MEASURING TEMPERAMENT TRAITS IN CATTLE FOR QTL IDENTIFICATION

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INTRODUCTION

Cattle show individual variation in their behavioural responses to handling and management systems on farms. These behavioural responses are presumed to reflect underlying temperament traits such as fear or aggression. Differences between breeds in behavioural traits demonstrate that variation in temperament has a genetic component, and heritabilities for such traits have generally been estimated as moderate to high (Burrows, 1997). Selection for favourable behavioural phenotypes would increase the ability of animals to cope with stressors encountered in modern agricultural systems, improving animal welfare and productivity, and human safety when handling stock. Hence information about the genetic loci that influence temperament may be of use in selective breeding programmes to select for animals with temperaments better suited to their environment.

Behavioural data obtained in temperament tests must be shown to reflect underlying traits by demonstrating intra-animal repeatability, inter-animal variability and validity. The aims of this study were to obtain reliable temperament measures in cattle using behavioural tests, and to use this data to localise quantitative trait loci (QTLs) involved in temperament. Two behavioural tests were carried out on groups of bull and heifer calves, and the variability and repeatability of the results were examined. The data from the behavioural phenotypes will be correlated with genetic markers to localise the QTLs involved.

MATERIALS AND METHODS

Behavioural responses to two important aspects of handling, human approach and separation from the group, were measured. A Flight-from-Feeder (FF) Test and a Social Separation (SS) Test were carried out on 49 bull calves and 56 heifer calves at approximately 11 months of age. The animals were second generation cross-bred Charolais x Holstein from a resource herd, and included F_2 calves and backcrosses to each parental breed. These animals were the first group of the 400 second-generation offspring in the herd. The bulls were reared with their dams at pasture for the first six months and then housed in groups. The heifers were reared on a dairy bucket system from 24 hours after birth and grouped at two weeks.

The FF Test. This test measured fearfulness of human approach, by measuring how quickly an animal moved away from a feeder when an observer approached. Each animal was given a score between 1 and 6 from a categorical scale, 1 being the score obtained when the animal moved back when the observer was >2m away, and 6 being the score obtained if the animal didn't move back when the observer touched it on the head.

The SS Test. This test measured how an animal responded to separation from its group when placed alone in its home pen for 5 minutes. Behaviours displayed during this time were continuously recorded, and total durations calculated. Principle Components Analysis (PCA) was used to group behaviours of a common motivational background.
Each test was carried out twice on each animal. Restricted Maximum Likelihood (REML) was used to calculate repeatability values.

RESULTS AND DISCUSSION

The FF Test demonstrated a wide range of scores between individuals (Figure 1a+b). High inter-animal repeatability of test scores was seen for both the bulls (REML; $r = 0.47 \pm 0.11$) and heifers ($r = 0.58 \pm 0.09$). The distribution of scores differed between the bulls and heifers, the bulls being generally more fearful of human approach than the heifers. Sex differences in temperament measures have previously been found in cattle (Buchenauer, 1999). However, the difference seen here is likely to be due to environmental experience, as the heifers received much more human contact during rearing than the bulls.

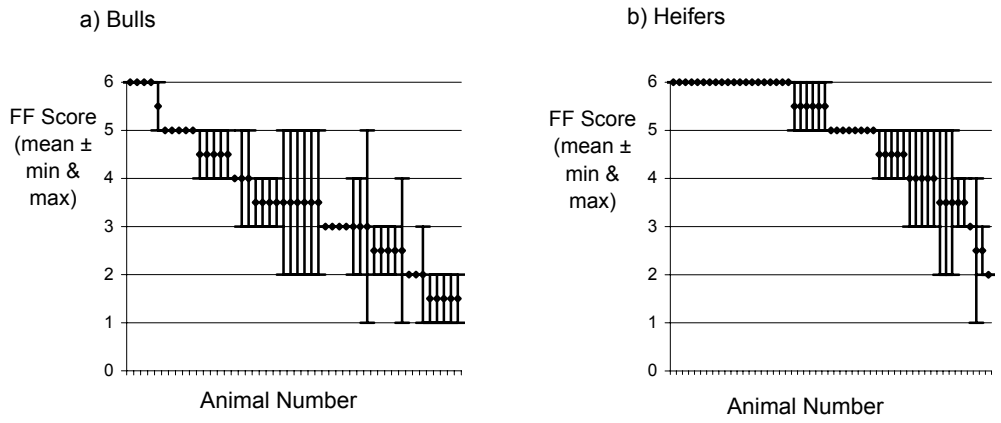

Figure 1a+b. Flight-from-Feeder scores obtained by a) the bull calves and b) the heifer calves

The score ranges from 1 (animal moves back when the observer is >2m away) to 6 (heifer doesn't move back when observer touches on the head).

