

## Supplementary Information

### Supplementary Figure 1. Expression of JMJD2B in interneuron

(a) *In situ* hybridization for *Jmjd2b* mRNA, followed by immunostaining for GAD67 (n=1) (b) (Right) *In situ* hybridization for *Jmjd2b* mRNA in the brain at embryonic days 13 mouse (Left) Magnified image of medial ganglionic eminence. (n=1) Scale bars; (a) 20 $\mu$ m, (b) 200 $\mu$ m (Left) 80 $\mu$ m (Right)

### Supplementary Figure 2. The expression of PSD95 in hippocampus

The expression of PSD95 was not changed between the genotypes (WT: n=3, KO: n=3)

### Supplementary Figure 3. Structure and number of spines in somatosensory cortex

(a) The percentage of mushroom, filopodia, thin, and stubby spines of dendrites in somatosensory cortex (b) The number of spines in somatosensory cortex between the genotypes. (WT, KO: n=3) n.s., not significant. Error bars represent s.e.m.

### Supplementary Figure 4. Mossy fiber morphology observed by Timm staining

The morphology of mossy fibers appears to be normal in JMJD2B mutant mice. WT, wild-type mice; KO, JMJD2B mutant mice. (WT: n=3, KO: n=3) Scale Bar: 100  $\mu$ m.

### Supplementary Figure 5. The results of additional behavioral tests

(a) The results of the elevated plus maze test to examine anxiety. The graph shows the ratio of the time in open arm to total time. (WT: n=13 KO: n=11) (b) The results of the pre-pulse inhibition test. The graph shows the pre-pulse inhibition rate at various pre-pulse volumes. (WT: n=10 KO: n=11) (c) The results of forced swim test to assess depression-like behavior.. The graph shows immobility time per trial. (WT: n=12 KO: n=11) (d) (Left) Time schedule of

the rhythm test. (Right) The graph shows the ratio of activity in the dark phase to total activity. (WT: n=8 KO: n=8) \*,  $P < 0.05$ ; \*\*, n.s., not significant. Error bars represent s.e.m.

**Supplementary Figure 6. The expression of Homer2, Rhob, and Rhog in hippocampus**

(a,b,c) The expression of Homer2, Rhob and Rhog in hippocampus was not changed between the genotypes. (WT: n=3 KO: n=3) n.s., not significant. Error bars represent s.e.m.

**Supplementary Table 1. Time schedule of behavioral test battery**

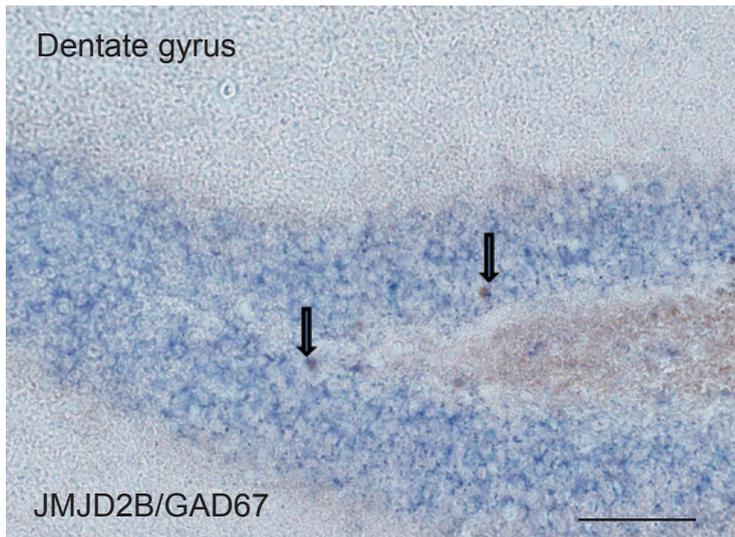
Each test was performed after an interval of at least 3 days from the previous test.

**Supplementary Table 2. The results of SHIRPA test**

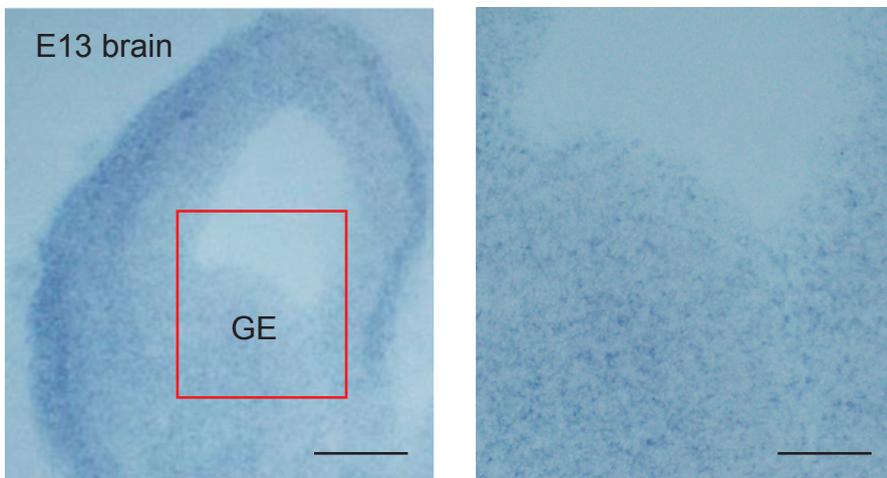
The table shows the contents of SHIRPA test and the difference between genotypes. (WT: n=13 KO: n=11) (n.s., not significant)

