | chr3:96500297-96512483 | WT | KO | OK | 33.5999 | 27.1402 | -0.308029 | 3.88195 | 0.00010362 | 0.00419456 | yes |
| ENSMUSG00000022150 | Dab2 | chr15:6249787-6390712 | WT | KO | OK | 66.1364 | 53.5269 | -0.30518 | 4.81807 | 1.45E-06 | 0.00010429 | yes |
| ENSMUSG00000034211 | Mrps17 | chr5:130221371-130224750 | WT | KO | OK | 76.5333 | 62.1951 | -0.299287 | 5.36729 | 7.99E-08 | 7.69E-06 | yes |
| ENSMUSG00000015133 | Lrrk1 | chr7:73371797-73533236 | WT | KO | OK | 38.2995 | 31.1478 | -0.298196 | 7.22412 | 5.04E-13 | 1.39E-10 | yes |
| ENSMUSG00000059851 | Suv420h2 | chr7:4691716-4699116 | WT | KO | OK | 31.0239 | 25.2454 | -0.297359 | 3.23918 | 0.00119872 | 0.0313913 | yes |
| ENSMUSG00000028959 | Fastk | chr5:23929654-23951105 | WT | KO | OK | 110.946 | 90.3375 | -0.296461 | 3.56719 | 0.00036083 | 0.0117133 | yes |
| ENSMUSG00000061559 | Wdr61 | chr9:54546679-54595757 | WT | KO | OK | 71.0191 | 58.0176 | -0.291717 | 3.10262 | 0.00191814 | 0.0442112 | yes |
| ENSMUSG00000031065 | Cdk16 | chrX:20265079-20277006 | WT | KO | OK | 125.708 | 102.71 | -0.291501 | 3.19678 | 0.00138972 | 0.0352125 | yes |
| ENSMUSG00000028973 | Abcb8 | chr5:23899480-23915872 | WT | KO | OK | 25.7534 | 21.1182 | -0.28628 | 3.86667 | 0.00011033 | 0.00441813 | yes |
| ENSMUSG00000028811 | Yars | chr4:128867003-128938648 | WT | KO | OK | 91.579 | 75.5182 | -0.278192 | 3.92564 | 8.65E-05 | 0.00364594 | yes |
| ENSMUSG00000059291 | Rpl11 | chr4:135584179-135609343 | WT | KO | OK | 283.906 | 234.559 | -0.275461 | 6.15349 | 7.58E-10 | 1.12E-07 | yes |
| ENSMUSG00000020814 | Mxra7 | chr11:116664375-116689360 | WT | KO | OK | 68.5702 | 56.8313 | -0.270895 | 3.97374 | 7.08E-05 | 0.00310031 | yes |
| ENSMUSG00000025142 | Aspscr1 | chr11:120534286-120570761 | WT | KO | OK | 86.8897 | 72.2104 | -0.266978 | 3.79618 | 0.00014694 | 0.00560615 | yes |
| ENSMUSG00000029106 | Add1 | chr5:34916312-34974957 | WT | KO | OK | 186.024 | 154.657 | -0.266412 | 3.15729 | 0.00159242 | 0.0387225 | yes |
| ENSMUSG00000047554 | Tmem41b | chr7:117115700-117130443 | WT | KO | OK | 56.4565 | 47.0502 | -0.26294 | 3.78956 | 0.00015091 | 0.00570842 | yes |
| ENSMUSG00000031392 | Irak1 | chrX:71259252-71269275 | WT | KO | OK | 110.036 | 92.0733 | -0.257123 | 3.2399 | 0.0011957 | 0.0313742 | yes |
| ENSMUSG00000029713 | Gnb2 | chr5:137923486-137981946 | WT | KO | OK | 615.239 | 514.817 | -0.257087 | 6.2861 | 3.26E-10 | 5.27E-08 | yes |
| ENSMUSG00000036241 | Ube2r2 | chr4:41082775-41140413 | WT | KO | OK | 119.654 | 100.658 | -0.249402 | 3.21313 | 0.00131299 | 0.0336536 | yes |
| ENSMUSG00000039205 | Ciz1 | chr2:32163990-32237458 | WT | KO | OK | 63.0171 | 53.5081 | -0.235985 | 3.52497 | 0.00042354 | 0.0134208 | yes |
| ENSMUSG00000022452 | 1500032L24Rik | chr15:82169371-82179521 | WT | KO | OK | 163.551 | 139.649 | -0.227936 | 3.08019 | 0.00206872 | 0.0467911 | yes |
| ENSMUSG00000022403 | St13 | chr15:81194098-81230507 | WT | KO | OK | 139.233 | 118.897 | -0.227793 | 4.63539 | 3.56E-06 | 0.00023052 | yes |
| ENSMUSG00000006476 | Nelf | chr2:24909874-24918401 | WT | KO | OK | 71.1876 | 61.3298 | -0.215038 | 3.17649 | 0.00149067 | 0.0370631 | yes |
| ENSMUSG00000028882 | Ppp1r8 | chr4:132382843-132399084 | WT | KO | OK | 50.1593 | 44.2852 | -0.179692 | 3.13901 | 0.0016952 | 0.0408015 | yes |
| ENSMUSG00000003573 | Homer3 | chr8:72806725-72826388 | WT | KO | OK | 67.6859 | 60.0766 | -0.172053 | 3.12226 | 0.0017947 | 0.0423474 | yes |
| ENSMUSG00000048537 | Phldb1 | chr9:44481315-44543281 | WT | KO | OK | 154.363 | 138.042 | -0.161216 | 3.40155 | 0.00067004 | 0.0197691 | yes |
| ENSMUSG00000018858 | Ict1 | chr11:115265065-115273988 | WT | KO | OK | 86.6078 | 81.1105 | -0.0946084 | 3.11029 | 0.00186902 | 0.043535 | yes |
