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The Neural Basis Underlying the Acquisition of Anticipation

Background: The occurrences of regularly scheduled resources and stimuli, such as food, mates, and pain, have profound effects on behavioral and physiological rhythms, as well as on neural activity. For example, when access to food is restricted to a specific time each day, animals will increase their locomotor activity in anticipation of the feeding time, known as food anticipatory activity (FAA). The specific brain circuits necessary and sufficient for the development of FAA are unknown, though various brain regions have been implicated in anticipatory processes including, the Nucleus Accumbens Core and Shell (NaC and NaS), the Prefrontal Cortex (PFC), and the Lateral Septum (LS).

Goal and Methods: The present study aims to understand the development of anticipation in an FAA paradigm by examining cFos, a marker of neuronal activity, in brain regions previously implicated in learning, anticipation, and emotionality, reward, and feeding. Animals were placed on a LD cycle, where food was available for 6 hours each day, from the mid-point of the light period (zeitgeber time, ZT6) until dark onset at ZT12.

Groups: Mice were sacrificed on day 1 of restricted feeding (RF Day 1), during the acquisition of FAA phase, day 3 (RF Day 3), or on day 10 (RF Day 10) when FAA was well established. Control animals were maintained on ad libitum for the duration of the experiment and were sacrificed at ZT4 and ZT6. Additionally, at each of these points, two times of day were examined, namely two hours prior to the time of food access (ZT4), and at the time of daily food access (ZT6), just prior to the delivery of food. cFos expression was compared by day and by time and was also examined in control animals.

Results: In the NaC and NaS Day 3 had significantly higher c-fos expression than the control and Day 1. Day 10 had significantly higher expression than all other days, and had a within day time difference between ZT4 and ZT6. Additionally, the ZT4 and ZT6 in Day 10 were respectively different than all after ZT4's and ZT6's in the other days. The LS and PFC both had significantly higher expression on Day 3 and Day 10 compared to the control and Day 1.