

## Symposia

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

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Sat. Aug 1, 2020 9:00 AM - 11:00 AM Room 3

**\*Videos are available throughout the meeting period.**

### [4S03m-01]Proactive metacognitive judgement in humans and monkeys

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To explore and survive in an unpredictable, volatile world with multiple alternatives available, people and other animals, such as macaque monkeys, need to estimate uncertainty before making a decision. However, the neural mechanism to enable proactive metacognitive judgements based on evaluation of uncertainties is unknown.

In our first study on humans with functional neuroimaging and transcranial magnetic stimulation, we newly invented a prospective metacognitive matching task. In the task, participants were required to estimate their performance ('subjective probability') to classify the direction of ambiguous motion in random-dot kinematogram task. Then they compared this subjective probability with the probability of reward offered by the alternative external cues ('environmental probability') and chose the better probability option in prior to performing the motion classification. Activity in several frontal and parietal areas reflected both subjective and environmental probabilities during perceptual decision making. Anterior lateral prefrontal cortex (alPFC, area 47), however, tracked evidence relating to subjective probabilities both when a choice was taken and when it was rejected. Moreover, fMRI signals in alPFC modulated by subjective probability predicted prospective metacognition performance and ability. These observations suggest that alPFC plays a critical role to assess one's own cognitive skills and mental states proactively to take an optimal choice in the future.

In our second study on monkeys with functional neuroimaging and targeted pharmacological intervention, we previously found that the dorsal prefrontal and frontopolar cortices confer decision confidence on experience and ignorance, respectively, during a serial-probe recognition memory task (Miyamoto et al., 2017, Science 355(6321); Miyamoto et al., 2018 Neuron 97(4)). We have newly found that the inferior parietal lobule (area PG) contributes to integrate these confidence read-outs and execute a strategically optimal decision making for post-decision wagering based on self-reflection of performance in the

precedent memory task.

These human and monkey studies converge to suggest that higher-order processes to proactively evaluate subjective uncertainties are implemented in primate neural networks. The neural mechanism would be essential to convert metacognition into action.