| ENSMUSG00000004151 | Etv1 | chr12:39505966-39594802 | WT | KO | OK | 17.7771 | 22.0262 | 0.3092 | -3.9062 | 9.38E-05 | 0.00387981 | yes |
| ENSMUSG00000027966 | Col11a1 | chr3:113733457-113923636 | WT | KO | OK | 28.3185 | 35.1975 | 0.313728 | -3.09014 | 0.00200059 | 0.0454827 | yes |
| ENSMUSG00000032228 | Tcf12 | chr9:71692058-71959626 | WT | KO | OK | 85.8507 | 107.264 | 0.32126 | -3.2499 | 0.00115445 | 0.0304726 | yes |
| ENSMUSG00000040785 | Ttc3 | chr16:94580369-94690829 | WT | KO | OK | 93.8145 | 120.002 | 0.355181 | -4.36557 | 1.27E-05 | 0.00068711 | yes |
| ENSMUSG00000045103 | Dmd | chrX:80194208-82451480 | WT | KO | OK | 36.8998 | 47.3523 | 0.359821 | -3.09953 | 0.00193831 | 0.0445241 | yes |
| ENSMUSG00000028565 | Nfia | chr4:97234823-97868605 | WT | KO | OK | 17.7128 | 23.2651 | 0.393376 | -7.03942 | 1.93E-12 | 4.84E-10 | yes |
| ENSMUSG00000042104 | Uggt2 | chr14:119384260-119514296 | WT | KO | OK | 16.3197 | 21.5376 | 0.40024 | -3.48651 | 0.00048938 | 0.0150753 | yes |
| ENSMUSG00000027570 | Col9a3 | chr2:180332494-180377413 | WT | KO | OK | 31.3152 | 41.5847 | 0.40919 | -3.83549 | 0.00012531 | 0.00492242 | yes |
| ENSMUSG00000057738 | Spna2 | chr2:29821079-29886971 | WT | KO | OK | 318.379 | 431.433 | 0.438393 | -10.1202 | 0 | 0 | yes |
| ENSMUSG00000025665 | Rps6ka6 | chrX:108501800-108651568 | WT | KO | OK | 5.46072 | 7.46007 | 0.450099 | -3.21688 | 0.00129592 | 0.0332803 | yes |
| ENSMUSG00000009614 | Sardh | chr2:27043912-27103857 | WT | KO | OK | 35.1336 | 48.3159 | 0.459647 | -3.36453 | 0.00076674 | 0.021987 | yes |
| ENSMUSG00000001036 | Epn2 | chr11:61330750-61393187 | WT | KO | OK | 44.8173 | 61.7301 | 0.461918 | -3.13055 | 0.00174481 | 0.0416651 | yes |
| ENSMUSG00000037736 | Limch1 | chr5:67137073-67448398 | WT | KO | OK | 21.7169 | 29.957 | 0.464074 | -4.13971 | 3.48E-05 | 0.00167079 | yes |
| ENSMUSG00000041112 | Elmo1 | chr13:20182487-20698397 | WT | KO | OK | 2.39299 | 3.38393 | 0.499881 | -4.54208 | 5.57E-06 | 0.00033464 | yes |
| ENSMUSG00000026556 | Vangl2 | chr1:173931090-173958575 | WT | KO | OK | 13.5823 | 19.2285 | 0.50151 | -4.52348 | 6.08E-06 | 0.00036056 | yes |
| ENSMUSG00000039004 | Bmp6 | chr13:38436994-38620693 | WT | KO | OK | 7.9047 | 11.5872 | 0.551749 | -3.1032 | 0.00191443 | 0.044205 | yes |
| ENSMUSG00000081075 | Gm13160 | chr4:146120856-146866310 | WT | KO | OK | 15.885 | 23.5683 | 0.569185 | -3.11559 | 0.00183578 | 0.0430629 | yes |
| ENSMUSG00000048458 | 6530418L21Rik | chr3:105507516-105523760 | WT | KO | OK | 37.476 | 56.2991 | 0.587145 | -5.85163 | 4.87E-09 | 6.21E-07 | yes |
| ENSMUSG00000030647 | Ndufc2 | chr7:104548512-104556312 | WT | KO | OK | 143.207 | 217.64 | 0.603849 | -5.27572 | 1.32E-07 | 1.20E-05 | yes |
| ENSMUSG00000024238 | Zeb1 | chr18:5491500-5775465 | WT | KO | OK | 38.1109 | 58.4526 | 0.617064 | -4.17086 | 3.03E-05 | 0.00148672 | yes |
| ENSMUSG00000024590 | Lmnb1 | chr18:56867466-56913078 | WT | KO | OK | 58.123 | 89.8194 | 0.627917 | -3.1357 | 0.00171442 | 0.0410872 | yes |
| ENSMUSG00000032878 | Ccdc85a | chr11:28285684-28484324 | WT | KO | OK | 2.9296 | 4.58982 | 0.647731 | -3.4587 | 0.00054278 | 0.0165667 | yes |
| ENSMUSG00000033721 | Vav3 | chr3:109143570-109488616 | WT | KO | OK | 15.184 | 24.3589 | 0.681899 | -3.54412 | 0.00039393 | 0.0125727 | yes |
| ENSMUSG00000033214 | Slitrk5 | chr14:112074336-112082356 | WT | KO | OK | 4.6001 | 7.46305 | 0.698102 | -3.3548 | 0.00079422 | 0.0226284 | yes |
| ENSMUSG00000053062 | Jam2 | chr16:84774367-84826173 | WT | KO | OK | 41.0686 | 66.9174 | 0.704347 | -3.4527 | 0.00055501 | 0.0168519 | yes |
| ENSMUSG00000034758 | Tle6 | chr10:81053648-81063818 | WT | KO | OK | 10.0909 | 16.4981 | 0.709239 | -3.1717 | 0.0015155 | 0.0374001 | yes |
