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Evidence of Social Buffering Benefits to Castration Stress in Beef Calves Housed With Familiar Pen-mates

Abstract

Commingling of beef feeder calves from different sources results in biological and behavioral stressors. The objective of this study was to explore whether preferential relationships among beef feeder cattle may produce social buffering that result in positive animal welfare, health and performance outcomes. Weaned calves (n=102) from 23 source farms were randomly assigned to 17 pens, each comprised of 3 familiar (F) calves from the same source farm and 3 unfamiliar (U) calves from 3 different source farms. We hypothesized that F calves would experience less stress than U calves during weekly handling events (D7, D14, D21, and D28 relative to feedyard arrival) and castration surgery (D14). Outcomes included chute calf order into the handling chute, chute vocalizations, exit speed, and ADG. Models included a day by treatment interaction and cohort as a fixed effect; for ADG, D0 weight was included as a covariate. A Friedman test ranked calf chute order across all handling events and compared them across treatment groups. Based on our preliminary data, we found no evidence F calves stayed in closer proximity to one another than U during handling events (p≥0.11). However, F calves vocalizations less (p=0.01) and exited faster (p≤0.02) than U calves on Day 21 when castration effects were greatest; other handling days did not differ. Additionally, F calves showed a higher post-castration ADG than U calves at D21 (p≤0.02). Based on our preliminary results, we found some evidence suggestive of social buffering benefits for F calves in response to castration stress.

Methods

- Randomized block design with 2 treatments (F, U), balanced within pen and cohort, and repeated measures over time. Sample size calculation indicated 99 replicates.
- To date, 102 weaned bull calves enrolled (51 replicates), sourced from 23 farms, 17 pens of 6 calves (3F, 3U) housed at the Iowa State University Beef Nutrition Farm (Fig.1)
- Time points associated with stressors and data collection are presented in Fig. 2 We identified comingling stress on D0 to D+14, and castration stress on D+14 to D+28.
- Calves were weighed weekly and average daily gain (ADG) was calculated.
- Data were analyzed utilizing SAS® software (SAS® inst. Cary, NC). Distributional properties of cortisol and MNT values were assessed (Proc Univariate) and a Gaussian distribution was used in the models. A mixed linear model (Proc GLIMMIX) was used to analyze outcomes. Models for ADG included the interaction of trial day by treatment interaction Cohort and D0 weight were included as covariates. Calf was included as subject in the models. P-value ≤ 0.05 was considered to be significant.

Figure 1



Figure 1: Two separate pens of 6 calves were balanced for familiar (F) and unfamiliar (U) treatments (3F, 3U). Calves were identified with unique green paint markings for future observations of stress and social behaviors. Each calf's daily feed intake was measured using a GrowSafe™ feed bunk.

