

# Enriching the lives of dairy cattle with opportunities to express adaptive behaviors

Jennifer M. Van Os, PhD

University of Wisconsin-Madison, Madison, WI 53706

## Abstract

Good animal welfare means that cattle are not only healthy and productive, but also that they can express important behavioral adaptations, and that negative experiences are minimized while opportunities for positive ones are provided. Environmental enrichments allow cattle to express species-specific and life-stage-appropriate adaptive behaviors in captivity. To be effective, environmental enrichments must be used and wanted by the animals and result in measurable benefits to welfare. These benefits may be transient (i.e., positive emotions while using the enrichments) or long-term, such as improved coping skills or stress resilience, resulting in cumulative positive welfare balance. Scientific studies have identified both experimental and practical options for relevant environmental enrichment for dairy cattle of different life stages.

**Key words:** environmental enrichment, animal welfare, positive welfare

## Introduction

The term animal welfare is used to describe either the subjective current status or cumulative quality of life of animals. The animals' experiences are directly affected by animal care decisions made by humans, including housing environments, management and husbandry practices, and direct human-animal interactions or handling. A common framework for thinking about animal welfare<sup>6</sup> is typically described as three overlapping types of ethical values about an animal's biological functioning, internal affective states (i.e., subjective emotions or feelings), and their ability to live a reasonably natural life (i.e., express behavioral adaptations). These concepts provide a structure to frame the priorities commonly found in other definitions of animal welfare. For example, the AABP supports the World Organization for Animal Health definition (2019), positing that cattle are considered to experience good welfare if they are healthy, safe and well-nourished (i.e., functioning well biologically), comfortable and not suffering from unpleasant states (i.e., negative affective states such as pain, fear, or distress); and are able to express innate (i.e., adaptive) behaviors.

Decades of research in the animal and veterinary sciences have provided a wealth of knowledge on the biological functioning of dairy cattle, including measures of health, growth or production, and reproduction. In the field of applied ethology, techniques to test cattle's preferences and motivation<sup>5</sup> can be used to determine how valuable particular resources or behaviors are from the animal's perspective. Specifically, preference testing generates information about animals' rank-order choices among provided resources; however, one limitation of this technique is that it cannot distinguish between valences (i.e., things that are desirable vs. aversive). In motivation testing, animals are required to pay a "price" (e.g., pushing increasingly heavy weights or pressing a button an increasing number of times) to access a resource; willingness to pay greater prices indicates the animals place a higher importance on a given resource. This concept is borrowed

from consumer demand theory and can be used to describe resources as relative necessities or luxuries (i.e., relatively inelastic vs. elastic demand). The resulting inferences can be used to determine which resources could be provided in captive environments to mimic important aspects of natural living, which can in turn improve affective states.<sup>7</sup> A growing body of literature has sought to evaluate animals' subjective internal experiences,<sup>11</sup> with applied goals of minimizing negative affective states and providing opportunities to promote positive ones.

Indeed, in recent years, a global trend has emerged focusing on "positive welfare." This concept proposes that, even if animals are not currently experiencing negative emotions, this does not necessarily mean they have "good" welfare – merely that they are not suffering;<sup>9</sup> to experience good welfare, they should also have positive experiences. Some authors clarify that it is unrealistic to expect animals to never have negative experiences in the course of their lifetimes; however, it is important to balance those with positive experiences to ensure an overall good quality of life (i.e., positive welfare balance).<sup>15</sup> Through this lens, it is possible to enrich animals' lives and provide them with opportunities for positive experiences through environmental enrichment.

## What is or is not enrichment?

Definitions and examples of environmental enrichment have varied in the literature, but with the common understanding that enrichment resources are used by the animals and provide some kind of measurable benefit to at least one aspect of welfare. However, the term enrichment is often misapplied to any objects added to an animal's environment, regardless of evidence that the animals use them, want them, or benefit from them. Such items would be termed "pseudo-enrichment."<sup>22</sup> Such objects may be provided with good intentions, but without evidence for benefits to welfare for that particular species or life stage. For example, "toys" such as balls, commonly marketed for horses or dogs, are often cited in literature reviews as examples of enrichment items for cattle, but without specific evidence to support their relevance to cattle welfare. Indeed, some recent experiments failed to find evidence of interest in balls by weaning-age beef cattle,<sup>1,3</sup> let alone positive animal welfare outcomes.

