



# A rat model of snacking and body weight control: limits of compensation after reward consumption



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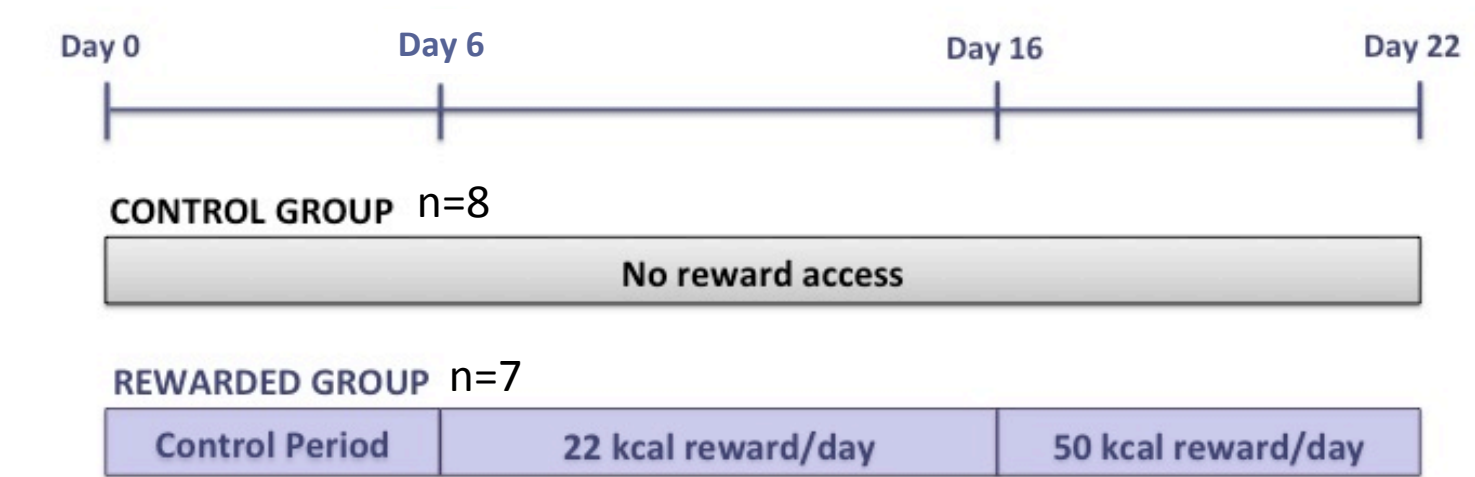


## Introduction & Objectives

Snacking is commonly regarded as a cause of weight gain in humans. However, this concept remains controversial due to opposing evidence on the relationship between snacking and long-term weight gain<sup>1-3</sup>. The aim of this study was to develop a rat model of snacking to investigate compensatory behaviour in both males and females in response to a palatable, rewarding food snack. We hypothesise that the homeostatic systems controlling energy balance may protect the body from weight gain by reducing caloric intake from other sources.

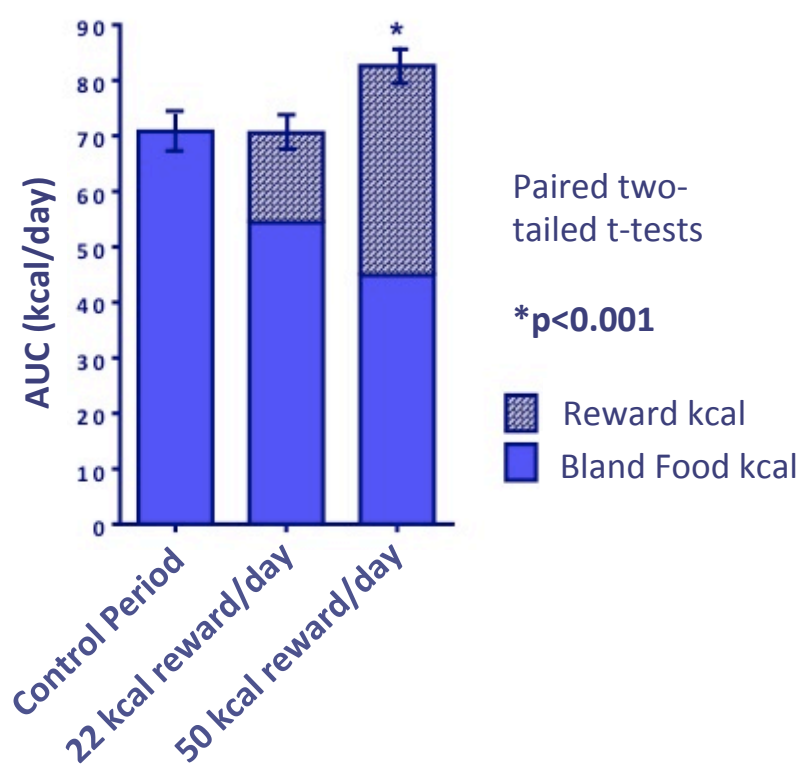
## 1. Males compensate for regular small food rewards only