Figure 2

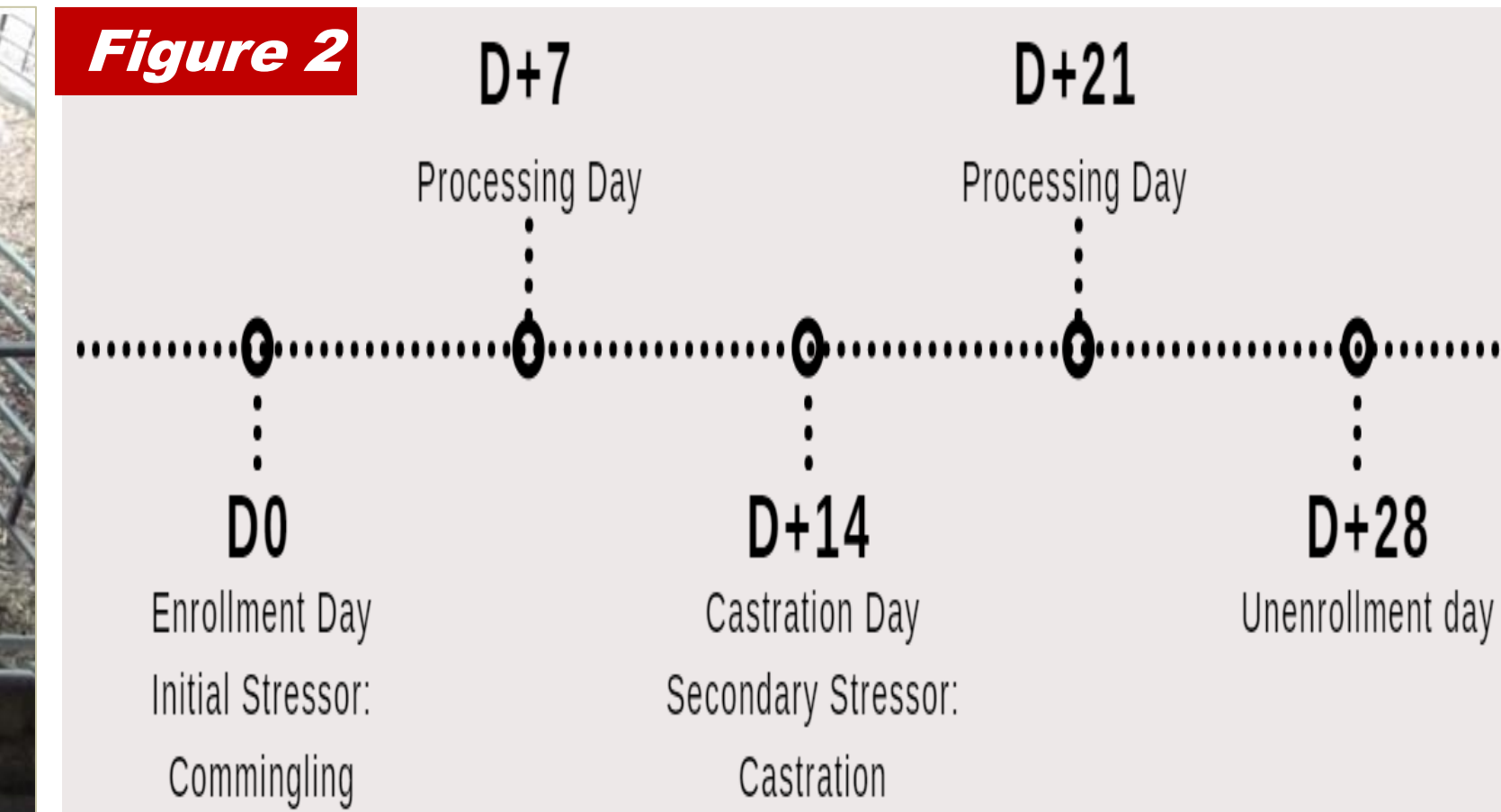


Figure 2: A timeline of the comingling experiment, outlining the hypothesized stressors. D0 through D+14 represents the introduction of comingling stress. D+14 through D+28 represents castration stress.

Results

- A significant day by treatment interaction was observed in ADG (p<0.01), on D+21 of the trial, F calves showed significantly higher ADG than U. [Table 1]
- F calves had a faster chute exit time than U calves (p=0.02) on D+21. [Table 2]
- F calves displayed fewer vocalizations at handling than U calves (p=0.01) on D+21. [Table 3]
- F calves, overall, spent more time lying than U calves (p=0.03). However, time spent lying did not differ on a weekly basis. [Table 4]
- No effect of treatment on overall calf activity that included standing duration, number of steps or number of lying bouts (p>0.12).

Discussion

- We hypothesized that F calves, when exposed to comingling and castration stress, would have superior performance, lower stress behaviors at handling, and fewer pain behaviors because of social buffering in comparison to U calves.
- Commingling Stress (D0 through D+14)
- Commingling of U and F calves resulted in no performance effects suggestive of social buffering in this period.
- Conversely, a study utilizing Holstein calves showed significant differences in behavior and cortisol responses to repeated social mixing, but not performance data (Veissier et al. 2001, JAS 79: 2580).
- Castration Stress (D+14 through D+28)
- We expected to see decreased performance on D+14 through D+28 for both groups as a result of castration stress.
- Decreased ADG in all calves supported the hypothesis that castration represents a significant stressor.
- ADG differing between F and U calves during this period suggests that F calves show more resilience even 3 weeks post mixing.
- 7 days post castration, F calves vocalized less than U calves, possibly correlating with decreased stress at handling.
- 7 days post castration, F calves had a faster chute exit speed than U calves, this may correlate with decreased pain, but could also correlate to more stress at handling.

