Animal Behavior and Well-Being: Focus on Behavior

50 Measurements of behavior are essential components in the assessment of animal welfare. J. Rushen*, University of British Columbia, Vancouver, BC, Canada.

In this talk, I argue that the measurement of cattle behavior is a necessary aspect in the assessment of their welfare. Issues of behavioral deprivation have been central to the concern about animal welfare since the beginning and surveys have shown repeatedly that the public/consumers are particularly concerned about the inability of farm animals to perform natural behavior in intensive housing systems. Furthermore, early research showed that even farm animals subject to generations of artificial selection still show much of their natural behavior when given the opportunity to do so. Some of the most contentious issues in dairy cattle welfare involve primarily behavioral issues. Measures of animal behavior also add precision in animal welfare assessment. For example, common behavioral responses to illness provide one means for us to assess the relative impact on dairy cow welfare of various diseases. Based on measures provide the best means we have at present of judging the acute emotional response of dairy cattle to short-term husbandry procedures and the longer term emotional state of the animals. However, to best use behavioral measures in animal welfare assessment, we need to better understand the causal and motivational bases of the behaviors. Finally, exploiting dairy cattle’s behavior provides a novel means of solving some husbandry problems, while giving animals a sense of control over their environment, potentially improving their welfare. Because of these matters, assessments of animal welfare that do not include behavioral measures do not provide a complete picture of the welfare of the animals.

51 Making stall beds more comfortable: The effect of longitudinal space on lying behavior and leg injuries on dairy cows housed in deep-bedded tie-stalls. S. McPherson* and E. Vasseur, McGill University, Sainte-Anne-de-Bellevue, QC, Canada.

Poor stall comfort impairs lying behavior and leads to injuries. Stall bed comfort is affected by the amount of longitudinal space, defined by the front restriction of the stall (manger wall) and the stall length, and bed comfort. This project aimed to maximize cow comfort by investigating the combined effect of 3 aspects of the stall bed: stall length, manger wall height, and bedding depth. A 7.6 cm deep straw bedding layer was maintained by a bedding guard. Cows were randomly divided into two rows of 12 tie-stalls. Each row had a different length: short (178 cm; length commonly found in Quebec) or long (188 cm). Two manger wall treatments were applied randomly to the stalls in each row: high (20 cm, upper tarsal; P ≤ 0.001, lateral tarsal; P ≤ 0.01, lateral calcanei). Manger wall height did not affect injury or lying time. Higher lying times in our study were comparable to those reported in deep-bedded loose-pens, indicating that cows with more bedding, especially those in long stalls, were more comfortable. Deep-bedded straw stalls with bedding guards are applicable on tie-stall farms and result in cows that are more comfortable, spend more time lying, and have fewer leg injuries.

Key Words: stall length, manger wall height, deep bedding

52 Effect of pre-milking waiting time on the activity behavior of dairy cows. D. Manriquez*, S. Zuniga, G. Solano, S. Paudyal1,2, and P. Pinedo1, 1Department of Animal Sciences, Colorado State University, Fort Collins, CO; 2Texas A&M University, College Station, TX.

The objective was to assess the effect of pre-milking waiting time in the holding area on the subsequent lying behavior and number of steps of dairy cows. Holstein cows (parity 1, n = 17; parity ≥ 2, n = 111) from a dairy in northern Colorado were affixed with a pedometer (IceQube, IceRobotics, Edinburgh, UK) in one rear leg providing number of steps (STP), lying time (LY; min), and standing time (STD; min). Cows were milked 3x in a 60-stalls rotary milking parlor (DeLaval). Time of entrance to the milking stall for each individual cow was automatically recorded from January to June 2018 (average DIM at enrollment = 15.3 ± 7.1). Starting time for each milking pen was also available. Individual waiting time was calculated for each milking as the difference between the pen starting time and the time of cow entrance to the milking stall. Waiting times were categorized (WaitCat) in low (≤30 min) and high (>30 min). STP, STD, and LY were added until the beginning of the subsequent milking and standardized in minutes/hour. General linear models were created to test the associations between waiting time categories and activity parameters. Parity (1; ≥ 2), shift (morning, afternoon, night), and their interactions with WaitCat were also included. Table 1 presents activity values by waiting category, as well as P-values for variables included in the models. Our preliminary analyses determined a tendency toward significant effect of WaitCat and parity on STP. A significant interaction between shift and WaitCat was observed for all the outcomes, suggesting that daily activities may modify the effect of waiting time on the behavior of dairy cows. Further analyses considering other potential confounding factors are required to clarify the significance of pre-milking waiting time on cow behavior.

