
Neural correlates of cognitive control and its modulation during learning in monkeys

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Abstract

Neural unit recordings in the anterior cingulate cortex have shown activity specific of particular outcomes or feedbacks during a trial and error task. This activity, which will be reviewed, represents different events that are all relevant for behavioural adaptation. This includes negative or positive feedbacks after choices, negative feedback after execution errors, or visual signals indicating new conditions. The specificity is suggestive of a mechanism involved in triggering adaptations like shifting after choice errors, compensating after execution errors, etc. In this context we are investigating the correlates of these adaptations in areas directly or indirectly connected to the anterior cingulate cortex.

Neural correlates of adaptation have been studied using unit, LFP, and ECoG recordings in frontal cortex of monkeys performing a trial and error task. In this task monkeys have to find by trial and error in each block of trials which of four targets is rewarded, and then repeat the correct response. The reward schedule is deterministic. The solution is changed after the monkey has repeated at least 3 times the correct response. Animals thus alternate between exploration and exploitation periods that require different levels of control on behaviour.

Our data show changes in lateral prefrontal activity and more distant precentral ECoG oscillations during adaptations. Low frequency (beta) oscillations are modulated by behavioural periods (learning vs repetitive behaviours), and after different feedbacks. These modulations seem to reflect changes in a specific task-related neural process, possibly cognitive control.

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