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Relationships among temperament, behavior, and growth during performance testing of bulls[1]

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ABSTRACT: Excitable cattle are dangerous to personnel and have reduced individual performance. The aim of this study was to 1) identify objective criteria for evaluating bull temperament and 2) examine relationships among temperament, behavior, and performance of bulls during an 84-d performance test. Angus bulls (n = 60) were reared in 6 pens based on BW and age. Pen scores (PS; 1 = docile and 5 = very aggressive) were assigned on d –1, 27, 55, and 83. Exit velocity (EV), BW, time to exit the chute, and order through the chute were recorded on d 0, 28, 56, and 84. The ADG was calculated for the 84-d test period, and ultrasound data and frame score calculations were recorded on d 84. Dataloggers measured steps taken, lying time, number of lying bouts, and lying bout duration of bulls (n = 27; 3 pens) from d 3 to 28 and d 59 to 84. Bulls with a d –1 PS of 1 or 2 were categorized as calm (PScalm; n = 40), whereas bulls with a PS of 3 or 4 were categorized as excitable (PSexcitable; n = 20). Bulls were separated into 2 groups based on the bottom 20 EV (EVcalm) and top 20 EV (EVexcitable) on d 0. Mixed model ANOVA (SAS 9.3) was used to compare groups for the two temperament assessment methods, behavior, and growth performance. Mean EV decreased (P < 0.05) by d 84. Total lying time from d 3 to 28 was greater (P < 0.05) for PScalm bulls when compared with PSexcitable bulls. However, total lying time from d 59 to 84 was greater (P < 0.05) for EVexcitable bulls when compared with EVcalm bulls. Regardless of initial contemporary group assignment, all bulls exited the chute slower (P < 0.001) on d 84 than on d 0. The PSexcitable bulls had greater (P < 0.01) frame scores and greater ADG than PScalm bulls. The PSexcitable bulls had more (P < 0.01) backfat than PScalm bulls. However, ribeye area was smaller (P < 0.01) in EVexcitable bulls than EVcalm bulls. Based on these results, bulls appeared to have habituated over the testing period. Additionally, the potential lack of innate temperament variation may have attributed to the little difference seen among the behavioral and performance data. Therefore, temperament should be reassessed within a novel environment with new handlers to differentiate between the bull's true temperament and its ability to habituate.

Key words: Angus bulls, behavior, growth performance, temperament

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INTRODUCTION

Handling cattle can be dangerous, especially when working with excitable bulls or cows with newborn calves. Between 2003 and 2008, 108 human fatalities were caused by cattle (CDC, 2009). Cattle temperament, or excitability, was defined as the reactivity, or fear response, to humans or novel environments and is moderately heritable (Fordyce et al., 1988). Several methods have been used for scoring temperament and the 3 most common measurements are chute score, pen score, and exit velocity (Curley et al., 2006). Exit

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velocity and pen score are used more frequently for assessing temperament, because there was less adaptation over time to these temperament measures as compared with chute score (Curley et al., 2006).

In addition, temperament influences production characteristics of cattle. For example, cattle deemed excitable according to chute score had lower ADG and produced less tender meat than docile cattle (Voisinet et al., 1997a,b). Nkrumah et al. (2007) reported exit velocity had a positive genetic correlation with ultrasound measured back fat thickness ($r = 0.36$) and longissimus muscle area ($r = 0.81$) but a negative genetic correlation with ultrasound measured marbling score ($r = –0.13$). Additionally, behavioral patterns (i.e., lying time, feeding behavior, etc.) can alter cattle temperament, such that a reduction in lying time may induce excitable behaviors (Wierenga, 1987; Fisher et al., 1997). However, to date, no study has examined the relationships between lying behavior and degree of temperament of bulls enrolled in an 84-d performance test.

The present study was conducted to 1) identify objective criteria for evaluating bull temperament and 2) examine relationships among temperament, behavior, and performance of bulls during an 84-d performance test.

