Supplementary Figure legends

Supplementary Figure 1. A normal expression of *TrkA*, *alpha-CGRP*, and *Ret* in IB4$^+$ neurons in *446/446* mice. Double staining of IB4 (green) and the mRNAs (red) of *TrkA*, *alpha-CGRP* and *Ret* on sections through thoracic DRG of P30 wild type and *446/446* mice. Note that expression of *TrkA* was virtually not expressed in IB4$^+$ neurons in both wild-type and *446/446* mice (A, B). Similarly, only a very small fraction of IB4$^+$ neurons showed an elevated expression of *alpha-CGRP* in both wild-type and *446/446* mice (C, D, arrows). Finally, quantitative analysis showed that over 90% of IB4$^+$ neurons expressed Ret in both wild-type and *446/446* mice (E, F, arrows). Therefore, deletion of the C-terminal repression domain does not affect the expression of *TrkA*, *alpha-CGRP*, and Ret.

Supplementary Figure 2. Normal expression of nociceptive ion channels and receptors in *446/446* mice. In situ hybridizations were performed on sections through thoracic DRG of P30 wild-type and *446/446* mice. Note that expression of nociceptive ion channels and receptors did not exhibit obvious changes between wild-type and *446/446* mice, including *TRPA1, TRPM8, TRPC3, Nav1.9* and *P2X3*. Therefore, Runx1 C-terminal repression domain is not required for Runx1-mediated activation of these sensory channels/receptors.

Supplementary Figure 3. Expansion of *MrgA3* and *MrgB4* expression in L4/L5 lumbar IB4$^+$ neurons in *446/446* mice. (A-D) Double staining of IB4 (A-D, green) and *MrgA3* mRNA (A, B, red) or *MrgB4* mRNA (C, D, red) on sections through L4/L5 lumbar DRG of P30 wild-type and *446/446* mice. Note that in wild type mice, *MrgA3* was expressed

in both IB4$^+$ (A, arrow) and IB4$^-$ (A, arrowhead) neurons, whereas *MrgB4* was expressed only in IB4$^+$ neurons (C, arrow), as the case seen in thoracic DRG in Fig. 7. In *446/ 446* mice, expression of both *MrgA3* and *MrgB4* was markedly expanded in IB4$^+$ neurons (B, D, arrows). (E) shows the quantitative data. The percentage of IB4$^+$ neurons in L4/L5 lumbar DRG that express *MrgA3* increased from 8.0 ± 2.5% in wild type mice to 46.1 ± 4.7% in *446/ 446* mice (*, $p < 0.006$), and *MrgB4*$^+$ neurons increased from 9.1 ± 1.6% to 40.0 ± 10.2% (**, $p < 0.02$). The net increase of *MrgA3* expression in the IB4$^+$ neurons in lumbar DRG (by 46.1-8.0=38.1%) is considerablly smaller than that in thoracic DRG (by 74.7-8.2=65.5%, see Fig. 7). In contrast, the net increase of *MrgB4* expression within IB4$^+$ neurons is comparable between lumbar DRG (by 40.0-9.1=30.9%) and thoracic DRG (by 37.4-6.9=30.5%), reinforcing the idea that expression of *MrgA3* and *MrgB4* is independently controlled.

Supplementary Figure 4. Smad4-mediated signaling is required for the expression of *MrgB4*. Mice that carried a Smad4 conditional null allele or *Smad4*^{F} were crossed with *SNS-Cre* mice, in which the *Cre* gene is expressed in most small diameter sensory neurons, where *Mrg* gene expression is detected, and Cre activity is detected around E17 (Agarwal et al., 2004). We found that in *Smad4*$^{F/F}$*; SNS-Cre* conditional null mice, expression of *MrgB4* is absent in T12 thoracic DRG at P4 and P30 (A-D), suggesting that *Smad4* is required for the establishment of *MrgB4* expression or for the survival of prospective *MrgB4*$^+$ neurons. Expression of *MrgA3*, *MrgC11*, *MrgD*, and other Runx1-dependent nociceptive ion channels/receptors was not affected in *Smad4*$^{F/F}$*;SNS-Cre* conditional null mice (E-J; data not shown), implying a quite specific role of Smad4-mediated signaling in controlling *MrgB4* expression.