An Aetiological *Foxp2* Mutation Causes Aberrant Striatal Activity and Alters Plasticity during Skill Learning

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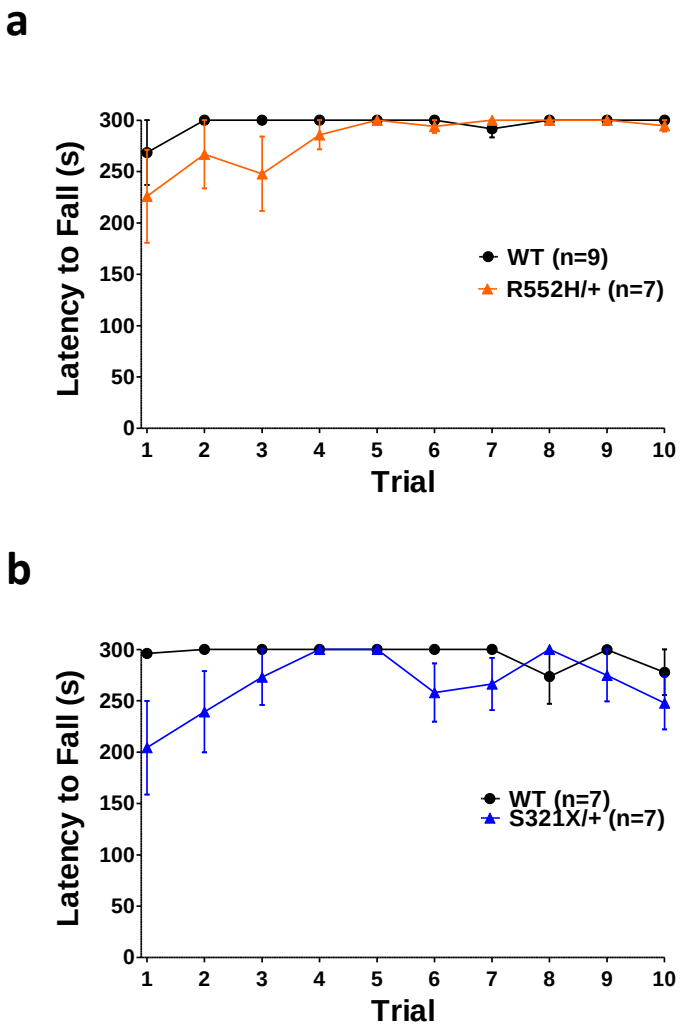
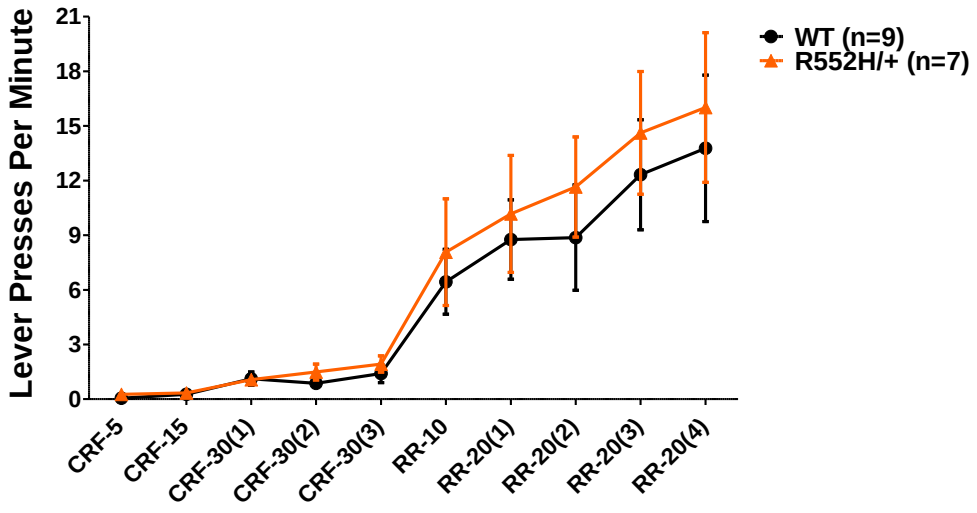


