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A simple model of cued T-Maze learning based on basal ganglia anatomy and sequence replay

Adam Ponzi*

Address: Laboratory for Dynamics of Emergent Intelligence, RIKEN Brain Science Institute, Hirosawa 2-1, Wako, Saitama, Japan 351-0198

Email: Adam Ponzi* - adam@brain.riken.jp

* Corresponding author

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I present a simple firing rate neural network model describing how a rat may learn to navigate a cued rewarded T-Maze. The model is based on a realistic approximation to the Basal Ganglia dopaminergic system anatomy including the 'Go' and 'No-Go' channels which project to the thalamus and substantia nigra and their differential feedback modulation by D1 and D2 dopamine receptors at the cortical-striatal synapses. The model includes an input from association layers in cortex or hippocampus where experienced sequences are replayed when the rat finds the reward location, as recently described by Foster and Wilson [1]. The sequence replay creates *task* and *expert* MSN neurons in the striatum with spatial response characteristics similar to those reported by Barnes et al [2] in dorsal striatum and Mulder et al [3] in ventral striatum. The system is able to produce expert neurons in striatum which specifically respond to cues and actions with strengths which reflects the reward predictabilities of the associated cues and actions. Such response modulation by reward predictability is well known in striatum [4]. In addition a simple action selection system is implemented so that the system is able to make a transition from a random choice 'exploratory' phase to a 'goal directed' phase as the learning proceeds. Some behavioural characteristics of the T-Maze learning are thereby reproduced.

References

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