Symposia

[4S03m]Beyond metacognition: parallel self-evaluative brain systems generate exploratory actions in novel environments

Organizer: Kentaro Miyamoto (Department of Experimental Psychology, University of Oxford), Rei Akaishi (Social Value Decision Making Unit, RIKEN CBS-Toyota Collaboration Center (BTCC))
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*Videos are available throughout the meeting period.

[4S03m-03]Who decides the future? Prefrontal and subcortical contributions to exploratory decision making

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All organisms, from slime molds to humans, have to decide whether to forego immediate rewards, like food, in order to explore an unknown option and learn if it is better than something already experienced. This trade-off is referred to as the explore-exploit dilemma. To balance exploration and exploitation biological agents need to know when exploration is advantageous. An efficient strategy for managing explore-exploit tradeoffs is to predict the immediate and future outcomes of each available choice option. Predicting whether choices will be immediately rewarded or unrewarded is easily computed based on past experience. Predicting how often choices are rewarded or unrewarded in the future is a much more difficult computation, as it relies on prospection. Yet these predictions can be integrated to decide when exploration is advantageous. Given theoretical and lay beliefs that balancing exploration and exploitation is difficult, prior studies have focused on identifying cortical mechanisms of exploratory decision making, ignoring how subcortical motivational circuits aid in managing explore-exploit tradeoffs. Here, we leverage theoretical advances in the use of partially observable Markov decision process models to understand how reward uncertainty motivates exploration, in order to characterize neural activity in the amygdala, ventral striatum, orbitofrontal cortex, and dorsolateral prefrontal cortex of macaque monkeys as they solve a multi-arm bandit task designed to query specific aspects of novelty seeking and explore-exploit decision making. Our findings challenge the widely held corticocentric view of how the brain solves the explore-explore dilemma, by emphasizing similarities in how subcortical and cortical regions encode value computations critical for deciding when exploration is warranted.