

Beyond the Scale: Targeting Compulsive Eating with Sensory Satiety

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Introduction

What is BED?:

- Binge Eating Disorder (BED) is a psychological condition characterized by frequent episodes of consuming large quantities of food in a short period, accompanied by feelings of loss of control and distress.

Importance of Understanding BED:

- BED is a significant public health concern due to its high prevalence and impact on individuals' physical and mental well-being.
- It can lead to severe health issues such as obesity, diabetes, and cardiovascular diseases.

Distinguishing BED from Non-BED Eating Behaviors:

- BED is associated with compulsive eating behavior, often involving palatable foods (e.g., high sugar or high fat foods).
- While non-BED individuals may also prefer palatable foods, they do not experience the same compulsive eating behaviors or distress.

Objective of the Research:

- To explore the underlying mechanisms of BED and distinguish them from general food preferences.
- To identify potential interventions and treatments that address the compulsive nature of BED rather than just food preferences.

Why This Research Matters:

- Addressing BED can improve quality of life for those affected and reduce the broader health burden associated with the disorder.
- Enhances understanding of compulsive eating behaviors and informs the development of targeted therapies.

Does the mouse binge-eating model replicate the impulsivity and habitual behavior seen in human BED?

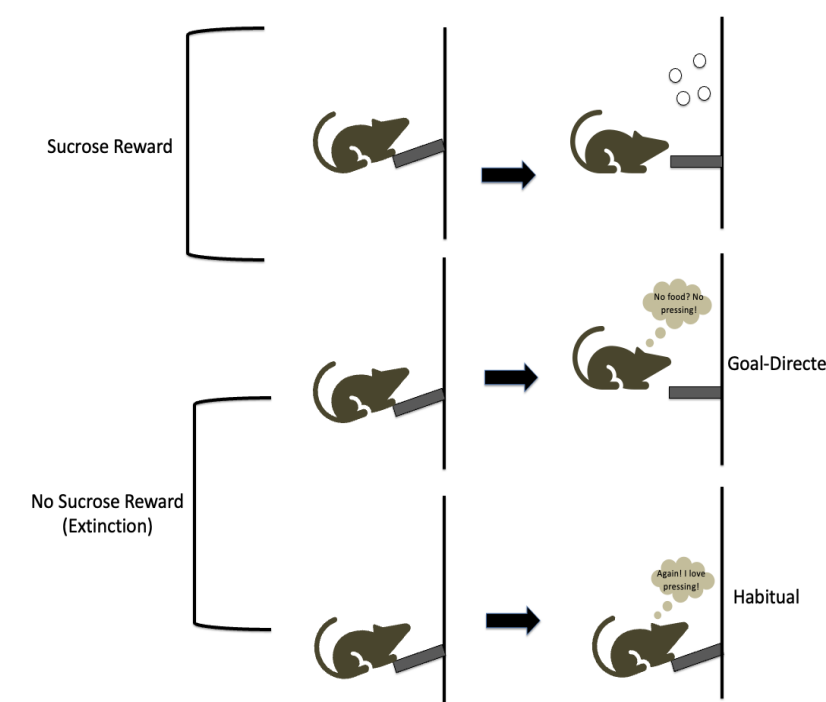
Research Goals

1. Recreate the Binge-Eating Phenotype:

- Objective:** Develop a mouse model exhibiting binge-eating behaviors similar to those seen in human BED.
- Method:** Implement a 9-day protocol with specific conditions (bedding and water) to induce binge eating in mice.

