Behavioral Associations during a Novel Object Test and Performance of Barrows Divergently Selected for Residual Feed Intake

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Summary and Implications

Selection for decreased RFI is controversial from a welfare standpoint, given that the genetic variation in RFI reflects the genetic variation in activity and response to stress. The objective of this experiment was to examine the behavioral metric correlations and growth performance of barrows divergently selected for residual feed intake (RFI) during a novel object test. Forty low-(LRFI, more feed efficient) and 40 high-RFI (HRFI, less feed efficient) barrows from the 8th generation Yorkshire selection lines were randomly selected. Barrows were evaluated in a Novel Object Test for zone crossing, zone 1 (defined as the mouth, nose, and/or face of the pig contact any part of zone 1), escape, freeze, urination and defecation frequencies and their effect on performance measures. Within the HRFI line, zone crossing frequency accounted for 10.9% of the variation in 10th-rib back fat at off test (r= 0.33; $P = 0.04$). Within the LRFI line, freeze frequency accounted for 13.7% of the variation in feed conversion ratio (r= 0.37; $P = 0.03$) and defecation frequency accounted for 11.6% of the variation in 10th-rib back fat at off test (r= 0.34; $P = 0.05$). Therefore, within the context of the ISU swine genetic selection program for improved lean accretion and feed efficiency, there were no negative behavioral metrics that determinately affected performance measures during the grow-finish period.

Introduction

Feed is one of the largest costs in pork production; therefore, improving feed efficiency can increase producer profitability. Residual feed intake (RFI) is used to measure feed efficiency. Pigs that consume less feed than expected for maintenance and growth have a lower RFI (LRFI) and are more feed efficient compared to higher RFI (HRFI) pigs. Selection for decreased RFI is controversial from a welfare standpoint, given that the genetic variation in RFI reflects the genetic variation in activity and response to stress. Colpoys and others (2014) reported that LRFI barrows were escaped less and froze less to novelty compared to HRFI barrows during a Novel Object Test. What remains unknown is how the behavior of LRFI and HRFI lines during a Novel Object Test affect performance during the grow-finish period. Therefore, the objective of this experiment was to examine the behavioral metric correlations and growth performance of barrows divergently selected for residual feed intake during a Novel Object Test.

Materials and Methods

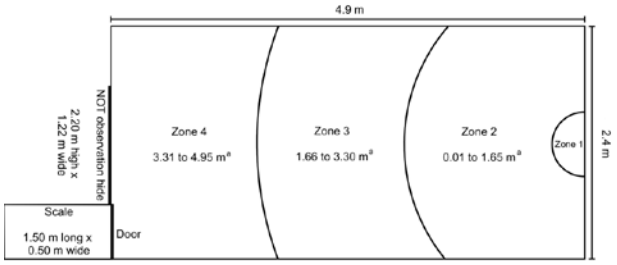
The protocol was approved by the Iowa State University Institutional Animal Care and Use Committee.

Animals: Forty low-(LRFI, more feed efficient) and 40 high-RFI (HRFI, less feed efficient) barrows (46.5 ± 8.6 kg) from the 8th generation Yorkshire selection lines were randomly selected.

Location: This work was conducted at the Lauren Christian Swine Research Center at the Iowa State University Bilsland Memorial Farm, near Madrid, IA.

Novel Object Test: Barrows were evaluated individually within a 4.9 x 2.4 m test arena. Arena sides were lined with black corrugated plastic at a height of 1.2 m. During testing, barrows were individually moved from their home pen to the test arena, which was located in a different room within the same building. Each individual barrow was placed for one minute in a weigh scale where it could not see the arena. At the conclusion of the one minute, the weigh scale door was opened into the back corner of the test arena. An orange traffic cone was in zone 1. Each barrow voluntarily approached the orange traffic cone. The Novel Object Test lasted for 10 consecutive minutes (Figure 1).

Figure 1: Novel object arena. [a]Indicates the zone distance from the orange traffic cone, located in zone 1 (Colpoys et al., 2014).



Behavioral acquisition: Three color cameras (Panasonic, Model WV-CP-484, Matsushita Co. LTD., Kadoma, Japan) were placed above the test arena. Video was collected and saved to a computer hard disk using Handy AVI (HandiAvi version 4.3 D, Anderson's AZcendant Software, Tempe, AZ, USA) at 10 frames/seconds.
Behavioral metrics: During the 10-minute Novel Object Test, barrows were continuously observed via video analysis for zone crossing, zone 1, escape and freeze frequencies by one observer using Observer software (The Observer XT version 10.5, Noldus Information Technology, Wageningen, The Netherlands). The frequency of urinations and defecations were collected live (Table 1).

Table 1: Behavioral metrics ethogram recorded during the Novel Object Test from barrows selected for HRFI and LRFI.

