Kentaro Miyamoto
RIKEN Center for Brain Science
https://www.kentaromiyamoto-lab.com/
https://cbs.riken.jp/en/faculty/k.miyamoto/
kentaro.miyamoto.wg@riken.jp

Talk Title:

Identification and disruption of neural networks for metacognition to generate strategic actions in primates

Abstract:

Primates, including humans, have the ability for metacognition, the introspective evaluation of their own cognitive states. In order to enable metacognition, a self-evaluative mechanism is necessarily implemented in the neural network of the brain. To elucidate the neural basis of this mechanism, it is important to examine the dynamics of activity in the whole brain, and non-invasive brain function mapping using fMRI is one of the best methods to do so. Furthermore, fMRI during task performance can be applied not only to humans but also to macaque monkeys, and is suitable for investigating the neural evolutionary origin of metacognition because it allows comparison of brain activity independent of differences in methods. Therefore, we used fMRI to compare whole-brain activity in humans and macaques during metacognitive judgments.

We previously found that the macaque dorsal prefrontal cortex (area 9) and frontopolar cortex (area 10) are responsible for reading out metacognitive signals related to confidence in memory and novelty, respectively. We newly found that the monkey posterior parietal lobule (pIPL) integrates the readout of confidence information for memory and novelty. We also found that the integrated information is delivered to the dorsal anterior cingulate cortex (dACC) and output as strategic actions. Pharmacological inactivation of the dorsolateral frontal cortex (area 9) or frontal pole (area 10) results in impaired metacognitive performance, but the degree of impairment was reduced the more active pIPL was, suggesting that pIPL is essential for metacognitive integration for strategy formulation. Metacognitive judgments are also important for switching future actions. We elucidated that the human anterior lateral prefrontal cortex (alPFC; area 47) is important for prospective decision making based on predictions of future self-performance by whole-brain neuroimaging with fMRI and disrupting it with transcranial magnetic stimulation.

Our studies demonstrate that primates share a common self-evaluative neural circuit

structure that enables the strategy-generating metacognitive abilities that are prominent in humans and that have their evolutionary origins in monkeys.

Biographical Information:

Completed Ph.D. Course at The University of Tokyo School of Medicine in 2014. Postdoctoral Fellow at The University of Tokyo (2014-2017) and at Department of Experimental Psychology, University of Oxford (2017-2021).Team Leader (principal investigator) at RIKEN Center for Brain Science since 2021.