Scientific assessment of cow comfort

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Introduction

What does the term 'cow comfort' really mean? When we hear dairy famers use this term we understand two different sorts of meaning. The first is very general, and roughly corresponds to what in the academic literature is termed 'animal welfare', meaning that the animal is doing well in every sense that is important to it – that it is to say it is healthy, happy, and able to perform those natural behaviors that are important to it (Fraser et al., 2007; see von Keyserlingk et al., 2009 for an application of these ideas to the dairy system). Dairy farmers often use the term cow comfort more specifically to relate to how well the cow fits and thrives in the environments we build for her, including the indoor environments in which many dairy cows spend most of their lives. But even this more specific meaning can cover all the ways she interacts with the housing and management systems designed for the cow, ranging from the milking parlor to the trimming chute. This talk will focus more specifically on how design and management features of the freestall barn, with a special focus on the lying stall, although as you will see addressing even this narrow conception of cow comfort requires some discussion of the broader concepts around animal welfare and even what conditions can be considered to be required to provide a good life for these animals.

Our research group has worked for some 20 years to identify methods of improving the welfare of dairy cows. Projects vary depending upon farmer and student interest, funding, etc., but one common feature is that we attempt to address real world problems faced on dairy farms, and to provide solutions that could be adopted by at least some farms.

For many of us who work with dairy cows, lameness is considered perhaps the greatest threats to dairy cow welfare; lameness is painful, long lasting and prevalent. We believe that cow comfort is important in its own right, and that many cases of lameness could be prevented by housing cows in barns that are more comfortable for the animals. We will address lameness, and how aspects of stall design and management can contribute to lameness, in a companion paper. Our aim here is to describe some of the main scientific approaches to assessing the more specific meaning of cow comfort, and review examples from our own research showing how freestall barn design and management can affect the cows.

We propose that the cow comfort assessments can take four main approaches: 1) observations of unnatural and injurious behaviors, 2) the measurement of injuries caused by the housing system, 3) the measurement of cow preferences including their motivation to access different housing options, and 4) the measurement of behaviors related to comfort, including standing and lying, when housed in different environments. Below we address each of the approaches in more detail.

Unnatural and injurious behaviors

A very important and perhaps under-appreciated role for veterinarians and other dairy professionals that visits many commercial farms is to provide a 'fresh pair of eyes' for the producer. It is normal that we become habituated to things around us, good and bad, so that it can become hard for people to spot problems on their own farms. This 'farm blindness' can affect us all. For example, we only became aware of the prevalence and seriousness of hock lesions on our own farm after these after a visitor photographed the injured legs of our own cows and sent the photos to the Dean of our Faculty. So cow comfort assessments can begin with something as simple as visiting a farm with a fresh set of eyes, and taking the time to see how the cow interacts with her environment.

We suggest that the best place to start by looking for evidence of unnatural behaviors. Unnatural is not the same as abnormal; on some farms behaviors that unnatural behaviors can be normal. Examples include lying down outside of the stall in the alley or elsewhere in the pen, 'dog sitting' in the stall, lying half out of the stall, or perching in the stall, with the front legs on the stall surface and the bag legs in the alley (Figure 1). We will return later to why some of these behaviors may also threaten the health of the cow, but for now it is enough to recognize these as unnatural, and to begin the trouble shooting process to identify the factor or factors that is resulting in the cow behaving in these ways.

Some unnatural behaviors may increase the risk of injuries to the cow, but even perfectly natural behaviors can lead to injuries in poorly designed and managed faculties. Again, taking the time to carefully observe the cows and how they interact with their facilities can provide indications of a problem. For example, the stall partitions and other hardware we use in freestall pens are designed to position the cow in the stall so that she is less likely to defecate on the stall surface. Ideally the cow should not contact this hardware at all, so if you see the cow hitting parts of the stall when she gets up and lying down this should be considered a problem. Even if you don't see the contact you can diagnose this indirectly, by taking the time to look at this hardware from the cows perspective. Do you see shiny (polished) metal surfaces? If so cows are likely in regular contact with that surface, perhaps with enough force to cause them injury.

