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Effect of Overstocking at the Feed Bunk on Indicators of Cow Temperament

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Abstract

Our objective was to investigate the effect of overstocking the feed bunk on dairy cow behavioral responses to human approach and reactivity to blood sampling. One hundred and twenty dry Holstein cows were allocated to 1 of 2 treatment groups with different stocking densities at the feedbunk (Overstocked (**OS**): 0.88 headlocks/cow; Understocked (**US**): 1.17 headlocks/cow). Over 2 testing periods (7 d apart), flight response was assessed using a human-approach test, with a 5-point ordinal scale defining the distance at which the cow stepped away from the approaching experimenter (0 = not approachable from 3 m to 4 = cow moves away when experimenter is 0 m from the cow). A qualitative assessment was also made of the cow's response to the experimenter using a visual analogue scale (**VAS**) that included the terms: relaxed, nervous, alert, shy, aggressive, social, and curious. Reactivity to blood sampling via the coccygeal vein was assessed in the pen using a 4-point scale (0 = least reactive to 3 = most reactive). Data were analyzed through a mixed model analysis, using treatment, time, and their interaction. The relationship between qualitative measures was assessed using a Pearson correlation. There was a treatment by time interaction whereby flight response scores decreased with time in OS cows and increased with time in US cows (OS: 1.65 to 1.47, US: 1.33 to 1.68; $P = 0.02$). Reactivity to blood sampling did not differ by treatment (OS: 1.11, US: 0.98; $P = 0.47$), and there was also no treatment by time interaction **(**OS: 1.17 to 1.11, US: 1.01 to 0.98; $P = 0.88$). The overall correlation between qualitative terms was low. However, the terms 'relaxed' and 'nervous' had a significant negative correlation (OS: r = -0.71; $P < 0.0001$; US: r = -0.61; *P*

< 0.0001). In conclusion, overstocking the feed bunk affected the animal's response to an approaching human. Cows in the OS treatment became less approachable over time, which may indicate fear, stress, or an increase in arousal. Future research should investigate the effect that overstocking may have on cow temperament for a longer duration, as this may further decrease approachability.

Introduction

The way in which dairy cows are housed during the dry period is a growing area of interest, as it may affect their welfare, behavior, and future production potential. During the dry period, the welfare of the cow is very important as she prepares for her upcoming parturition and transition to lactation. A potential source of social stress during this period is overstocking at the feed bunk. Current industry-recommended best practices are to provide at least 0.6 m of linear feeding space per cow when they are housed in a freestall barn (NFACC, 2009). However, even with these recommendations, overstocking remains common with 58% of farms providing less than the recommended feeding space per cow (USDA, 2010).

The human-animal relationship is very important on a dairy farm due to the many interactions between stockpersons and the cows that occur every day. However, this relationship can be negatively affected by stress imposed on the animal. For example, stress due to negative interactions with stock people has been shown to have a negative impact on the human-animal relationship (Hemsworth et al., 2000).

Overstocking

The negative behavioral and physiological effects of overstocking dairy cows have been well documented. For example, Fregonesi et al. (2007) reported that cows spent, on average, 12.9 h/d lying when 1 stall was available per cow, but this time significantly decreased to 11.2 h/d when cows were overstocked to 150%. Additionally, cows competed indirectly for stall usage; they were observed lying down more quickly after returning from the parlor as opposed to eating. Huzzey et al. (2006) also reported that cows were displaced more often at the feed bunk, and therefore, spent more time standing idle when they were overstocked at the feed bunk with 0.67 versus 0.33 headlocks/cow. Under these competitive conditions, increased standing time is also associated with increased plasma cortisol concentrations (Gonzalez et al., 2003), which may be attributed to the increased number of displacements often observed at overstocked feed bunks or freestalls (Huzzey et al., 2006; Fregonesi et al., 2007). Therefore, the negative behavioral and physiological consequences of overstocking dairy cattle are well documented; overstocking may place unwarranted social stress on the animal. However, it is unknown as to whether this stress will affect the response and reactivity of animals to an approaching human or to blood sampling.