Table 1. University of Tennessee Bull Testing Station[1] feed composition and nutrient analysis

Feed composition	% (as-fed basis)
Wheat middlings	33.3
Cottonseed hulls	20.0
Rice hulls	6.5
Corn	10.0
Corn gluten pellets	10.0
Soy mill feed	7.1
Distiller's grains and solubles	6.5
Limestone	1.9
Liquid binder	1.5
Cottonseed meal	1.3
Salt	0.5
Sodium bicarbonate	0.4
Vitamin/mineral premix[2]	1.1
Nutrient content[3]	**% (DM basis)**
TDN	60.66
CP	12.26
Ca	0.91
P	0.47
K	0.85
CF	16.60
Salt	0.50

[1]Spring Hill, TN.

[2]Vitamin/mineral premix included the following per kilogram of DM: 7.8 KIU of Vitamin A, 1.8 KIU of Vitamin D, 37.1 IU of Vitamin E, 0.02 g of copper, 0.09 g of zinc, 0.04 g of manganese, and 0.3 mg of selenium.

[3]Nutrient content of pelleted feed ration fed to all bulls ad libitum.

MATERIALS AND METHODS

Animals and Housing

All animal procedures were approved by the University of Tennessee Institutional Animal Care and Use Committee. Bulls ($n = 65$) born between December 2012 and March 2013 were delivered to the University of Tennessee Bull Testing Station at Middle Tennessee Research and Education Center (**MTREC**) located in Spring Hill, TN. Bulls originated from producers located in Tennessee and Kentucky. Sixty bulls were registered Angus, and the remaining bulls were Simmental, SimAngus, and Santa Gertrudis breeds; however, only the data collected from the Angus bulls ($n = 60$; 263 ± 36 d of age; 345.3 ± 45.4 kg BW) were included in the final data set and subsequent analyses. Enrolled bulls were accompanied by a health certificate from a licensed veterinarian, including vaccination records and results of a negative test for bovine viral diarrhea. All bulls were revaccinated with BRD Shield (Bovine Rhinotracheitis – Virus Diarrhea – Parainfluenza 3 – Respiratory Syncytial Virus; Novartis Animal Health, Greensboro, NC) on arrival at MTREC.

Bulls were allocated to pens (357 m^2 uncovered dirt pad and 68 m^2 covered concrete pad) of 8 to12 bulls per pen based on similar BW and age. Approximately 35 m^2 of space per bull was provided. Feed bunks and cradle-style hay feeders were located under the covered portion of the pen and automatic waters were located at the boundary of the covered and uncovered portions of the pen. Bulls received ad libitum access to hay (orchard grass and tall fescue blend) and a pelleted feed (Table 1). Bulls were habituated to this environment for 14 d before beginning the 84-d performance test.

Temperament Data Collection

On the day before being worked through the chute system, (d –1, 27, 55, and 83), bulls were randomly grouped within their pens (3 to 5 bulls/group; 2 to 3 groups/pen) and pen scores (**PS**) were assigned when each bull was approached for approximately 30 s by an observer. The same observer throughout the study approached each bull and assigned a PS (1 to 5 scale) based on the animal's reactivity, both aggressiveness and fearfulness to the observer. Scoring criteria was as follows: 1 = docile animal, lets observer approach closely, and walks slowly; 2 = runs along fence when observer approaches and is standoffish toward observer; 3 = runs along fence, head held up, and runs away from observer when approached; 4 = runs, very cautious of observer, and may run into fences trying to escape; and 5 = very aggressive, destructive, easily agitated, and runs into fences and possibly observer (Kunkle et al., 1986; Hammond et al., 1996).

