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AN EXAMINATION OF MULTIBREED TEMPERAMENT MEASURES RECORDED IN THE SOUTHERN MULTIBREED RESOURCE POPULATION

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SUMMARY

Temperament has important impacts on on-farm profitability through its impact on other production traits like reproduction, production and meat quality in addition to its direct impact on the welfare of farm staff. The Southern Multibreed project to date has recorded over 9,800 flight time (FT) and crush score (CS) phenotypes to create a multibreed reference population for cattle temperament. This paper also examines the impact animal handling due to extensive trait recording has on the quality of temperament measures using genetic parameters. The heritabilities for FT were moderate in steers (0.27-0.31) and low to moderate in heifers (0.15-0.25). The heritabilities for CS were moderate for both steers (0.24-0.25) and heifers (0.29-0.36). The phenotypic variance for FT decreased between the weaning and yearling stages in steers but increased in heifers. The phenotypic variance for CS increased between the weaning and yearling stages in steers but decreased in heifers. The genetic correlation between FT measures at weaning and yearling stages was 0.95 in steers and 0.69 in heifers. The correlations between weaning and yearling stages for CS were 0.72 and 0.59 in steers and heifers, respectively. The correlations between steer and heifer FT and CS at the weaning stage were 0.95 and 0.87, respectively. At the yearling stage these correlations were 0.69 and 0.84. These results suggest that the heifers assimilated to the crush environment as time progressed due to extensive phenotypic recording while the steers displayed their inherent behaviour when they were exposed to the stress associated with the new environment when entering the feedlot. These outcomes indicate it is important that animals are in an environment where learnt behaviours don't impact the expression of inherent behaviour when temperament traits are recorded.

INTRODUCTION

Temperament is a trait that has been shown to impact profitability through reproduction and maternal behaviour (Phocas *et al.* 2006), meat quality (Kadel *et al.* 2006), animal and handler welfare (Grandin 1993) and production costs (Burrow 1997). Therefore, improving temperament through selection would help to improve on-farm profitability. To successfully improve profitability, selection tools must provide predictive accuracy for all traits that impact profitability and form the basis of current and future estimated breeding values and selection indexes. The capacity to do this is impacted by the circumstances under which traits are measured. Currently, temperament-related traits are recorded at weaning and included in only a limited number of BREEDPLAN genetic

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evaluations (Docility/Crush Score (CS): Angus/Hereford, Flight Time (FT): Brahman) and only on a within-breed basis (Walkom *et al.* 2018). The Southern Multibreed project (SMB: Walmsley *et al.* 2021) provides a multibreed reference population that can be used to enhance current BREEDPLAN evaluations to better target profitability gains through selection for temperament. This paper provides a brief update on the progress of recording temperament-related traits in the SMB Project and an examination of the impact of animal handling due to extensive trait recording on the quality of temperament measures using genetic parameters.

MATERIALS AND METHODS

Animal Data. Temperament traits were recorded on 1,988 SMB heifers and 1,979 steers from five *Bos taurus* breeds (Angus (n=1,319), Charolais (n=437), Hereford (n=913), Shorthorn (n=563), Wagyu (n=591)) and the Brahman breed (n=144). The SMB animals were bred as part of the SMB project – an extensive reference population collecting many phenotypes from birth to slaughter (Walmsley *et al.* 2021). The animals were born in 2020, 2021 and 2022 (Walmsley *et al.* 2023) across five New South Wales Department of Primary Industries and Regional Development research facilities; Trangie Agricultural Research Centre; Grafton Primary Industries Institute; Tocal Agricultural Centre; Glen Innes Agricultural Research and Advisory Station; and Elizabeth MacArthur Agricultural Institute; Menangle.

All animals had FT and CS recorded at the weaning and yearling stages, while only heifers were recorded post-mating (final). The heifers were only recorded on their birth property while the steers were recorded on their birth property at weaning and at the University of New England (UNE) research feedlot, "Tullimba" (Kingstown) as they entered the feedlot as yearlings. Crush scores were visually assessed when animals were confined in a crush for 5 seconds based on a 5-point scale of agitation; 1=calm/docile, 2=restless, 3=nervous, 4=flighty, or 5=aggressive (Grandin 1993). The scale was modified to include half scores to increase the number of levels. All crush scores were assessed by one assessor. Flight time was measured as the time to break 2 infrared sensors 1.7m apart after exiting the crush into an open yard (Burrow *et al.* 1988). All animals were managed in mixed breed groups. Animals were excluded from the analysis where the sire or dam was unknown or where the animal was born as a twin. Animals with a FT phenotype three standard deviations greater than the overall mean were capped, so their FT phenotype was equal to the mean + 3 standard deviations.