Human-Animal Interactions

The interactions between humans and dairy cows have also been well documented. Much of the research involving human-cow interactions has been aimed at developing an on-farm test to assess the temperament and welfare of the animal. Many researchers have done this through the evaluation of human approach and avoidance tests of animal’s in three different positions: standing in the passageway, lying in a freestall, and/or while at the feed bunk (Waiblinger et al., 2003; Rousing and Waiblinger, 2004; Winckler et al., 2007; Windschnurer et al., 2008). It was observed that of these possible testing situations, approaching the cows standing in the passageway showed the most consistency over time when compared to approaching the cows while they were lying or at the feed bunk. Therefore, it was determined that avoidance distance is well correlated with human-animal interactions and is a valid and applicable method of determining the human-animal relationship as part of on-farm welfare assessments.

In addition to measuring avoidance distance, the reactivity of dairy cows to humans has been assessed qualitatively by Gibbons et al. (2009) using a method similar to that used by Wemelsfelder et al. (2001) in evaluating the behavior of pigs towards humans. This type of assessment allows experimenters to capture subtle fluctuations in behavioral expressions, such as changes in posture or slight movements, which can give a better assessment of the animal's temperament. It has also been suggested that certain interactions with humans can affect avoidance behavior. For example, it has been reported that stroking an animal can decrease the avoidance of an animal to humans (Schmied et al., 2008). There is also evidence that negative attitudes and behaviors of stockpersons may negatively affect approach-avoidance behavior by increasing avoidance distance (Breuer et al., 2000; Hemsworth et al., 2000). However, it is unknown whether stress from overstocking during the dry period may affect the approach-avoidance behavior of cows.

Reactivity to Blood Sampling

In addition to the assessment of approach-avoidance behavior, the cow's reactivity to blood sampling was used as another measure of how overstocking at the feed bunk may affect the cows' temperament. While the reactivity of cows to blood sampling has not been investigated, the reactivity and behavioral responses of both cows and calves to other veterinary procedures has been explored. For example, Waiblinger et al. (2004) used a numerical rating scale to assess how previous handling impacted the response of cows to rectal palpation. In this study, they used a 3-point scale to assess the animals' reaction to several different handling situations. For example, during stroking, they measured whether a cow stood calm using a scale of 2 = yes, 1 = partly, and 0 = no. Additionally, a similar numerical rating scale has also been used to assess the degree of pain that dairy calves seemed to be experiencing from dehorning procedures (Braz et al., 2012). The numerical rating scale in this study was larger, ranging from 0 = "no pain" to 10 = "very severe pain".

Problem Identification and Hypotheses

To date, the effects that overstocking at the feed bunk may have on the human-animal relationship and dairy cow behavioral responses to blood sampling have not been investigated. This social stressor may potentially have a negative impact on the behavioral responses of dairy cows to humans and blood sampling. Thus, this form of social stress may negatively impact the welfare of the cow during the critical dry period, as overstocking the feed bunk may cause cows to become more reactive to their changing environment and potentially increase their avoidance behavior when handled by humans. Furthermore, by providing data indicating the potential behavioral effects due to social stress, improvements can be made on-farm to management practices in order to improve animal welfare.

The aim of this study was to investigate the effect of overstocking the feed bunk may have on dairy cow behavioral responses to human approach and reactivity to blood sampling. It was hypothesized that the stress imparted from overstocking the feed bunk would increase the flight response and reactivity of cows to humans. It also was hypothesized that the stress imparted from overstocking the feed bunk would increase the reactivity of cows to blood sampling procedures.

<u>**Materials and Methods**</u>

This study was conducted at Catalpadale Dairy Farm located in Marshallville, Ohio. One hundred twenty multiparous Holstein cows were dried-off approximately 60 d before their expected calving date. Using a randomized complete block design, cows were assigned to 1 of 2 treatment groups and balanced by expected calving date, lactation number, previous 305-d mature-equivalent milk yield, and sire. The stocking densities of the 2 treatment groups were as follows:

Understocked (**US**): stocking density of approximately 88% at the feed bunk; n = 60;

Overstocked (**OS**): stocking density of approximately 117% at the feed bunk; n = 60.