On the following day (d 0, 28, 56, and 84), each pen of animals was worked through a chute system and the order the bulls entered the chute was recorded to ascertain if there was any relationship between temperament and willingness to enter the chute. The time it took to exit the chute after the head gate was completely opened was recorded to assess the animal's initial reaction time. When the head gate was completely opened, a sensor was triggered and initiated the timing to start and was ceased as the bull crossed the first infrared sensor. An additional time was recorded as each bull crossed a fixed distance (1.83 m) extending from the first infrared sensor to a second infrared sensor. Exit velocity (**EV**) was calculated as velocity = distance (m)/time(s) (see Schmidt et al., 2014).

Behavioral Data Collection

A datalogger (IceTag; IceRobotics Ltd., Edinburgh, Scotland, UK) was attached to the left rear fetlock of the same 27 Angus bulls (3 pens) from d 0 to 28 and d 56 to 84. Attachment allowed for continuous behavior measurements that included the following: steps taken, lying time, number of lying bouts, and lying bout duration. A 3-d conditioning period was implemented after datalogger attachment (MacKay et al., 2012). Data collected during the conditioning period were not included in the final analyses.

Performance Data Collection

Frame score was determined at the end of the test period by combining age of the bull with his hip height measured on d 84 (BIF, 1996; Vargas et al., 1999). The ADG was calculated over the 84-d testing period, and backfat thickness (**FAT**), ribeye area (**REA**), and intramuscular fat percentage (**IMF**) data were collected on each bull by ultrasonography performed on d 84.

Statistical Analyses

All statistical analyses were performed in SAS 9.3 (SAS Inst. Inc., Cary, NC). Bulls were separated into two contemporary groups (calm and excitable) according to PS and EV. Based on the categorical PS definitions, bulls with a d –1 PS of 1 or 2 were categorized as calm (**PScalm**), whereas bulls with a PS of 3 or 4 were categorized as excitable (**PSexcitable**). No bulls received a PS of 5. Using PROC SORT, the bottom 20 bulls on d 0 were categorized as **EVcalm**, whereas the top 20 bulls were categorized as **EVexcitable**. PROC SORT was not used for PS because of its categorical nature, whereas the continuous temperament assessment method (EV) could be ranked to identify the top 20 and bottom 20 bulls in each assessment method.

Table 2. Means (SEM) for pen score and exit velocity for bulls on day of test

Day	Temperament assessment method: Pen score[1]	Exit velocity[2]
0	2.26 (0.08)	2.57[a] (0.16)
28	2.06 (0.08)	1.92[b] (0.12)
56	2.09 (0.08)	1.59[c] (0.10)
84	2.13 (0.08)	1.53[c] (0.10)

[a–c]Means within a column with different superscript differ (*P* < 0.05).

[1]Pen score was assigned to each bull (*n* = 60) based on the reactivity of each bull when approached by a human (1 = docile to 5 = very aggressive).

[2]The rate of speed traversing 1.83 m, recorded as meters per second.

Mixed model ANOVA was used to evaluate how contemporary groups changed in regards to mean PS and EV over the 84-d testing period and to examine the effect of d –1 PS and d 0 EV on bull behavior and growth performance data collected over the 84-d testing period. Pen number and bull were included in the model as random effects with day of test as a repeated measure for variables assessed multiple times over the testing period. The PS on d –1 and EV categories on d 0 were used as a fixed effect to analyze behavior and growth performance. Fisher's LSD were used to separate means ($P < 0.05$).

RESULTS

Temperament

Mean PS for all Angus bulls did not change ($P > 0.05$) over the 84-d testing period (Table 2). However, EV decreased ($P < 0.05$) by the end of the testing period (d 84).

Bulls categorized as PSexcitable habituated ($P < 0.001$) over the 84-d testing period and became calm (Fig. 1). Similarly, EVexcitable bulls became more docile ($P < 0.001$) over the testing period. However, EVexcitable bulls did not become as docile as the EVcalm bulls at the conclusion of the test. Bulls within the EVcalm group remained constant over the testing period.

