Introduction

- Impulsive choice behavior involves choosing between a smaller reward after a shorter delay (smaller-sooner, SS) versus a larger reward after a longer delay (larger-later, LL).
- The delay and/or amount of rewards can be manipulated to determine general patterns of preference for the SS or LL options.
- A tendency to make impulsive choices (SS) has been linked with impaired choice behavior such as drug use, gambling, and poor financial decisions.
- Conversely, self-control is a predictor of adaptive choice behavior, such as improved school performance, better interpersonal relationships, and better financial decisions.
- Impulsive choice behavior is also linked with ADHD and this may be due to an over-responsive Nucleus Accumbens core (NAc).
- NAc is believed to play a central role in determining the value of rewards that guides choice behavior.
- Our previous research with NAc lesions indicated deficits in adjusting to increases in reward magnitude, so that when reward magnitude increased, choice behavior did not change significantly.
- Also, recent work from our lab showed that dynamic tasks may result in more random and more impulsive behavior.
- The previous NAc lesion studies used dynamic procedures, and thus may be susceptible to non-specific deficits of the lesions when dealing with dynamic environments.

Purpose:

Here, we tested NAc lesions in a systematic steady state procedure that maximizes opportunities for learning the reward options. Also, we tested reward sensitivity in the absence of differences in delay to verify the effects. We determined whether the NAc is necessary for the computation of reward value in an impulsive choice task, when the magnitude of reward for one of the alternatives was increased over phases.

Hypothesis:

Rats with NAc lesions should show deficits in adjusting to increases in LL magnitude in comparison to control rats.

Methods

- Animals: 24 male Sprague Dawley rats
  - Pair-housed, food restricted (85% weight), 90 days old.

Procedure

Surgery: Rats received neurotoxic lesions of the NAc or control lesions.

Surgical procedure:

- Rats anesthetized with isoflurane
- Holes exposed and bregma located
- Skull screws and screws 
- 30 gauge infusion needle injected bilaterally:
  - Lesion
  - Control

Design:

- Male SD rats (n = 12)
- Male SD rats (n = 12)

Methods (Cont.)

a) Impulsive choice task

- Modification of the Green and Estle (2003) procedure:
  - Rats were exposed to the same magnitude for several sessions.
  - The LL and SS delays remained the same throughout each session.
  - Session = 82 trials → Randomly interleaved
    - SS: Free Choice + SS Forced Choice + LL Forced Choice
    - LL: reward incremented systematically across phases (2 phase = 15-20 sessions)
    - Trained on each magnitude until stable choice behavior was reached

- Free choice trials:
  - Both levers (left + right) = SS or LL
  - Counterbalanced across rats
  - The choice initiated a delay until food was available to be delivered

- Forced choice tasks:
  - Only one lever presented = SS or LL
  - Counterbalanced across rats
  - Lever press initiated a delay until food was available to be delivered

b) Reward sensitivity task:

- Both levers (SS + LL) presented → each with a VI 30 s schedule of reinforcement.
- Variable-interval (VI) = mean intertrial interval is 30 sec, but delays varied (1-59 sec)
- Reward magnitude manipulation: SS = 1 pellet; LL = 1 → 2 → 4 pellets

Results

- Figure 1:
  - The rats began by making more SS choices then progressively switched to LL choices as the magnitude increased.
  - Differences in percent LL choice are evident between the groups. The control rats made more SS choices overall.
- Figure 2:
  - When both the SS and LL option were 1 pellet, the control rats quickly chose the SS while the lesion rats took longer, but eventually made more SS choices.
  - The lesion rats never reached exclusive SS choice and instead continued to wait for one pellet on a subset of trials.

References