All cows were housed in a freestall barn divided into 2 pens. The conditions of overstocking at the feed bunk were simulated in the OS pen by attaching hog panels to the headlocks by cable ties in order to restrict access (OS: 0.88 headlocks/cow; US: 1.17 headlocks/cow). All cows were fed ad libitum twice daily and provided with a total mixed ration (**TMR**) diet formulated according to the recommendations of the National Research Council (NRC, 2001).

Human-Animal Interaction Assessment

Flight response was assessed over 2 testing periods (7 d apart) during the far-off period (-60 to -26 d prior to expected calving date) using a human-approach test with a 5-point ordinal scale adapted from Gibbons et al. (2009). This scale defined the distance at which a cow stepped away from an approaching experimenter (0 = Not approachable from 3.1 m to 4 = Cow moved away when the experimenter was 0 m away) (**Table 1).** Focal cows that were facing the experimenter while standing in the passageway with room to step away from the experimenter were approached starting at a distance of 3.1 m away from the animal. From this standardized distance, the experimenter took approximately 0.46 m long steps at a diagonal towards the shoulder of the animal while avoiding eye contact and keeping arms at the sides. After each step, the experimenter would remain motionless for 3 seconds to allow the cow to respond. The test was considered complete when the cow stepped away from the experimenter.

A qualitative assessment also was made of the cow's response to the approaching experimenter by a second identically dressed experimenter. This assessment was done using a visual analogue scale (**VAS**), adapted from Gibbons et al. (2009), which included the terms: relaxed, nervous, alert, shy, aggressive, social, and curious (**Table 2**). The VAS consisted of a 69 mm horizontal line with 2 vertical lines marking the extreme points of the scale (0 mm = term absent, 69 mm = term present throughout the test) (**Figure 1**). Scores for each term were measured as the distance in millimeters from the 0-point.

Reactivity to Blood Sampling

Behavioral reactivity of the cows to blood sampling from the coccygeal vein was assessed in the pen at dry-off and 45 d prior to calving while cows were headlocked. This was done using an original 4-point numerical rating scale where 0 = not reactive and 3 = very reactive (**Table 3**).

Statistical Analysis

Data were analyzed using the mixed model procedure of SAS, Version 9.3 (SAS, 2012), using treatment, time, and their interaction as fixed effects; block was included as a random effect. The relationship between qualitative measures was assessed using a Pearson correlation.

Significant differences were considered as $P < 0.05$ and a trend as $P < 0.10$.

Results and Discussion

Human-Animal Interaction

There was no main effect of treatment with relationship to the animal's flight response score (Figure 2). However, there was a significant treatment by time interaction in which flight response score decreased with time among the OS cows and increased with time among the US cows (**Figure 2**; OS: 1.65 to 1.47, US: 1.33 to 1.68; $P = 0.02$). This indicates that the OS cows were becoming less approachable with time, while the US cows were becoming more approachable.

The overall correlation between qualitative behavioral terms was low (**Table 4**). However, the terms 'relaxed' and 'nervous' showed significant negative correlation across both days (r=- 0.76; $P < 0.0001$); the more nervous the cow was, the less relaxed she seemed to be. 'Nervous' behavior was also correlated with 'alert' behavior (r=0.56; $P < 0.0001$); an 'alert' cow was also identified as a 'nervous' cow. 'Alert' behavior also was negatively correlated with 'relaxed' behavior (r=-0.46; $P < 0.0001$); an alert cow seemed to be less relaxed. The results also revealed that 'relaxed' behavior was correlated with 'shy' behavior (r=-0.41; $P < 0.0001$); a more relaxed cow seemed to be less shy. Additionally, 'shy' behavior was also correlated positively with 'nervous' behavior (r=0.39; $P < 0.0001$); a shy cow was also a more nervous cow.