Statistical Analyses. For analysis, FT was multiplied by 100. Genetic parameters and heritabilities were estimated from univariate mixed linear animal models using ASReml (Gilmour *et al*. 2021). The statistical model fitted the contemporary group and breed as fixed class effects and animal age as a fixed covariate. The contemporary group was defined by the herd of birth, year of birth, sex and the calving/management group. The animal was fitted as a random effect, and the dam's permanent environment effect was tested for significance. The categorical nature of CS was ignored because genetic correlation estimates are not affected by the statistical treatment of the categorical trait (Kadarmideen *et al.* 2003). Five generations of pedigree were used, with 359 sires represented by an average half-sib family size of 11.1, ranging from 1 to 52.

RESULTS AND DISCUSSION

The heifers were, on average, 233, 405 and 604 days of age when recorded at the weaning, yearling and final stages, respectively, while the steers were 231 and 493 days of age at the weaning and yearling stages. The mean FT and CS were similar at weaning for steers and heifers while at the yearling stage mean FT was higher and mean CS tended to be lower in heifers. Variance component estimation (Table 1) showed that FT had moderate heritabilities of 0.31 (0.06) and 0.27 (0.06) in steers at the weaning and yearling stages, respectively, and low to moderate heritabilities of 0.25 (0.06), 0.22 (0.05) and 0.15 (0.05) in heifers at the weaning, yearling and final stages. The heritabilities estimated agreed with those found for tropically adapted breeds (Kadel *et al.* 2006). The heritability estimates for crush score in this study tended to be higher than those reported for tropically adapted (0.15; Kadel *et al.* 2006) and Angus (0.21; Walkom *et al.* 2018) cattle. However, higher estimates were reported for Limousin cattle (0.39; Walkom *et al.* 2018). The dam's permanent environmental effect was significant (data not shown) for CS when assessed on steers entering the feedlot at the yearling stage. This was evident in the means and phenotypic variances of the two sexes between stages. The mean and phenotypic variance of FT decreased, and CS increased between the weaning and yearling stage measurements for steers (Table 1). This suggests the steers were more agitated upon entering the feedlot than when they were measured at their birth property. In comparison, FT's mean and phenotypic variances increased, and CS decreased between the weaning, yearling and final stage measurements for heifers. In contrast to the steers, this suggests the heifers became more assimilated rather than agitated to the crush environment on their birth property due to continued handling throughout the project.

Table 1. Summary statistics, phenotypic variance (V_p) and heritability (h^2: standard error) estimates for flight time (FT: seconds*100) and crush score (CS) recorded on steers and heifers at weaning, yearling and final stages

Sex	Trait	Stage	N	Mean	Std	Min	Max	V_p	h^2
Steer	FT	Weaning	1973	139.9	68.5	35.8	446	3492.2	0.31 (0.06)
		Yearling	1930	108.5	51.3	37.7	444	2268.2	0.27 (0.06)
	CS	Weaning	1973	1.4	0.4	1	3	0.14	0.24 (0.06)
		Yearling	1930	1.7	0.6	1	3.5	0.29	0.25 (0.07)
Heifer	FT	Weaning	1982	139.5	70.5	40	446	3719.7	0.25 (0.06)
		Yearling	1974	140.9	81.9	11	444	4747.1	0.22 (0.05)
		Final	1958	179.8	112.1	41.1	605	8609.6	0.15 (0.05)
	CS	Weaning	1982	1.4	0.4	1	3	0.15	0.30 (0.06)
		Yearling	1974	1.4	0.5	1	3	0.18	0.29 (0.06)
		Final	1958	1.2	0.4	1	3	0.11	0.36 (0.06)

