



# Forum

## Global reward state modulates exploration and neural activity in humans and monkeys



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October 12, 16:00(JST)

ZOOM URL:



Navigating dynamic environments often requires humans and other animals to consider information beyond currently experienced choice values. I present two functional magnetic resonance imaging (fMRI) experiments, one in humans and one in macaque monkeys, that demonstrate the impact of global reward signals on explorative behaviour and neural activity. First, I show that representations of how well we are doing – representations of reward rates – exist simultaneously at multiple time scales in a human brain network including dorsal anterior cingulate cortex (dACC) and the agranular insula (Ia). Such signals can be used to compute the change in reward rate in the environment and to construct estimates of future values that are different from the values experienced in the past. Their relative strengths govern how we decide to persist in our environment or switch to an alternative course of action; this can lead animals to keep exploring poor environments despite low reward rates in anticipation of future reward. In a second project we scanned macaque monkeys during a 3-armed bandit task. By carefully controlling for the effects of choice-contingent reward and choice repetition, we revealed that their choice strategy was again distinctly influenced by the global reward state. Remarkably, the global reward state affects the way that each choice outcome is valued and influences future decisions so that the impact of both choice success and failure is different in rich and poor environments. Successful choices are more likely to be repeated but this is especially the case in rich environments. Unsuccessful choices are more likely to be abandoned but this is especially likely in poor environments. In other words, a low global reward state incentivized the animals to increasingly explore alternative options even if their current choice was successful. Just as in the first study in humans, we found that dACC and Ia, but in addition the dorsal raphe nucleus, track global reward state as well as specific outcome events.

Host: Rei Akaishi, Social Value Decision Making Unit, RIKEN CBS-TOYOTA Collaboration Center (ext.7194)