Correlation between the qualitative behavioral terms, flight response score, and blood sampling reactivity score also was low. However, there was a significant positive, but low, correlation between 'relaxed' behavior and flight response score (r=0.13; $P = 0.04$); a 'relaxed' cow was more approachable. Additionally, there was a positive correlation between ‘curious’ behavior and flight response score (r=0.39; $P < 0.0001$); a more ‘curious’ cow was more approachable. There also was a trend between ‘nervous’ behavior and the blood sampling reactivity score (r=-0.11; $P = 0.09$); the more nervous a cow, the less reactive she tended to be to blood sampling. This may indicate a tendency for nervous cows to halt when having their blood sampled.

Reactivity to Blood Sampling

Reactivity of the cows to blood sampling did not differ by treatment as hypothesized (OS: 1.14, US: 1.00; $P = 0.24$). The reactivity of the cow’s to blood sampling also did not differ by day (Day 1: 1.10, Day 2: 1.04; $P = 0.66$). There also was no significant treatment by time interaction with respect to the cow’s reactivity to blood sampling (**Figure 3**; OS: 1.17 to 1.11, US: 1.01 to 0.98; $P = 0.88$).

Conclusions

Overstocking the feed bunk affected the animal’s response to an approaching human. OS cows became less approachable over time, while US cows became more approachable. These results may indicate fear, stress, or an increase in arousal of the animal. An animal that becomes more fearful of humans will experience added stress through their daily interactions with people. This additional stress may negatively affect the animal’s welfare, and could lead to a decrease in milk production. Additional stress on the animal could also lead to potential negative implications for workers on the farm as ease of handling will be decreased if an animal is stressed or fearful; the animals may bunch-up or attempt to flee, making them difficult to manage. The farm may also potentially be affected by a loss of profit due to the potential decrease in production associated with stress.

A limitation of this study is that testing was completed only twice. Future research should investigate the effect that overstocking the feed bunk may have on the human-animal relationship for longer than was investigated in the current study, as overstocking the feed bunk for a longer duration may further decrease approachability.

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Table 1. The scoring system used to score the cow's flight response to the approach test[1].

Score	Behavioral response
0	Cow moves away when experimenter was > 3.1 m away
1	Cow moves away when experimenter is between 2.1 and 3.1 m away (~1-2 steps)
2	Cow moves away when experimenter is between 1.2 and 2.1 m away (~3-4 steps)
3	Cow moves away when experimenter is between 0.3 and 1.2 m away (~5-6 steps)
4	Cow moves away when experimenter is 0 m away

[1]Adapted from Gibbons et al. (2009).

Table 2. Qualitative terms and descriptions used in the approach test[1].

Term	Description
Relaxed	A calm animal showing no sign of tension
Nervous	An animal that is quite restless/wary/uneasy as the experimenter approaches. May avoid experimenter, or quiver/flinch when a hand is placed on her, whites in eyes visible
Alert	Animal is very alert and attentive to the experimenter approaching and/or other events happening around her, ears may be pointed toward experimenter
Shy/submissive	Animal appears hesitant but not nervous, could show signs of submission like lowered head or freezing
Aggressive	An animal that appears agitated/irritated or annoyed as experimenter approaches. A dominant animal which may attempt to kick or to butt the experimenter by lowering her head to swing/lunge towards the experimenter.
Social	An animal that interacts positively with the experimenter, maybe try to sniff/lick/rub against experimenter.
Curious	Animal appears inquisitive, protrudes muzzle to sniff/investigate experimenter

[1]Adapted from Gibbons et al. (2009).

Table 3. The scoring system used to score the cow's reactivity to blood sampling.

Score	Reactivity	Description
0	Not reactive	Cow does not show any movement when sampled
1	Somewhat reactive	Cow shows some gentle movement upon initial handling, shifts weight back and forth and slightly sways
2	Reactive	Cow shows active movement upon initial handling, including movement and swaying, but stops movement after a few seconds
3	Very reactive	Cow is active for the duration of sampling period; aggressively sways and moves around and may kick

Table 4. Coefficients of simple correlations between qualitative behavioral terms, flight response score, and blood sampling reactivity score.