### 1.1 Schematic Protocol



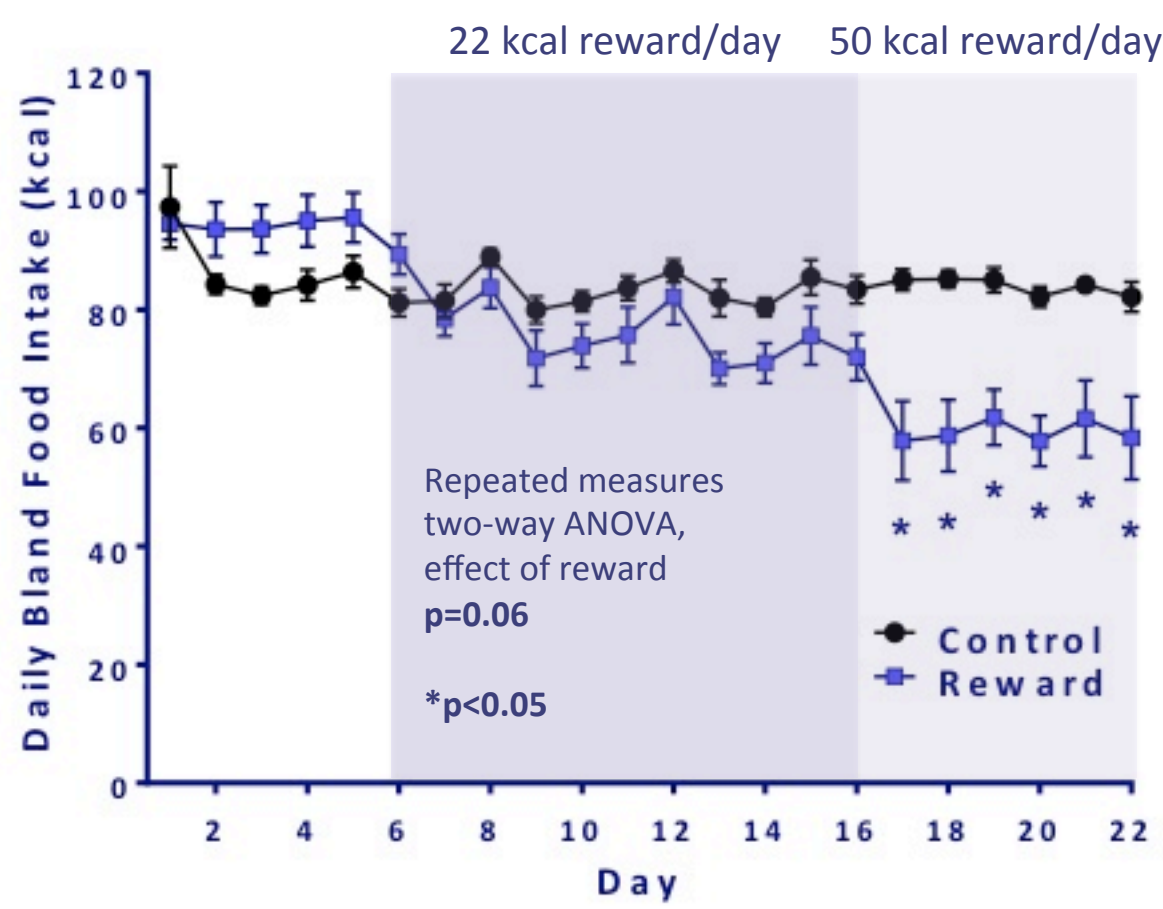
Male Sprague Dawley rats were individually housed with *ad lib* access to bland food and water. The food reward given was diluted sweetened condensed milk.