In addition, other items or environmental modifications may measurably improve animal welfare, yet should more appropriately be considered "environmental improvement"<sup>22</sup> rather than enrichment per se. These improvements describe basic resources to primarily address biological or physiological needs and counteract negative welfare status. By fulfilling these types of needs, "suffering" is reduced, such as the negative affective states of hunger, thirst or discomfort. For example, a wealth of literature has demonstrated the importance of heat abatement for protecting both production and welfare in dairy cattle of all ages.<sup>23</sup> Without access to shade to prevent heat gain or active cooling to dissipate heat, cattle can experience great discomfort

and negative welfare. Therefore, heat abatement resources to prevent or reduce heat stress should be considered basic or essential environmental resources, rather than enrichment.

To be considered environmental enrichment, a resource must address a behavioral need, allowing cattle to express relevant behavioral adaptations appropriate to their life stage. The enrichment should produce positive emotions (e.g., pleasure, reward) instead of merely providing relief from negative states.<sup>9</sup> Some recent literature reviews define environmental enrichments, compared to “improvements”, as those identified through preference or motivation testing to address animals’ behavioral needs or wants.<sup>22</sup> However, it should be noted that these techniques can also be used to identify important environmental “improvements”, such as heat abatement.<sup>23</sup> Indeed, evidence from preference or motivation testing can emphasize the importance of improvements, such as heat abatement, from the animal’s perspective. These techniques are not limited to identifying behavioral needs or enrichments per se.

Some authors take this concept a step further and define either “true” enrichment<sup>26</sup> or higher-tier enrichments<sup>22</sup> as resources that lead to longer-lasting improvements to animal welfare beyond immediate positive emotions – that is, contributing to positive welfare balance.<sup>15</sup> These types of enrichments contribute to long-term positive welfare balance by equipping the animal with improved coping skills, stress resilience, improved cognitive abilities, or flexibility and adaptability to challenges.

## Types of enrichment

To describe types and examples of enrichments for cattle, some commonly cited classifications have included physical, sensory, occupational, nutritional and social.<sup>8</sup> More recent reviews have expanded these classifications to physical, sensory, exercise, cognitive, feeding-based and social, as well as clarified that they are not mutually exclusive.<sup>26</sup> Here, I describe these classifications with brief examples.

Physical enrichment describes modifications to the structure of the animals’ environment, such as greater space, or partitions within the space to define different functional areas. For example, experimental studies have shown that leading up to and during parturition, dairy cows prefer blinds or partitions that can provide seclusion from herd-mates;<sup>13</sup> this mimics their natural behavior of distancing from the herd in extensive production systems. Some commercial dairy farms have adapted this concept by providing curtains or other solid barriers to give cows an element of privacy at calving.<sup>14</sup> Exercise, a form of physical occupational enrichment, is often combined with physical enrichment, as larger or more open spaces can stimulate activity. For example, cows housed in freestall barns prefer additional access to pastures or outdoor exercise yards with soft footing (e.g., sand or bark mulch).<sup>20,21</sup>

Sensory enrichment refers to objects that stimulate the senses (i.e., visual, auditory, olfactory, gustatory or tactile). Grooming brushes are a common form of tactile enrichment. Adult cows are highly motivated to access automatic mechanical rotating brushes.<sup>10</sup> They push increasingly heavy weights, equivalent to their willingness to push for access to fresh feed after a period of deprivation; their demand for brushes (and feed) is less elastic than for access to an empty pen (i.e., a negative control).<sup>10</sup> From a practical perspective, mechanical brushes can be an expensive investment for farmers; however, cattle also willingly use simpler stationary brushes. Weaned dairy heifers naïve to

brushes approach stationary brushes within seconds or a few minutes on first exposure,<sup>17,24</sup> and continue to use them daily – not only for grooming, but also for oral manipulation (licking or chewing the bristles). This illustrates the importance of testing potential enrichments for the target age class of cattle, as adaptive behaviors vary with age. For example, feeding-based enrichment for pre-weaned calves includes feeding through a nipple to provide an appropriate outlet for innate suckling behavior. Nipple-feeding reduces abnormal oral behaviors, including calves cross-sucking on each other.<sup>18</sup> Another experimental way to mimic natural feeding behavior is to provide hay through a simple pipe-based device with holes so that calves grasp the hay with their tongues, similar to when grazing.<sup>4</sup>

