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Deletion of $\beta 2^*$ nicotinic acetylcholine receptors in striatal GABAergic interneurons alters behavior of conditional knockout mice.

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The importance of the striatum in the control of behavior and cognition has been extensively studied, but little is known about the functional role of nicotinic acetylcholine receptors (nAChRs) expressed by striatal GABAergic interneurons (GABA_{IN}s). The striatal medium spiny projecting neurons (MSNs) express only very low levels of nAChRs, hence the vast majority of nAChRs expressed by striatal neurons is represented by nAChRs on striatal interneurons, either cholinergic (CINs) or GABAergic. We hypothesize that acetylcholine released by CINs activates nAChRs expressed by GABA_{IN}s and that this activation is important for modulating striatal-based behavior.

To determine the function of nAChRs expressed by GABA_{IN}s, we deleted beta2 nicotinic subunit by injecting Cre-expressing AAV viral vector into the dorsal striatum of beta2-flox/flox mice. These mice were tested in a battery of behavioral tasks focused on striatal-based behavior including open field test, social preference test and response learning in the cross-maze and the operant box. In addition, neuronal activity markers were evaluated by immunohistochemistry to see if the beta2 deletion in GABA_{IN}s led to changes in activation/inhibition balance in the striatum.

Successful deletion of beta2 nicotinic subunit in virus-transduced cells was confirmed by RT-qPCR. By immunofluorescence and RNA-scope, we further assessed that the deletion was limited to the striatum and the viral vector was not retrogradely transported to other brain regions. Mice with deletion of beta2* nAChRs showed hyperactivity and increased anxiety in the open field, less social interaction in the social preference test and impaired response learning in the T-maze. Furthermore, mutant mice were more responsive to the stimulant drug amphetamine, showing both hyperactivity and higher c-Fos expression in the dorsal striatum.

We conclude that beta2* nAChRs expressed by striatal interneurons are important for controlling striatal-based behavior including locomotor activity and learning. However, the exact mechanisms involved in this control are not clear and they need to be further investigated.

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