### 1.3 Total Caloric Intake



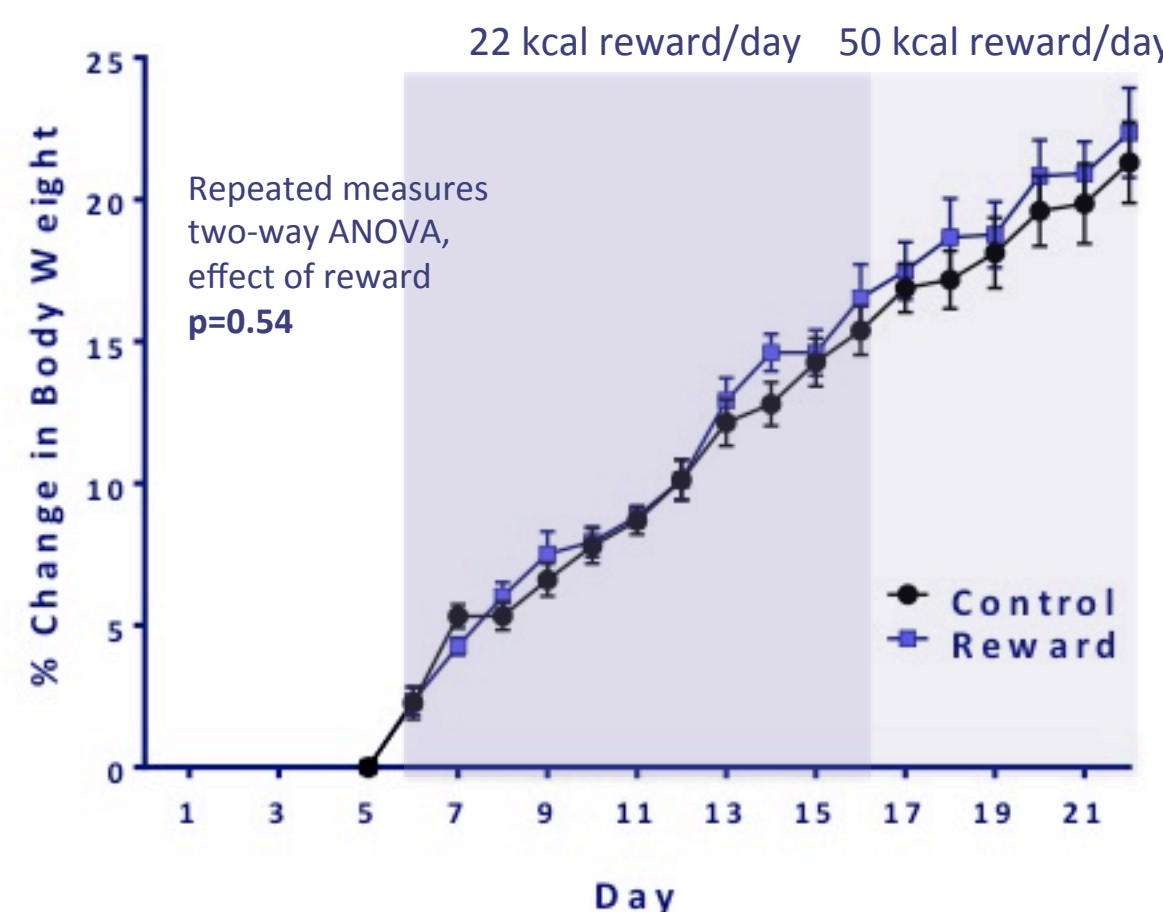
Animals compensated for the small food reward (22 kcal) by reducing bland food intake (17±4 kcal). However, animals only partially compensated for the large food reward (50 kcal) by reducing bland food intake to an extent (31±6 kcal).

### 1.2 Bland Food Intake



Control animal's food intake remained stable throughout, but rewarded animals reduced their food intake in response to daily consumption of a small food reward (22 kcal). Rewarded animals then further reduced food intake in response to daily consumption of a large food reward (50 kcal).

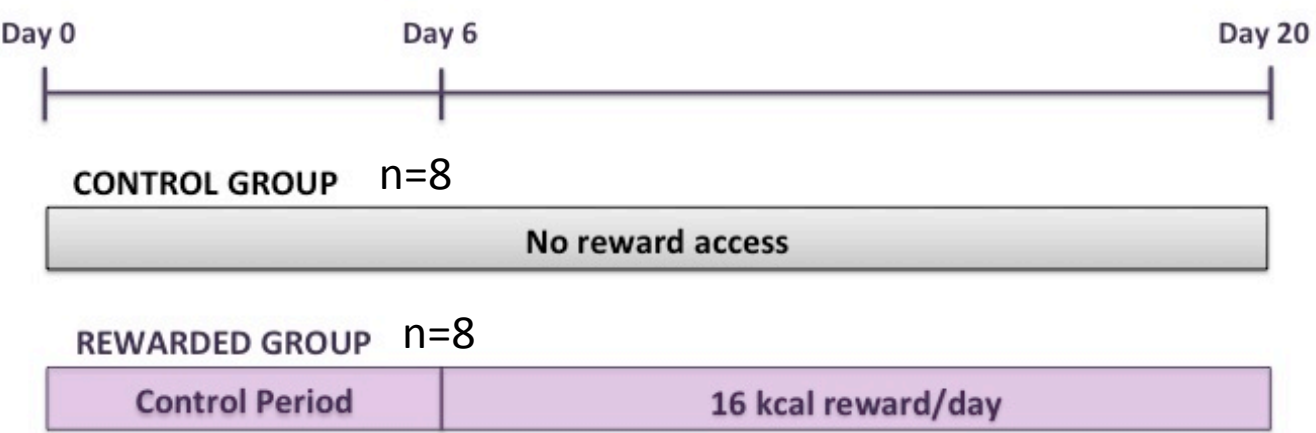
### 1.4 Percentage Body Weight Change



Rewarded animals % body weight change did not diverge from control animals during the rewarding periods.