| ENSMUSG00000022200 | Golph3 | chr15:12251204-12281346 | WT | KO | OK | 58.5053 | 95.6834 | 0.7097 | -3.17097 | 0.0015193 | 0.0374245 | yes |
| ENSMUSG00000019843 | Fyn | chr10:39088660-39451813 | WT | KO | OK | 112.563 | 185.167 | 0.718097 | -10.7104 | 0 | 0 | yes |
| ENSMUSG00000049122 | Frmd3 | chr4:73659337-73848118 | WT | KO | OK | 2.40087 | 3.99962 | 0.736308 | -4.33649 | 1.45E-05 | 0.00076888 | yes |

Stem Cells and Development
Loss of NFIX transcription factor biases postnatal neural stem/progenitor cells towards oligodendrogenesis. (doi: 10.1089/scd.2015.0136)


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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENSMUSG00000003948 | Mmd | chr11:90048997-90139903 | WT | KO | OK | 14.0896 | 23.6041 | 0.744406 | -4.80627 | 1.54E-06 | 0.0001086 | yes |
| ENSMUSG00000024143 | Rhoq | chr17:87362421-87424746 | WT | KO | OK | 67.8525 | 113.995 | 0.748498 | -3.4158 | 0.00063595 | 0.0189315 | yes |
| ENSMUSG00000054555 | Adam12 | chr7:141074881-141423829 | WT | KO | OK | 35.8535 | 61.0328 | 0.767471 | -3.85288 | 0.00011674 | 0.00462663 | yes |
| ENSMUSG00000032281 | Acsbg1 | chr9:54452683-54509677 | WT | KO | OK | 63.1547 | 107.547 | 0.768012 | -3.29332 | 0.00099012 | 0.0270491 | yes |
| ENSMUSG00000043518 | Rai2 | chrX:158155000-158217428 | WT | KO | OK | 1.631 | 2.79124 | 0.775154 | -11.4997 | 0 | 0 | yes |
| ENSMUSG00000047085 | Lrrc4b | chr7:51684387-51718721 | WT | KO | OK | 19.5528 | 33.8671 | 0.792509 | -3.99185 | 6.56E-05 | 0.00289183 | yes |
| ENSMUSG00000058914 | C1qtnf3 | chr15:10882086-10909905 | WT | KO | OK | 1.93277 | 3.399 | 0.814444 | -9.03674 | 0 | 0 | yes |
| ENSMUSG00000020122 | Egfr | chr11:16652205-16818161 | WT | KO | OK | 13.8685 | 24.3919 | 0.814585 | -4.92848 | 8.29E-07 | 6.51E-05 | yes |
| ENSMUSG00000022899 | Slc15a2 | chr16:36750263-36785048 | WT | KO | OK | 19.4531 | 34.4196 | 0.823231 | -4.13139 | 3.61E-05 | 0.00172206 | yes |
| ENSMUSG00000038305 | Spats2l | chr1:57831005-58005241 | WT | KO | OK | 29.6498 | 52.4669 | 0.823385 | -5.8127 | 6.15E-09 | 7.58E-07 | yes |
| ENSMUSG00000020218 | Wif1 | chr10:120471015-120537706 | WT | KO | OK | 1.69293 | 3.04455 | 0.846711 | -3.92006 | 8.85E-05 | 0.00370778 | yes |
| ENSMUSG00000038665 | Dgki | chr6:36796021-37250184 | WT | KO | OK | 1.79305 | 3.29093 | 0.876078 | -3.20805 | 0.00133639 | 0.0341216 | yes |
| ENSMUSG00000033768 | Nrxn2 | chr19:6418730-6544899 | WT | KO | OK | 28.6906 | 52.7745 | 0.879261 | -4.86333 | 1.15E-06 | 8.76E-05 | yes |
| ENSMUSG00000027200 | Sema6d | chr2:123915704-124493506 | WT | KO | OK | 24.3696 | 44.8696 | 0.880656 | -6.73205 | 1.67E-11 | 3.42E-09 | yes |
| ENSMUSG00000050671 | Ism2 | chr12:88619587-88640655 | WT | KO | OK | 4.7837 | 8.90427 | 0.896369 | -5.78815 | 7.12E-09 | 8.59E-07 | yes |
| ENSMUSG00000032826 | Ank2 | chr3:126624524-127111949 | WT | KO | OK | 18.6751 | 34.767 | 0.896602 | -3.71907 | 0.00019995 | 0.0074364 | yes |
| ENSMUSG00000020524 | Gria1 | chr11:56824888-57143746 | WT | KO | OK | 12.3223 | 23.273 | 0.917389 | -4.0134 | 5.99E-05 | 0.0026666 | yes |
| ENSMUSG00000000202 | Btbd17 | chr11:114652530-114657259 | WT | KO | OK | 37.8563 | 71.7422 | 0.922289 | -9.90835 | 0 | 0 | yes |
| ENSMUSG00000041119 | Pde9a | chr17:31523178-31613255 | WT | KO | OK | 6.95165 | 13.2595 | 0.931597 | -4.32585 | 1.52E-05 | 0.00079423 | yes |
| ENSMUSG00000040998 | Npnt | chr3:132544708-132613255 | WT | KO | OK | 14.7287 | 28.5339 | 0.954045 | -5.9788 | 2.25E-09 | 3.11E-07 | yes |
| ENSMUSG00000060961 | Slc4a4 | chr5:89315842-89668678 | WT | KO | OK | 42.3651 | 82.462 | 0.960852 | -4.96399 | 6.91E-07 | 5.52E-05 | yes |
