EFFECTS OF TEMPERAMENT AND ANIMAL HANDLING ON FERTILITY

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For over a century, the word temperament has been used to define the fear-related behavioral responses of cattle when exposed to human handling (Fordyce et al., 1988). As cattle temperament worsens, their response to human contact or any other handling procedure becomes more excitable. Within the beef cattle industry, producers select cattle for temperament primarily for safety reasons. However, recent studies demonstrate that cattle temperament may also have productive and economic implications to beef operations.

Is Excitable Temperament a Stress Response?

Stress response is defined as the reaction of cattle to internal and external factors that affect their well being, and animals that are unable to cope with these factors are classified as stressed. Examples are extreme temperatures, diseases, and injuries. Based on this concept, the agitated and/or aggressive responses expressed by cattle with excitable temperament when exposed to human handling can be attributed to their fear and consequent inability to cope with this situation; therefore, classified as a stress response. In addition to altered behavior, temperamental cattle may also experience changes in their body physiology, and the hormones produced during this fear-related stress reaction influence several aspects, such as growth, health, and reproduction.

One of the main hormones produced during a stress response is cortisol. Several studies reported that blood cortisol concentrations are greater in temperamental cattle compared to calm cattle (Table 1). This outcome validates that excitable temperament can be classified as a stress response, and is one of the reasons why cortisol is commonly considered paramount to the behavioral stress response.

Assessment of Temperament in Beef Cattle

Cattle temperament can be visually evaluated by many methods, which can be categorized into non-restrained and restrained techniques (Burrow and Corbet, 2000). Within the non-restrained techniques, cattle temperament is evaluated by their fear or aggressive response to man when they are free to move within the evaluation area. Examples of these techniques are chute exit velocity and pen score. Exit velocity evaluates the speed of an individual animal immediately after it leaves the squeeze chute by measuring the time required for the animal to travel a pre-determined distance. This assessment can be expressed in actual speed measures (i.e., feet/second), or in a 1-5 scale, where 1 are the slowest and 5 are the fastest animals. The pen score evaluates the behavioral response of an individual animal when it enters a small pen and interacts with a person standing inside the pen. Typically in a 1-5 scale, the pen score increases as the animal response becomes more aggressive toward the person; 1 = unalarmed and unexcited animal that walks slowly away from the evaluator, 2 = slightly alarmed animal that trots away from the evaluator, 3 = moderately alarmed and excited animal that runs away from the evaluator, 4 = very alarmed and excited animal that runs with head held high and may charge the evaluator, or 5 = animal very excited and aggressive in a manner that requires evasive actions by the evaluator to avoid contact. The restrained techniques evaluate cattle temperament when these are physically restricted, such as in the squeeze chute. An example of the restrained techniques is the chute score, also denominated crush score. Cattle are individually restrained in the chute and scored in a 1-5 scale according to its behavior; where 1 = calm with no movement, 2 = restless movements, 3 = frequent movement with vocalization, 4 = constant movement, vocalization, shaking of the chute, and 5 = violent and continuous struggling. This measurement can be taken in cattle that are squeezed or not in the chute. However, squeezed animals may not express their real temperament. Other methods to assess cattle temperament have also been reported; however, chute score, exit velocity, and pen score have been shown to be repeatable within animals and relatively simple to carry out during handling procedures. Additionally, these techniques are typically related to each other and with blood cortisol concentrations, indicating that these 3 measurements can similarly assess cattle temperament and denote the amount of behavioral stress that the animal is experiencing (Figure 1). Nevertheless, temperamental cattle can "freeze" when restrained or slip when exiting the chute, influencing their chute score and exit velocity evaluation, respectively. To prevent this problem and ensure that cattle temperament is adequately assessed, producers can utilize more than one technique and combine the results into an overall temperament score.

Factors that Influence Temperament in Beef Cattle

Cattle temperament is influenced by several factors such as sex, age, and horn status (Fordyce et al., 1988; Voisinet et al., 1997). However, none of these characteristics has been shown to affect cattle temperament as much as production system and breed type (Table 2). Cattle with *Bos indicus* influence have more excitable temperament compared to *B. taurus* cattle (Fordyce et al., 1988; Voisinet et al., 1997). Still, both *B. indicus*-influenced and *B. taurus* cattle with excitable temperament have increased blood cortisol concentrations compared to calm cohorts (Table 1). Cattle reared in extensive systems are also expected to have more excitable temperament compared to cattle reared in intensive operations because of less frequent interaction with humans (Fordyce et al., 1985). Therefore, cattle reared on extensive production systems, particularly if they have *Bos indicus* influence, are potentially difficult to control and handle, which can pose significant management, economic, and productivity problems.