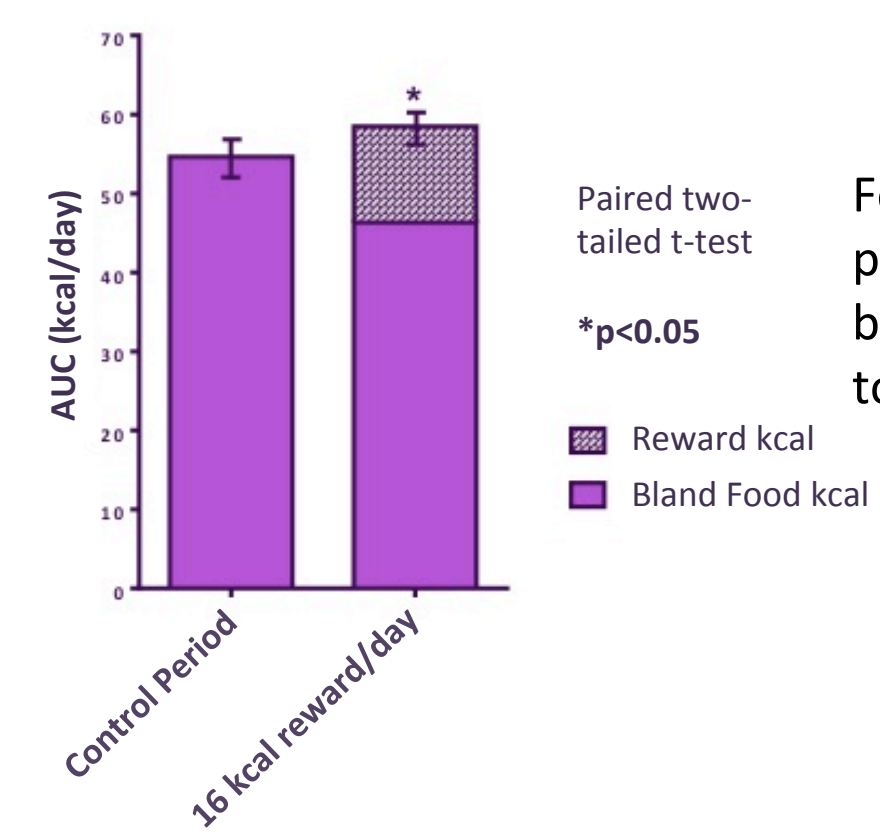
## 2. Females partially compensate for regular small food rewards

### 2.1 Schematic Protocol



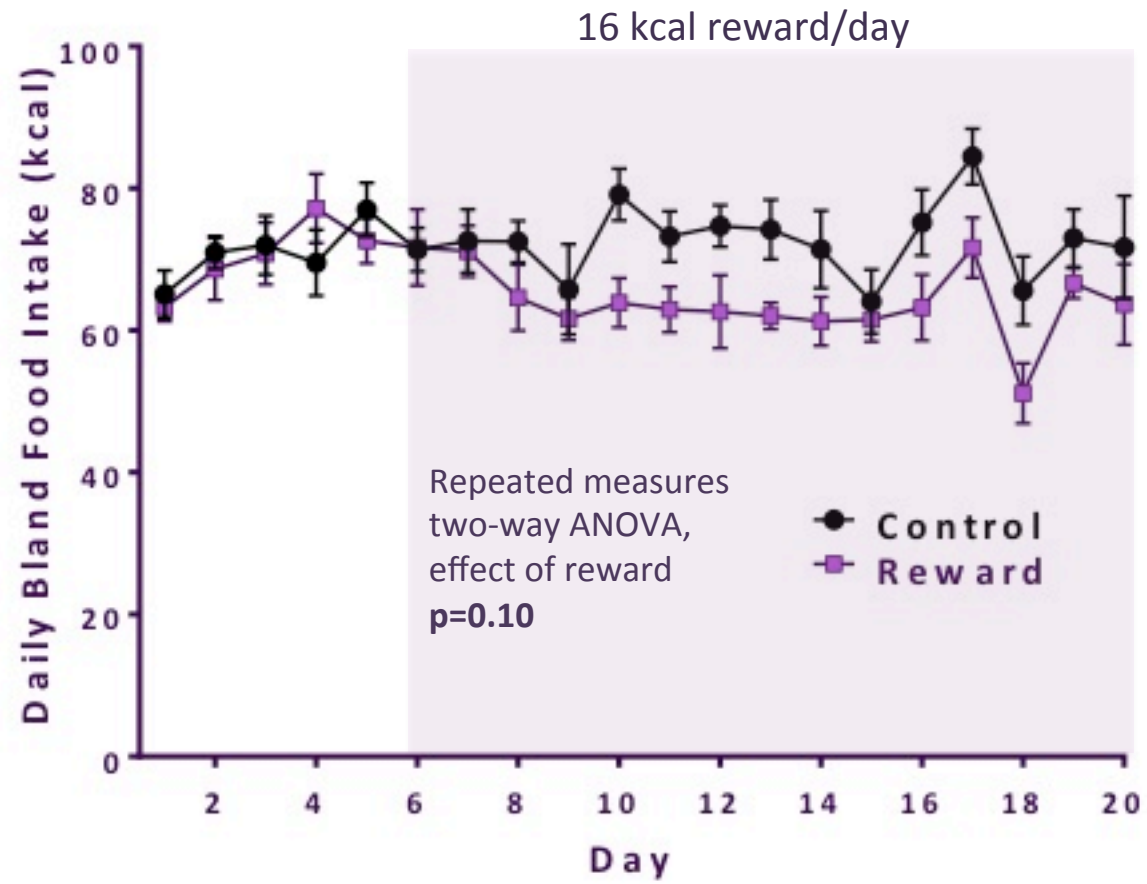
Female Sprague Dawley rats were individually housed with *ad lib* access to bland food and water. The food reward given was diluted sweetened condensed milk.