| ENSMUSG00000029778 | Adcyap1r1 | chr6:55401971-55451445 | WT | KO | OK | 8.91517 | 17.3857 | 0.963566 | -4.89732 | 9.72E-07 | 7.53E-05 | yes |
| ENSMUSG00000030283 | St8sia1 | chr6:142762750-142912972 | WT | KO | OK | 11.0811 | 21.6168 | 0.964054 | -4.71271 | 2.44E-06 | 0.00016407 | yes |
| ENSMUSG00000000305 | Cdh4 | chr2:179177135-179634078 | WT | KO | OK | 22.6305 | 44.2904 | 0.968727 | -4.06809 | 4.74E-05 | 0.00217759 | yes |
| ENSMUSG00000029669 | Tspan12 | chr6:21721394-21802515 | WT | KO | OK | 33.9614 | 66.637 | 0.972428 | -6.7868 | 1.15E-11 | 2.38E-09 | yes |
| ENSMUSG00000062980 | A430107O13Rik | chr6:21935907-22206404 | WT | KO | OK | 13.0006 | 25.5577 | 0.97518 | -13.9711 | 0 | 0 | yes |
| ENSMUSG00000004872 | Pax3 | chr1:78097841-78193711 | WT | KO | OK | 1.46925 | 2.94485 | 1.00311 | -3.12807 | 0.00175959 | 0.0418676 | yes |
| ENSMUSG00000037962 | Fam101a | chr5:125483816-125492917 | WT | KO | OK | 15.4572 | 31.0591 | 1.00674 | -3.51465 | 0.00044034 | 0.0138212 | yes |
| ENSMUSG00000006344 | Ggt5 | chr10:75024348-75079713 | WT | KO | OK | 1.07461 | 2.17808 | 1.01924 | -5.12733 | 2.94E-07 | 2.50E-05 | yes |
| ENSMUSG00000005360 | Slc1a3 | chr15:8584123-8660764 | WT | KO | OK | 131.201 | 265.932 | 1.01928 | -4.72225 | 2.33E-06 | 0.00015881 | yes |
| ENSMUSG00000043051 | Disc1 | chr8:127578094-127785758 | WT | KO | OK | 1.19254 | 2.43037 | 1.02714 | -3.17264 | 0.00151059 | 0.0373533 | yes |
| ENSMUSG00000054263 | Lifr | chr15:7079558-7147489 | WT | KO | OK | 1.81114 | 3.76442 | 1.05553 | -5.52129 | 3.37E-08 | 3.49E-06 | yes |
| ENSMUSG00000031700 | Gpt2 | chr8:88016474-88051459 | WT | KO | OK | 13.3197 | 27.8905 | 1.06622 | -4.8382 | 1.31E-06 | 9.66E-05 | yes |
| ENSMUSG00000056073 | Grik2 | chr10:48819265-49508572 | WT | KO | OK | 0.718114 | 1.50893 | 1.07124 | -3.21816 | 0.00129015 | 0.0331964 | yes |
| ENSMUSG00000059974 | Ntm | chr9:28802334-29770726 | WT | KO | OK | 4.65217 | 9.94663 | 1.0963 | -4.86585 | 1.14E-06 | 8.70E-05 | yes |
| ENSMUSG00000074607 | Tox2 | chr2:163028860-163149906 | WT | KO | OK | 4.96542 | 10.6587 | 1.10205 | -3.83764 | 0.00012422 | 0.0048941 | yes |
| ENSMUSG00000032649 | Glt25d2 | chr1:154246959-154357825 | WT | KO | OK | 0.507422 | 1.09147 | 1.10502 | -3.5462 | 0.00039083 | 0.0125036 | yes |
| ENSMUSG00000020431 | Adcy1 | chr11:6963491-7078509 | WT | KO | OK | 3.15797 | 6.84348 | 1.11573 | -6.35951 | 2.02E-10 | 3.40E-08 | yes |
| ENSMUSG00000051359 | Ncald | chr15:37295929-37722325 | WT | KO | OK | 7.29083 | 15.9532 | 1.12969 | -4.35717 | 1.32E-05 | 0.00071109 | yes |
| ENSMUSG00000056306 | 6030405A18Rik | chr3:54700989-54719809 | WT | KO | OK | 2.07728 | 4.55632 | 1.13317 | -3.50057 | 0.00046427 | 0.0144359 | yes |
| ENSMUSG00000030077 | Chl1 | chr6:103460869-103699671 | WT | KO | OK | 5.60697 | 12.3118 | 1.13475 | -11.1701 | 0 | 0 | yes |
| ENSMUSG00000052889 | Prkcb | chr7:129432264-129777916 | WT | KO | OK | 5.71274 | 12.6164 | 1.14304 | -5.89069 | 3.85E-09 | 4.97E-07 | yes |
| ENSMUSG00000027015 | Cybrd1 | chr2:70955979-70980983 | WT | KO | OK | 21.4725 | 47.4328 | 1.14339 | -3.38733 | 0.00070577 | 0.020777 | yes |
| ENSMUSG00000057751 | Megf6 | chr4:153544838-153649822 | WT | KO | OK | 6.80131 | 15.1033 | 1.15098 | -7.10401 | 1.21E-12 | 3.28E-10 | yes |
| ENSMUSG00000004902 | Slc25a18 | chr6:120723785-120744000 | WT | KO | OK | 31.9449 | 71.2699 | 1.15771 | -3.13828 | 0.00169942 | 0.0408015 | yes |
| ENSMUSG00000058806 | Col13a1 | chr10:61300983-61441856 | WT | KO | OK | 0.709749 | 1.58904 | 1.16278 | -4.19075 | 2.78E-05 | 0.00137743 | yes |
| ENSMUSG00000020000 | Moxd1 | chr10:23943322-24022596 | WT | KO | OK | 9.731 | 21.872 | 1.16843 | -3.17707 | 0.00148772 | 0.0370631 | yes |