Introduction

- Commingling, mixing of calves from multiple sources, is considered a significant stressor for beef cattle entering feedlot systems (Mench et al. 1990, CJAS 70:345, O'Connor et al. 2005, AJVR 66:2130)
- Stressed calves have increased risk of anorexia (Tsyglakova et al. 2019, FRONT NEUROENDOCRIN 54:100771), immune suppression (Mench et al. 1990, CJAS 70:345), bovine respiratory disease (BRD) (Griebel et al. 2014, AHRR 15: 161), and subsequent need for antibiotic treatment (Wiegand et al. 2020, TAS 4: S79).
- Previous research by our team identified that individual calves form preferential bonds with other calves (Robbins et al. 2020, JAS 98: 157).
- Social buffering refers to augmented recovery from distress in the presence of a conspecific, and if present may confer stress resilience in commingled beef cattle (Kikusui et al. 2006, PHILOS T R SOC B 361: 2215).
- We hypothesized that familiar (F) calves from the same source farm would experience social buffering and subsequent stress resilience relative to unfamiliar (U) calves. If stress resilience confers to familiar calves, they may have a higher average daily gain (ADG), fewer stress behaviors at handling, and fewer pain behaviors when compared to unfamiliar calves.

Figure 3

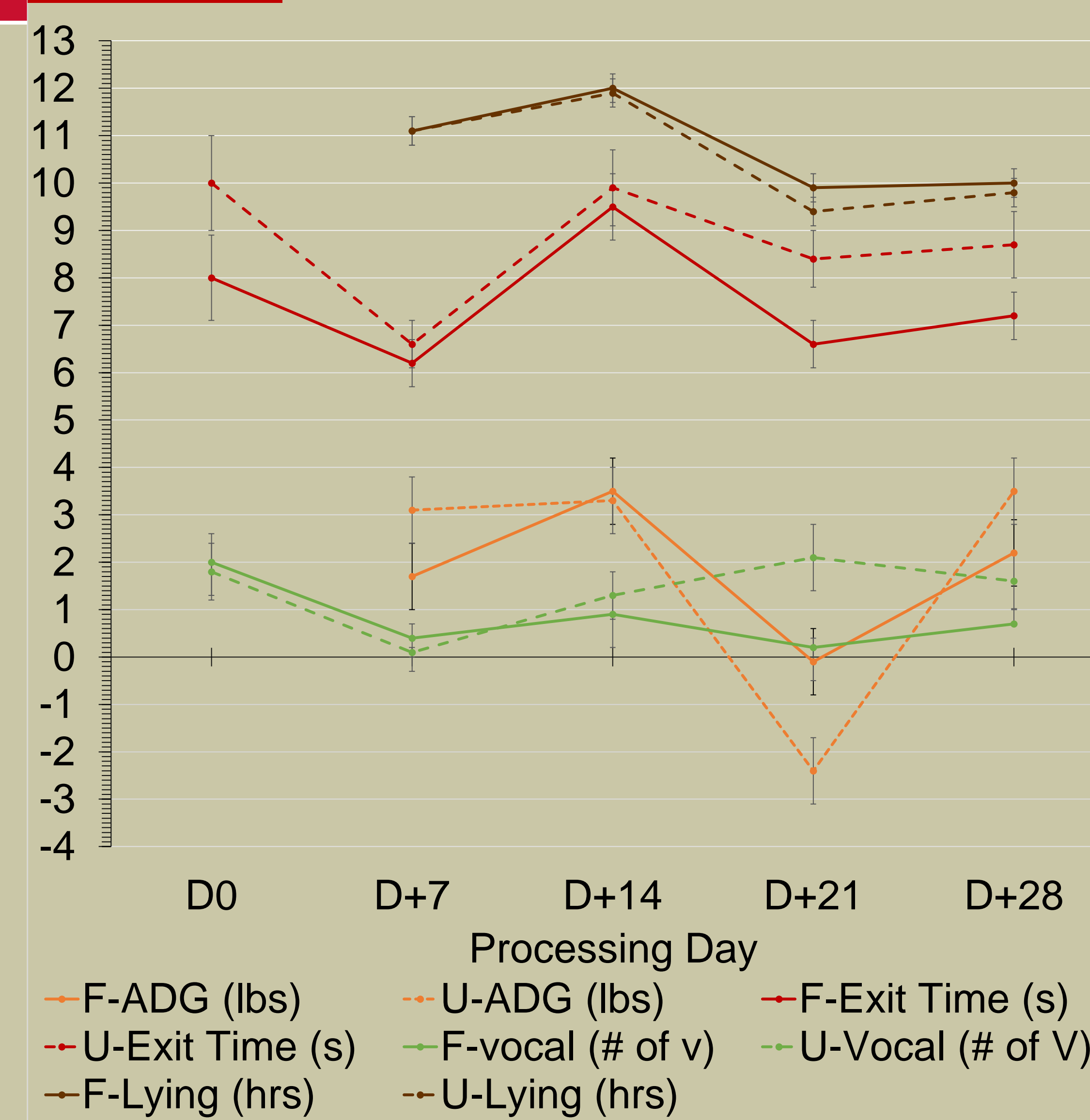


Figure 3: A graphical representation comparing average daily gain (ADG), exit time from the handling chute, hours spent lying in home pen, and number of vocalizations across trial days.

