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A rat model of reward conditioning using optogenetic VTA stimulation

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To survive in an ever changing world, organisms have to adapt to changing stimulus-outcome contingencies. A major driving force for such adaptation is reward. In the mammalian brain, rewards are processed by the mesolimbic dopamine system, which—through the encoding of reward-prediction error—facilitates neuronal plasticity. Here we present a novel paradigm to measure the effects of reward conditioning through its influence on the acoustic startle response. We transduced the VTA of TH::Cre rats with ChR2 and implanted an optical fiber into the VTA, allowing specific stimulation of dopamine neurons. After two weeks of expression time, rats underwent a baseline startle measurement and seven consecutive sessions of optogenetic self-stimulation (US). Animals could only operate the self-stimulation nose poke in the presence of a visual cue (CS), but not in the absence of the cue. Following this operant conditioning, animals underwent a second startle test to assess the influence of visual cue presentation on startle. To compare our results to previous studies, we also include rats that underwent electrical, instead of optogenetic, self-stimulation. In both groups we find a reduction in startle amplitude following the presentation of the paired CS.