Characterization of sound-evoked responses of photo-identified auditory striatal neurons

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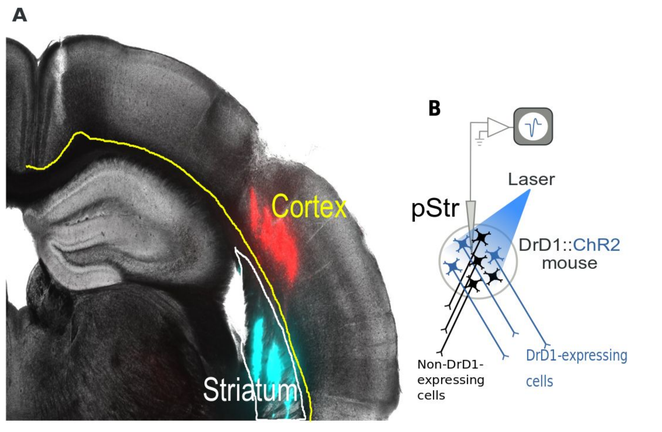
Introduction

Our focus is on auditory decision making. The striatum is an area of the brain that specializes in facilitating voluntary movement. More specifically, the posterior area of the striatum (pStr) integrates signals from auditory cortex and auditory thalamus. The pStr contains a subclass of neurons called Medium Spiny Neurons (MSNs), which participate in the reaction to sound stimuli. MSNs are divided into two classes: direct pathway, which expresses Dopamine receptor D1 (DrD1), and the indirect pathway, which expresses DrD2.

Research Question

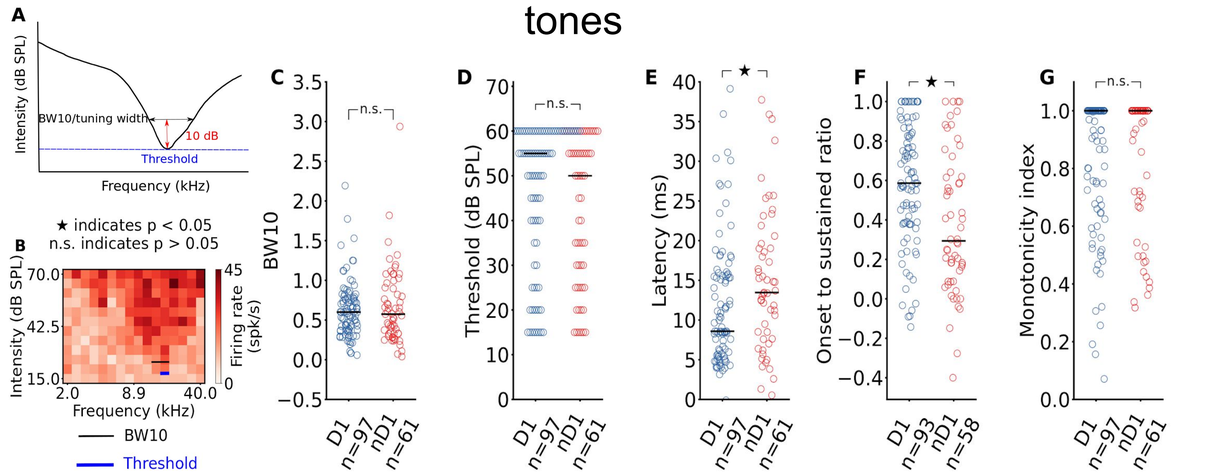
Do direct and indirect pathway neurons respond differently to sound stimuli in naïve mice?

Methods



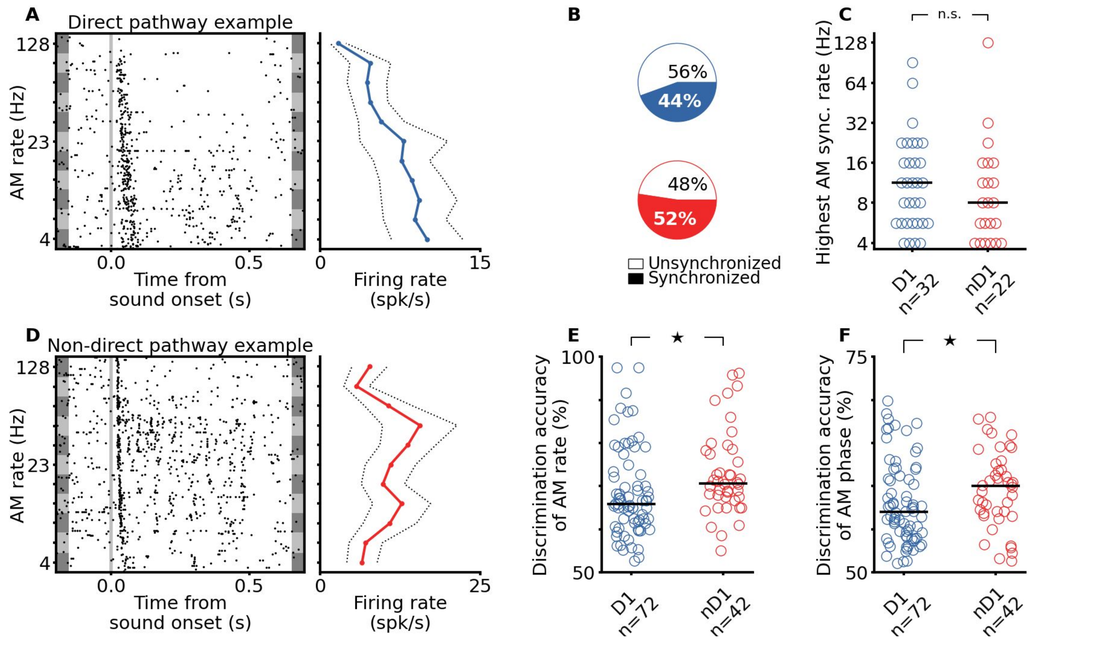
We used transgenic mice as our subjects. The light sensitive protein, Channelrhodopsin-2, was used to activate DrD1 neurons (Panel **B**). Neurons were recorded extracellularly using silicon probe electrophysiology and optogenetics was used to identify neuron type while recording. Recording sites were determined post-mortem from epifluorescent microscopy of the extracted brains as probes were coated in a dye (Panel **A**).

D1 and nD1 neurons differ in response dynamics to pure tones



Pure tones were presented for 100 ms at 16 frequencies on a logarithmic scale and 12 intensities. No differences were found in how the neurons responded to different frequencies or intensities (Panels **C**, **D**, and **G**). The populations did differ in how they respond over time, with direct pathway neurons responding faster and having stronger onset responses than non-direct pathway neurons (Panels **E** and **F**).

nD1 cells display higher temporal resolution



Amplitude modulated white noise was presented for 500 ms intervals with 11 different rates. Non-direct pathway neurons can better discriminate both the rate of amplitude modulation as well as the phase of the sound compared to direct pathway neurons (Panels **E** and **F**).

Conclusions

Naïve mice have no behavioral associations with the sounds presented. These neuron populations contribute to movement in response to sound stimuli so it is unsurprising there are no limited differences across the two populations. Once a behavior is established the two populations may diverge in responses to the same sounds.

Future Directions

Now that these baseline differences have been identified, the next step would be to train mice to do behavioral movement tasks in response to these sound presentations and identify if any properties of plasticity are shown for each of the cell populations.

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