Photoinhibition of the medial Prefrontal Cortex alters decision-making during foraging behavior.

During natural foraging, animals continuously adapt their decisions based on past actions, outcomes, and changing reward contingencies. Prior work on foraging behavior suggests that action values — internal estimates of the expected reward associated with each possible action — are stably represented across trials in the medial prefrontal cortex (mPFC). However, the causal role of mPFC in driving these decisions remains unclear.

Here, we investigated mPFC involvement in adaptive choice behavior in mice performing a two-armed bandit task with block-wise changes in reward probabilities and variable inter-trial intervals (ITI, 0–30 s). In this task, mice typically persisted in choosing the previously rewarded option across trials and switched to the alternative option only after a series of non-rewarded outcomes following a block change. We estimated the probability of switching (P(switch)) using a generalized linear model (GLM) that quantified the evidence to persist or switch into a latent variable, named Switching Evidence (SE).

To causally probe mPFC function, we expressed the inhibitory opsin ACR2 in pyramidal neurons and suppressed their activity during the ITI in 20% of trials. Model-free analyses revealed that photoinhibition increased switching rates and reduced accuracy in selecting the more rewarded option.

Model-based analyses showed that photoinhibition reduced the sensitivity of choices to SE: in trials with low SE, in which animals typically persisted in their previous choice, photoinhibition disrupted this persistence and led to excessive switching.

Together, our results indicate that mPFC activity shapes how across-trial accumulated evidence is used to guide adaptive choices, and that its disruption leads to maladaptive switching behavior.