Injuries caused by the housing system

Perhaps the most obvious example of poor cow comfort is when the housing systems we provide our animals cause them injuries. Unfortunately, such injuries are all too common.

Of all the injuries caused by freestall housing perhaps the most common, and our opinion the easiest to solve, is the hock lesion. Hock lesions are any skin injury on or around the carpal joint. Most typically these appear on the lateral surface of the carpal joint, but lesions also occur on the medial surface and on the dorsal, medial and ventral surfaces of the tuber calcis (Weary and Taszkun, 2000). Unlike hoof lesions that require a freshly trimmed hoof to observe and that are difficult to score consistently, hock lesions can be easily observed whenever the cow is in the milking parlor, and producer friendly scoring systems are available that allow these lesions to be scored consistently (e.g. Hock Assessment Chart for Cattle developed by Cornell Cooperative Extension; www.ansci. cornell.edu/prodairy/pdf/hockscore.pdf ; where 1 =healthy hock, 2=bald area on the hock without evident swelling, and 3=evidently swollen and/or severe injury). At the herd or group level prevalence can be calculated using the % of cows scored with a visible hock injury (i.e. score = 2) and the % with a severe injury (hock scored = 3).

The results of a number of studies (e.g. Weary and Taszkun, 2000) have shown that the risk of hock injuries can be much reduced by changes in housing. Specifically, these lesions are much less common on farms with well-bedded stalls, meaning copious quantities of dry bedding. Farms using little or no bedding typically have high rates of hock injuries bedded surfaces like mats and mattresses.

In one cross-farm study we visited dairy farms in the north-eastern United States (New York, Vermont and Pennsylvania) and in California (Barrientos et al., 2013).

Figure 1.Cows ‘perching’ in the stall, with the front hooves on the stall surface and the rear hooves in the alley (photo credit Animal Welfare Program).

In the farms in the north-eastern United States many farms used poorly bedded mattresses or mats, but farms with deep-bedded stalls had a much reduced the odds of hock lesions (Figure 2). Other management practices linked to reduced hock injuries included dry bedding and access to pasture during the dry period.

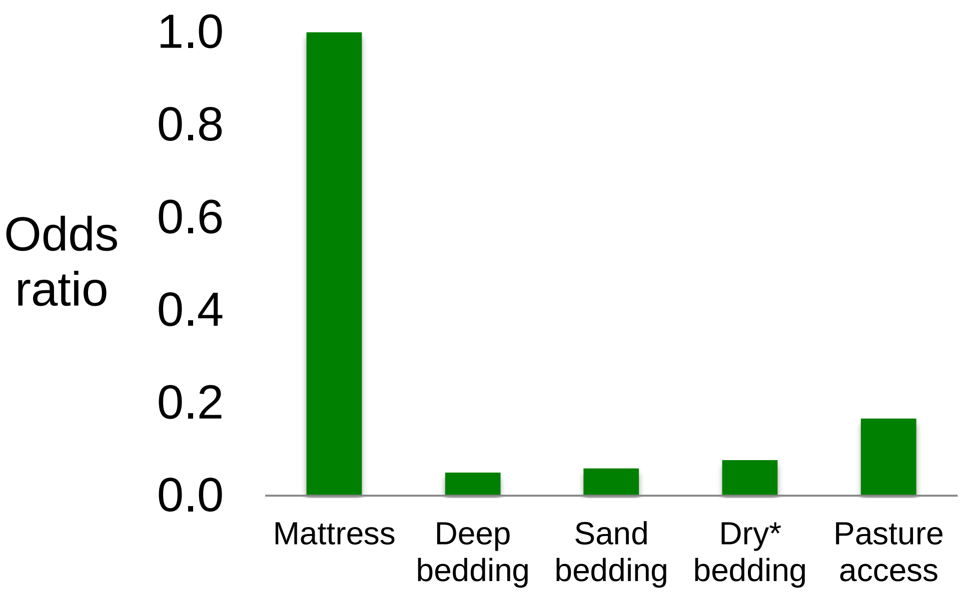

Figure 2.Odds of hock injuries on farms in the north-eastern United States using different management practices. Farms with deep-bedded stalls normally bedded with sand, and sand stalls tend to have a relative dry stall surface (*DM > 84%), so these protective factors should not be considered independent. Data are from Barrientos et al. (2013).

