# Genetic selection for temperament impacts on post-prandial thermogenesis and core body temperature in sheep

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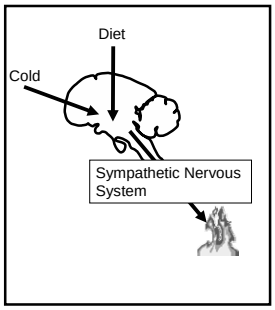
## Thermogenesis and Energy Expenditure




- Contributes to around 15% of total daily energy expenditure
- In rodents, known to occur in specialised brown adipose tissue (BAT)
- Recent studies have demonstrated functional brown fat in humans (NEJM 2009: 360: 1500-8; 360:1509-17; 360:1518-25, FASEB J 23: 1-23 Diabetes 58:1526-1531)
- Sheep are similar to humans in that this species has adipose regions that are particularly rich in BAT

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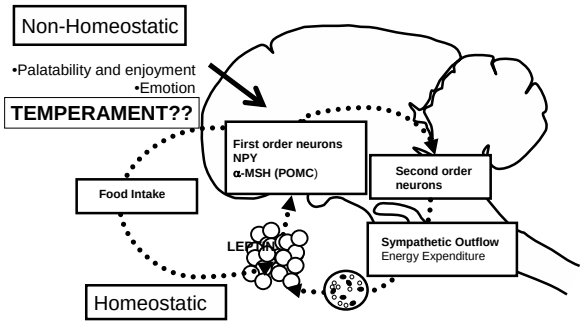
## Homeostatic versus non-homeostatic regulation of appetite and energy expenditure

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## Temperament and Non-exercise activity thermogenesis (NEAT)

- Human subjects that are resistant to diet-induced obesity display greater NEAT (maintenance of posture, talking, fidgeting) Levine et al., 1999.
- Similar behaviours and observations have also been reported in people with a high activity temperament.

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## **Nervous** and **Calm** sheep

- Sheep have been selected for Nervous or Calm traits for 16 years
- Selection was based on the arena and box tests- animal to human avoidance tests
- Does temperament cause changes in thermogenesis?

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AIM: To determine the effect of inherent differences in temperament on adipose thermogenesis and thermoregulation in sheep.

Exp 1. Effects of maintenance feeding and high or low energy intake on post-prandial temperature responses.

Exp 2. Effects of meal anticipation on temperature profiles.

Exp 3. Gene profiling of UCP 1, 2 and leptin mRNA in retroperitoneal and subcutaneous fat depots.

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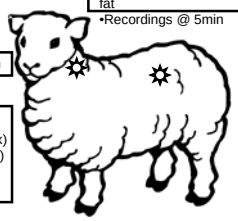
## Effects of maintenance and high/low energy diets on post-prandial thermogenesis in Nervous and Calm sheep.

- Thermistor in carotid artery for measurement of core body temperature
- Temperature probe (ibutton) in retroperitoneal fat
- Recordings @ 5min

Feeding window 0900-1600h

1. Maintenance Feeding
2. High energy diet (1.5x)
3. Low energy diet (0.7x)

Each for 12 days



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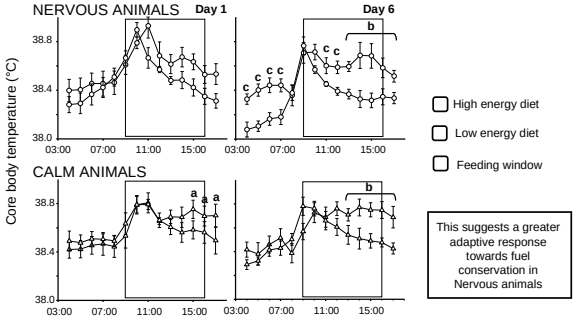
## Core body temperature is higher in Calm animals with maintenance feeding and high/ low energy intake




This suggests a greater adaptive response towards fuel conservation in Nervous animals

[a] P<0.05 effect of temperament
[b] P<0.05 effect of diet
[c] P<0.05 effect of diet in Nervous animals only