	Relaxed	Nervous	Alert	Shy	Aggressive	Social	Curious	Flight Score	Blood Score
Relaxed	1.00								
Nervous	-0.76 <0.0001	1.00							
Alert	-0.46 <0.0001	0.56 <0.0001	1.00						
Shy	-0.41 <0.0001	0.38 <0.0001	0.22 0.0008	1.00					
Aggressive	0.09 0.184	-0.09 0.205	0.07 0.325	-0.02 0.761	1.00				
Social	0.22 0.001	-0.16 0.017	0.003 0.959	-0.11 0.095	0.02 0.753	1.00			
Curious	0.16 0.019	-0.29 <0.0001	-0.01 0.867	-0.059 0.382	0.133 0.049	0.35 <0.0001	1.00		
Approach	0.13 0.043	-0.04 0.511	0.14 0.040	0.053 0.429	0.05 0.455	0.20 0.003	0.39 <0.0001	1.00	
Blood	0.10 0.138	-0.11 0.087	-0.04 0.597	-0.05 0.500	0.11 0.084	-0.01 0.861	-0.03 0.666	-0.02 0.757	1.00

Figure 1. Visual analogue scale for qualitative behavior assessment[1]

Date	Cow	Term	0 *Visual Analog Scale* 69
		Relaxed	|---|
		Nervous	|---|
		Alert	|---|
		Shy/submissive	|---|
		Aggressive	|---|
		Social	|---|
		Curious	|---|

[1]Adapted from Gibbons et al. (2009).

Figure 2. Least square means (± SEM) of flight response score for cows exposed to understocked or overstocked feed bunk conditions.

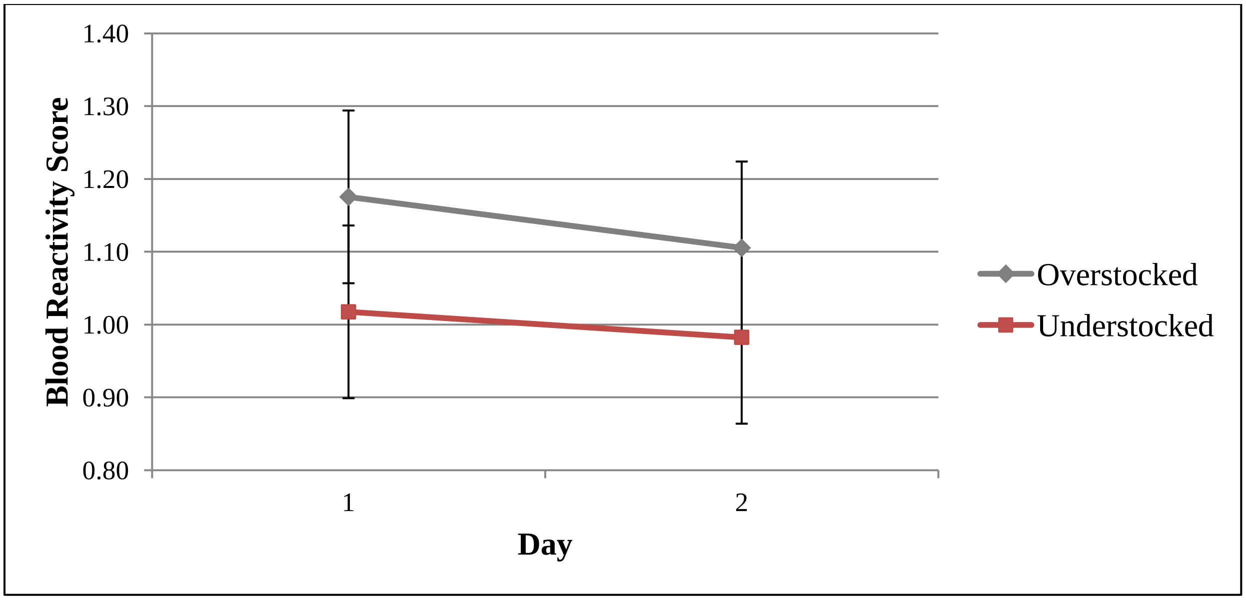

Figure 3. Least square means (+ SEM) of blood sampling reactivity score for cows exposed to understocked or overstocked feed bunk conditions.