### 2.3 Total Caloric Intake



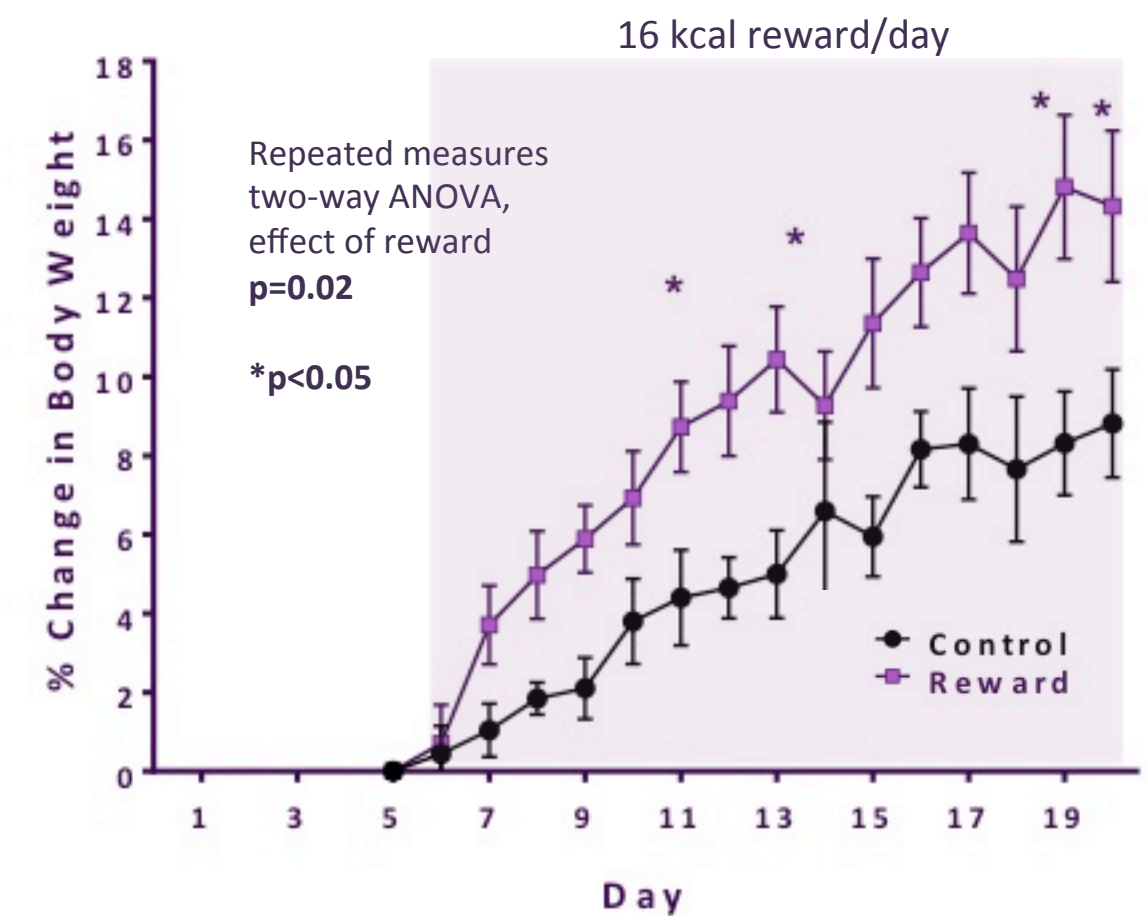
Female animals compensated partially for the small reward by reducing bland food intake to an extent.

### 2.2 Bland Food Intake



Control animals food intake remains stable throughout, but rewarded animals partially reduce their food intake in response to small reward (16 kcal) consumption (10±3 kcal).