Table 1 (Abstr. 52). Summary of activity parameters (mean ± SE) by pre-milking waiting category.

<table>
<thead>
<tr>
<th>WaitCat (min)</th>
<th>Steps (no./h)</th>
<th>Standing time (min/h)</th>
<th>Lying time (min/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤30</td>
<td>107.5 ± 4.24</td>
<td>34.8 ± 0.54</td>
<td>25.2 ± 0.54</td>
</tr>
<tr>
<td>&gt;30</td>
<td>112.0 ± 4.25</td>
<td>34.7 ± 0.54</td>
<td>25.3 ± 0.54</td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WaitCat</td>
<td>0.10</td>
<td>0.70</td>
<td>0.70</td>
</tr>
<tr>
<td>Parity</td>
<td>0.002</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>WaitCat × Parity</td>
<td>0.01</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>Shift</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Shift × WaitCat</td>
<td>0.60</td>
<td>0.03</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Key Words: lying, milking, behavior
53 Rumination time and metritis in grazing dairy cows. R. Held*1 and P. Sepúlveda-Varas2, 1Escuela de Graduados, Facultad de Ciencias Veterinarias, Universidad Austral de Chile, Valdivia, Chile 2Instituto de Ciencias Clinicas Veterinarias, Universidad Austral de Chile, Valdivia, Chile.

Changes in rumination time (RT) can be used as an indicator of illness, yet no work to date has evaluated this relationship in dairy cows on pasture. The objectives of this study were to describe the RT of grazing dairy cows during the transition period and to determine the relationship between metritis and RT. Our sample included 53 multiparous and 17 primiparous Holstein cows that calved during the spring season at the Experimental Dairy Farm of the Universidad Austral de Chile (Valdivia, Chile). Cows were assessed every 2 or 3 d between 3 and 21 d in milk, and metritis was diagnosed by inspection of the vaginal discharge. Any presence of other clinical disease was recorded, and cows were subsequently categorized into 2 health categories: (1) healthy, no metritis and had no other signs of clinical (retained placenta, milk fever, metritis, mastitis) postpartum diseases; and (2) metritis, diagnosed as having metritis with no other signs of clinical postpartum disease with the exception of retained placenta. RT was recorded daily using an automated monitoring system from 3 wk before calving to 3 wk after calving. Data were analyzed using mixed linear models (SAS v9.4). The RT differed between healthy primiparous and multiparous cows; primiparous cows had lower RT during the precalving (d −21 to d −2; 504 ± 41 min/d vs. 559 ± 19 min/d; P < 0.001) and postcalving period (d2 to d21; 423 ± 9 min/d vs. 483 ± 5 min/d; P < 0.001) compared with multiparous cows, but RT did not differ between these parity classes at calving (d −1 to d 1; 412 ± 33 min/d vs. 426 ± 18 min/d; P = 0.60). The average number of days from calving to the first signs of metritis was 7.5 ± 0.7 d for primiparous cows and 6.7 ± 0.6 d for multiparous cows. An alternative form of outdoor access is a deep-bedded pack, but it is of estrus but providing access to quality pasture is not always feasible. Pasture access can help prevent lameness and facilitate the expression of estrus but has the potential to increase the risk of hoof disease. The use of activity monitoring technologies to identify cows diagnosed with hoof disorders (H; n = 69) and sound cows (S; n = 69), matched by age and hoof trimming date. Hoof disorder diagnoses included digital dermatitis, white line disease, and sole ulcers. The CowManager system was used to collect cow ear temperature, activity, rumination, and eating behaviors for 7 d before hoof trimming, day of hoof trimming, and 7 d after hoof trimming. Data were analyzed to compare differences between cows using PROC MIXED in SAS. A 3-way interaction among cow age, hoof health status, and day of study was detected for ear temperature (P < 0.0001), active (P < 0.0001), non-active (P = 0.0002), rumination, (P = 0.008), and eating (P = 0.0003) behaviors. All cow groups had the lowest ear temperatures before hoof trimming and highest ear temperatures after hoof trimming, with the greatest difference occurring in the 5-yr-old cows (P = 0.03). The oldest cows (7 yr of age and older) with hoof disorders showed more variation in all behaviors over the 15-d period than sound counterparts. The youngest cows (3 yr of age) with hoof disorders spent less time being active (H: 2.14 ± 0.01 h vs. S: 2.61 ± 0.01 h) or eating (H: 2.12 ± 0.02 h vs. S: 2.70 ± 0.02 h) in non-active counterparts (8.30 ± 0.04 h). The greatest difference in ruminating between cows with hoof disorders and sound cows occurred in the oldest cows (H: 7.91 ± 0.05 h vs. S: 9.97 ± 0.04 h). The use of activity monitoring technologies to identify changes in behavior could aid in the early detection of hoof disorders in dairy cows; however, the age of the animal being monitored should be considered, as demonstrated in this study.

