Behaviour of Merinos selected for multiple rearing ability in response to human beings

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Introduction

In sheep which are subjected to extensive management conditions, it has been shown that temperament is related to the ability of ewes to rear their lambs (Kilgour and Szantar-Coddington, 1995). Divergent selection based on response of animals led to an unresponsive genotype as compared to an exceedingly nervous genotype (Lindsay, 1996, Murphy et al., 1998). Lambs born from the unresponsive line were more likely to survive than those lambs born from the excitable line. Murphy et al. (1994) also reported that animals of quite temperament grew faster and were better producers than restless animals.

This paper reports on the response of 8-month-old Merino lambs to a human being in an arena test. The experimental animals were descended from two Merino lines that were divergently selected for the ability of ewes to rear twins. Cloete and Scholtz (1998) indicated that these lines differed markedly in lamb survival, with particularly multiple-born progeny of the line selected in the upward direction (High or H line) being more likely to survive than those descended from the line selected in the downward direction (Low or L line). It was hypothesized that the behaviour of animals from these lines would react differently to humans in an arena test.

Material and methods

Animals and location: Animals used in this investigation have been selected divergently involving the ability of ewes to rear multiples (Cloete and Scholtz, 1998). Ewe and ram progeny of ewes rearing more than one lamb per joining (i.e. reared twins at least once) were preferably used as replacements in the H line. Replacements were preferably descended from ewes rearing fewer than one lamb per joining (i.e. ewes were barren or lost lambs born at least once) in the L line. Selection decisions on rams in particular were mostly based on three or more maternal lambing opportunities. Once selected, ewes remained in the breeding flock for at least five lambing opportunities, unless in the case of severe teeth or udder malfunction. Ewes and lambs of the lines were shown to differ markedly in their behaviour at lambing (Cloete and Scholtz, 1998; Cloete et al., 2003), and in their ability to rear multiples (Cloete and Scholtz, 1998). These lines were maintained on the Elsenburg Research farm near to Stellenbosch for the period of the study. The management, pastures utilized and climate at the experimental site were described by Cloete and Scholtz (1998).

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Testing procedure: A total number of 1370 animals that were born from 2001 to 2008 were assessed in a modified arena test at an age of approximately eight months. The arena test that was conducted involved the placing of a single sheep in an arena (10.6 m x 4.0 m) surrounded by a barrier to prevent escape. The floor of the arena was marked out in 18 numbered squares each measuring 1.77 m x 1.33 m. At one end of and outside the arena was a pen containing six to seven sheep, from the same contemporary group as the sheep being tested. An operator sat on a chair in the arena directly in front of this pen within the arena. The animals to be tested were kept in a separate pen out of sight. A second operator introduced the sheep tested to the arena at a distance of 10.6 m from the human operator inside the arena. The test sheep remained in the arena for a total of three minutes and was observed by at least two recorders located in a building outside and overlooking the arena. The numbered square in which the front left foot of the animal under assessment rested was noted every 15 seconds. The distance of each square from the seated operator was known. It was thus possible to calculate the following parameters to describe the behaviour of the sheep: (i) The mean distance, being the average distance from the person over the twelve readings. (ii) The total number of boundaries between squares crossed during the test, giving an indication of the total distance travelled by an individual. Other data recorded were the number of bleats and the number of times an animal urinated or defecated (Cloete et al., 2005). These tests were adapted from corresponding procedures employed by Murphy et al. (1994) and Kilgour and Szantar-Coddington (1995). Animals were tested once, as outcomes from the studies by Murphy et al. (1994) and Wolf et al. (2008) suggested that the repeatability of measures of temperament were fairly high (> 0.38).

Statistical analyses: The data that were recorded was analysed using an animal model that included the single random effect of animal (Gilmour et al., 2002). Fixed effects included in the analysis were year of birth, gender, age of the dam of the animal to be tested and birth type. In recent years, crosses and backcrosses were made between the H and L lines. However, because of small numbers for specific crossbred combinations that also differed between years, it was not included in the analyses as fixed effects. Instead, breeding values for the H and L lines were accessed and compared as described later. Initially only single-trait analyses were conducted on each of the five traits. Subsequent analyses involved three three-trait analyses to enable the derivation of genetic and phenotypic correlations among traits. Heritability estimates derived from the single-trait analyses and from the respective three-trait analyses were all within 0.02 from each other, and only a single set of figures from the three-trait analyses were tabulated. Animal solutions corresponding to breeding values were obtained from the output of the three-trait analyses and used to calculate genetic trends for the respective lines for the period of assessment.