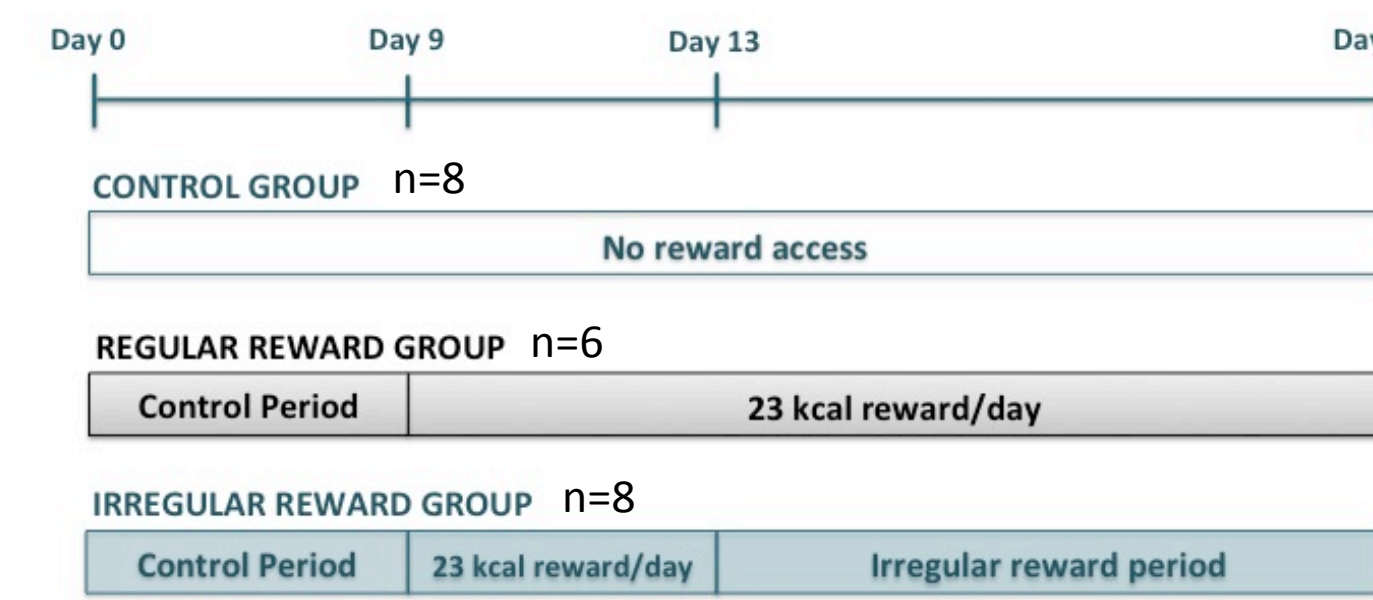
### 2.4 Percentage Body Weight Change



Rewarded animals % body weight change diverged from control animals.

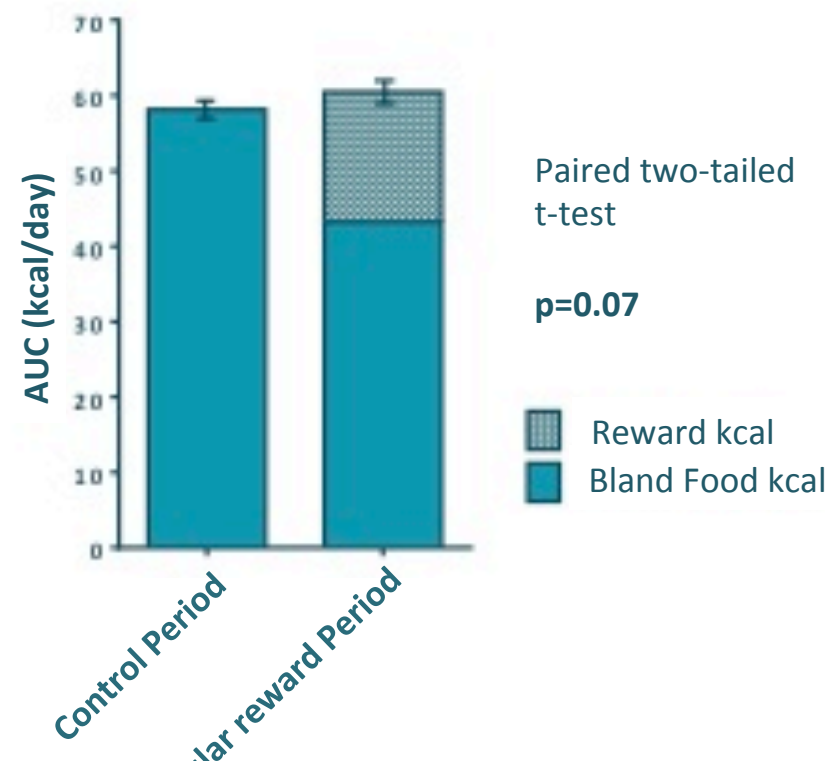
## 3. Males compensate for irregularly presented food rewards

