Contribution ID: **5** Type: **Short talk**

Adaptation of rats to a volatile hidden Markov model for reward collection

Tuesday, July 4, 2023 3:10 PM (30 minutes)

In an environment where sensory evidence indicates reward location, while a non-sensory, hidden probabilistic structure simultaneously imposes reward location likelihood, how will the two information channels interact in the brain? We developed a two-alternative forced-choice foraging task, where matching the probabilistic environment promotes reward collection. Rats initiate each trial at a central nose-poke. Then they withdraw and select the right or left reward spout based on the estimated likelihood of a reward being on that side. We manipulated the probability (p) of the baited side on trial n being the same as on trial n-1, following a Markov model with two states (right/left). Informed gambling can optimize gains. Two conditions, p=0.8 and p=0.2, were tested in separate daily sessions. Rats learned to align their left/right transition likelihood according to p. To maximize rewards, rats developed a "win-stick lose-switch"strategy for p=0.8 and the opposite strategy, "win-switch lose-stick", for p=0.2. While the after-win behavior was fully optimal ("win-stick"for p=0.8 and "win-switch"for p=0.2), the after-lose behavior was less consistent, suggesting that rewarded trials provided stronger confirmation of strategy than did non-rewarded trials. Reaction times provided evidence of the subjects'awareness of the correct strategy: in both conditions, rats were faster –commonly taken as a sign of confidence –when they responded by employing the optimal strategy. When p is changed within a testing session, the rats flexibly adapt. Combining this foraging task with an overlapping perceptual task will shed light on the merging of congruent or incongruent forces in decision making.

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Session Classification: Short talk