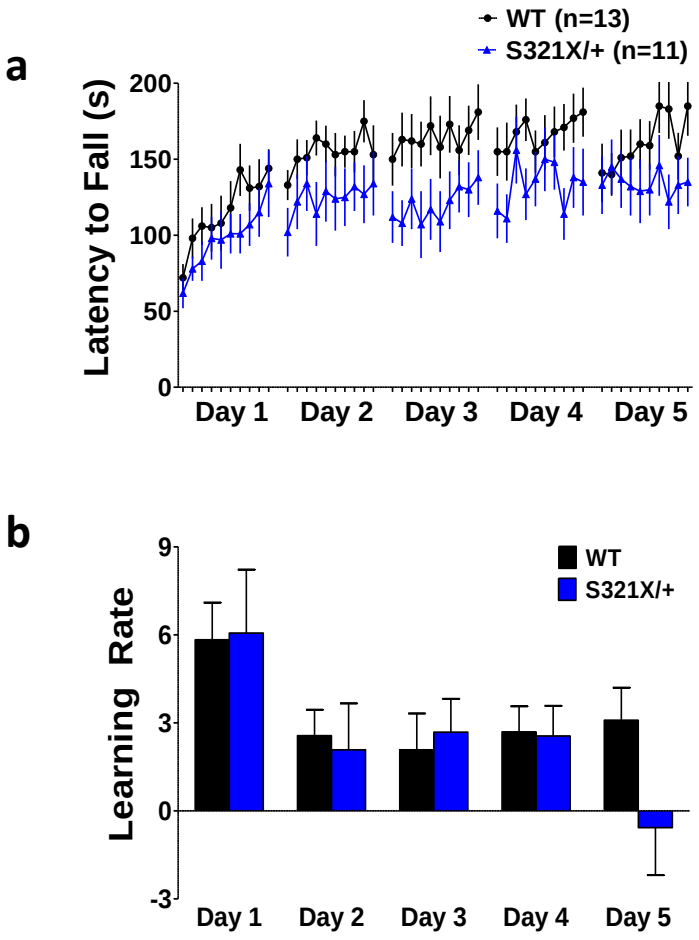
Supplementary Figure 1 Motor coordination analysis. *Foxp2-R552H/+* **(a)** and *Foxp2-S321X/+* **(b)** mice were run at a constant speed on a rat rotarod (ENV-575, Med-Associates), where the larger rod allows animals to run in an almost horizontal position reducing the difficulty of the task. Animals received 10 trials in a single day and ran at a fixed speed of 8 rpm until they fell or 300s time elapsed. No significant differences in performance were seen between *Foxp2-R552H/+* or *Foxp2-S321X/+* and their respective littermate controls (*post hoc* $P > 0.05$, trials 1-10). Error bars represent s.e.m.



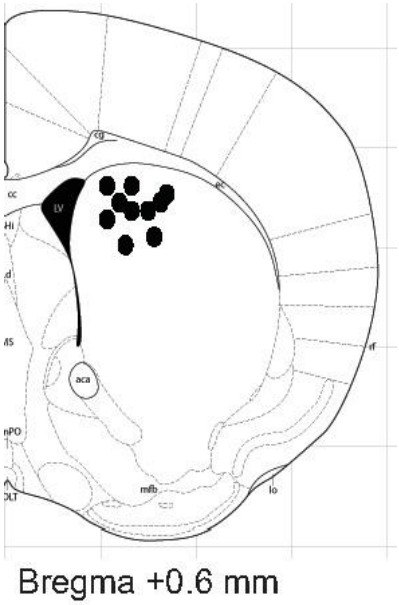
Supplementary Figure 2 Operant learning task. Animals were trained in sound attenuated operant chambers (Med-Associates, St. Albans, VT) with one extended lever positioned next to a food magazine. Pellets or 20µl volumes of 10% sucrose solution were delivered to the magazine via a pellet dispenser or a dipper. Mice were placed on a food deprivation schedule the day before training commenced, and maintained 85-90% of their original body weight throughout the experiment. Training was by the following schedule:

Magazine Entry – 30 reinforcers were delivered at random (on average 1 per min). These data are not displayed on the above graph.
CRF (continuous reinforcement) – animals obtained a reinforcer for each lever press. Sessions lasted for 90 mins or until mice received 5, 15 or 30 reinforcers.
RR (random ratio) – animals obtained a reinforcer after on average 10 or 20 lever presses. Sessions lasted for 90 mins or until mice received 30 reinforcers.

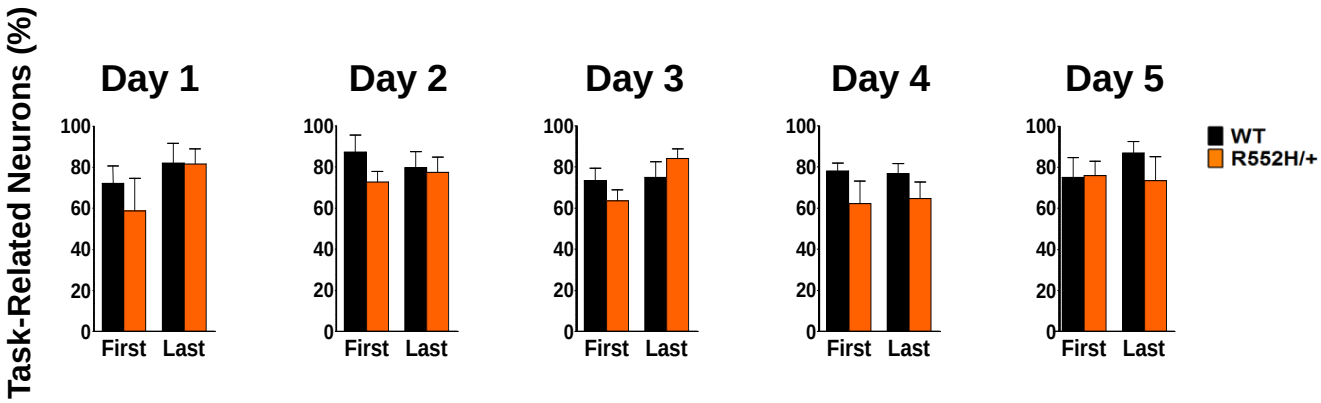
There was no significant difference in ability to acquire the task between *Foxp2-R552H/+* and wild-type controls ($F_{1,14} = 0.33$, $P > 0.05$). Error bars represent s.e.m.