Frequency (n)	Description
Zone crossing	Sum of the total number of zone 4, 3, and 2 entrances
Zone 1	The mouth, nose, and/or face of the pig contact any part of zone 1 (defined as the orange traffic cone)
Escape	The front two or all four pig's hooves were off the arena floor in attempt to remove itself from the test arena
Freeze	No movement of any portion of the pig's body was visible for ≥3 seconds
Urination	Excreting urine
Defecation	Excreting feces

Performance measures: Performance measures were collected over the grow-finish period, and included ADG, feed conversion ratio, live weight, 10th-rib backfat-and loin eye area off test. The ADG was estimated as the slope from simple linear regression of weekly body weight on number of days on test. Feed conversion ratio was a rate measuring the efficiency with which the barrow body converts feed. The10th-rib backfat- and loin eye area were measured by ultrasound using an Aloka 500V SSD ultrasound machine fitted with a 3.5-MHz, 12.5-cm, linear array transducer (Corometrics Medical Systems Inc., Wallingford, CT).

Statistical analysis: All data were evaluated using the correlation procedure of SAS® (version 9.3, SAS Inst. Inc., Cary, NC). Data were sorted by line and then within lines, Pearson correlation coefficients were determined among behavioral metrics and performance measures. Relationships were considered statistically significant at the $P \leq 0.05$ level. For significant values the percent variation accounted for by the performance measure was calculated as the correlation coefficient (r) raised to the second power and multiplied by 100 ($r^2 \times 100$).

Results and Discussion

Within the HRFI line, zone crossing frequency accounted for 10.9% of the variation in 10th-rib back fat at off test (r= 0.33; P = 0.04; Table 2). Within the LRFI line, freeze frequency accounted for 13.7% of the variation in feed conversion ratio (r= 0.37; P = 0.03) and defecation frequency accounted for 11.6% of the variation in 10th-rib back fat at off test (r= 0.34; P = 0.05; Table 3).

Conclusion

In conclusion, zone crossing frequency was moderately correlated with 10th-rib backfat at off test in HRFI barrows. In LFRI barrows, freeze frequency was moderately correlated with feed conversion ratio and defecation frequency was moderately correlated with10th-rib backfat at off test during Novel Object Test. Therefore, within the context of the ISU swine genetic selection program for improved lean accretion and feed efficiency, movement, escape, freezing, urination and defection responses made by LRFI barrows during the Novel Object Test did not detrimentally effect these performance measures.

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Table 2: Pearson correlations(r) among HRFI[1] barrow behavioral metrics and performance during Novel Object Test.

		Performance measures				
Behavioral metrics (n)		ADG	Feed conversion ratio[2]	Live weight[3]	10th-rib backfat[4]	Loin eye area[4]
Zone crossing	r	0.19	-0.03	0.05	0.33	-0.26
	P-value	0.26	0.86	0.76	0.04	0.11
Zone 1	r	0.23	0.10	-0.07	0.25	-0.17
	P -value	0.17	0.56	0.67	0.13	0.31
Escape	r	-0.26	0.04	-0.30	-0.18	0.02
	P -value	0.11	0.83	0.07	0.28	0.89
Freeze	r	0.01	-0.14	0.15	-0.20	0.12
	P -value	0.96	0.41	0.39	0.23	0.48
Urination	r	0.01	0.01	0.07	0.14	0.00
	P -value	0.98	0.95	0.68	0.39	0.98
Defecation	r	-0.09	0.02	-0.01	-0.24	-0.04
	P-value	0.57	0.93	0.96	0.15	0.81

[1]High residual feed intake pigs consume more feed than expected for a given population.
[2]The ratio between feed intake and weight gain
[3]Off-test live weight data were collected prior to barrows leaving the farm. Targeted market weight was 118 kg or greater.
[4]10th-rib back fat and loin eye area measurements occurred when mean barrow body weight was 121.5 ± 7.2 kg at 241 ± 7 d of age.

Table 3: Pearson correlations (r) among LRFI barrow behavioral metrics and performance during Novel Object Test.

		Performance measures				
Behavioral metrics (n)		ADG	Feed conversion ratio[2]	Live weight[3]	10th-rib backfat[4]	Loin eye area[4]
Zone crossing	r	0.19	-0.33	0.001	0.18	0.05
	P-value	0.28	0.05	0.99	0.28	0.76
Zone 1	r	0.12	-0.18	-0.09	0.18	-0.10
	P -value	0.49	0.31	0.62	0.30	0.55
Escape	r	0.02	0.18	-0.16	0.09	-0.07
	P -value	0.91	0.30	0.38	0.60	0.69
Freeze	r	-0.18	0.37	-0.23	-0.04	-0.18
	P -value	0.29	0.03	0.21	0.80	0.30
Urination	r	0.03	-0.08	-0.11	0.08	-0.16
	P -value	0.88	0.66	0.55	0.64	0.36
Defecation	r	-0.10	0.15	-0.01	0.34	-0.19
	P-value	0.57	0.37	0.95	0.05	0.26

[1]Low residual feed intake pigs consume less feed than expected for a given population.
[2]The ratio between feed intake and weight gain.
[3]Off-test live weight data were collected prior to barrows leaving the farm. Targeted market weight was 118 kg or greater.
[4]10th-rib back fat and loin eye area measurements occurred when mean barrow body weight was 121.5 ± 7.2 kg at 241 ± 7 d of age.