### 3.1 Schematic Protocol



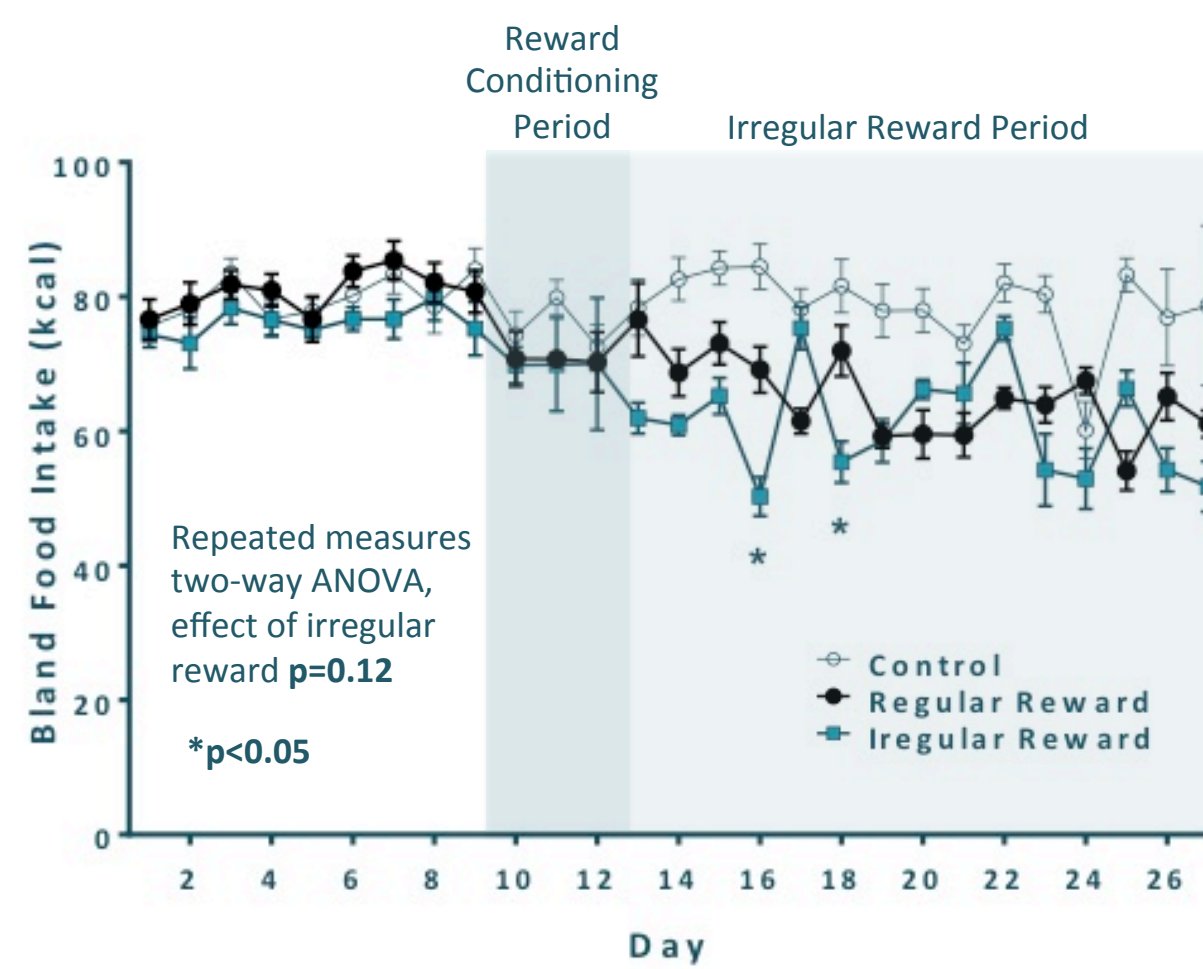
Male Sprague Dawley rats were individually housed with *ad lib* access to bland food and water. The food reward given was diluted sweetened condensed milk. After a control period, regularly rewarded animals received access to a small food reward (23 kcal), for 18 days at 10.00. Irregularly rewarded animals received access to a small food reward (23 kcal) for 5 days to condition the animals to consume the reward, followed by 14 days of irregular rewards (0-4 rewards/day, presented between 09.00 and 18.00). Throughout the experiment both regularly and irregularly rewarded groups received access to the same number of rewards

### 3.3 Total Caloric Intake



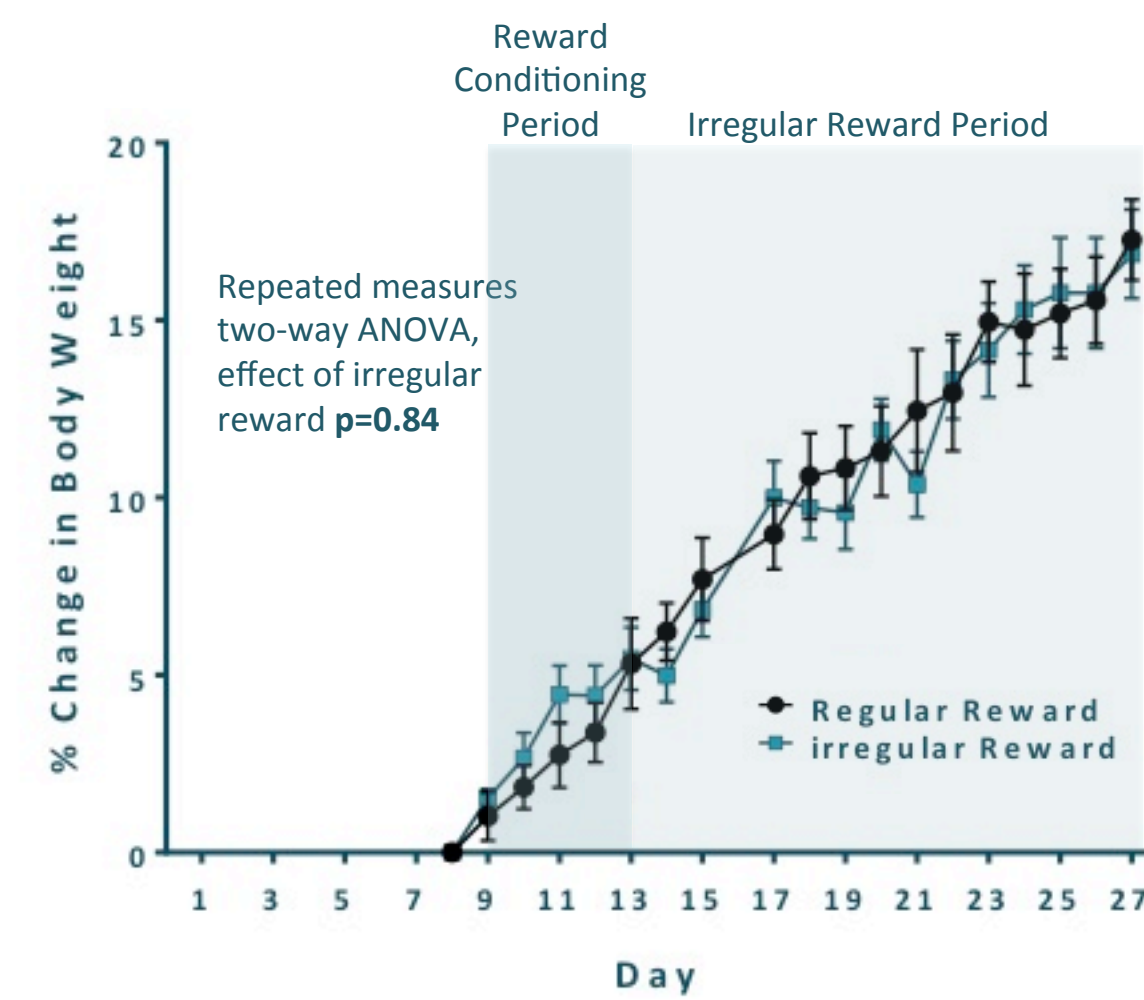
Irregularly rewarded animals compensated for the food rewards on a daily basis by reducing bland food intake.