Temperament and Reproduction in Beef Females

Excitable temperament is highly detrimental to the nutritional status of cattle, given that temperamental cattle have decreased feed intake compared to calm cohorts (Brown et al., 2004; Nkrumah et al., 2007). In addition, cattle with excitable temperament also have altered metabolism and partitioning of nutrients in order to sustain the behavioral stress response, which results in further decreases in nutrient availability to support body functions (Cooke et al., 2009a; Cooke et al, 2009b). Nutritional status largely determines reproductive performance in cattle; therefore, excitable temperament may indirectly impair reproduction in beef heifers and cows by decreasing nutritional balance.

Also, the hormones produced during a stress response, particularly cortisol, directly disrupt the physiological mechanisms that regulate reproduction in beef females, such as ovulation, conception, and establishment of pregnancy. As an example, cows with calm temperament have reduced cortisol and greater blood concentrations of luteinizing hormone, the hormone required for puberty establishment and ovulation, compared to temperamental cows (Echternkamp, 1984). Accordingly, it was recently demonstrated that *B. indicus*-influenced beef heifers with calm temperament reached puberty sooner than temperamental cohorts (Table 3). Further, *B. indicus*-influenced beef cows with excitable temperament had decreased chances of becoming pregnant during the breeding season compared to calm cohorts (Figure 2). The same effect was detected when *B. taurus* cows were evaluated (Figure 3). Similar relationships were detected when blood cortisol concentrations were evaluated against puberty or pregnancy instead of temperament in *B. indicus*-influenced heifers and cows (Table 3 and Figure 2). Therefore, excitable temperament has detrimental effects on reproduction of beef females, independently of breed type, which are likely mediated by elevated cortisol concentrations. Further, the genetic relationship among behavioral and reproductive traits is still unknown, whereas a genetic evaluation might help explain why pregnancy rates are reduced in temperamental cattle. Nevertheless, management strategies that improve the overall temperament of the herd will thus benefit the reproductive performance and consequent productivity of cow-calf operations (Plasse et al., 1970; Cooke et al. 2009a).

Improving Temperament of Beef Cattle

One alternative to improve temperament and consequently benefit reproduction in beef females is to adapt them to human handling. Early studies reported that cattle accustomed to human handling had calmer temperament, reduced blood cortisol concentrations, and increased LH concentrations compared to non-acclimated cattle (Crookshank et al., 1979; Echternkamp, 1984; Fordyce et al., 1985). Further, *B. indicus*-influenced replacement heifers exposed to an acclimation process to human handling for 4 weeks after weaning had improved temperament, reduced cortisol, and reached puberty and became pregnant earlier compared to non-acclimated cohorts (Table 4). However, no beneficial effects on temperament and reproduction were detected when mature cows were exposed to acclimation to human handling. Therefore, adapting beef females to human interaction early in their productive lives may be an alternative to improve their temperament and consequently hasten their reproductive development. Further, including temperament in culling/selection criteria might be the most appropriate alternative to improve the overall temperament and consequent reproductive performance of the adult cow herd.

Conclusions

In summary, excitable temperament is a fear-related behavioral response that has detrimental effects on reproductive function of beef heifers and cows, independently of breed type. Temperament may influence cattle reproduction indirectly by decreasing nutritional status, and directly by altering the physiological mechanism required for ovulation and conception. Also, a potential genetic relationship among behavioral and reproductive traits might help explaining why reproduction is impaired in temperamental cattle. Beef producers can evaluate cattle temperament by visual assessments that can be conducted during common handling procedures, such as assessing chute score when cattle have to be handled for vaccination or weaning. Depending on the outcome, producers can adopt management strategies to improve the overall temperament of the cow herd. Examples are acclimation to human handling and consideration of temperament in selection/culling decisions, which will bring benefits to the reproductive performance and consequent productivity of cow-calf operations containing temperamental cattle able 1. Blood cortisol concentrations (ng/mL) of cattle with calm or excitable temperament.[1]

Animals	Calm Temperament	Excitable Temperament
	Mean concentrations ± *standard error*	
Growing cattle		
B. indicus-influenced heifers	45.5 ± 0.15	57.9 ± 0.26
B. taurus steers	34.4 ± 3.73	56.7 ± 6.85
Mature cattle		
B. indicus-influenced cows	27.1 ± 0.64	38.0 ± 0.81
B. taurus cows	15.1 ± 1.38	19.7 ± 1.72

[1] Adapted from Cooke et al. (2009a), Cooke et al. (2009b), Cooke et al. (2010), and Fell et al. (1999).