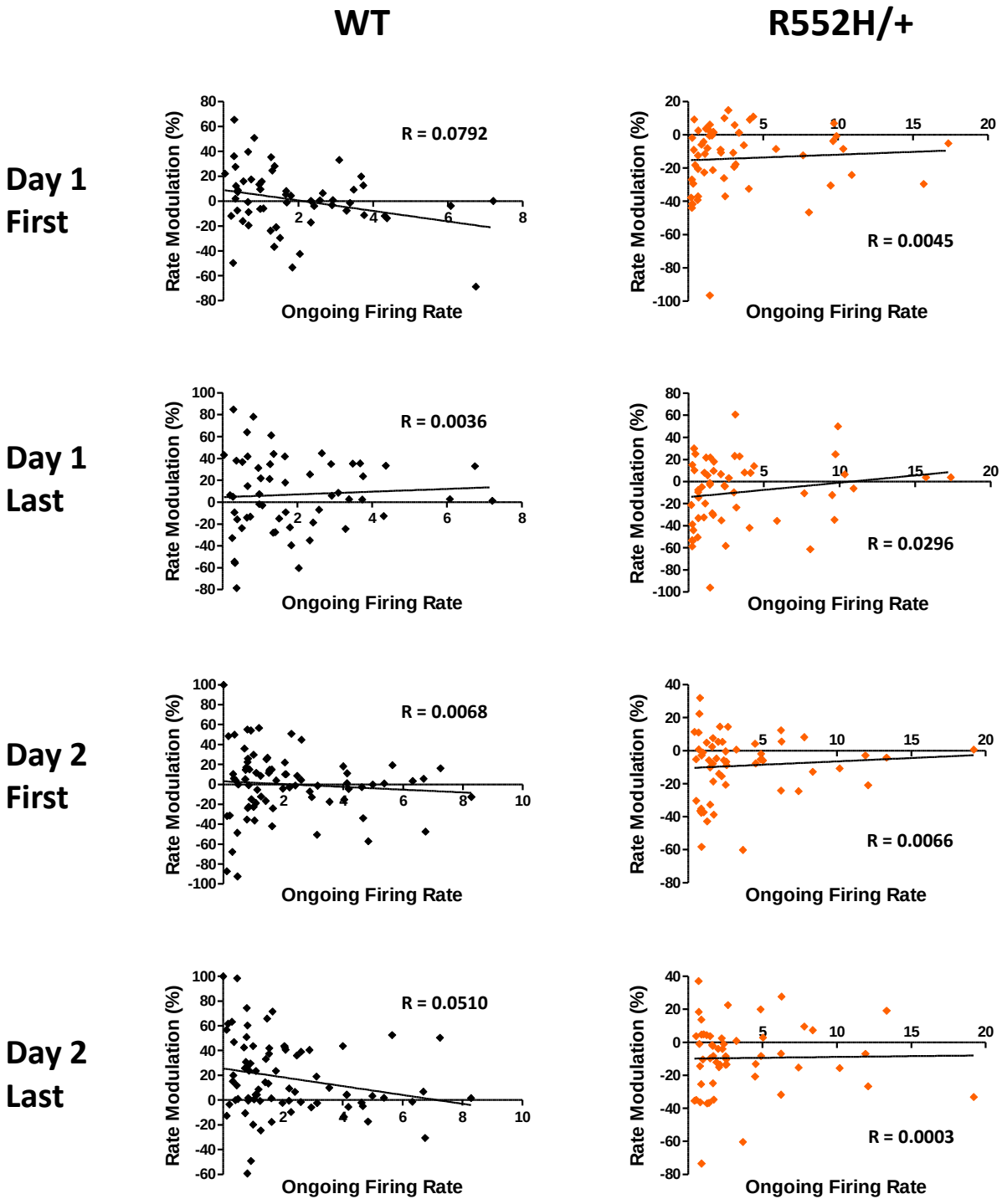
Supplementary Figure 3 Performance of *Foxp2-S321X/+* mice on the accelerating rotarod. **(a)** Latency to fall of wild-type and *Foxp2-S321X/+* mice during training; although there was a tendency for *Foxp2-S321X/+* mice to fall earlier there was no significant difference between genotypes ($F_{1,22} = 3.09$, $P > 0.05$) **(b)** Rate of learning in wild-type and *Foxp2-S321X/+* mice. No significant difference in learning rate was observed between genotypes (*post hoc* $P > 0.05$, days 1-5). Error bars represent s.e.m.



