Tracking the Response of Dopaminergic Pathways using DLight1 Sensors in the Nucleus Accumbens

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When a person is under the influence of drugs, their motor sensors are temporarily impaired, decreasing reaction time and skewing their sense of perception. When introduced to a stimulus, mammals' Basolateral Amygdala area of the brain is activated. From there, a memory store is created of the stimulus which is stored in the Dorsomedial Striatum (DMS) and Dorsolateral Striatum (DLS). From there, the stimulus results in goal-directed behavior, which is then released as a motor output. In the case of this experiment, the reaction to the stimulus depends on the dose of methamphetamine. Each exposure to the drug causes a new memory store to be created and stored in the DMS and DLS which eventually leads to addiction.

In this experiment we utilized dLight1, a bioluminescent, to track the path of dopamine through the dopaminergic pathways. The rats were then put through a behavioral experiment involving multiple motor-function-inducing behavior which eventually led to a sucrose reward. The rats then underwent the process of fiber photometry in which three separate fiber optic implants were placed into each half of the Nucleus Accumbens as well as the Basolateral Amygdala which mediates the release of dopaminergic neurons to the rest of the body. When analyzing the results of the photometry, we looked for spikes that last for about three seconds captured by the fiber optics which cancel out most white noise, thus isolating the dopaminergic innervation. We found that the rats that were under the influence of the drug exhibited a quicker release of dopamine which traveled much quicker away from the brain to the rest of the body.

Tracking the origin of dopaminergic innervations elicited by constant drug intake is a key component in the targeting and early diagnosis of possible neurological disorders, which could potentially be progressive. Early diagnosis and action can help prevent permanent neurological impairment.

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