Feeding-based enrichments can also overlap with cognitive enrichment, with the distinction that the latter aims to stimulate cognitive abilities, rather than primarily to mimic natural feeding behavior. To date, no practical cognitive enrichments have been developed for cattle. However, in many experiments designed to test other research questions, cattle have shown interest in completing tasks and solving problems. For example, cattle demonstrate a concept known as contrafreeloading, in which they expend effort to obtain a resource that is simultaneously and freely available (e.g., hay from behind a weighted gate, when it is concurrently offered ad libitum in an open bunk).<sup>25</sup> Opportunities to overcome solvable challenges and express choices and agency may provide cattle with enriching, positive experiences that can result in positive welfare balance.<sup>15,26</sup>

Last, social enrichment for herd species such as cattle can also provide opportunities for long-term coping benefits and positive welfare balance. For pre-weaned calves, the industry status quo is individual housing through weaning. However, a wealth of literature has documented a variety of animal welfare benefits from social housing (i.e., pair or group housing), which fulfills calves’ motivation and preference for full social contact. Early-life social housing has been shown to facilitate calves’ social development, physical development (e.g., coping with cold stress;<sup>16</sup> greater solid feed intake and weight gain),<sup>2</sup> and cognitive development, which translates into resilience to stress during weaning, and greater adaptability to new feeds and situations. Furthermore, some social science research suggests that pair or group housing of calves may be more acceptable to the public than individual housing,<sup>12</sup> although not when the practice of cow-calf separation is highlighted.<sup>19</sup> Nonetheless, social housing of pre-weaned calves is a clear example of a type of enrichment that results in numerous long-term animal welfare benefits and contributes to positive welfare balance.

## Conclusion

Environmental enrichment allows dairy cattle to express behavioral adaptations, which is an important dimension of animal welfare. Enrichments can take many non-mutually exclusive forms, including larger or more complex physical spaces, opportunities for exercise, sensory stimulation, feed-delivery methods to mimic natural feeding behavior, cognitive challenges, and social contact. Because enrichment can provide cattle with the opportunity to experience positive welfare, this concept is important from an ethical standpoint. Furthermore, giving cattle the opportunity for positive experiences may boost public perception of dairy farming practices. Therefore, dairy farmers may consider providing meaningful environmental enrichment to cattle to promote good animal welfare and contribute to the social sustainability of the industry.

## References

1. Bruno K, DeSocio E, White J, Wilson BK. Effect of environmental enrichment devices on behavior of individually housed beef heifers. *Transl Anim Sci.* 2020;4:1-10.
2. Costa JHC, von Keyserlingk MAG, Weary DM. Invited review: Effects of group housing of dairy calves on behavior, cognition, performance, and health. *J Dairy Sci.* 2016;99:2456-2467.
3. Dickson EJ, Monk JE, Lee C, Campbell DLM. Environmental enrichment during yard weaning alters the performance of calves in an attention bias and a novel object recognition test. *Front Anim Sci.* 2024;5:1364259.
4. Downey BC, Tucker CB. Providing long hay in a novel pipe feeder or a bucket reduces abnormal oral behaviors in milk-fed dairy calves. *J Dairy Sci.* 2023;106:1968-1985.
5. Fraser D, Nichol CJ. Preference and motivation research. In: Appleby MC, Mench JA, Olsson IAS, Hughes BO, eds. *Animal Welfare.* 2<sup>nd</sup> ed. Wallingford, UK: CAB International. 2011;183-199.
6. Fraser D, Weary DM, Pajor EA, Milligan BN. A scientific conception of animal welfare that reflects ethical concerns. *Anim Welf.* 1997;6:187-205.
7. Kirkden RD, Pajor EA. Using preference, motivation and aversion tests to ask scientific questions about animals' feelings. *Appl Anim Behav Sci.* 2006;100:29-47.
8. Mandel R, Whay HR, Klement E, Nicol CJ. Invited review: Environmental enrichment of dairy cows and calves in indoor housing. *J Dairy Sci.* 2016; 99:1695-1715.
9. Mattiello S, Battini M, De Rosa G, Napolitano F, