This research project is aimed to measure dopamine release events and neuronal populations activities in the motor cortex of awake mice performing motor task. To achieve this goal we will utilize novel fluorescent protein-based sensors to measure simultaneous dopamine release and neuronal dynamics in neurons expressing dopamine receptors, to determine how spatiotemporal differences in dopamine levels relate to ongoing neuronal activity and influence behavior. Experiments will be performed on animals trained to reach for, grab and manipulate joystick in order to obtain reward. During imaging sessions reward outcome will be manipulated to test how dopamine levels and neuronal population activities in the motor cortex respond to a mismatch in expected reward magnitude (i.e. whether they encode reward prediction errors). All behavioral events will be analyzed by deep learning algorithm and correlated with fluorescence signals measured during imaging session. Moreover, we will probe the functional role of cells in the motor cortex by performing chemogenetic and optogenetic perturbations during ongoing behavior. Pioneering nature of the experiments planned in the proposal allows us to believe that the results of the project will significantly expand the current state of our knowledge. We believe that the better understanding of the function of neural circuits involved in motor learning is crucial for developing novel and more effective therapies for people suffering from neurological disorders and stroke.