Key Words: transition, pasture, illness


Hot-iron disbudding, a husbandry procedure that prevents horn bud growth through tissue cauterization, is painful for calves. The resulting burns remain sensitive to mechanical stimulation for weeks, but the procedure’s influence on behaviors that involve movement of the head, such as resting with the head down and ruminating, is largely unknown. We assigned female Holstein calves to 1 of 2 treatments: disbudded with a heated iron at 4 to 10 d of age (n = 11) or not disbudded (n = 11). Disbudded calves received a lidocaine cornual nerve block and oral meloxicam at the time of the procedure. All calves were provided starter from 5 d of age and half of the animals had access to hay, balanced across disbudding treatments. We recorded resting and ruminating behavior using 5-s scans taken every 5 min for 24 h once a week capturing the window from 3 to 21 d after the procedure. In addition to scan sampling, we used ear tag accelerometers (eSense by Allflex) to monitor behavior in 1-min intervals throughout the experiment. Mixed β regressions were used to test the effect of treatment and its interaction with age on the daily proportions of time the calf spent lying and ruminating based on the live scan observations thus far. Calf was fitted as a random effect in the models. Compared with controls, disbudded calves ruminated less in the first 2 wks after disbudding (mean ± SE: 10 ± 1% vs 18 ± 2% of total time; P = 0.003) and were more likely to lie with their head down and still across all weeks (31 ± 1% vs 26 ± 1% of total lying time; P = 0.012). A decrease in ruminating and increase in lying with the head down and still may reflect an avoidance of moving the head in ways that could aggravate disbudding wounds. We conclude that disbudding, in addition to resulting in prolonged sensitivity of the wounds, is severe enough to alter daily behavior patterns for at least 3 wks, raising additional welfare concerns about the procedure.

Key Words: cauterity disbudding, pain, animal welfare

55 Age affects Holstein cow behavioral responses to hoof disorders. C. Toet*1 and A. Adams-Progar*2, 1Wageningen University and Research Centre, Wageningen, the Netherlands, 2Washington State University, Pullman, WA.