2. Assess Impulsivity and Habitual Behavior:

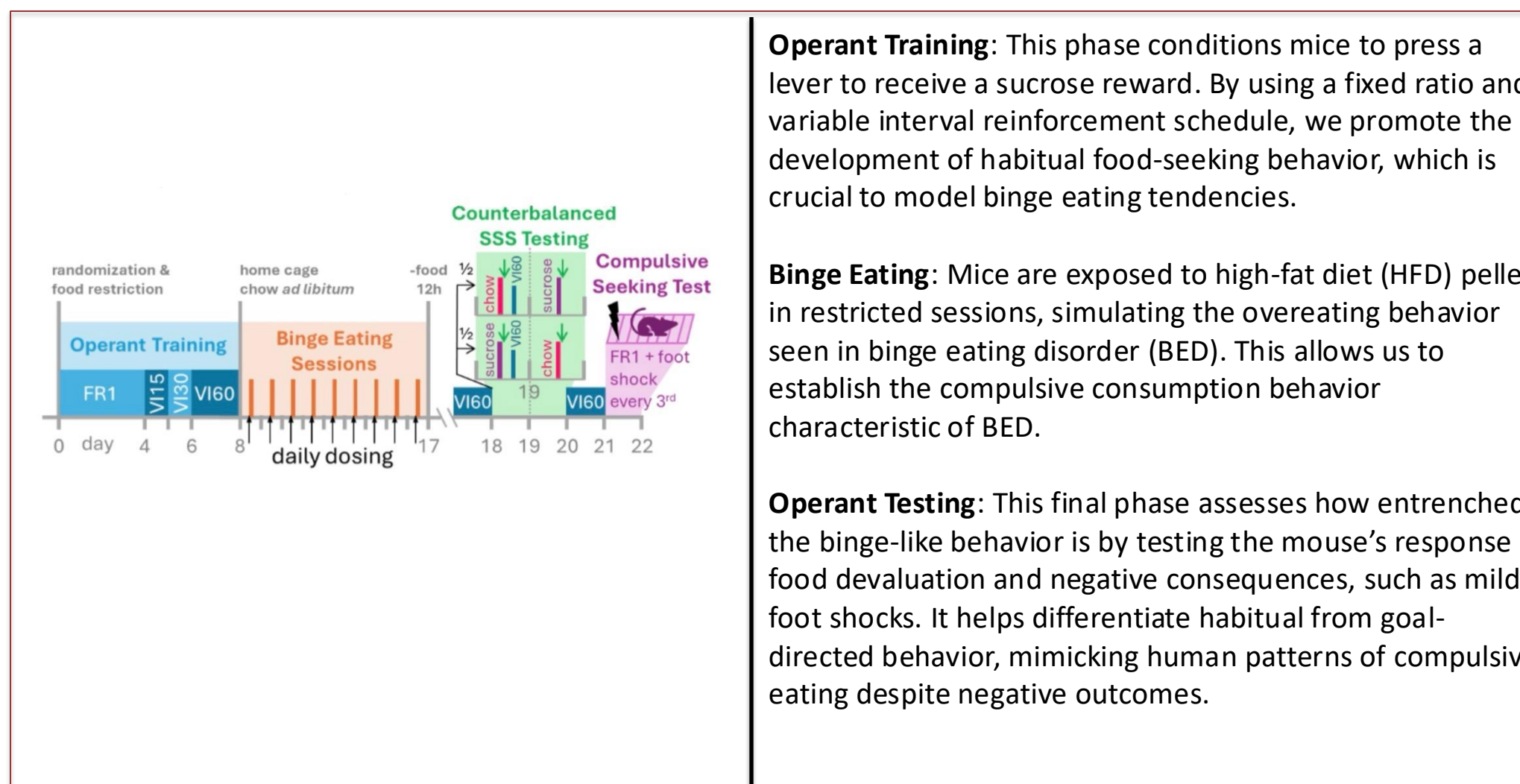
- Objective:** Determine if the induced binge-eating behavior in mice reflects impulsivity and habitual actions comparable to human BED.
- Methods:**
 - Operant Conditioning:** Use varying reward schedules to measure goal-directed vs. habitual behavior.
 - Devaluation Tests:** Assess if the perceived value of sucrose changes with pre-exposure to gauge goal-directed behavior.
 - Punishment Resilience:** Examine if mice continue compulsive lever pressing despite mild shocks.
 - Habitual Pressing:** Evaluate lever pressing behavior in the absence of sucrose to test for habitual actions.



3. Validate the Model for Treatment Testing:

- Objective:** Ensure that the mouse model is suitable for evaluating potential treatments for BED.
- Method:** Confirm that the model exhibits characteristics of BED that can be targeted by therapeutic interventions.

Methods



Operant Training: This phase conditions mice to press a lever to receive a sucrose reward. By using a fixed ratio and variable interval reinforcement schedule, we promote the development of habitual food-seeking behavior, which is crucial to model binge eating tendencies.

