ABSTRACT

Animals engage in intricately woven action sequences that are constructed from trial-and-error learning, but the mechanisms by which the brain links together individual actions which are later recalled as fluid chains of behavior are not fully understood. The aim of this dissertation is to investigate the learning and goal-directed control of action sequences in rats. Experiment 1 addresses a question that comes out of a reinforcement learning model of action sequencing: how does the extent of training change how the performance of an action sequence is impacted by reward devaluation. The data show that action sequences remain goal-directed overall regardless of the extent of training, but the locus of goal-directed control shifts over training. The subsequent experiments address how the direct and indirect basal ganglia pathways contribute to the learning and goal-directed control of action sequences. Experiments 2 through 5 make use of the same action sequence task used in Experiment 1 while also introducing chemogenetic manipulations during and/or after training. Manipulations are targeted to either D1 receptor-expressing neurons in the dorsomedial or dorsolateral striatum (Experiments 2 and 3, respectively) or D2 neurons in the dorsomedial or dorsolateral striatum (Experiments 4 and 5, respectively). While chemogenetic-mediated inhibition spared goal-directed control at the level of sequence rates across all experiments, the completion and initiation of sequences were compromised by D1 and D2 neuronal inhibition in the dorsomedial striatum, respectively. In addition, inhibiting D2 neurons in the dorsolateral striatum compromised action sequence learning and performance during training.