| ENSMUSG00000049690 | Nckap5 | chr1:127810196-128727376 | WT | KO | OK | 1.95999 | 4.42188 | 1.17381 | -3.94443 | 8.00E-05 | 0.00342591 | yes |
| ENSMUSG00000039959 | Hip1 | chr5:135882392-136020992 | WT | KO | OK | 27.3542 | 61.8645 | 1.17735 | -3.2865 | 0.00101442 | 0.027543 | yes |
| ENSMUSG00000078816 | Prkcc | chr7:3303639-3330714 | WT | KO | OK | 0.677717 | 1.53548 | 1.17994 | -4.60621 | 4.10E-06 | 0.00025561 | yes |
| ENSMUSG00000027188 | Pamr1 | chr2:102390168-102483198 | WT | KO | OK | 11.6016 | 26.2875 | 1.18005 | -4.39524 | 1.11E-05 | 0.00061212 | yes |
| ENSMUSG00000071984 | Fndc1 | chr17:7931433-8020167 | WT | KO | OK | 2.4136 | 5.47264 | 1.18105 | -3.1127 | 0.00185382 | 0.0432568 | yes |
| ENSMUSG00000026587 | Astn1 | chr1:160292470-160621917 | WT | KO | OK | 4.25139 | 9.68749 | 1.18819 | -4.05682 | 4.97E-05 | 0.0022619 | yes |
| ENSMUSG00000022836 | Mylk | chr16:34745295-35002520 | WT | KO | OK | 4.90112 | 11.1819 | 1.18998 | -7.689 | 1.49E-14 | 4.94E-12 | yes |
| ENSMUSG00000025892 | Gria4 | chr9:4417898-4796234 | WT | KO | OK | 2.5661 | 5.89722 | 1.20046 | -9.37916 | 0 | 0 | yes |
| ENSMUSG00000054934 | Kcnmb4 | chr10:115854916-115912375 | WT | KO | OK | 7.01164 | 16.5496 | 1.23898 | -4.41762 | 9.98E-06 | 0.00056381 | yes |
| ENSMUSG00000022464 | Slc38a4 | chr15:96825253-96886387 | WT | KO | OK | 0.941963 | 2.24712 | 1.25433 | -4.55406 | 5.26E-06 | 0.00032097 | yes |
| ENSMUSG00000002266 | Zim1 | chr7:6628153-6649161 | WT | KO | OK | 0.383825 | 0.916416 | 1.25555 | -3.61479 | 0.00030059 | 0.0102069 | yes |
| ENSMUSG00000050010 | Shisa3 | chr5:67999121-68300252 | WT | KO | OK | 19.369 | 46.5688 | 1.26561 | -3.1832 | 0.00145656 | 0.0364194 | yes |
| ENSMUSG00000055653 | Gpc3 | chrX:49625602-49972224 | WT | KO | OK | 32.4744 | 78.4657 | 1.27276 | -3.30291 | 0.00095687 | 0.0263576 | yes |
| ENSMUSG00000046997 | Spsb4 | chr9:96843900-96922462 | WT | KO | OK | 9.6475 | 23.3697 | 1.27641 | -5.43424 | 5.50E-08 | 5.49E-06 | yes |
| ENSMUSG00000048022 | Tmem229a | chr6:24901140-24906297 | WT | KO | OK | 5.16776 | 12.611 | 1.28708 | -3.44688 | 0.00056711 | 0.0171124 | yes |
| ENSMUSG00000060548 | Tnfrsf19 | chr14:61582670-61665692 | WT | KO | OK | 8.99719 | 21.964 | 1.28759 | -5.29329 | 1.20E-07 | 1.11E-05 | yes |
| ENSMUSG00000068762 | Gstm6 | chr3:107741764-107772201 | WT | KO | OK | 1.39125 | 3.48348 | 1.32414 | -3.90545 | 9.40E-05 | 0.00387981 | yes |
| ENSMUSG00000028369 | Svep1 | chr4:58055313-58219731 | WT | KO | OK | 1.48692 | 3.76671 | 1.34098 | -3.24205 | 0.00118672 | 0.0312002 | yes |
| ENSMUSG00000042116 | Vwa1 | chr4:155142257-155150270 | WT | KO | OK | 8.59252 | 21.9657 | 1.3541 | -3.49365 | 0.00047647 | 0.0147805 | yes |
| ENSMUSG00000058975 | Kcnc1 | chr7:53651866-53693745 | WT | KO | OK | 7.91081 | 20.2605 | 1.35677 | -4.50087 | 6.77E-06 | 0.00039759 | yes |
| ENSMUSG00000087060 | 2810442I21Rik | chr11:16835156-16851285 | WT | KO | OK | 3.74541 | 9.73623 | 1.37824 | -7.01879 | 2.24E-12 | 5.43E-10 | yes |
| ENSMUSG00000073988 | Ttpa | chr4:19935084-19957932 | WT | KO | OK | 2.57048 | 6.70093 | 1.38233 | -4.67545 | 2.93E-06 | 0.00019538 | yes |
| ENSMUSG00000024598 | Fbn2 | chr18:58168276-58369580 | WT | KO | OK | 3.57367 | 9.35561 | 1.38843 | -3.96188 | 7.44E-05 | 0.00322651 | yes |
| ENSMUSG00000068748 | Ptprz1 | chr6:22825501-23002916 | WT | KO | OK | 48.4912 | 127.034 | 1.38942 | -3.55913 | 0.00037209 | 0.0120199 | yes |
| ENSMUSG00000035686 | Thrsp | chr7:104561447-104566240 | WT | KO | OK | 20.8859 | 55.2125 | 1.40246 | -3.67675 | 0.00023622 | 0.00838592 | yes |
| ENSMUSG00000036019 | Tmtc2 | chr10:104624718-105020930 | WT | KO | OK | 3.143 | 8.32859 | 1.40593 | -4.62463 | 3.75E-06 | 0.00023839 | yes |
