Diet-induced impulsivity: The relationship between obesity and impulsive choice

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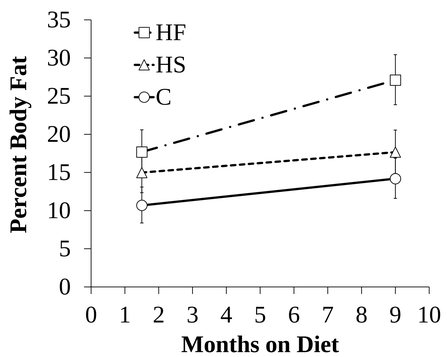
Introduction

- Impulsive choice is implicated as a possible factor leading to the obesity epidemic
  - People who are obese make more impulsive decisions[1]
  - People who eat diets high in fat and sugar are more impulsive[2]
- Rodent models have shown that diets high in fat or sugar induce impulsive behavior[3], as indicated by a preference for the smaller-sooner (SS) reward over the larger-later (LL) reward and increased sensitivity to delay
- This may explain the relationship between obesity and impulsive choice
- Current study aims:
  - Replicate the effects of long-term exposure of high-fat and high-sugar diets on impulsive choice
  - Determine the relationship between body fat percentage and impulsive choice

Diet and Body Fat

- Subjects: 36 male Sprague Dawley rats
- 8 week diet manipulation
  - Time restricted with a 4 hr eating window
  - Groups (eucaloric diets):
    - Chow (C): 100% rat chow
    - Fat (HF): 60% rat chow and 40% Crisco
    - Sugar (HS): 60% rat chow and 40% powdered sugar
- Body fat percentage
  - DEXA scan of abdomen
  - Measured after 6 weeks and 9 months on the diet
- Data analysis: repeated measures linear regression
  - Fixed effects: diet*time, all lower effects
  - Random effects: intercept

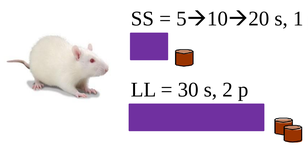
Body Fat in Abdomen



The HF group (b = 21.59%) and HS group (b = 15.89%) had a significantly higher body fat percentage than the C group (b = 12.15%)

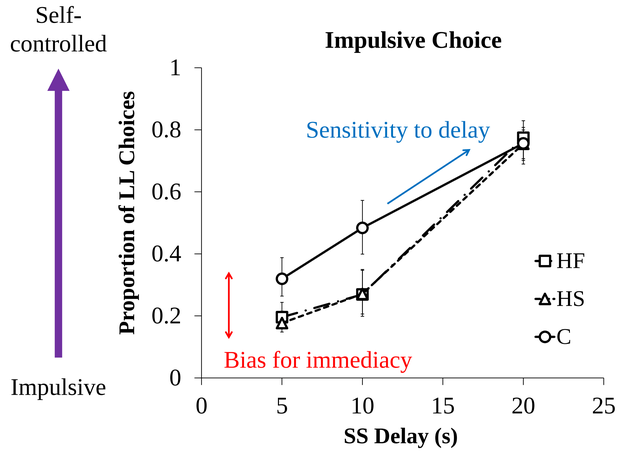
Impulsive Choice

Impulsive choice task



Data analysis

Repeated measures logistic regression
- Fixed effects: diet*delay, all lower effects
- Random effects: intercept



Bias: The HS group had a greater bias for the immediate reward (b = .04) compared to the C group (b = .09)

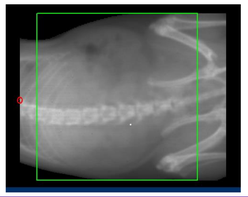
Sensitivity: The HF group (b = 6.26) and HS group (b = 6.96) were more sensitive to changes in the delays compared to the C group (b = 5.76)

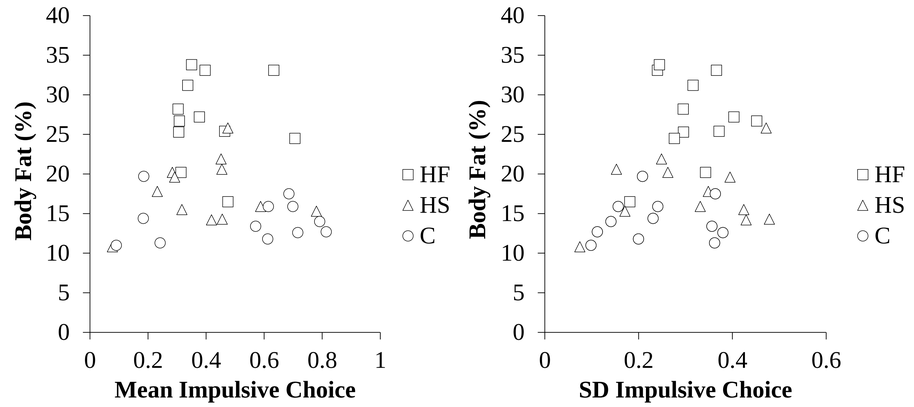
Correlations

Data analysis

Correlation between body fat percentage and mean LL choices (as a measure of bias, left) and the standard deviation of choice across phases (as a measure of sensitivity to delay, right)

DEXA Scan



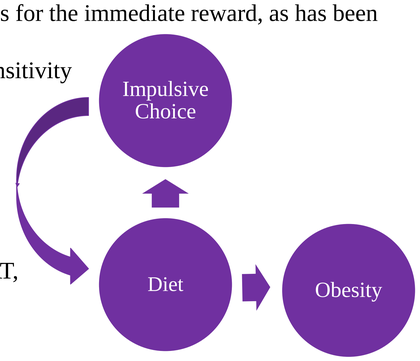


Bias: Mean impulsive choice and body fat were not significantly correlated, r = -.11

Sensitivity: Standard deviation of impulsive choice was not correlated with body fat percentage, r = .27

Discussion

- Despite similarities in food intake (not shown), the high-fat and high-sugar diets resulted in greater body fat percentage in the abdomen
- Diets high in fat and sugar induced impulsive behavior, replicating previous research[3]
  - The high-sugar diet induced a bias for the immediate reward
  - The high-fat diet failed to induce a significantly greater bias for the immediate reward, as has been found previously
  - Both the high-fat and high-sugar diet resulted in greater sensitivity to delay, as previously reported
- While diet increased impulsive behavior, body fat percentage did not correlate with impulsive choice
- The results suggest that the correlation between obesity and impulsive choice in humans[1] may be driven by diet
- Future research should investigate the mechanism by which diet induces impulsive choice behavior (e.g. D2 receptors, DAT, insulin, and leptin)



References

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2. Lumley, J., Stevenson, R. J., Oaten, M. J., Mahmut, M., & Yeomans, M. R. (2016). Individual differences in impulsivity and their relationship to a Western-style diet. *Personality and Individual Differences*, *97*, 178–185.
3. Steele, C. C., Pirkle, J. R. A., & Kirkpatrick, K. (2017). Diet-induced impulsivity: Effects of a high-fat and a high-sugar diet on impulsive choice in rats. *PLoS ONE. 12*(6).

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