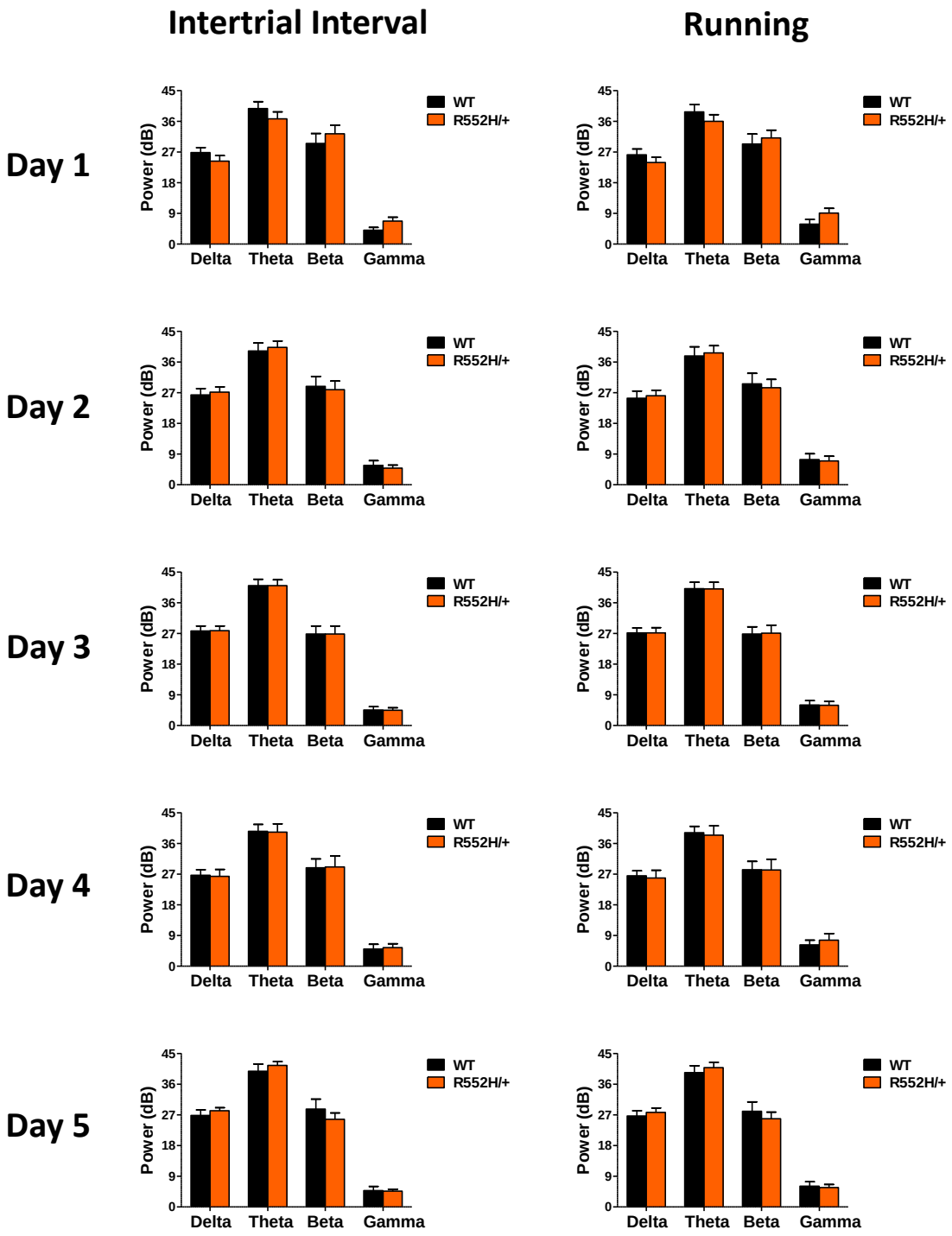
Supplementary Figure 4 Example locations of the multielectrode arrays. Diagram depicting the position of the tips of the multi-electrode arrays implanted in the dorsomedial striatum of wild-type and *Foxp2-R552H/+* mice.



Supplementary Figure 5 Percentage of neurons exhibiting task-related activity. Proportion of cells showing a significant change in firing rate between intertrial intervals and running, during the first and last trials of a session, in wild-type and *Foxp2-R552H/+* mice. No significant difference between genotypes was observed ($F_{1,9} = 0.98$, $P > 0.05$). Error bars represent s.e.m.