Bull order through the chute system showed no day of sampling effect ($P > 0.10$) or day of sampling × group interaction ($P > 0.10$) for PS (Table 3). Only in regards to d 0 EV was there a day of sampling × group interaction ($P < 0.05$), such that EVcalm bulls entered the chute system after the EVexcitable bulls on d 28 (Table 3). In regards to the time it took the bulls to exit the chute, only a day of sampling effect was present. Bulls exited the chute slower ($P < 0.001$) on d 84 than on d 0 (0.97 s ± 0.12 vs. 0.32 s ± 0.04, respectively).

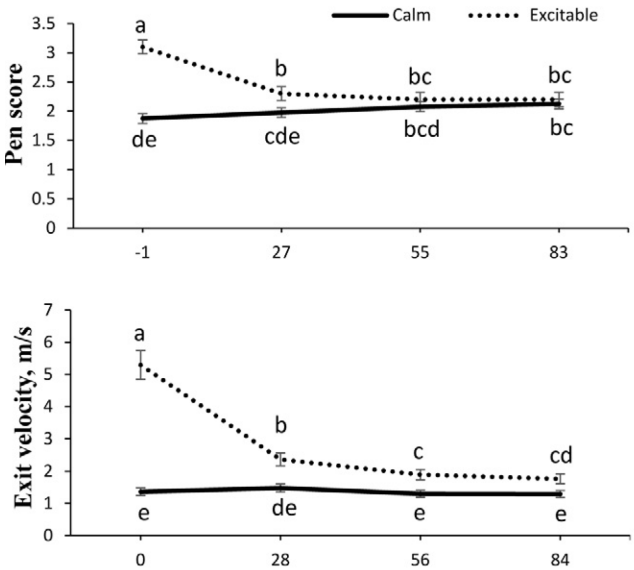

Figure 1. Mean pen score and exit velocity over the 84-d testing period for bulls initially categorized as calm and excitable. Pen score was assigned on d −1 based on the reactivity of each bull when approached by a human (1 = docile to 5 = very aggressive). Exit velocity was assessed on d 0 and is defined as the rate of speed traversing 1.83 m. Pen score and exit velocity had a contemporary group with day of sampling interaction (P < 0.001) over the 84-d testing period. [a–e]Means within a temperament assessment method with different superscripts differ (P < 0.001).

Table 3. Mean (SEM) order through the chute for calm and excitable bulls according to pen score and exit velocity contemporary groups

	Temperament assessment method	
	Pen score[1]	
Day recorded	Calm (n = 40)	Excitable (n = 20)
0	6.05 (0.54)	5.54 (0.75)
28	6.02 (0.53)	5.59 (0.75)
56	5.99 (0.53)	5.99 (0.75)
84	6.76 (0.54)	4.84 (0.75)
	Exit velocity[2]	
	Calm (n = 20)	Excitable (n = 20)
0	5.50^{bcd} (0.71)	5.70^{abcd} (0.14)
28	6.85^{a} (0.14)	4.75^{cd} (0.14)
56	5.00^{cd} (0.14)	5.70^{abcd} (0.14)
84	6.55^{abc} (0.14)	5.40^{abcd} (0.14)

[a–d]Means within a row or column with different superscripts differ (P < 0.05).

[1]Pen score was assigned on d −1 based on the reactivity of each bull when approached by a human (1 = docile to 5 = very aggressive).

[2]Exit velocity was assessed on d 0 and is defined as the rate of speed traversing 1.83 m, recorded as meters per second.

Behavior

Mean (SEM) total steps taken from d 3 to 28 did not vary (P > 0.10) between bulls initially deemed calm or excitable according to PS or EV (Table 4). However, total lying time was greater (P < 0.05) for PScalm bulls when compared with PSexcitable bulls during this same period. The EVcalm bulls had a greater (P < 0.05) number of lying bouts when compared with EVexcitable bulls. Additionally, EVcalm bulls had shorter (P < 0.05) lying bout durations as compared with EVexcitable bulls (Table 4).