Table 1: Mean ADG (lb ± SE) of commingled male beef calves.

Treatment	D0 ¹ (lb±SE)	D+7 (lb±SE)	D+14 ² (lb±SE)	D+21 (lb±SE)	D+28 (lb±SE)
F (n=51)	-	1.7±0.7	3.5±0.7	-0.1±0.7	2.2±0.7
U (n=51)	-	3.1±0.7	3.3±0.7	-2.4±0.7	3.5±0.7

Table 2: Mean Exit Time (seconds ± SE) of commingled male beef calves.

Treatment	D0 ¹ (s±SE)	D+7 (s±SE)	D+14 ² (s±SE)	D+21 (s±SE)	D+28 (s±SE)
F (n=51)	8.0±0.9	6.2±0.5	9.5±0.7	6.6±0.5	7.2±0.5
U (n=51)	10±1.0	6.6±0.5	9.9±0.8	8.4±0.6	8.7±0.7

Table 3: Mean Number of Vocalizations (V) (V ± SE) of commingled male beef calves.

Treatment	D0 ¹ (v±SE)	D+7 (v±SE)	D+14 ² (v±SE)	D+21 (v±SE)	D+28 (v±SE)
F (n=51)	2.0±0.6 ^{ac}	0.4±0.3 ^b	0.9±0.4 ^a	0.2±0.2	0.7±0.3
U (n=51)	1.8±0.6 ^{ac}	0.1±0.1 ^b	1.3±0.5	2.1±0.7	1.6±0.58

Table 4: Mean hours spent lying (hrs ± SE) of commingled male beef calves.

Treatment	D0 ¹ (hrs±SE)	D+7 (hrs±SE)	D+14 ² (hrs±SE)	D+21 (hrs±SE)	D+28 (hrs±SE)
F (n=51)	-	11.1±0.3 ^a	12.0±0.3 ^b	9.9±0.3 ^c	10.0±0.3 ^c
U (n=51)	-	11.1±0.3 ^a	11.9±0.3 ^b	9.4±0.3 ^c	9.8±0.3 ^c

Table 5: Mean hours spent lying (hrs ± SE) of commingled male beef calves.

Treatment	D0 ¹ (hrs±SE)	D+7 (hrs±SE)	D+14 ² (hrs±SE)	D+21 (hrs±SE)	D+28 (hrs±SE)
F (n=51)	-	11.1±0.3 ^a	12.0±0.3 ^b	9.9±0.3 ^c	10.0±0.3 ^c
U (n=51)	-	11.1±0.3 ^a	11.9±0.3 ^b	9.4±0.3 ^c	9.8±0.3 ^c

Table 6: Mean hours spent lying (hrs ± SE) of commingled male beef calves.

Treatment	D0 ¹ (hrs±SE)	D+7 (hrs±SE)	D+14 ² (hrs±SE)	D+21 (hrs±SE)	D+28 (hrs±SE)
F (n=51)	-	11.1±0.3 ^a	12.0±0.3 ^b	9.9±0.3 ^c	10.0±0.3 ^c
U (n=51)	-	11.1±0.3 ^a	11.9±0.3 ^b	9.4±0.3 ^c	9.8±0.3 ^c

Conclusion

With the preliminary results available, for performance, vocalizations, exit speed, and accelerometer outcomes our hypothesis that a significant stress resilience exists for F calves is somewhat supported. Future findings will be informed by additional replicates of the study, as well as additional stress and behavioral outcomes. We are cautious when interpreting our data, since it represents preliminary results and hence risk of Type II errors. Furthermore, effects of social buffering on performance results will be informed by additional outcomes related to home pen behavior [D0-D+28], chute struggle score at handling [D0, D+7, D+14, D+21, D+28], cortisol [D0, D+14, D+21, D+28], wound healing scores and scrotal infrared thermography [D+21, D+28] outcomes.