In California (where all the herds assessed had access to deep bedding) hock injuries were far less common, and farms with well-maintained stalls (i.e. level in the stalls) had the lowest rates. Thus across regions, farms that use well-maintained, deep-bedded stalls had fewer cows with hock injuries. Access to deep-bedded stalls (and well-bedded outdoor dry lots) may also explain the low prevalence of cows with swollen knees in CA versus the NE.

In our view, these results are so clear that the render the issue hock lesions essentially solved: we know that these lesions can be prevented by keeping cows on well-bedded lying surfaces. Indeed, farms that make such changes in the lying surface and bedding management can achieve impressive reductions in lesion prevalence (Chapinal et al., 2014). What is required now is to get this knowledge out onto dairy farms so that these changes are made and hock lesions become a problem of the past.

Other types of injuries still require study, but we believe should also be relatively easy to trouble shoot. In our experience swollen front knees are remarkably common and our sense is that this issue is due to inadequate cushioning of the stall surface, with lesions most common on concrete and hard rubber mats, or poorly designed mattresses and waterbeds. Thus access to deep-bedded stalls (and well-bedded outdoor dry lots) may also explain the low prevalence of cows with swollen knees in California versus the north-eastern United States. Neck lesions can also be common on some farms (often associated, we believe, with poorly designed feed barriers); these too deserve attention. We conclude that recording lesions provides a remarkable straightforward and important method in cow comfort assessment, and can provide veterinarians and others some success when helping farmers address issues with cow comfort on their farms.

Preference and motivation

Allowing animals to choose between different options, and recording their choices, can provide a straightforward way of addressing issues related to cow comfort. The basic idea of allowing animals to 'vote with their feet' is one of the oldest and most important techniques in animal welfare science, despite a number of well-known limitations to the method (Fraser and Nicol, 2011).

We have used preference tests to examine a number of housing factors relevant to cow comfort. Preferences for lying areas seem to be especially affected by the quality of the lying surface. For example, cows strongly prefer to lie down on dry bedding (Fregonesi et al., 2007), and chose to lie down in stalls with deep bedding versus on poorly bedded mattresses (although this preference is also affected by familiarity; Tucker et al., 2003). Cows also choose to avoid lying areas with hardware that impedes their ability to lie down and stand up, for example avoiding stalls with restrictive neck rail barriers (Tucker et al., 2005) and preferring an open lying area (with no stall partitions) to conventional freestalls (Fregonesi et al., 2009). Interestingly, the suitability of the surface seems to trump other factors in the cows choice of where to lie down; cows will choose to lie down in a conventional freestall rather than an open bedded area with wooden barriers that rise only slightly from the lying surface (Adabe et al., 2015).

The preferences of animals will vary depending upon the behavior that they are most motivated to engage in. For example, cows search for both a comfortable area to lie down, and for a comfortable area to stand upon. Like the lying area, cows will generally prefer a dry, soft area for standing. Cows could use the freestall for both lying and standing, but stalls are typically designed to make it hard for cows to stand fully on the stall surface; moving the neck rail makes it easier for the cow to stand in the stall, and thus avoid the wet, hard, concrete surface outside of the stall (Fregonesi et al., 2009). Preferences for a dry, soft standing surface, as well as for an unrestricted lying surface, likely explains why cows also show a preference for pasture (versus staying inside the freestall barn) when this choice is made available (Legrand et al., 2009). Interestingly, this is a partial preference, as cows choose to go outside especially at night (so long as weather conditions are suitable) but tend to stay inside during the day (Figure 3). We believe that the preference to stay indoors during the day is driven by the cows' motivation to avoid exposure to the summer sun and flies, and their motivation to consume the high-energy mixed ration, fed fresh during the day.