Table 2. Factors that affect cattle temperament.[1]

Item	Method of Assessment[2]	Mean ± Std. Error[3]
Sex		
Male	*Temperament Score; 1 – 5 scale*	2.7 ± 0.11
Female		3.0 ± 0.11
Age		
< 2 years	*Exit Velocity Score; 1 – 5 scale*	3.1 ± n.a.
> 2 years		2.8 ± n.a.
Horn status		
Horned	*Exit Velocity Score; 1 – 5 scale*	2.7 ± n.a.
Polled		3.0 ± n.a.
Breed type		
Brahman x Hereford	*Temperament Score; 1 – 5 scale*	3.6 ± 0.15
Brahman x Angus		3.8 ± 0.22
Angus		1.7 ± 0.19
Simmental x Angus		1.8 ± 0.07
Human interaction		
Frequent	*Crush Score; 1 – 7 scale*	1.5 ± n.a.
Infrequent		2.1 ± n.a.

[1] Adapted from Voisinet et al. (1997), Fordyce et al. (1985, 1988), and Cooke et al. (2009a).
[2] As score increases, exit velocity increases, and behavior becomes more excitable.
[2] n.a. = standard errors not provided in the referenced article, but means were reported to differ at $P < 0.05$.

Table 3. Post-weaning temperament scores (1 = calm; 5 = excitable temperament) and blood cortisol concentrations of replacement heifers that attained or not puberty by 12 months of age. [1]

Item	Non-pubertal	Pubertal
	Mean ± standard error	
Temperament Score	2.7 ± 0.14	2.3 ± 0.12
Cortisol, ng/mL	50.0 ± 3.34	39.7 ± 2.06

[1] Adapted from Cooke et al. (2009b).

Table 4. Effects of acclimation to human handling on temperament, cortisol, and reproduction of replacement heifers. [1,2]

Item	Acclimated	Non-acclimated
	Mean ± standard error[3]	
Chute score, 1 – 5 scale	1.4 ± 0.09	1.9 ± 0.09
Cortisol, ng/mL	37.8 ± 1.58	50.5 ± 1.62
% of pubertal heifers by 12 months of age	65 ± n.a.	39 ± n.a
% of pregnant heifers 30 days into breeding season	50 ± n.a	32 ± n.a

[1] Acclimated heifers were exposed to a handling process 3 times weekly for 4 weeks after weaning. Control heifers remained undisturbed on pasture.
[2] Adapted from Cooke et al. (2009b).
[3] Standard errors not calculated for percentage values.

