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Abstract:

Neural mechanisms and computations underlying the selection and maintenance of behavioural activity

Action selection is a neural mechanism underlying adaptive behaviour. It mediates selection and maintenance of behavioural actions and their organization into action sequences by facilitating appropriate, while inhibiting competing, motor programs. This action selection process involves neural circuits in the central brain of insects and vertebrates, including the central complex and the basal ganglia, respectively. Previous studies led to insights into the functional anatomy of basal ganglia substructures and their role in adaptive behaviour. In addition, neural computation models have been developed which allow specific predictions to be tested. Thus far, however, the *in vivo* mechanisms and computations underlying action selection remained largely elusive. We recently resolved a highly conserved structural and functional ground pattern organization of the insect central complex and the vertebrate basal ganglia. Our comparative analyses reveal that central complex and basal ganglia circuitries share pattern-generating algorithms that implement comparable connections and associated functionalities. These are characterized by neural mechanisms and computations that implement dimensionality reduction and transition through attractor states, whereby spatially organised parallel projecting loops integrate and convey sensorimotor representations for the selection and maintenance of behavioural activity. In both taxa, these neural systems are modulated by dopamine signalling that also mediates memory-like processes. Using the insect species *Drosophila* as a paradigmatic example, I will illustrate some of the emerging principles and discuss their relevance for 'living machines'.

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