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ACTION-INHIBITION HIERARCHIES: USING A SIMPLE GASTROPOD MODEL TO INVESTIGATE SEROTONERGIC AND DOPAMINERGIC CONTROL OF ACTION SELECTION AND REINFORCEMENT LEARNING

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Introduction: Basal ganglia (BG) activity plays an important role in action selection and reinforcement learning. Inputs from and to other areas of the brain are modulated by a number of neurotransmitter pathways in the BG. Disturbances in the normal function of the BG may play a role in the aetiology of psychiatric disorders such as schizophrenia and bipolar disorder.

Aims: Develop a simple animal model to evaluate interactions between glutamatergic, dopaminergic, serotonergic and GABAergic neurones in the modulation of action selection and reinforcement learning.

Objectives: To characterise the effects of changing dopaminergic and serotonergic activity on action selection and reinforcement learning in an animal model.

Methods: The food seeking / consummation (FSC) activity of the gastropod Planorbis corneus was suppressed by operant conditioning using a repeated unconditioned stimulus-punishment regime. The effects of elevated serotonin or dopamine levels (administration into cerebral, pedal and buccal ganglia), on operantly-conditioned FSC activity was assessed.

Results: Operantly-conditioned behaviour was reversed by elevated ganglia serotonin levels but snails showed no food consummation motor activity in the absence of food. In contrast, elevated ganglia dopamine levels in conditioned snails elicited food consummation motor movements in the absence of food but not orientation towards a food source.

Conclusions: The modulation of FSC activity elicited by reinforcement learning is subject to hierarchical control in gastropods. Serotoninergic activity is responsible establishing the general activity level whilst dopaminergic activity appears to play a more localised and subordinate 'command' role.

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