

## Heretical thoughts about the role of phasic dopamine signaling in learning

A hypothesis at the core of contemporary accounts of learning arose from the confluence of research in psychology, computer science, and neuroscience. According to this hypothesis, payoff from future actions is maximized by incremental adjustment of connection weights in neural networks underlying prediction and choice. These adjustments are driven by discrepancies between experienced and expected rewards, called “reward-prediction errors.” Phasic firing in midbrain dopamine neurons is held to both *encode* reward-prediction errors and to *cause* the weight changes underlying learning. There is indeed abundant correlational evidence linking phasic firing in dopamine neurons to reward-prediction errors. However, I will present new behavioral and electrochemical findings from studies of electrical and optical intracranial self-stimulation that are not easily reconciled with the hypothesized causal role for dopamine-mediated reward-prediction errors. I will share some heretical thoughts about what these data may mean, and I will discuss implications for the form of learning induced by direct, selective activation of dopamine neurons in laboratory rats.