| ENSMUSG00000029371 | Cxcl5 | chr5:91188324-91190651 | WT | KO | OK | 7.66782 | 20.6873 | 1.43185 | -3.93971 | 8.16E-05 | 0.00347156 | yes |
| ENSMUSG00000020297 | Nsg2 | chr11:31900462-31959202 | WT | KO | OK | 3.62242 | 9.81165 | 1.43754 | -3.37251 | 0.00074486 | 0.0215929 | yes |
| ENSMUSG00000028766 | Alpl | chr4:137297647-137352299 | WT | KO | OK | 3.65779 | 9.95229 | 1.44406 | -4.08607 | 4.39E-05 | 0.00205114 | yes |
| ENSMUSG00000026768 | Itga8 | chr2:12028258-12232927 | WT | KO | OK | 13.9955 | 38.0851 | 1.44427 | -5.52767 | 3.25E-08 | 3.39E-06 | yes |
| ENSMUSG00000021256 | Vash1 | chr12:88019649-88036630 | WT | KO | OK | 10.6941 | 29.359 | 1.45698 | -5.90725 | 3.48E-09 | 4.62E-07 | yes |
| ENSMUSG00000020037 | Rfx4 | chr10:84218792-84369281 | WT | KO | OK | 12.9015 | 35.5135 | 1.46083 | -6.85618 | 7.07E-12 | 1.57E-09 | yes |
| ENSMUSG00000079022 | Col22a1 | chr15:71626224-71864657 | WT | KO | OK | 1.30099 | 3.61136 | 1.47293 | -3.2629 | 0.00110279 | 0.0294602 | yes |
| ENSMUSG00000014773 | Dll1 | chr17:15504317-15516439 | WT | KO | OK | 2.53798 | 7.06248 | 1.4765 | -4.64281 | 3.44E-06 | 0.00022369 | yes |
| ENSMUSG00000029838 | Ptn | chr6:36665662-36761361 | WT | KO | OK | 291.05 | 814.124 | 1.48398 | -4.60036 | 4.22E-06 | 0.00026167 | yes |
| ENSMUSG00000042943 | 4922501L14Rik | chr3:154374282-154411788 | WT | KO | OK | 0.4846 | 1.3644 | 1.4934 | -3.55735 | 0.00037461 | 0.0120307 | yes |
| ENSMUSG00000005672 | Kit | chr5:75970940-76052747 | WT | KO | OK | 1.52004 | 4.30173 | 1.50081 | -3.22681 | 0.00125177 | 0.0325877 | yes |
| ENSMUSG00000026249 | Serpine2 | chr1:79790771-79855271 | WT | KO | OK | 259.526 | 740.575 | 1.51277 | -3.3716 | 0.00074734 | 0.0216175 | yes |
| ENSMUSG00000063415 | Cyp26b1 | chr6:84521937-84543740 | WT | KO | OK | 5.26484 | 15.2044 | 1.53003 | -5.828 | 5.61E-09 | 7.03E-07 | yes |
| ENSMUSG00000022762 | Ncam2 | chr16:81200941-81624530 | WT | KO | OK | 0.936446 | 2.73933 | 1.54856 | -4.81756 | 1.45E-06 | 0.00010429 | yes |
| ENSMUSG00000045994 | B3gat1 | chr9:26541312-26614053 | WT | KO | OK | 0.938 | 2.78695 | 1.57103 | -9.0286 | 0 | 0 | yes |
| ENSMUSG00000030223 | Ptpro | chr6:137200819-137413150 | WT | KO | OK | 2.16959 | 6.5246 | 1.58847 | -6.09561 | 1.09E-09 | 1.56E-07 | yes |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENSMUSG00000041731 | Pgm5 | chr19:24757505-24936345 | WT | KO | OK | 1.58241 | 4.76341 | 1.58987 | -3.95502 | 7.65E-05 | 0.00329887 | yes |
| ENSMUSG00000044548 | Dact1 | chr12:72410870-72422647 | WT | KO | OK | 4.08032 | 12.4775 | 1.61257 | -6.63219 | 3.31E-11 | 6.55E-09 | yes |
| ENSMUSG00000010064 | Slc38a3 | chr9:107552969-107569705 | WT | KO | OK | 7.18961 | 22.199 | 1.62651 | -4.39131 | 1.13E-05 | 0.00062009 | yes |
| ENSMUSG00000054342 | Kcnn4 | chr7:25155281-25170228 | WT | KO | OK | 2.74909 | 8.55622 | 1.63802 | -8.14092 | 4.44E-16 | 1.90E-13 | yes |
| ENSMUSG00000032482 | Cspg5 | chr9:110146286-110165079 | WT | KO | OK | 14.4981 | 45.8033 | 1.65959 | -4.61727 | 3.89E-06 | 0.00024466 | yes |
| ENSMUSG00000057722 | Lepr | chr4:101390008-101487959 | WT | KO | OK | 6.20504 | 19.9907 | 1.68782 | -5.30487 | 1.13E-07 | 1.05E-05 | yes |
| ENSMUSG00000004892 | Bcan | chr3:87791452-87804278 | WT | KO | OK | 18.8905 | 61.7155 | 1.70797 | -4.66517 | 3.08E-06 | 0.00020369 | yes |
| ENSMUSG00000024552 | Slc14a2 | chr18:78342882-78405833 | WT | KO | OK | 0.513722 | 1.67873 | 1.70831 | -3.17675 | 0.00148937 | 0.0370631 | yes |
| ENSMUSG00000030310 | Slc6a1 | chr6:114232628-114267516 | WT | KO | OK | 10.5072 | 34.9008 | 1.73188 | -5.36535 | 8.08E-08 | 7.72E-06 | yes |
| ENSMUSG00000021953 | Tdh | chr14:64111183-64127929 | WT | KO | OK | 0.48967 | 1.63167 | 1.73646 | -3.08927 | 0.00200652 | 0.0455393 | yes |