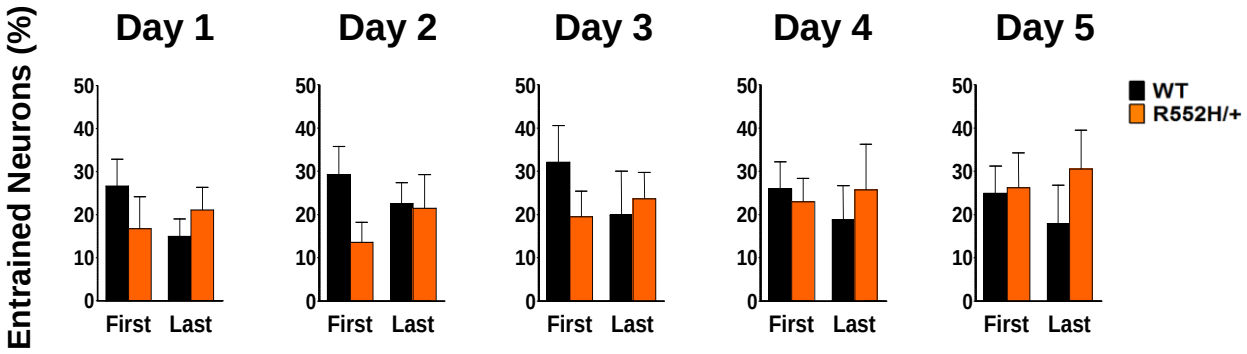


Supplementary Figure 6 Relationship between ongoing firing rate and modulation of firing rate during running. Plots of ongoing firing rate against firing rate modulation during running in wild-type and *Foxp2-R552H/+* mice. Data are shown for the first and last trials of days 1 and 2 when modulation of firing rate was greatest.

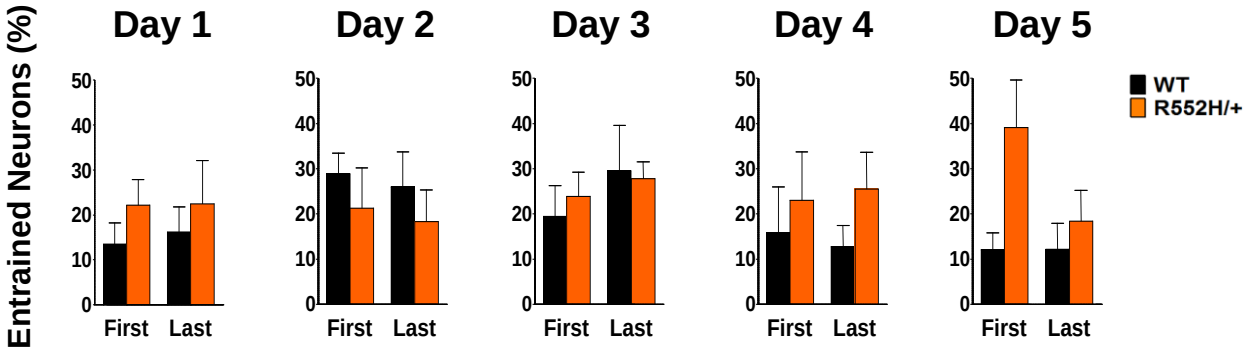


Supplementary Figure 7 Local field potential analyses. Power (dB) of the delta, theta, beta and gamma frequency oscillations of the LFP in wild-type and *Foxp2-R552H/+* mice. Error bars represent s.e.m.

