NMDAR blockade reduces engagement by promoting choice repetition in mice across multiple cognitive tasks

Attractor dynamics are proposed to support short-term memory and decision-making. N-methyl-D-aspartate receptors (NMDARs) are thought to play a key role due to their slow kinetics, which enable memory maintenance and evidence accumulation. However, it remains unclear whether and how NMDARs affect behavior across tasks. To address this, expert mice received pharmacological NMDAR blockade while performing three cognitive tasks with either a memory or an evidence accumulation component: a two-alternative forced-choice (2AFC) task, a two-alternative delayed-choice (2ADC) task, and a multi-choice delayed-response (MCDR) task. Whereas the 2AFC and 2ADC were auditory and head-fixed, the MCDR was visual and freely-moving. Under NMDAR blockade, mice decreased accuracy independently of task difficulty (delay length or evidence strength) and increased choice repetition. We fitted a Generalized Linear Model (GLM) with lapses to all tasks, including regressors for stimulus, action trace (weighted sum of previous choices), and session bias. The model revealed that under NMDAR blockade, mice significantly increased their lapse rates, defined as the fraction of responses not guided by the stimulus. We hypothesized that these effects reflect reduced task engagement, as measured by a Hidden Markov Model (HMM). By extending the GLM with a two-state HMM, engaged and disengaged states emerged, driven primarily by the stimulus and the action trace, respectively. Under NMDAR blockade, performance in engaged trials was preserved, but the fraction of engaged trials decreased. These results point to NMDAR hypofunction producing task-independent deficits through enhanced choice repetition (i.e., task disengagement) rather than impaired stimulus representation or maintenance.