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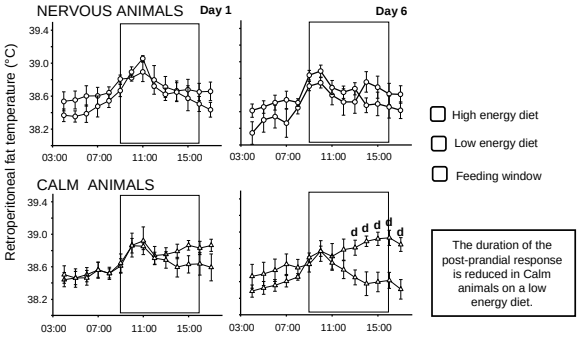
## Adipose temperature is similar in Nervous and Calm animals with maintenance feeding but not with high/ low energy intake




The duration of the post-prandial response is reduced in Calm animals on a low energy diet.

[d] P<0.05 effect of diet in Calm animals only

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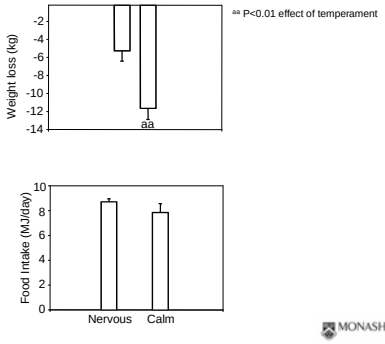
## Increased core body temperature is associated with increased weight loss in Calm animals fed a maintenance diet

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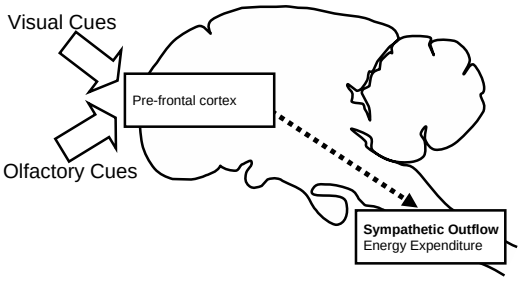
## Non-homeostatic regulation of thermogenesis?

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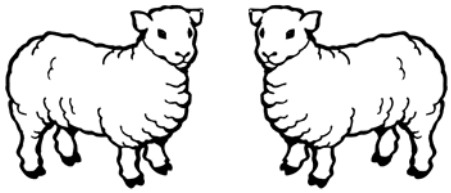
## Meal anticipation/ Friend-feeding paradigm

Program-fed sheep is fasted



"Friend" is fed in visual contact with fasted animal

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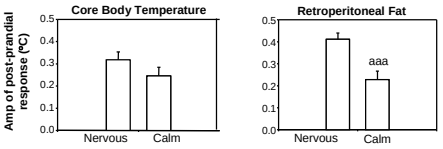
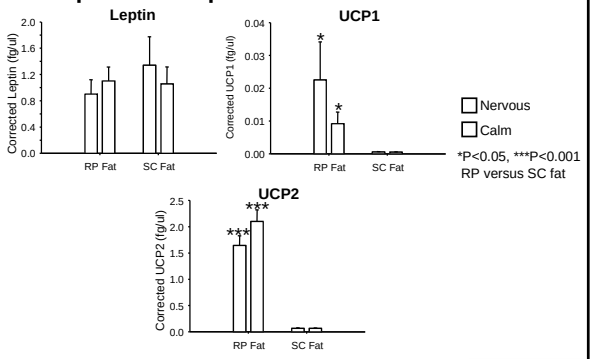
## The amplitude of response to meal anticipation in adipose tissue is greater in Nervous compared to Calm animals




aaaP<0.001 effect of temperament



## Effect of temperament on the expression of UCP 1, 2 and leptin in retroperitoneal and subcutaneous fat






## Conclusions

- **Under homeostatic conditions**, Calm animals exhibit higher core body temperature, which appears to translate to increased energy expenditure
- Both gene (measurement of UCP1 mRNA) and temperature profiling of the retroperitoneal fat indicate that increased core body temperature in Calm animals is not due to a higher rate of putative thermogenesis.
- Other sites important for thermogenesis- skeletal muscle?

- **Under non-homeostatic conditions**, such as meal anticipation, Nervous animals exhibit a more robust thermogenic response than Calm animals.