One criticism of preference studies is that it is hard to know how important it is to the animal to be able to access their preferred option. One way to assess the strength of preferences is to compare motivation for one thing against another. In a now classic study, Metz (1985) found that cows were willing sacrifice eating for the chance to lie down, even if animals had been restricted from both lying and feeding for 3 h before the test. Another way of assessing the strength of preferences is to have animals perform some type of work to access a preferred resource. For example, cows could be trained to push upon a weighted gate to gain access to food, to a comfortable lying area, or to pasture, and we can measure the amount of weight that cows are willing to push as a measure of their motivation to access each the resources. In current work at UBC we are developing these tests.

In addition to measuring motivation directly with the motivational tests described able, we can also develop indirect tests based upon the way that cattle use the resources we provide to them. For example, we can measure how often cows choose to lie down or stand up in different areas, and the amount of time that they spend engaged in these activities – we turn to these types of usage measures below.

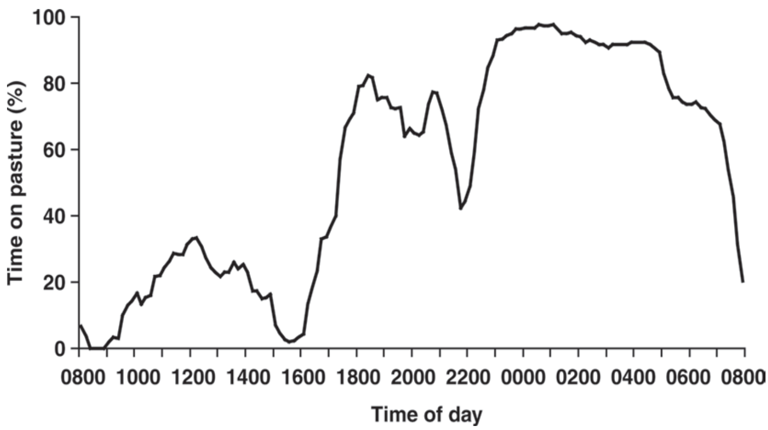

Figure 3. Cows spent the majority of the nighttime outside on pasture but spent the majority of the daytime inside the freestall barn. Cows were milked at approximately 0800 and 1500 h. Researchers associate warm daytime temperatures with the cows' preference for staying in the barn during the day. Adapted from Legrand et al., 2009.

Standing and lying behaviors

In many studies using conducted at our own research farm we have tested various design and management features to see how these affect cow behavior (e.g. Abade et al., 2015; Bernardi et al., 2009; Winkler et al., 2015). For example, in a series of studies we have found that cows spend more time lying down in stalls with deep, dry, and well maintained bedding (Tucker at al., 2009; Fregonesi et al., 2007; Drissler et al., 2005).

The gold standard for measuring these behaviors is continuous, 24 h observation. This type of data can be collected using video cameras, but in practice setting up cameras in barns can be difficult, especially to achieve the appropriate coverage of the important lying, standing and feeding areas, etc. In addition, this video still needs to be watched and scored by an observer, requiring an enormous number of hours to score a number of cows over a number of complete days. Now several types of electronic monitoring device are available that can automate the recording of some behaviors. For example, we have found that the Hobo data loggers can be used to accurately record the total time animals spend lying down, the number of lying down and standing up events, and the duration of each of these lying and standing bouts. Validation data has been published for dairy cows and calves, and most recently we have also published validation data for the use of these devices in dairy goats (Zobel et al., 2015).