The genetic correlation between FT weaning and yearling measures were high for steers (Table 2), suggesting the same FT trait is being measured at weaning and yearling stages. In comparison, the correlations in heifers were lower. The correlations between the final stage measures and those at the weaning and yearling stages varied. The correlation between the weaning and final stages was 0.93 (0.18) for FT and 0.58 (0.12) for CS. In contrast, the yearling and final stages correlations were 0.70 (0.17) for FT but 0.95 (0.07) for CS. When comparing steers and heifers at weaning, the correlations were 0.95 (0.14) for FT and 0.87 (0.14) for CS (Table 2). The high correlations between steers and heifers at the weaning stage suggest the same trait is being measured. At the yearling stage, the correlations were 0.69 (0.14) for FT and 0.84 (0.12) for CS. The reduction in the correlation at the yearling stage between steers and heifers for FT supports that some assimilation may have occurred in the heifers due to continued handling through the crush on the home property while the steers were exposed to a foreign environment.

CONCLUSIONS

The SMB project has measured over 9,800 FT and CS traits in the first three cohorts of the project to establish a multibreed reference population to help make genetic improvements for temperament in Australian cattle. The estimated heritabilities agree with past studies. The genetic correlations were high between measurements at different stages in steers but were less consistent and tended to be lower in heifers. The correlations between steers and heifers were high at the weaning stage but lower at the yearling stage. These results suggest that the SMB heifers tended to assimilate to the crush environment on their birth property due to continued handling, while the steers were better able to display their inherent behaviour due to being exposed to a foreign environment for the yearling measurement taken in the feedlot before entry. These outcomes indicate that it is important that whenever temperament traits are recorded, animals are in an environment where learnt behaviours don't impact the expression of inherent behaviour.

Table 2. Estimated genetic (r_g) and phenotypic (r_p) correlations (standard error) for flight time (seconds*100) and crush score between weaning, yearling and final stages for steers and heifers, and between steers and heifers at weaning and yearling stages

Sex x Stage		**Flight time**		**Crush score**	
		r_g	r_p	r_g	r_p
Steer weaning	Steer yearling	0.95 (0.10)	0.33 (0.02)	0.72 (0.13)	0.33 (0.02)
Heifer weaning	Heifer yearling	0.69 (0.13)	0.30 (0.02)	0.59 (0.12)	0.30 (0.02)
Heifer weaning	Heifer final	0.93 (0.18)	0.23 (0.02)	0.58 (0.12)	0.26 (0.02)
Heifer yearling	Heifer final	0.70 (0.17)	0.33 (0.02)	0.95 (0.07)	0.47 (0.02)
Steer weaning	Heifer weaning	0.95 (0.14)	0.26 (0.04)	0.87 (0.14)	0.26 (0.04)
Steer yearling	Heifer yearling	0.69 (0.14)	0.22 (0.05)	0.84 (0.12)	0.27 (0.05)

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REFERENCES

Burrow H.M. (1997) *Anim. Breed. Abstr.* **65**: 477.

Burrow H.M., Seifert G.W. and Corbet N.J. (1988) *Proc. Aust. Soc. Anim. Prod.* **17**: 154.

Gilmour A.R., Gogel B.J., Cullis B.R., Welham S.J. and Thompson R. (2021) 'ASReml SA User Guide Release 4.2' VSN International Ltd, Hemel Hempstead, HP1 1ES, UK.

Grandin T. (1993) *Appl. Anim. Behav. Sci.* **36**: 1.

Kadel M.J., Johnston D.J., Burrow H.M., Graser H-U. and Ferguson D.M. (2006) *Aust. J. Agri. Res.* **57**: 1029.

Kadarmideen H.N., Thompson R., Coffey M.P. and Kossaibati M.A. (2003) *Livest. Prod. Sci*. **81**: 183.

Phocas F., Boivin X., Sapa J., Trillat G., Boissy A. and Le Neindre P. (2006) *Anim. Sci*. **82**: 805.

Walmsley B.J., Donoghue K.A., Johnston D.J., Clark S.A., Siddell J.P., Walkom S.F., Granleese T. and Arthur P.F. (2021) *Proc. Assoc. Advmt. Anim. Breed. Genet*. **24**: 423.

Walkom S.F., Jeyaruban M.G., Tier B. and Johnston D.J. (2018) *Anim. Prod. Sci.* **58**: 213.

Walmsley B.J., Moore, K.L., Walkom, S.A., Clark S.A., Granleese T. and Donoghue K.A. (2023) *Proc. Assoc. Advmt. Anim. Breed. Genet*. **25**: 310.