Supplementary figure 1

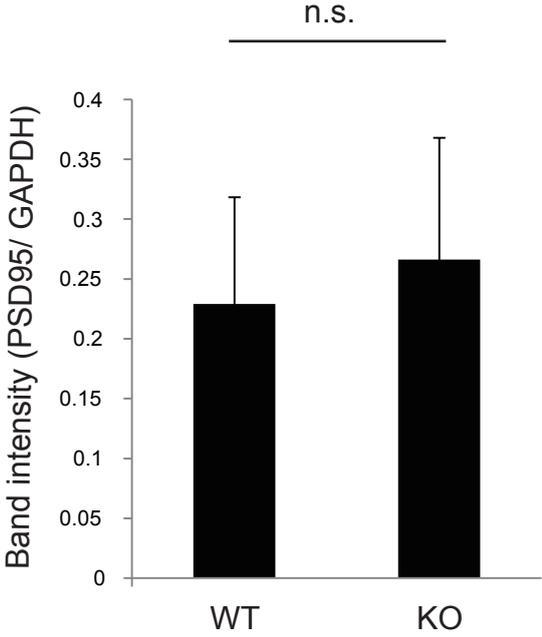
a



b

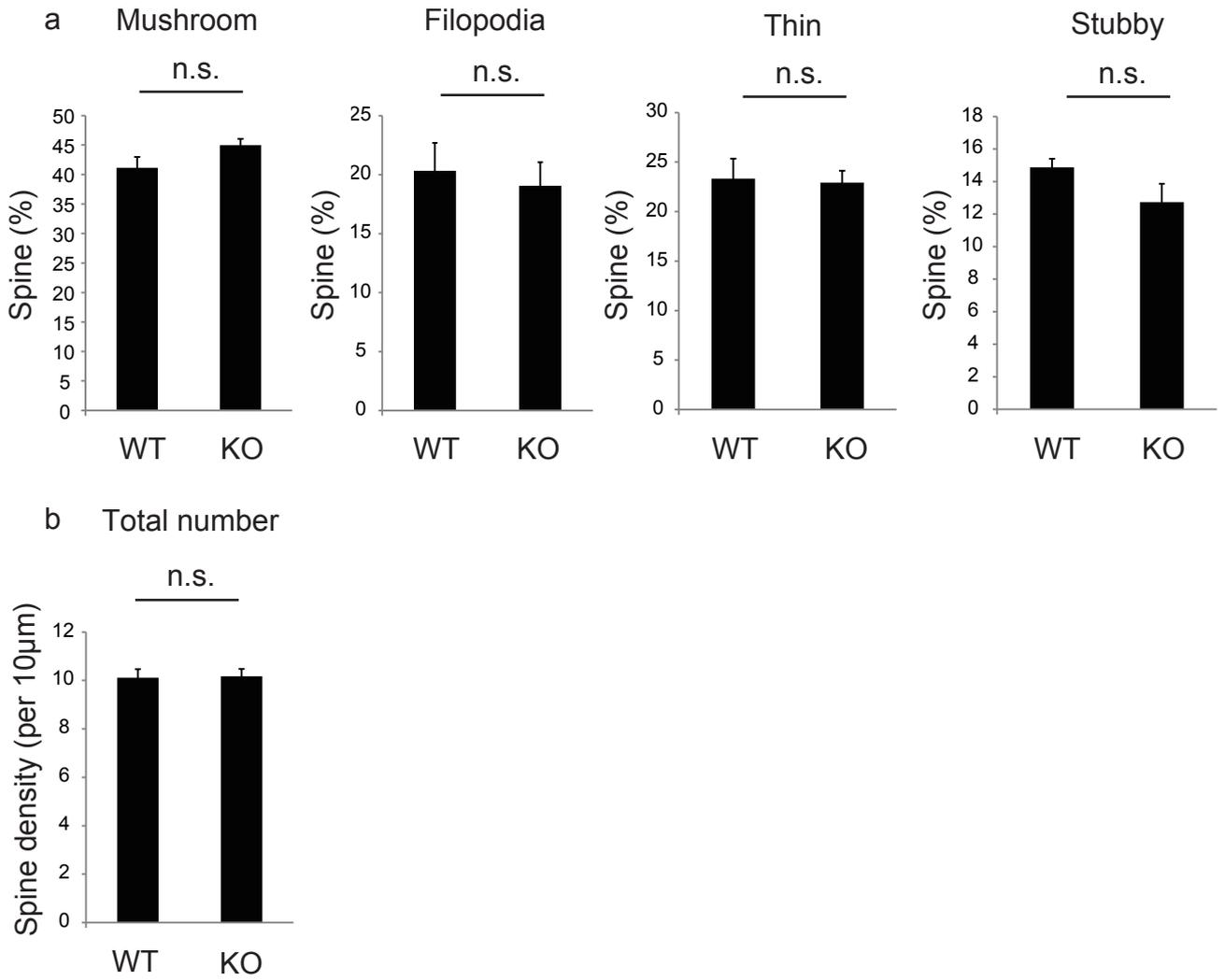


Supplementary Figure 2



# Supplementary Figure 3

## Cortex



## Supplementary Figure 4

WT

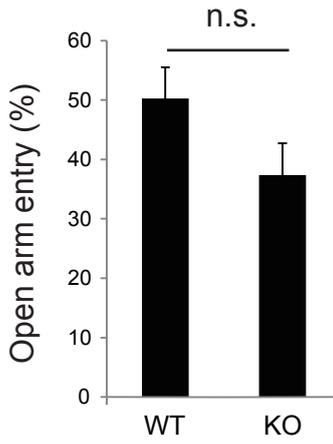


KO