From d 59 to 84, PScalm bulls took fewer (P < 0.05) steps than PSexcitable bulls (Table 4). However, total lying time was greater (P < 0.05) for EVexcitable bulls when compared with EVcalm bulls. Total number of lying bouts and lying bout duration did not differ (P > 0.05) among bulls categorized as calm or excitable regardless of temperament assessment method used.

Performance

Frame score and ADG differed (P < 0.01) only between PS contemporary groups, such that PSexcitable bulls had a larger frame and greater ADG than PScalm bulls (Table 5). Bulls categorized as PSexcitable had more (P < 0.01) FAT when compared with PScalm bulls. However, REA was smaller (P < 0.01) in EVexcitable bulls when compared with EVcalm bulls. Mean IMF did not differ (P > 0.10) between contemporary groups for either temperament assessment method.

DISCUSSION

Regardless of temperament assessment method used (PS and EV), the results of the present study found that bulls initially deemed excitable of similar breed and age and subjected to a mutual performance test revert to a calmer disposition over time. This was particularly evident in bulls where PS was used to assess temperament. There were 3 factors (habituation, lack of bulls with a PS = 5, and overall increase in BW) that likely contributed to the observed reduction in excitability. First, Curley et al. (2006) reported that over a 120-d period, cattle became more docile as measured by PS, chute score, and EV, which the authors suggested was due to the animals adapting to the presence of humans. Price (2008) defined habituation as a decrease in a particular response due to repeated stimulation. Therefore, we hypothesize that bulls in the present study also became familiarized with the University of Tennessee Bull Testing Station personnel and facilities. This would explain the overall reduction in PS and EV by the end of the performance test. Second, because unruly bulls were selectively removed, those included in the test and deemed excitable may be classified as having an intermediate temperament in a study that possesses a larger population with a greater variation in temperament. Therefore, the process of habituation seen among

Table 4. Differences in datalogger-recorded pen activity of bulls categorized as calm or excitable according to pen score and exit velocity

		Temperament assessment method[1]	
		Pen score[2]	
Days	Behavioral variable[3]	Calm (n = 18)	Excitable (n = 9)
3 to 28	Steps	1,364.49 (25.88)	1,350.91 (30.90)
	Lying time, h	14.29[a] (0.10)	13.98[b] (0.12)
	No. lying bouts	14.81 (0.45)	14.58 (0.51)
	Lying bout duration, h	0.99 (0.02)	0.96 (0.03)
59 to 84	Steps	1,279.00[b] (33.18)	1,362.20[a] (40.74)
	Lying time, h	14.27 (0.10)	14.33 (0.12)
	No. lying bouts	14.31 (0.43)	13.57 (0.46)
	Lying bout duration, h	1.05 (0.03)	1.10 (0.03)
		Exit velocity[4]	
		Calm (n = 8)	Excitable (n = 9)
3 to 28	Steps	1,363.19 (38.67)	1,384.66 (37.81)
	Lying time, h	14.34 (0.12)	14.24 (0.12)
	No. lying bouts	15.48[a] (0.54)	13.76[b] (0.53)
	Lying bout duration, h	0.94[b] (0.02)	1.04[a] (0.02)
59 to 84	Steps	1,266.95 (46.15)	1,287.83 (45.34)
	Lying time, h	14.20[b] (0.20)	14.80[a] (0.20)
	No. lying bouts	14.10 (0.57)	14.39 (0.57)
	Lying bout duration, h	1.04 (0.04)	1.08 (0.04)

[a,b]Means within a row with different superscripts differ ($P < 0.05$).

[1]Each number represents the mean (SEM).

[2]Pen score was assigned on d –1 based on the reactivity of each bull when approached by a human (1 = docile to 5 = very aggressive).

[3]Dataloggers were attached to the same bulls (n = 27) from d 3 to 28 and d 59 to 84.