| ENSMUSG00000037754 | Ppp1r16b | chr2:158491133-158592070 | WT | KO | OK | 0.388525 | 1.3146 | 1.75854 | -3.59272 | 0.00032724 | 0.0109716 | yes |
| ENSMUSG00000066392 | Nrxn3 | chr12:89961319-91573375 | WT | KO | OK | 0.884878 | 3.14366 | 1.8289 | -5.09677 | 3.45E-07 | 2.92E-05 | yes |
| ENSMUSG00000074575 | Kcng1 | chr2:168085616-168107236 | WT | KO | OK | 0.305333 | 1.09786 | 1.84624 | -3.2549 | 0.00113431 | 0.0300605 | yes |
| ENSMUSG00000043631 | Ecm2 | chr13:49559395-49748124 | WT | KO | OK | 0.85403 | 3.07339 | 1.84747 | -3.6538 | 0.00025838 | 0.00898052 | yes |
| ENSMUSG00000029420 | Rimbp2 | chr5:129266275-129459237 | WT | KO | OK | 0.310669 | 1.12678 | 1.85875 | -3.11492 | 0.00183994 | 0.0430844 | yes |
| ENSMUSG00000063297 | Luzp2 | chr7:62091328-62520736 | WT | KO | OK | 5.31086 | 19.4708 | 1.87429 | -4.1053 | 4.04E-05 | 0.0019011 | yes |
| ENSMUSG00000021364 | Elovl2 | chr13:41277863-41315774 | WT | KO | OK | 1.42875 | 5.25466 | 1.87885 | -4.22763 | 2.36E-05 | 0.00118771 | yes |
| ENSMUSG00000025422 | Agap2 | chr10:126515962-126530225 | WT | KO | OK | 0.849948 | 3.20412 | 1.91448 | -3.89106 | 9.98E-05 | 0.00405234 | yes |
| ENSMUSG00000022209 | Dhrs2 | chr14:55840843-55860272 | WT | KO | OK | 0.458489 | 1.735 | 1.91998 | -3.40773 | 0.00065507 | 0.0194136 | yes |
| ENSMUSG00000063142 | Kcnma1 | chr14:24117982-24622526 | WT | KO | OK | 0.290659 | 1.1041 | 1.92547 | -5.0653 | 4.08E-07 | 3.38E-05 | yes |
| ENSMUSG00000039899 | Fgl2 | chr5:20798778-20930495 | WT | KO | OK | 0.792439 | 3.0266 | 1.93332 | -3.79852 | 0.00014557 | 0.00557462 | yes |
| ENSMUSG00000003949 | Hlf | chr11:90197848-90252231 | WT | KO | OK | 3.08462 | 12.0895 | 1.9706 | -5.7631 | 8.26E-09 | 9.88E-07 | yes |
| ENSMUSG00000029189 | Sel1l3 | chr5:53498322-53604691 | WT | KO | OK | 1.0868 | 4.27076 | 1.97441 | -4.07332 | 4.63E-05 | 0.00214411 | yes |
| ENSMUSG00000050840 | Cdh20 | chr1:106665105-106892058 | WT | KO | OK | 3.21098 | 12.864 | 2.00225 | -4.93763 | 7.91E-07 | 6.25E-05 | yes |
| ENSMUSG00000030307 | Slc6a11 | chr6:114081234-114199880 | WT | KO | OK | 3.91905 | 16.8443 | 2.10368 | -5.24722 | 1.54E-07 | 1.39E-05 | yes |
| ENSMUSG00000028753 | Vwa5b1 | chr4:138121274-138191799 | WT | KO | OK | 0.390943 | 1.74029 | 2.1543 | -3.09329 | 0.00197948 | 0.0452969 | yes |
| ENSMUSG00000068735 | Trp53i11 | chr2:93027704-93041916 | WT | KO | OK | 19.0869 | 84.9692 | 2.15436 | -10.5464 | 0 | 0 | yes |
| ENSMUSG00000020723 | Cacng4 | chr11:107593670-107657296 | WT | KO | OK | 0.709275 | 3.20953 | 2.17795 | -3.68335 | 0.00023019 | 0.0082156 | yes |
| ENSMUSG00000001260 | Gabrg1 | chr5:71142285-71233856 | WT | KO | OK | 1.53046 | 7.0776 | 2.2093 | -7.04222 | 1.89E-12 | 4.83E-10 | yes |
| ENSMUSG00000034177 | Rnf43 | chr11:87476223-87549041 | WT | KO | OK | 0.422548 | 1.99674 | 2.24046 | -3.16435 | 0.0015543 | 0.0381451 | yes |
| ENSMUSG00000050272 | Dscam | chr16:96813685-97392359 | WT | KO | OK | 0.171379 | 0.85273 | 2.3149 | -4.04574 | 5.22E-05 | 0.00235543 | yes |
| ENSMUSG00000004633 | Chn2 | chr6:53989547-54453762 | WT | KO | OK | 1.0234 | 5.35962 | 2.38876 | -6.52487 | 6.81E-11 | 1.27E-08 | yes |
| ENSMUSG00000085541 | Gm16010 | chr9:96843900-96922462 | WT | KO | OK | 0.660945 | 3.46629 | 2.39079 | -3.67333 | 0.00023941 | 0.00847638 | yes |
| ENSMUSG00000046178 | Nxph1 | chr6:8898430-9199032 | WT | KO | OK | 1.11762 | 5.86709 | 2.39222 | -9.06538 | 0 | 0 | yes |
| ENSMUSG00000036218 | Pdzrn4 | chr15:92227345-92602250 | WT | KO | OK | 0.753059 | 3.99602 | 2.40773 | -4.86903 | 1.12E-06 | 8.61E-05 | yes |
| ENSMUSG00000058145 | Adamts17 | chr7:73984620-74297511 | WT | KO | OK | 0.170763 | 0.925145 | 2.43769 | -3.12614 | 0.00177117 | 0.0420676 | yes |
