

**LINKS BETWEEN BEHAVIOURAL AND
PHYSIOLOGICAL PARAMETERS
DURING ADAPTATION TO STRESS**

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ABSTRACT

The scientific study of livestock management issues that have a significant animal welfare component has long included the measurement of both behavioural responses and physiological effects. One of the recurring problems in this area of research is a failure to adequately link these two fields of measurement. In order to do this, a model is required that allows incremental increases of the intensity of the stressor, so that behavioural and physiological adaptive responses can be monitored at the different levels, and the links between those two responses can be used as a measure of animal welfare. The first in a series of five experiments with Merino sheep investigated the individual differences between 24 ewes in their motivation to work for food, using a behavioural demand methodology. Motivation was measured by the slope of the demand curve (workload \times rewards obtained) at five different workloads (fixed ratio values; 5, 10, 20, 30 and 50), and no difference was found between animals, although there was a significant difference in work intensity between animals, as measured by the mean total number of rewards obtained individually. The results contributed to the design of the following behaviour experiments. The second and third experiments investigated feed restriction as an example stressor, to examine the links between behaviour and physiology, whereby metabolic adaptation and feeding motivation were examined for how they influence one another after 1, 3, 5 or 7 days of a low feeding level ($0.3 \times$ maintenance requirements). Adaptive responses were seen in blood concentrations of albumin, beta-hydroxy butyrate and urea nitrogen, indicating that lipolysis was initiated in response to the treatment. However, the treatment periods were possibly not long enough to differentiate between motivation to eat as influenced by the daily hunger

cycle and that influenced by longer-term energy replenishment, as the motivation as measured by the slopes of the demand curves was not different between treatments. The fourth and fifth experiments investigated heat challenge as an example stressor to investigate the links between behaviour and physiology, whereby adaptive responses were measured at 20, 25, 30 and 35°C and 70% relative humidity over a 5-day period, and motivation to avoid the same levels of heat challenge by working for access to a cool pen at four different fixed ratio values (1, 4, 10 and 25) was examined. The number of cool pen entries increased with increasing temperature, and the number of rewards obtained remained steady at fixed ratio 1, 4 and 10 but declined at 25. Respiration rates increased at fixed ratio 25, indicating that a combination of working for cool pen access and increasing respiration rates was the most biologically cost effective way to avoid overheating. It was concluded that measuring the physiological adaptive responses of animals to a stressor challenge, combined with the behavioural motivation to avoid or alleviate the stressor, provides a novel and objective approach to the measurement of welfare in farm animals. In addition, a need was identified to determine which responses to a particular stressor are influencing the animal's behavioural motivation being measured, in order to confirm that the physiology – behaviour links being identified are genuine.

CERTIFICATION

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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Signature

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