[4]Exit velocity was assessed on d 0 and is defined as the rate of speed traversing 1.83 m, recorded as meters per second.

Table 5. Mean (SEM) growth performance variables for calm and excitable bulls according to pen score and exit velocity contemporary groups

	Temperament assessment method	
	Pen score[1]	
Growth performance variable	Calm (n = 40)	Excitable (n = 20)
Frame score[2]	5.87[b] (0.04)	6.03[a] (0.05)
ADG,[3] kg/d	1.99[b] (0.03)	2.10[a] (0.03)
FAT,[4] cm	0.76[b] (0.02)	0.86[a] (0.02)
REA,[5] cm^2	81.09 (0.97)	81.11 (1.36)
IMF,[6] %	4.74 (0.15)	4.74 (0.99)
	Exit velocity[7]	
	Calm (n = 20)	Excitable (n = 20)
Frame score	5.80 (0.05)	5.81 (0.05)
ADG, kg/d	2.06 (0.04)	2.01 (0.04)
FAT, cm	0.81 (0.02)	0.80 (0.02)
REA, cm^2	85.11[a] (0.69)	82.67[b] (0.69)
IMF, %	4.71 (0.12)	4.69 (0.12)

[a,b]Means within a row with different superscripts differ ($P < 0.01$).

[1]Pen score was assigned on d –1 based on the reactivity of each bull when approached by a human (1 = docile to 5 = very aggressive).

[2]Frame score was calculated by combining age and hip height on d 84 (BIF, 1996).

[3]ADG was assessed from d 0 to 84.

[4]Backfat thickness (FAT) was measured via ultrasonography on d 84.

[5]Ribeye area (REA) was measured via ultrasonography on d 84.

[6]Intramuscular fat percentage (IMF) was measured via ultrasonography on d 84.

[7]Exit velocity was assessed on d 0 and is defined as the rate of speed traversing 1.83 m, recorded as meters per second.

the excitable bulls may have been a result of lack of innate temperament variation between calm and excitable bulls. Third, as bulls grew in regards to BW over the 84-d testing period, speed and reactivity may have been hindered (Riley et al., 2010). Based on these results, we suggest that repeated temperament evaluations where bulls are subjected to novel environments and new handlers may help differentiate between the bull's ability to habituate and its true excitable nature.

Similar to the results of Wierenga (1987), which reported finding an inverse relationship between lying time and bull temperament, lying time from d 3 to 28 was greater for PScalm bulls compared with PSexcitable bulls. However, we found that EVexcitable bulls had longer lying bout durations and fewer lying bouts from d 3 to 28 when compared with EVcalm bulls. Regardless of the observed differences between groups in the current study, all bulls engaged in more lying bouts for longer periods, which is in contrast to that reported by MacKay et al. (2013). However, the differences in lying bout duration and number of lying bouts, and the overall behavior compared with previously reported values (MacKay et al., 2013), does not suggest an impact on overall well-being because lying time and steps taken did not differ between EV contemporary groups. From d 59 to 84, PSexcitable bulls took more steps than PScalm bulls; however, no other behavioral variables that we examined differed between the contemporary groups of PS to indicate an impact on the animals' well-being. Contrary to the results reported by Wierenga (1987), EVexcitable bulls spent more time lying when compared with EVcalm bulls. However, it remains unclear as to why excitable bulls spent more time lying than calm bulls because no other behavioral variables differed between contemporary groups for EV. We may further attribute the lack of innate temperament variation between bulls classified as calm and excitable for the minute behavioral differences recorded in the present study.

