Effects of dietary manipulations on body weight, locomotor activity, and impulsive choice in rats

CATHERINE HILL & KIM KIRKPATRICK

KANSAS STATE UNIVERSITY
DEPARTMENT OF PSYCHOLOGICAL SCIENCES
REWARD, TIMING, & DECISION LABORATORY
Impulsive choice underlies...

- Maladaptive behaviors:
  - Substance abuse (Bickel & Marsh, 2001)
  - Gambling (Alessi & Petry, 2003)

- Diseases
  - ADHD (Solanto et al, 2001)
  - Obesity
Obesity & Impulsive Choice

- Higher body fat percentage is associated with more impulsive choice behavior (Rasmussen, Lawyer, & Reilly, 2010)

- The correlation between obesity and impulsive choice could be due to:
  - (1) trait impulsivity as the cause of obesity
  - (2) obesity as the cause of trait impulsivity
  - (3) another related factor, such as diet, causing both
Diet-induced Models of Obesity

- Studies typically include either high-fat or high-fat/high-sugar diets
- Impulsive choice behavior decreased for rats on high-fat diet (Narayanaswami et al., 2013)
  - Used adjusting procedure (Peterson, Hill, & Kirkpatrick, 2015)
  - Had ab libitum access to food → differences in energy budget
  - Tested when rats were off of the diet
Current Study:

How do high-fat and high-sugar diets affect body weight, locomotor activity, and impulsive choice behavior?
Method

24 male Sprague Dawley rats

Pre-locomotor test → Diet manipulation

Control
25 g of chow

High-fat
15 g of chow
4.38 g of lard

High-sugar
15 g of chow
10.33 g of sucrose

101.75 calories
Weights

- Start diet
- Start behavioral testing

**Graph:**
- **Y-axis:** Weight (g)
- **X-axis:** Date
- **Lines:**
  - Chow
  - Fat
  - Sugar

**Legend:**
- Chow
- Fat
- Sugar
Method

24 male Sprague Dawley rats

Pre-locomotor test → Diet manipulation → Post-locomotor test

Control
25 g of chow

High-fat
15 g of chow
4.38 g of lard

High-sugar
15 g of chow
10.33 g of sucrose
Before diet | 8 weeks of diet | 20 weeks of diet
--- | --- | ---
Total Distance Moved | | |
Locomotor
Chow | Fat | Sugar
Method

24 male Sprague Dawley rats

Pre-locomotor test → Diet manipulation → Post-locomotor test → Impulsive choice task

Control
25 g of chow

High-fat
15 g of chow
4.38 g of lard

High-sugar
15 g of chow
10.33 g of sucrose
Impulsive Choice Task

SS = 5→10→20 s, 1 p

LL = 30 s, 2 p

(Green & Estle, 2003)
Impulsive Choice

\[
\log \frac{LL + .5}{SS + .5}
\]

High-fat and high-sugar diets led to more impulsive behavior.
Random effects:
- Intercept
- SS_Delay

Fixed effects:
- Group*SS_Delay*Session
Conclusions

- High-fat and high-sugar diets result in greater impulsive choice behavior
  - Effects on impulsivity are not a result of hyperactivity or weight
- The high-sugar diet appears to be affecting the brain and behavior before physical signs of obesity occur

- See Board Z42 on Tuesday from 8-12 for details on short- and long-term effects of dietary manipulations of impulsive choice and motivation
Questions?

Acknowledgements

- Dr. Kimberly Kirkpatrick
- RTD lab members:
  Jen Peterson, Christian Davis, Amanda Crawford, Jesseca Pirkle, Sydney Edmisten, Andrew Marshall, and Sarah Stuebing
Random effects