**Modeling Neurocircuitry in Binge Drinking**

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Binge drinking occurs when a person vigorously seeks alcohol intoxication. It is characterized by two distinct phases: a period of high-rate consumption, called “front-loading,” followed by a period of lower-rate “maintenance” drinking. Frequent binge drinkers exhibit increased levels of depression, stress, violent behavior, and impaired judgment when sober. They are also at an increased risk for alcohol use disorders and dependence. Understanding and simulating front-loading and maintenance during a binge session may shed light on the role of biological factors on excessive alcohol use and possible pharmacological solutions.

The involvement of striatal networks in binge drinking has been well-documented, but the exact connections that govern the transition between front-loading and maintenance are unclear. We devise a computational model, terminating in the striatum, that integrates glutamatergic projections from the insula and medial prefrontal cortex (mPFC), as well as dopaminergic projections from the midbrain. We propose that the striatum relays information about the rate and vigor with which one drinks to the motor cortex. Neuron groups in the mPFC track the agent’s consumption, ultimately inhibiting downstream activity once an internal tolerance is reached. Conditioned stimulus reinforces seeking behavior and mediates dopamine release, which then modulates firing characteristics of the striatum.

Our model uses a system of differential equations to encode the excitatory and inhibitory connections between neuron populations. A neuron group’s excitability, drive, synaptic weights, and time constants are parameterized within physiologically relevant bounds. Using data components supplied by rodent models, we replicate front-loading and maintenance phases, as well as population-specific activity. By tuning parameters, we mimic brain irregularities and observe resulting changes in drinking behavior. Novel patterns in our model may help motivate future research on the networks involved in binge drinking.

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