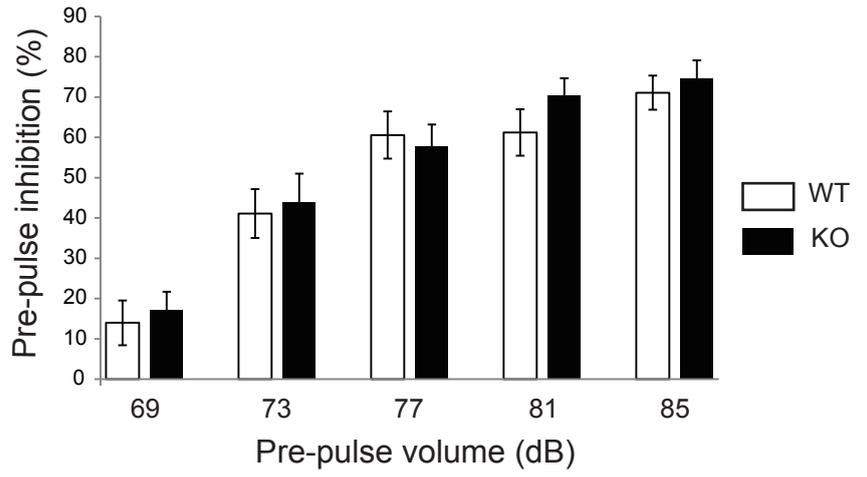


# Supplementary Figure 5

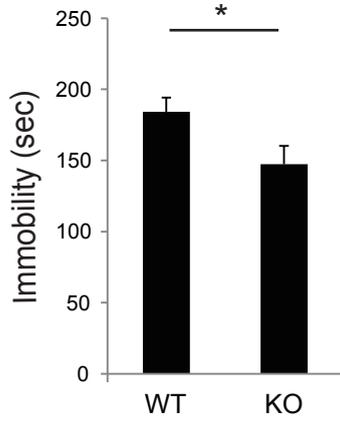
## a Elevated plus maze



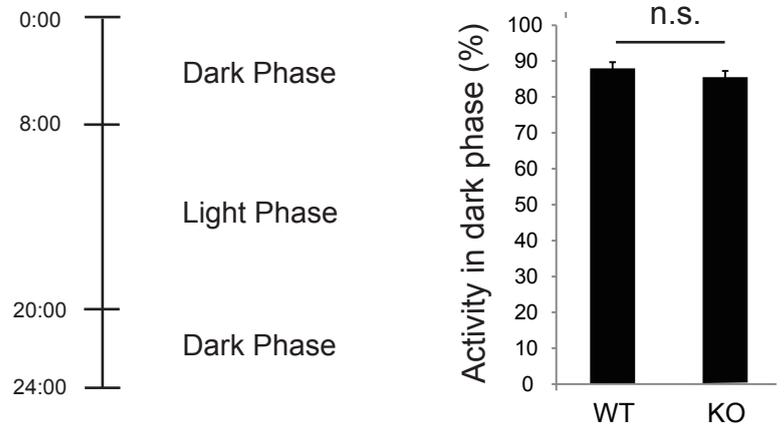
## b Pre-pulse inhibition



## c Forced swim



## d Rhythm



Supplementary Figure 6