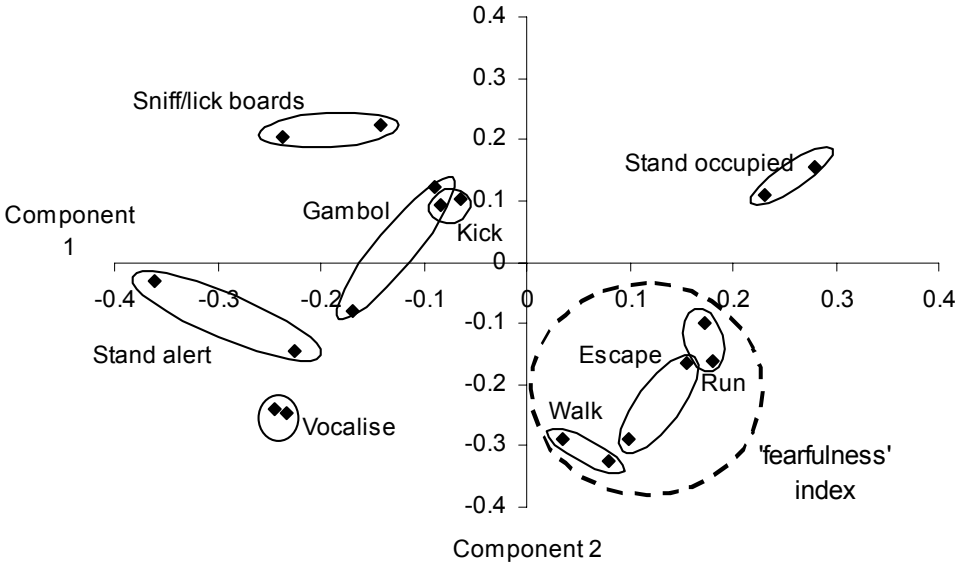

Figure 2. Principal Components Analysis of behaviours displayed by the heifers in the Social Separation Test

Durations of behaviours shown in the 2 tests are ringed. Component 1 explains 26.4% of the variation, Component 2, 11.2%. The summed durations of Escape, Run and Walk are used as a measure of fearfulness (dashed circle).

The animals showed a range of behaviours during the SS Test. A PCA analysis clustered the durations of walking, running and escape behaviours (Figure 2). Hence it was possible to identify these behaviours as likely to be reflecting fearfulness. The durations of walking, running and escape behaviours were summed ('WER') and the distributions of WER levels shown by the individual animals are shown in Figure 3a+b. A wide range in the level of these behaviours exhibited was found for both the bull and heifer calves. The heifers showed a high repeatability of $r = 0.63 \pm 0.11$, but the bulls had lower repeatability of $r = 0.40 \pm 0.13$. Again a difference in distribution was seen between the bull and heifer calves, with the bulls generally exhibiting lower levels of WER behaviours than the heifers. The heifers were kept in much closer proximity in indoor pens during rearing whereas the bulls were on grass for the first six months, and therefore differences between the sexes are again likely to be related to the rearing differences experienced by the animals.

CONCLUSION AND FUTURE PLANS

The data from the temperament tests demonstrated high inter-animal variability and intra-animal repeatability, from both the heifer and bull calves. Hence the data is suitable for use in

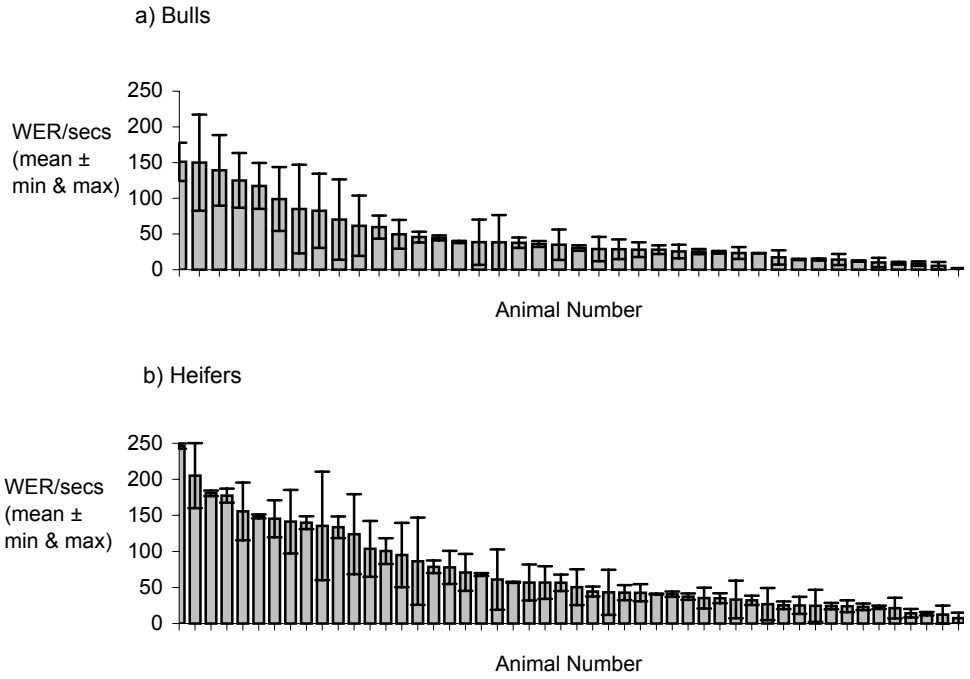

Figure 3. WER levels obtained in the SS Test by a) the bull calves and b) the heifer calves 'WER' is the combined total durations of the time spent walking, running and showing escape behaviours in 5 mins spent alone in the home pen.

associating behavioural phenotypes with genetic markers for the potential identification of QTLs. Sex differences in behavioural measurements were seen, but are likely to be due to differences in rearing methods. Regression methods for mapping QTLs are to be applied to the data and genotyping information from 186 microsatellite markers, which cover the genome at 20 cM intervals. Preliminary analysis of the transformed data from the F2 calves is underway, using QTL express (Seaton *et al*.; Haley *et al*., 1994). Data on the analysis of the full number of animals will be presented, and should identify the major QTLs associated with temperament in cattle.

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