| ENSMUSG00000070644 | Etnk2 | chr1:135260148-135276913 | WT | KO | OK | 0.335881 | 1.82751 | 2.44386 | -3.45655 | 0.00054714 | 0.0166614 | yes |
| ENSMUSG00000049583 | Grm5 | chr7:94750951-95283417 | WT | KO | OK | 1.95371 | 10.6326 | 2.44421 | -10.1038 | 0 | 0 | yes |
| ENSMUSG00000036422 | Pcdh8 | chr14:80166586-80171119 | WT | KO | OK | 0.681019 | 3.71757 | 2.44859 | -4.53684 | 5.71E-06 | 0.00033998 | yes |
| ENSMUSG00000028341 | Nr4a3 | chr4:48058024-48099319 | WT | KO | OK | 0.549447 | 3.04414 | 2.46998 | -6.27919 | 3.40E-10 | 5.44E-08 | yes |
| ENSMUSG00000003436 | Dll3 | chr7:29076672-29087257 | WT | KO | OK | 0.605482 | 3.40539 | 2.49167 | -4.95735 | 7.15E-07 | 5.68E-05 | yes |
| ENSMUSG00000041261 | Car8 | chr4:8068639-8166188 | WT | KO | OK | 2.11281 | 12.3011 | 2.54155 | -5.83253 | 5.46E-09 | 6.90E-07 | yes |
| ENSMUSG00000004031 | Fam5b | chr1:160175401-160286391 | WT | KO | OK | 0.546407 | 3.20196 | 2.55091 | -4.9158 | 8.84E-07 | 6.91E-05 | yes |
| ENSMUSG00000019906 | Lin7a | chr10:106708898-106862199 | WT | KO | OK | 0.45736 | 2.68096 | 2.55135 | -4.89662 | 9.75E-07 | 7.53E-05 | yes |
| ENSMUSG00000058665 | En1 | chr1:122499063-122504568 | WT | KO | OK | 0.335584 | 1.97272 | 2.55544 | -3.70104 | 0.00021472 | 0.0078751 | yes |
| ENSMUSG00000031803 | B3gnt3 | chr8:74214654-74225688 | WT | KO | OK | 0.115312 | 0.703388 | 2.60878 | -3.65818 | 0.00025401 | 0.008875 | yes |
| ENSMUSG00000057897 | Camk2b | chr11:5869646-5966365 | WT | KO | OK | 3.055 | 19.9956 | 2.71044 | -11.6202 | 0 | 0 | yes |
| ENSMUSG00000028736 | Pax7 | chr4:139292976-139388883 | WT | KO | OK | 0.122739 | 0.831778 | 2.7606 | -3.97621 | 7.00E-05 | 0.00307848 | yes |
| ENSMUSG00000036699 | Zcchc12 | chrX:33735898-33739153 | WT | KO | OK | 0.980385 | 6.92268 | 2.81991 | -10.6176 | 0 | 0 | yes |
| ENSMUSG00000038156 | Spon1 | chr7:120909511-121186884 | WT | KO | OK | 1.38648 | 10.4666 | 2.91629 | -7.01801 | 2.25E-12 | 5.43E-10 | yes |
| ENSMUSG00000040610 | Tlx3 | chr11:33100753-33103541 | WT | KO | OK | 0.131981 | 1.04008 | 2.9783 | -3.30654 | 0.00094455 | 0.0262704 | yes |
| ENSMUSG00000073945 | Olfr618 | chr7:110745831-110746788 | WT | KO | OK | 0.233024 | 1.83856 | 2.98003 | -3.68805 | 0.00022598 | 0.0081538 | yes |
| ENSMUSG00000032269 | Htr3a | chr9:48707318-48719204 | WT | KO | OK | 0.245273 | 2.14748 | 3.13018 | -4.53872 | 5.66E-06 | 0.00033848 | yes |
| ENSMUSG00000039095 | En2 | chr5:28492235-28498706 | WT | KO | OK | 1.0206 | 9.47003 | 3.21395 | -6.0999 | 1.06E-09 | 1.53E-07 | yes |
| ENSMUSG00000044681 | Cnpy1 | chr5:28527358-28572332 | WT | KO | OK | 1.46598 | 14.1754 | 3.27344 | -9.12525 | 0 | 0 | yes |
| ENSMUSG00000013523 | Bcas1 | chr2:170172490-170253345 | WT | KO | OK | 1.39028 | 13.9856 | 3.3305 | -11.2238 | 0 | 0 | yes |
| ENSMUSG00000036578 | Fxyd7 | chr7:31827535-31836481 | WT | KO | OK | 0.302555 | 3.66888 | 3.60007 | -4.57986 | 4.65E-06 | 0.00028733 | yes |
| ENSMUSG00000027559 | Car3 | chr3:14863537-14872351 | WT | KO | OK | 1.7894 | 21.7165 | 3.60124 | -6.92488 | 4.36E-12 | 1.03E-09 | yes |
| ENSMUSG00000003411 | Rab3b | chr4:108551667-108644682 | WT | KO | OK | 1.50296 | 18.3564 | 3.61041 | -8.58342 | 0 | 0 | yes |
| ENSMUSG00000074252 | Gm10654 | chr8:73455303-73456936 | WT | KO | OK | 0.0354664 | 0.887273 | 4.64485 | -3.15432 | 0.00160872 | 0.0389813 | yes |
| ENSMUSG00000091345 | AC119951.1 | chr9:105758399-105862974 | WT | KO | OK | 0.080365 | 3.0779 | 5.25924 | -7.95417 | 1.78E-15 | 6.74E-13 | yes |
| ENSMUSG00000026247 | Ecel1 | chr1:89044229-89053096 | WT | KO | OK | 0.472969 | 0 | -1.79769e+308 | -1.79769e+3( | 0.00157675 | 0.0384825 | yes |