Throughout the 84-d testing period, bulls spent between 13 and 15 h/d lying regardless of contemporary group. Hoffman and Self (1973) reported that feedlot steers spend approximately 12 h/d lying regardless of season, which was slightly less than the lying time in the present study. We speculate that environmental conditions, management routine, and pen size could have attributed to differences in lying time between the two studies. Feedlot steers in the study conducted by Hoffman and Self (1973) were provided less lying space per steer than the bulls in the present study, which could have reduced lying time. Hoffman and Self (1973) also reported that steers were housed on concrete and were not provided bedding throughout the study, whereas the bulls in our study were provided a dirt pad, which could contribute to the differing results in lying behavior. More recently, Hickey et al. (2003) determined the provision of less than 2 m^2 reduced lying times of finishing steers and providing straw bedding increased daily lying times. The space allocated per bull (35 m2) in the current study eliminated this limitation on lying behaviors.

Although previous research has not examined the relationship between temperament and order through a chute system, we hypothesized that due to their flighty nature, excitable bulls would hesitate to enter the chute system and would be the last to be worked through the chute. However, contrary to our hypothesis, only on d 28 was there a difference in the order as to which EV contemporary groups entered the chute, such that EVcalm bulls entered the chute system after the EVexcitable bulls. The present study was limited in regards to the number of excitable bulls because those considered to be a threat to personnel were removed before the start of the test. Therefore, future studies involving larger groups of cattle with a greater variation in temperament are necessary to determine if a repeatable relationship exists between temperament and the order in which cattle enter a chute system. On d 84, bulls exited the chute slower than on d 0, which may be a further consequence of them becoming habituated to the chute system (Curley et al., 2006). Alternatively, initial speed exiting the chute may have been hindered by the increase BW over the performance test period as proposed by Riley et al. (2010).

Contrary to results previously reported by Voisinet et al. (1997b), our study found that ADG was greater for PSexcitable bulls when compared with PScalm bulls. Furthermore, the PSexcitable bulls had larger frames than PScalm bulls. Reinhardt et al. (2009) reported that large-framed feedlot heifers and steers have greater ADG than smaller-framed individuals. Therefore, the difference in ADG seen here in calm bulls was likely a result of a smaller frame rather than an effect of temperament.

In the present study, FAT was greater in PSexcitable bulls when compared with PScalm bulls; however, IMF was not different. It was previously found that both FAT and marbling scores were greater in docile feedlot cattle when compared with excitable feedlot cattle (Schmidt et al., 2013). These conflicting results may be due to differences in gender, nutrition, and genetics between our study and theirs, all of which have been noted to influence FAT (Smith et al., 1984; Crouse et al., 1989; Charagu et al., 2000) and IMF (Field et al., 1966; Crouse et al., 1989; Pethick et al., 2004). Furthermore, Schmidt et al. (2013) examined a large population ($n = 2{,}877$) where both calm and truly excitable cattle were present, which is in contrast to the smaller population size used in our study.

The REA was larger for bulls categorized as EVcalm when compared with EVexcitable bulls. Black et al. (2013) assessed temperament in heifers of different breed types every 2 wk over a 70-d period by evaluating both PS and EV and concluded that REA did not differ due to temperament. Gender and breed differences may explain these conflicting results. Bulls have greater growth rates and have larger REA than heifers of the same age and sire (Hedrick et al., 1969), and accelerated growth rate may have led to larger variations in REA among the bulls in this study. The heifers in the study conducted by Black et al. (2013) were a mixture of *Bos taurus* and *Bos indicus* breed types, whereas the bulls in the present study were *B. taurus* and were a uniform group of Angus bulls for comparison of body conformation measurements.

In conclusion, our results suggest that bulls subjected to repeat assessment of temperament in a controlled setting, using measures of PS and EV, appear to undergo a classical habituation process. Additionally, repeated measures of pen behavior, order through the chute, and initial reactivity to exiting the chute did not prove to be effective determinants of temperament. As a result of habituation over the 84-d testing period and the potential lack of innate temperament variation that may have attributed to the little differences observed for behavior and performance, we suggest that temperament should be assessed in novel environments with new handlers to differentiate between the bull's true temperament and its ability to habituate.

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