Recent work has shown that the tail of the striatum is essential for learning and executing auditory-driven behaviours, forming organized connections with other brain areas such as the substantia nigra pars reticulata (SNr), the main output of the basal ganglia. In this project, we aim to investigate the general motivational mechanisms underlying auditory-guided behavior. We obtained preliminary behavioral results that provide a foundation for further exploration.

We developed two complementary behavioral paradigms targeting distinct motivational dimensions: reward-directed behavior and fear-avoidance behavior. These paradigms allow us to dissect how different motivational contexts shape auditory-driven decision-making. To causally examine the underlying circuitry, we plan to use chemogenetic approaches to manipulate the projection from the SNr to the inferior colliculus (IC) across both behavioral tasks as the first step.

In a two-alternative forced-choice (2AFC) task, we observed that animals' choices are influenced not only by sensory stimuli but also by their recent choice history. Notably, animals exhibit distinct behavioral strategies when responding to auditory versus visual inputs. In the escape paradigm, we find two fear modes of animals, freezing and escaping. But animals gradually adapt to the scared auditory stimulus as the experiment progresses. Interestingly, we also find a reflex-like motor responses of the looming sound.

All together, these findings offer an good reference for future work exploring the motivational mechanisms underlying action selection in animals.

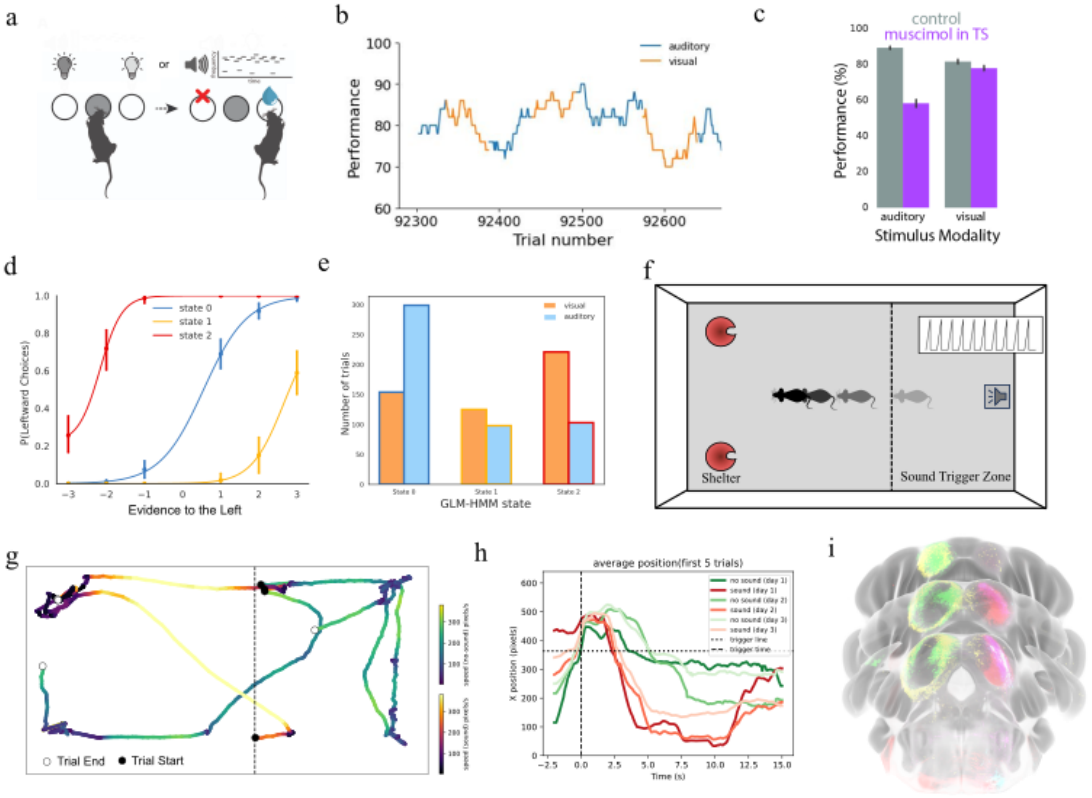

Fig. 1: Behavior paradigms and circuit characterization. **a** Schematic diagram of the two-alternative forced-choice (2AFC) task. Subjects choose the correct side to obtain a water reward based on either visual or auditory stimuli. **b** Example performance from a multimodal session with trials of different behavioral modalities indicated by color. **c** Performance comparison between auditory- and visual-guided sessions in the 2AFC task following injection of muscimol (purple) or saline (gray) into the tail of the striatum (TS). **d** Psychometric curves across three behavioral states identified by a GLM-HMM model. **e** Proportions of visual and auditory trials across the different behavioral states shown in d. **f** Schematic diagram of the escape paradigm. Animals trigger a ramping sound (illustrated in inset) upon entering the sound-trigger zone. **g** Example trajectories showing changes in speed when the sound is triggered (inferno) or not (viridis). Trial starts are indicated by black dots and trial ends by white dots. **h** Distance traveled along the x-axis of the arena, comparing conditions with sound (red) and without sound (green) across three consecutive days. **i** Three sections showing the bottom-up (right hemisphere) and top-down (left hemisphere) inputs to IC. Different colors indicate distinct sources: cochlear nucleus (red), superior olivary complex (magenta), lateral lemniscus (cyan), primary auditory cortex (green), and SNr (yellow).