THE NEURONAL BASIS OF BIASES

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Background: For an optimal behaviour our choices should be based on all relevant information available at hand which in the field of perceptual decision making is reflected as a dependence of the choice on the current stimulus and the prior history of stimuli, choices and outcomes. Those prior expectations create biases which might be beneficial especially when sensory information is weak or ambiguous. However when the current choice is unrelated to the prior history, the bias can be detrimental.

Aims: We aimed to establish if the history-dependent biases exist in the behavior of highly-trained monkeys performing a discrimination task in which there was no incentive to develop them. We wanted to determine a neuronal representation of the these biases in the prefrontal cortex activity and to reveale how such bias signal combines with the sensory evidence signal to form the final decision.

Method: We recorded population activity of prearcuate gyrus (PAG) neurons while two monkeys performed a direction discrimination task. In the task stimulus direction and strength varied randomly across trials making previous history irrelevant for the current choice. In a window of tens to hundreds of trials we calculated slow bias as a monkey's preference towards one of the motion directions. Fast bias was defined as a categorical variable reflecting previous choice and outcome. We used a logistic regression model to predict choice from the linear combination of the stimulus strength, slow and fast biases. Next we used a linear regression model to determine if the pre – stimulus activity of PAG population represents behavioral biases.

Results: We showed that even extensively trained monkeys exhibit small but significant biases. These biases fluctuated at distinct slow and fast time scales. Both significantly improved our ability to predict monkeys' upcoming choice on individual trials compared to a situation when choice was predicted solely based on the stimulus strength. Pre – stimulus PAG activity represented both the fast and slow biases. Crucially, the same activity was predictive of upcoming choice, suggesting a functional role for the bias representations.

Conclusions: Our results indicate that the prefrontal cortex activity carries the information about the history biases and demonstrate the mechanisms how such bias signal is integrated into the decision-making process.

Keywords: Behavioural bias, Decision making, Prefrontal cortex, Macaque monkey

Publications:

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