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2. Title
   Mechanisms Underlying a Novel Effect on Pyramidal Neurons in Medial Prefrontal Cortex

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4. Summary
   In this study, we have elucidated neural mechanisms underlying Nic-induced enhancement of object recognition memory. Electrophysiological recordings using brain slices revealed that bath application of Nic persistently increased firing activity of mPFC layer V pyramidal neurons, which was mediated by intracellular Ca^{2+} influx via stimulation of α4β2 and α7 nAChRs and the subsequent inhibition of Kv7 channels. Nic also enhanced the summation of excitatory synaptic inputs to layer V pyramidal neurons via inhibition of Kv4.3 channels. Using the NOR combined with chemogenetic and optogenetic techniques, we found that systemic or intra-mPFC administration of Nic enhanced object recognition memory, and these effects were mediated by stimulation of α4β2 and α7 nAChRs and the subsequent inhibition of Kv7 and Kv4.3 channels in the mPFC. Additionally, activation of the mPFC-PRH pathway play a critical role for the effects of Nic. Furthermore, Var facilitated object recognition memory encoding via activation of PLC and IP_3Rs by stimulating α7 nAChRs in the mPFC. Conversely, systemic administration of Nic enhanced memory retrieval by indirectly activating mPFC neurons.