The ventral tegmental area as engine for cortical plasticity in primates

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Compelling correlation-based evidence in monkeys has shown that dopaminergic neurons in the ventral midbrain signal the discrepancy between an obtained reward and its prediction, which is also known as a reward prediction error. These dopaminergic signals are suggested to play a critical role in many forms of learning, and in adult cortical plasticity. Rodent studies have targeted the ventral midbrain using microstimulation and optogenetics and confirmed its causal role in cortical plasticity. For example, strong dopaminergic-dependent plasticity was observed in rat auditory cortex when a tone was repeatedly paired with electrical stimulation of the ventral tegmental area (VTA). Such causal evidence, however, is lacking in primates, in which the mesocortical and mesolimbic systems expanded substantially compared to rodents. In my presentation, I will present functional magnetic resonance and behavioral data showing that repeated microstimulation of the VTA can lead to changes in visual representations in monkey cortex. Furthermore, I will also show that pairing of a visual feature with VTA stimulation leads to perceptual improvements for these features, such as also observed during reward-driven (task-irrelevant) perceptual learning experiments. Importantly, I will show that both the functional and perceptual changes occur in the absence of selective attention to
these features. These data indicate that the VTA plays a critical role in driving adult cortical plasticity and perceptual learning-like phenomena in primates.