Synchronization of midbrain dopaminergic neurons is enhanced by rewarding events

By vaadia
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By vaadia January 26, 2011


Abstract:

The basal ganglia network is divided into two functionally related subsystems: the neuromodulators and the main axis. It is assumed that neuromodulators adjust cortico-striatal coupling. This adjustment might depend on the response properties and temporal interactions between neuromodulators. We studied functional interactions between simultaneously recorded pairs of neurons in the basal ganglia while monkeys performed a classical conditioning task that included rewarding, neutral, and aversive events. Neurons that belong to a single neuromodulator group exhibited similar average responses, whereas main axis neurons responded in a highly diverse manner. Dopaminergic neuromodulators transiently increased trial-to-trial (noise) correlation following rewarding but not aversive events, whereas cholinergic neurons of the striatum decreased their trial-to-trial correlation. These changes in functional connectivity occurred at different epochs of the trial. Thus, the coding scheme of neuromodulators (but not main axis neurons) can be viewed as a single-dimensional code that is further enriched by dynamic neuronal interactions.

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