Binge Eating: Mice are exposed to high-fat diet (HFD) pellets in restricted sessions, simulating the overeating behavior seen in binge eating disorder (BED). This allows us to establish the compulsive consumption behavior characteristic of BED.

Operant Testing: This final phase assesses how entrenched the binge-like behavior is by testing the mouse's response to food devaluation and negative consequences, such as mild foot shocks. It helps differentiate habitual from goal-directed behavior, mimicking human patterns of compulsive eating despite negative outcomes.

Results

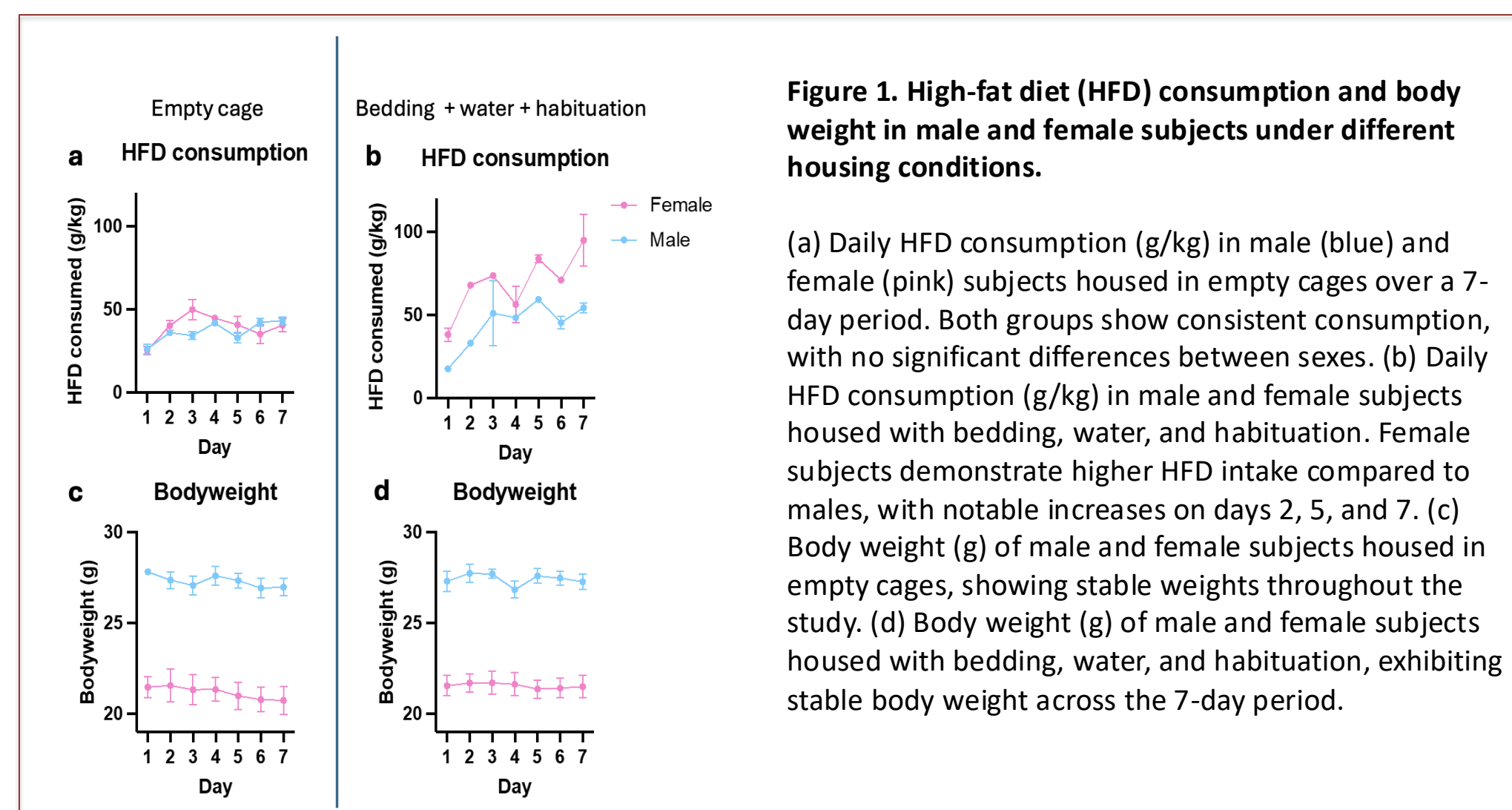


Figure 1. High-fat diet (HFD) consumption and body weight in male and female subjects under different housing conditions.