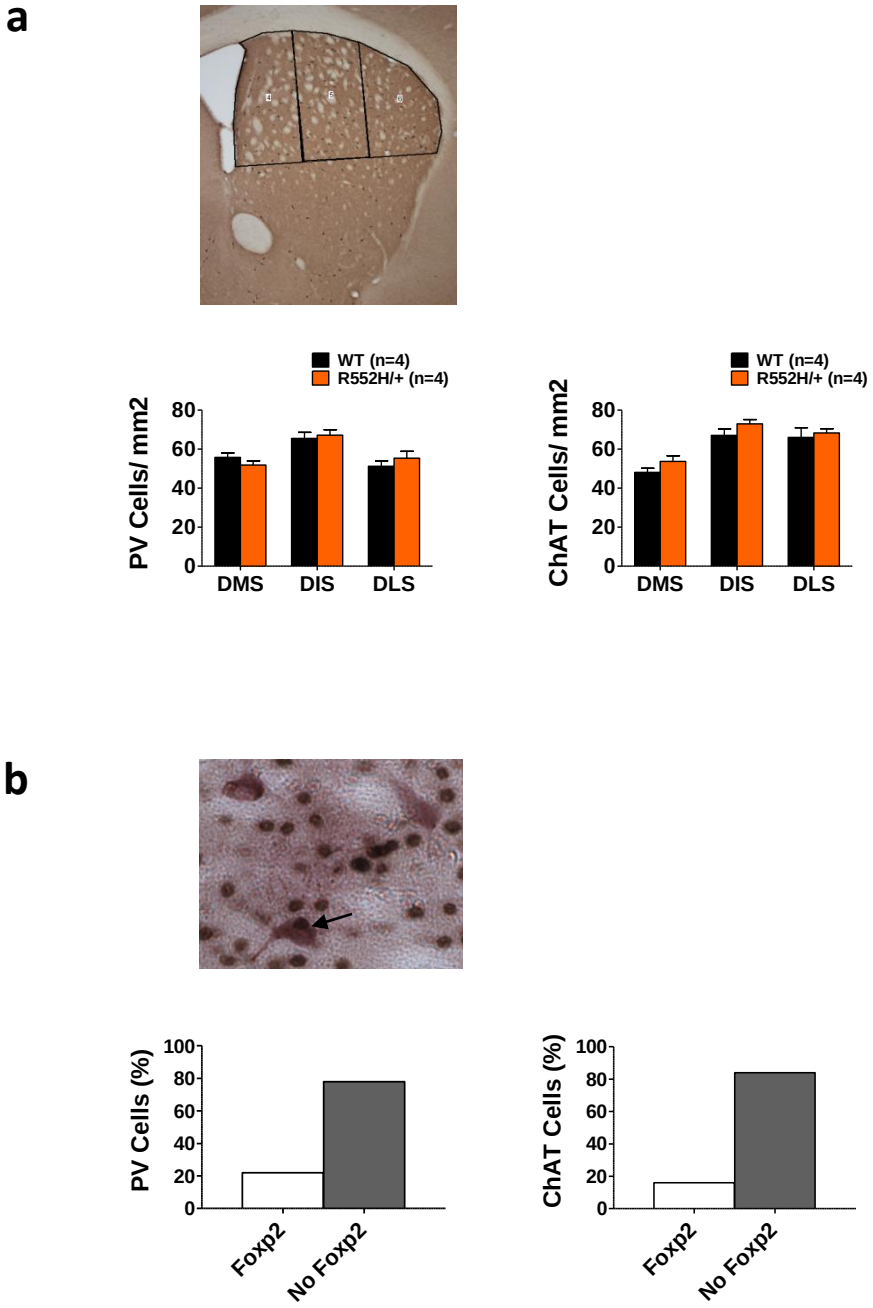
Intertrial Interval



Running



Supplementary Figure 8 Analyses of the temporal relationship between the firing of individual striatal cells and the oscillatory phase of the LFP. Entrainment of neurons to the LFP during intertrial intervals (top) and running (bottom), during the first and last trials of a session, in wild-type and *Foxp2-R552H/+* mice. Error bars represent s.e.m.



Supplementary Figure 9 Histology and cell counts of striatal interneurons**. (a)** Top panel: example of a ChAT stained section divided into dorsomedial (DMS), dorsointermediate (DIS) and dorsolateral (DLS) striatal regions in preparation for cell counting. Bottom panel: number of (left) PV and (right) ChAT positive cells in the DMS, DIS and DLS of wild-type and *Foxp2-R552H/+* mice. **(b)** Top panel: example of a section stained for Foxp2 (brown) and ChAT (purple). The arrow indicates a cell in which both proteins are expressed. Bottom panel: co-localisation of (left) PV or (right) ChAT positive cells with Foxp2 positive cells in wild-type mice. 424 and 466 PV and ChAT cells were counted respectively. Error bars represent s.e.m.