

Factors effecting reward based decision making : a computational study

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Abstract

Basal Ganglia (BG) are known to be responsible for action selection, decision making and reward based learning in a changing environment. We present a biologically plausible decision making model of BG and attempt to examine if action selection is affected under the influence of certain external factors with respect to stimulus representation. The model is a reference implementation of Guthrie et al, 2013 [1]. When presented with two differently rewarding stimuli at the same time, the model learns to select a stimulus associated with a higher reward.

We allow the model to learn, eventually to select a higher rewarding stimulus always. We analyze the impact of visual salience of the stimuli, temporal difference in the appearance of stimuli and other possibilities while learning itself. We test the model presenting the worst choice (lesser rewarding stimulus) with more visual salience than that of the best choice (higher rewarding stimulus). Early results show that the model, despite having learned, could make a bad decision choosing the worst choice if its salience is greater than that of the best choice by a certain difference. In another attempt, the worst choice is presented first and the best one after a certain time delay. Though the delay is considerably small compared to the total time of stimuli presentation, it is observed that the worst choice could be selected if the best choice appears after a certain delay. The difference in salience or time of presentation which cause the model to take a bad decision is observed to be associated to the difference in reward values of the choices presented. We also studied the possibility that BG learns to associate the reward not just to the cognitive aspect (shape) of the stimuli, but also to the position of stimuli which fetched the reward. Such a learning is observed to reduce the overall performance accuracy of the model, making more number of bad decisions.

Keywords

decision making, action selection, cortico-basal ganglia loops, reinforcement learning

References

- [1] Martin Guthrie, Arthur Leblois, André Garenne, and Thomas Boraud. Interaction between cognitive and motor cortico-basal ganglia loops during decision making: a computational study. *Journal of neurophysiology*, 109(12):3025–3040, 2013.