(a) Daily HFD consumption (g/kg) in male (blue) and female (pink) subjects housed in empty cages over a 7-day period. Both groups show consistent consumption, with no significant differences between sexes. (b) Daily HFD consumption (g/kg) in male and female subjects housed with bedding, water, and habituation. Female subjects demonstrate higher HFD intake compared to males, with notable increases on days 2, 5, and 7. (c) Body weight (g) of male and female subjects housed in empty cages, showing stable weights throughout the study. (d) Body weight (g) of male and female subjects housed with bedding, water, and habituation, exhibiting stable body weight across the 7-day period.

Presses during operant extinction

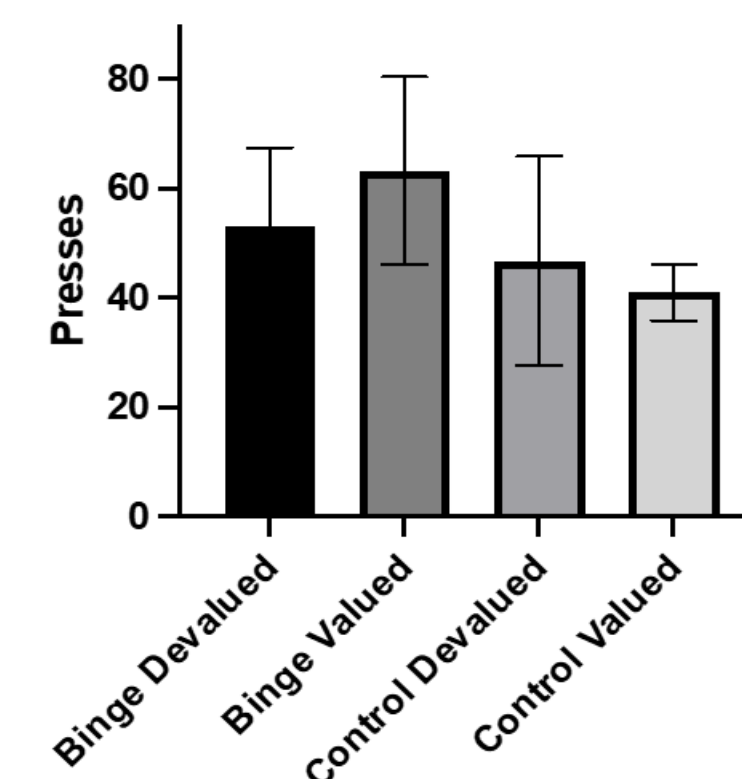


Figure 2. Presses during operant extinction under binge and control conditions for devalued and valued outcomes.

The graph displays the number of presses during the operant extinction phase across four conditions: Binge Devalued, Binge Valued, Control Devalued, and Control Valued. The "Binge Valued" group shows higher pressing behavior compared to the "Binge Devalued" group. Similarly, the "Control Devalued" group presses more frequently than the "Control Valued" group.

Future Directions

Development of Pharmacological Interventions:

- Drug Development:** We are developing a drug aimed at modulating dopamine activity to influence binge eating behaviors. This intervention will help assess the potential for pharmacological treatment to mitigate compulsive eating patterns.

Compulsive Behavior Analysis:

- Punishment and Persistence:** Investigate if mice continue pressing the lever despite punishment, mimicking the human experience of guilt and shame associated with binge eating. This will help determine if binge-eating animals exhibit increased persistence compared to controls.

Behavioral and Pharmacological Optimization:

- Impact Assessment:** Examine how the new drug influences both behavioral persistence and dopamine activity, providing insights into its effectiveness for treating binge eating.

Broader Behavioral Assessments:

- Compulsive Behavior Beyond Food:** Explore additional forms of compulsive behavior to gain a comprehensive understanding of binge eating mechanisms. This includes evaluating behaviors beyond food intake and their relationship with dopamine signaling.

References

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Acknowledgements