Results and discussion

Ewe progeny uttered more bleats and defecated more often than their ram contemporaries ($P<0.05$) (Table 1). Defecation is widely accepted as a response to stressful conditions in small laboratory animals (Archer, 1973). This suggests that ewes were possibly more stressed than rams by the conditions they were placed in. Consistently with results of Wolf et al. (2008), no differences were found between single and multiple born lambs for any of the observations made in the arena test ($P > 0.05$). Significant differences in average distance

from the human operator, the number of crosses, the number of bleats, as well as the number of times experimental animals urinated and defecated were also found between birth years. Birth year effects are transient and unpredictable in animal breeding experiments. Because of the variation it controls, it is usually considered in animal breeding experiments. Although it was tried to manage the experimental animals as extensively as possible prior to the tests, it was impossible to completely standardize the handling of animals across years. Factors like routine handling for drenching and other routines as well as the provision of supplementary hay in some years may have added to year effects. A reduced wariness of humans is not unexpected in animals routinely subjected to handling (Boissy et al., 2002).

Table 1: Least square means (±S.E.) depicting the effects of gender for the distance from the human (average distance), number of crosses, number of bleats, and the number of times urinated or defecated during the arena test

Trait	Average distance	Number of crosses	Number of bleats	Times urinated	Times defecated
Gender	NS	NS	**	*	*
Rams	3.71±0.15	17.2±1.0	13.6±1.3	0.87±0.06	1.05±0.07
Ewes	3.66±0.15	18.0±1.0	17.4±1.3	0.75±0.06	1.17±0.07

NS- Not significant (P>0.01); *-Significant (P<0.05); ** Significant (P<0.01)

Table 2 suggests that significant genetic variation occurred for all the traits assessed except for the number of times animals defecated. Wolf et al. (2008) accordingly reported heritability estimates of 0.39 for number of bleats and 0.29 for squares entered. Significant genetic correlations suggested that animals keeping a greater distance between themselves and the human operator were more likely to bleat and defecate. Phenotypic correlations were in the same direction, but smaller. Animals bleating at a high frequency were also more likely to defecate on the genetic level.

Table 2: Phenotypic variance (σ^2_p), heritability (h^2 – in bold on the diagonal), genetic correlations (in normal text above the diagonal) and phenotypic correlations (in italic print below the diagonal) for the average distance from operator (average distance), number of crosses, number of bleats and the number of times urinated or defecated during the arena test

Trait	Average distance	Number of crosses	Number of bleats	Times urinated	Times defecated
Total phenotype (σ^2_p)	2.443	105.5	100.9	0.4832	1.113
Average distance	**0.16**	0.25	0.55*	0.43	0.97*
Number of crosses	*0.25**	**0.16**	0.04	-0.07	-0.17
Number of bleats	*0.34**	*0.20**	**0.32**	-0.06	0.52*
Times urinated	*0.01*	*0.04*	*-0.02*	**0.12**	0.56
Times defecated	*0.13**	*-0.04*	*0.05*	*0.19**	**0.05**

Standard errors for h^2 estimates were 0.03 to 0.05, while it ranged from 0.15 to 0.37 for genetic correlations and 0.03 to 0.04 for phenotypic correlations. Significant correlations are denoted by * (P < 0.05)

Averaged breeding values in the H line were reduced for the times they defecated (b ± s.e. = -0.037 ± 0.009; r = 0.84; P<0.01). A corresponding increase in the defecation rate was observed in the L line over time (b ± s.e. = 0.041 ± 0.009; r = 0.83; P<0.05). Corresponding tendencies were found for the number of times the experimental animals urinated during the test (P=0.11 in the H line and P=0.08 in the L line). Animals in the L line also increased their distance from the human operator over time (b ± s.e. = 0.063 ± 0.019; r = 0.80; P<0.05).

Conclusion

This study clearly indicated genetic variation in the response of experimental animals to a human operator. Divergent selection for multiple rearing ability also seemed to lead to divergent responses in some of the behavioural attributes studied. Animals in the L line generally responded by showing more aversion to the human, with the opposite trend in the H line. A number of recent studies indicated that selection against aversion for humans can be successful in other species (see review by Jensen et al., 2008). The advantage of better reproduction by animals exhibiting lower levels of stress or fear during unfamiliar procedures involving humans is obvious from an ethical viewpoint, since animal welfare considerations are becoming of greater importance during routine husbandry procedures (Boissy et al., 2002).

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