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Optogenetic stimulation of the ventral tegmental area affects early intracolumnar and late cortico-cortical tone-evoked processing in gerbil primary auditory cortex

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Dopamine belongs to the key neuromodulators regarding learning and task associated processing. Previous studies revealed that dopaminergic levels increase within the primary auditory cortex (AI) during initial acquisition learning in a Go/No-Go auditory discrimination task. However, the impact of dopamine on cortical circuits of sensation are still elusive. In this study, our goal was to reveal the contribution of the circuitry between the main source of cortical dopamine, the ventral tegmental area (VTA), and AI. We transduced the ipsilateral VTA with an AAV containing a C1V1 opsin with an YFP-tag, that expression is controlled by a CAMαII promotor sequence and implanted a fiber for optogenetical stimulation of the VTA. Successful recruitment of reward-related brain circuits was evaluated by self-stimulation behavior. Subsequently, we characterized auditory cortex circuitry activation after pure tone presentation by CSD analysis in anaesthetized animals before, with and after a coupled optical VTA stimulation. Based on linear mixed models, we demonstrate a significant increase of overall columnar current flow and corresponding effects on infra- and supragranular layers during laser stimulation that lasted over half an hour later on, verifying cortical effects of VTA-AI projections. Our study thereby contributes to a better understanding of the circuit effects of the VTA-based dopaminergic system and its impact on learning-dependent plasticity in sensory cortex.