With this type of automated monitoring it becomes relatively easy to measure the effects of different types of housing options on these behaviors. We have found that the preferences described above generally correspond well to these usage measures. For example, cows prefer stalls with copious amounts of well maintained bedding and also spend more time lying down in these stalls even when they are restricted only a single option. In one study we experimentally manipulated the leveling of sand bedding in the stall (Drissler et al., 2005) and found that cows showed a linear, dose-dependent response to bedding maintenance, with lying times declining by more than 2 h when stalls are poorly maintained (Figure 4).

In a series of experiments we have found changes in lying times varying with the way in which stalls are configured and managed. However, lying times also vary greatly among cows, so sensitive tests for treatment differences require that tests be done within cow (i.e. testing each animal in each condition, so as to use the cow as her own control).

In some cases, the number and structure of lying bouts can be more relevant than the total time spent lying. In recent work we have become especially interested in the design and management of facilities for more vulnerable cows, including sick cows and cows around the time of calving. In one study we kept cows in calving bens with different types of stall flooring, and found that cows engaged in more transitions between standing and lying when kept on deep bedded surfaces in comparison with rubber mats, especially near the time of calving when the frequency of standing and lying down movements typically peak (Campler et al., 2014).

We suggest that the most can be learnt from a careful consideration of a number of behaviors relevant to how the animals use the facilities that we design and manage.

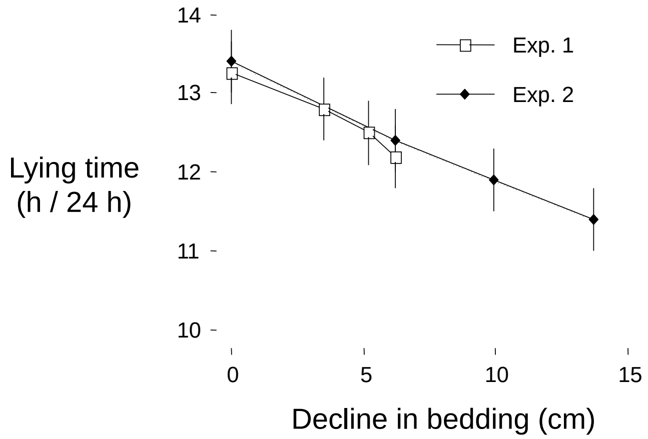

Figure 4.The lying time (h/24 h) for cows housed in sand-bedded free stalls, in relation to how well these stalls were maintained. Stall maintenance was varied experimentally to match the condition of stalls after they had been used for varying periods with leveling, with the baseline condition being a 0-cm decline in bedding depth (i.e. a level stall surface). In Experiment 1 and 2 assessed varying ranges in in stall bedding decline. Adapted from Drissler et al., 2005.

The way that different behavioral measures can be affected by a management factor is illustrated in by Winkler et al.'s (2015) work on the effects of stocking density. As expected, cows spent less time lying down when fewer stall were available (density varied from under-stocking at 75% to overstocking at 150% cows:stalls). More interestingly, these differences in lying time were most apparent at night when cows are especially motivated to lie down. When cows could not lie down in the stall they spent more time standing in the alley. Cows were also more likely to competitively displace each other from lying stalls when housed at higher densities, and the socially subordinate cows least able to displace others were those most likely to spend time lying down in the stall during the day time when other cows were active.

What next?

The science of cow comfort has seem amazing progress over the past decade, in terms of what to measure, how to measure this, and in terms of better identifying the design and management features that help provide a comfortable environment for housed dairy cattle. In terms of measuring cow comfort, we especially encourage veterinarians and other dairy professionals to focus especially on measures of cow injuries, as these are relatively easy to observe and much is known about how these can be prevented on commercial farms. In terms of housing features we suggest a special focus on the bedded surface: comfort is perhaps most affected by the availability of copious quantities of clean, dry bedding. This review has focused especially on freestall housing, as this is the system that has been most studied both by our group and by other researchers. However, we encourage new work examining a broad range of alternative housing systems. We suggest that there are likely far more comfortable environments that we can design and management for our cows, but finding these options will require creativity and stepping beyond the conventional structures that we typically find on commercial farms today.

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