Early detection and treatment of hoof disorders in dairy cattle is imperative for animal well-being and production. Changes in cow behavioral patterns may assist with the early detection of hoof disorders. The objective of this study was to evaluate how hoof disorders affect behavioral patterns in Holstein cows. Hoof trimming records collected over 2 yr at the Washington State University Knott Dairy Center (Pullman, WA) were used to identify cows diagnosed with hoof disorders (H; n = 69) and sound cows (S; n = 69), matched by age and hoof trimming date. Hoof disorder diagnoses included digital dermatitis, white line disease, and sole ulcers. The CowManager system was used to collect cow ear temperature, activity, rumination, and eating behaviors for 7 d before hoof trimming, day of hoof trimming, and 7 d after hoof trimming. Data were analyzed to compare differences between cows using PROC MIXED in SAS. A 3-way interaction among cow age, hoof health status, and day of study was detected for ear temperature (P < 0.0001), active (P < 0.0001), non-active (P = 0.0002), rumination, (P = 0.008), and eating (P = 0.0003) behaviors. All cow groups had the lowest ear temperatures before hoof trimming and highest ear temperatures after hoof trimming, with the greatest difference occurring in the 5-yr-old cows (P = 0.03). The oldest cows (7 yr of age and older) with hoof disorders showed more variation in all behaviors over the 15-d period than sound counterparts. The youngest cows (3 yr of age) with hoof disorders spent less time being active (H: 2.14 ± 0.01 h vs. S: 2.61 ± 0.01 h) or eating (H: 2.12 ± 0.02 h vs. S: 2.70 ± 0.02 h) than sound counterparts. A significant difference (P = 0.01) in non-active behavior occurred between 4-yr-old cows with hoof disorders (6.85 ± 0.03 h) and sound counterparts (8.30 ± 0.04 h). The greatest difference in ruminating between cows with hoof disorders and sound cows occurred in the oldest cows (H: 7.91 ± 0.05 h vs. S: 9.97 ± 0.04 h). The use of activity monitoring technologies to identify changes in behavior could aid in the early detection of hoof disorders in dairy cows; however, the age of the animals being monitored should be considered, as demonstrated in this study.

Key Words: activity monitor, cow behavior, hoof disorder

56 The effect of access to an outdoor pack on lameness and estrus expression. A. Smid*, M. von Keyserlingk, and D. Weary, University of British Columbia, Vancouver, BC, Canada.

Pasture access can help prevent lameness and facilitate the expression of estrus but providing access to quality pasture is not always feasible. An alternative form of outdoor access is a deep-bedded pack, but it is unknown if access to an outdoor open pack is beneficial in these ways.
The aims of this study were to investigate if access to an outdoor open pack can: 1) prevent the development of lameness, and 2) facilitate the expression of estrus behavior. A total of 36 cows were enrolled directly after calving and randomly assigned to either the OUTDOOR or INDOOR treatment and followed for a total of 12 weeks. All cows were housed in the same pen, but only OUTDOOR cows had access to an outdoor open pack. Each week, cows were gait scored from video observations. Cow behavior in the pen and on the outdoor pack was continuously followed by video recordings. Following an alert from the activity monitoring system, cows were checked for the presence of a preevulatory follicle and the absence of a mature corpus luteum (CL) by rectal ultrasonography following milking as well as from 48 h and 7 d thereafter to confirm ovulation. Both suspected estrus and false alerts were scanned 7 d post-alert to confirm estrus classification (i.e., if the alert was correctly classified as a true or false estrus). For each true estrus event, the number of visits to the outdoor pack by OUTDOOR cows was investigated. The effect of treatment on gait score was assessed using a mixed model with treatment specified as fixed effect and cow as repeated effect. The effect of estrus status on visits to the outdoor pack was assessed using a mixed model with estrus status (i.e., in estrus or not) as fixed effect. No effect of treatment was found on mean gait score: INDOOR: 2.46 ± 0.15; OUTDOOR: 2.61 ± 0.15, but OUTDOOR cows visited the outdoor pack more often on days when they were in estrus (1.78 vs 6.07 visits/d). These results indicate that access to an outdoor pack has a positive effect on the expression of estrus behavior for freestall-housed dairy cows.

