

Molecular fMRI of Input/Output Relationships in the Reward System

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Determining functional relationships among neural circuit elements that participate in reward processing is one of the core challenges in addiction research. Our laboratory has created and applied novel probes to study the dynamics of such relationships using functional magnetic resonance imaging (fMRI) methods that provide molecular and cellular precision in intact animals. In the first part of this talk, I will discuss wide-field mapping of dopaminergic function in the striatum using molecular fMRI. By combining dopamine imaging with conventional fMRI, we can discern the topography of dopamine release and its neuromodulatory effects on postsynaptic signaling during rewarding stimulation. In addition to local effects on the magnitude and duration of neural activity, striatal dopamine potentiates a network of distal responses we can delineate using neurochemically-dependent functional connectivity analysis. In the second part of the talk, I will introduce a new tool we have developed for genetically-targeted fMRI of neural circuitry throughout the brain. I discuss validation of the tool and its initial application for imaging activity of specific neural pathways that provide input to the striatum in a reward paradigm. We expect that this approach could offer important capability for analyzing mechanisms of addiction.