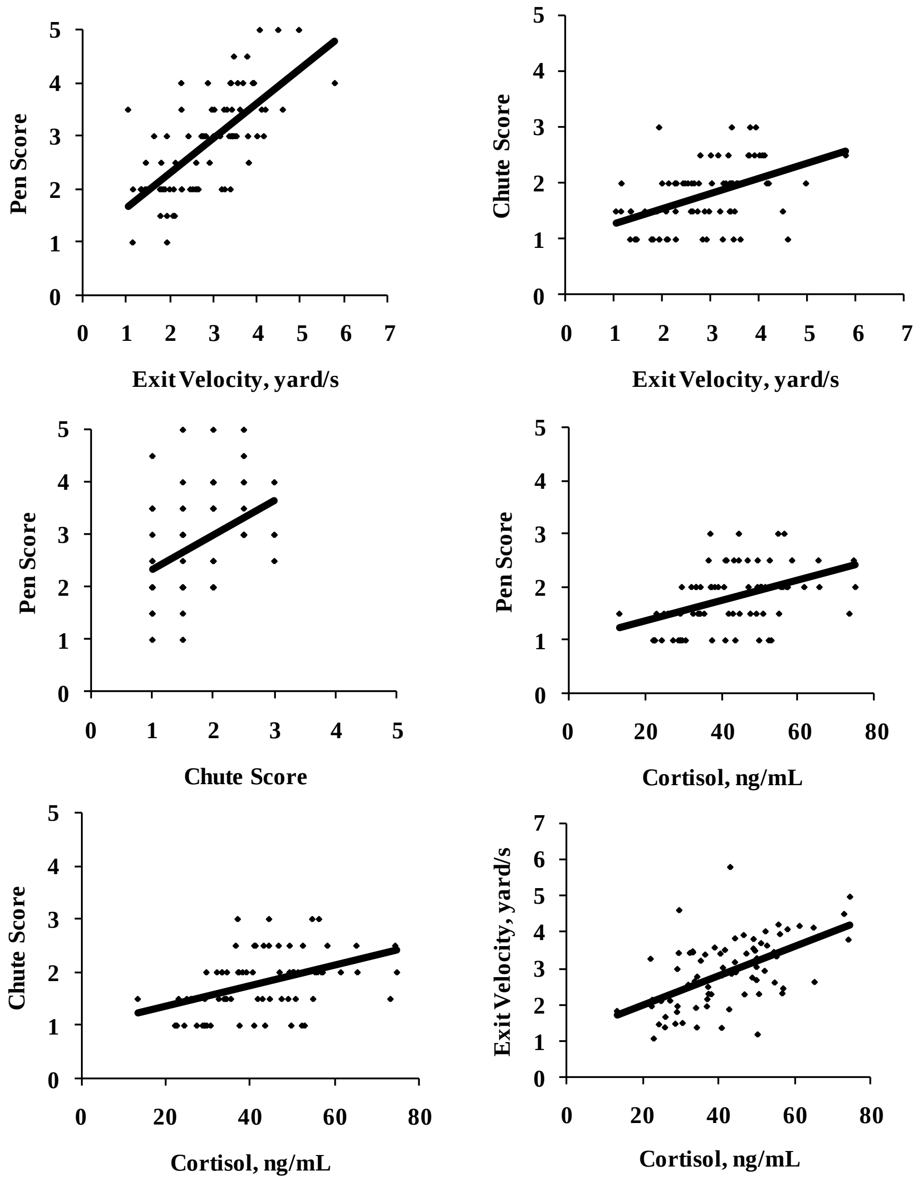

Figure 1. Relationship among measurements of temperament and blood cortisol concentrations in beef heifers. Adapted from Cooke et al. (2009b).

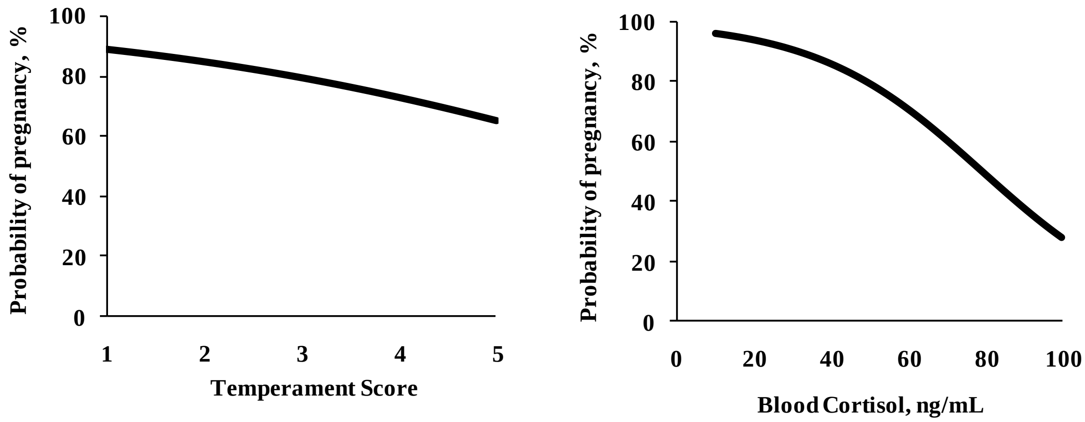

Figure 2. Probability of *B. indicus*-influenced beef cows to become pregnant according to temperament score (1 = calm; 5 = excitable temperament) and blood cortisol concentrations assessed at the beginning of the breeding season. Adapted from Cooke et al. (2009a).

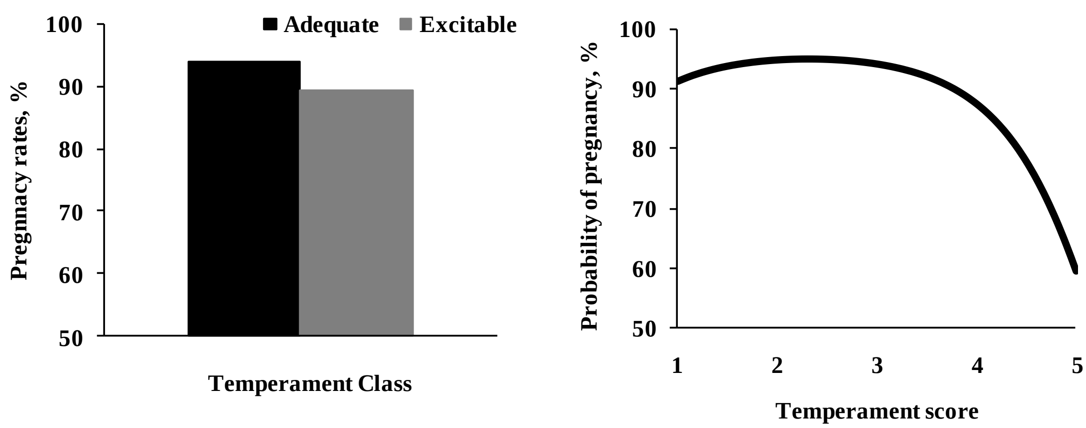

Figure 3. Pregnancy rates and probability of *B. taurus* beef cows to become pregnant according to temperament (1 = calm; 5 = excitable temperament; ≤ 3 = adequate temperament, > 3 = excitable temperament) assessed at the beginning of the breeding season. Adapted from Cooke et al. (2010).

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