Key Words: outdoor area, bedded pack, exercise


Calfoth diseases during early stages of growth can detrimentally affect productive performance in dairy cattle, resulting in considerable economic losses to the dairy industry. Health issues can alter calf behavior, so that change on behavior pattern could be used as an earlier indicator to prevent diseases. However, in large dairy operations, the daily monitoring of calf behavior is laborious, and the large number of animals becomes a limiting factor for such evaluation. Thus, the objective of this study was to develop an automated computer vision system to individually monitor behavior of dairy calves housed in groups. The experiment was conducted at the Dairy Research Cattle Center of the University of Wisconsin-Madison. Five calves were housed in a group from the 4th to 8th weeks of age. All calves had ad libitum access to water and calf starter from the first week of life until the end of the trial. A Wi-Fi camera with night vision capability (Amcrest Outdoor Wi-Fi Camera, model: IP3M-956EW) was installed 4 m above the pen. Images were acquired every 5 s and sent to a data storage in the cloud platform. For each image, calves were spatially located and then labeled for their respective identification (ID, from Calf 1 to Calf 5) and classified for animal behavior (lying, drinking, eating, and standing). A total of 650 images were used for training purpose and 100 images were used for validation. A deep neural network approach called Mask RCNN was implemented to generate the predictions. The algorithm was trained by adopting the strategy of transfer learning, for which the weights from COCO data set were used. All analyzes were implemented in Python using the open source frameworks TensorFlow and Keras. The accuracy to recognize a specific calf were: 77% (Calf 1), 70% (Calf 2), 80% (Calf 3), 92% (Calf 4), 80% (Calf 5). The accuracy to predict the behavior activity of lying, drinking, eating, and standing were: 91, 86, 85, and 100%, respectively. These results indicate that a computer vision system can be a powerful tool to monitor behavior of dairy calves housed in groups.

Key Words: outdoor area, bedded pack, exercise

58 Deriving intake from multiple 3-dimensional accelerations in peripartal Holstein dairy cows. N. Carpinelli*1, J. Halfen1,2, and J. Osorio1, South Dakota State University, Brookings, SD, Universidade Federal de Pelotas, Pelotas, Rio Grande do Sul, Brazil.

Dry matter intake is commonly observed to decreased around calving in dairy cows and this can have severe health consequence depending how acute and prolonged this effect occurs. The objective was to evaluate the use of 3-dimensional accelerometer sensors to estimate DMI in peripartal dairy cows. Twelve Holstein dairy cows housed in bedded pack pens during close-up were fitted with 3 sensors that record acceleration in the 3-axis (i.e., x, y, and z), one sensor on the lateral side of the left hind leg and 2 attached to a halter directly superpose over the jaw and nose. After calving, cows were moved to a free-stall barn bedded with straw. Cows were assigned 2 groups, a data collection group (A; n = 6) and a validation group (B; n = 6). Accelerations and individual intakes were collected from −7 to 7 d relative to parturition. Cows were trained to use Calan gates at least 7 d before data collection. Sensors were set to record the accelerations at 1 min intervals. Acceleration characteristics highly associated with DMI determine in a previous study were used to cross-reference accelerometer data and DMI in group A. Six new variables were derived based on lag-times in jaw and nose accelerations. The REG procedure of SAS was used in group B derive DMI from acceleration combinations (DMIA) and compared this against the actual DMI using the CORR and MIXED procedures of SAS. Previously, 921 acceleration combinations were deemed relevant for DMI estimation, and these were tested in the current study. LegX+JawZ×NoseX model had the strongest positive correlation (r = 0.54), and its DMIA was similar (P = 0.26) than the actual DMI (14.5 vs 15.9 kg/d), but it did not follow the rapid decreased observed in actual DMI around calving (P = 0.07). In contrast, LegZ×JawZ×NoseZ×NoseX model had the closest actual DMI estimation (P = 0.99), but a not significant correlation (P = 0.46). The intermediate model LegZ×JawZ×NoseZ×JawY×NoseY had a weak correlation (r = 0.30) but described a similar decreased (P = 0.53) between DMIA and actual DMI around calving. Accelerometer sensors have a great potential to estimate peripartal DMI, could be a future approach utilize by commercial dairy farms to flag cows at risk to develop a postpartal disease.

Key Words: accelerometer, intake, sensor technology