### 3.2 Bland Food Intake



Control animals food intake remains stable throughout, but regularly and irregularly rewarded animals reduce their food intake in response to food reward consumption.

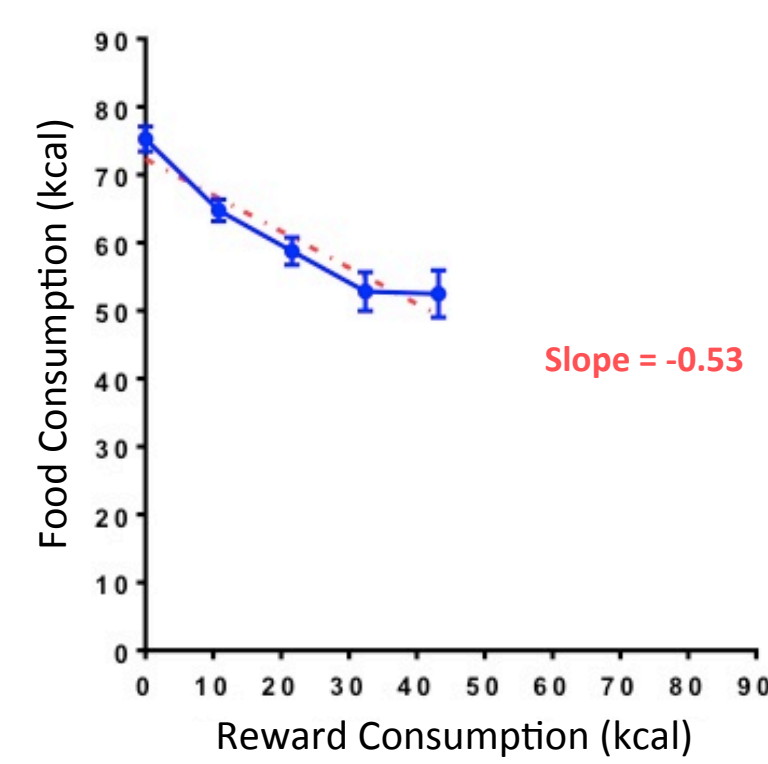
### 3.4 Percentage Body Weight Change



Irregularly rewarded animals % body weight change did not diverge from regularly rewarded animals.

## 4. Limits of compensation in males

### Bland food kcal consumption vs reward kcal consumption



There is a negative correlation between bland food consumption kcal and reward consumption kcal (p = 0.01). However, this correlation is not perfect.

With increasing reward consumption kcal, bland food kcal consumption decreases but plateaus at high levels of reward consumption, demonstrating the limits of compensation.

## Conclusions

1. Male rats compensate for small daily food rewards by reducing bland food intake. However, there is a limit to this compensation as males only partially compensate for large daily food rewards.
2. Females partially compensated for small daily food rewards by reducing bland food intake and appeared to gain weight quickly in response. The explanation for this compensatory sex difference is unknown.
3. Male rats compensate for daily irregularly presented food rewards, suggesting that learning is not required and instead, homeostatic mechanisms are able to track total daily kcal consumption, allowing the animals to compensate appropriately.

## References

1. Field, A. E., Austin, S. B., Gillman, M. W., Rosner, B., Rockett, H. R., & Colditz, G. A. (2004). Snack food intake does not predict weight change among children and adolescents. *International journal of obesity*, 28(10), 1210-1216.
2. Grydeland, M., Bergh, I. H., Bjelland, M., Lien, N., Andersen, L. F., Ommundsen, Y., ... & Anderssen, S. A. (2012). Correlates of weight status among Norwegian 11-year-olds: The HEIA study. *BMC public health*, 12(1), 1053.
3. Larson, N., & Story, M. (2013). A review of snacking patterns among children and adolescents: what are the implications of snacking for weight status?. *Childhood Obesity*, 9(2), 104-115.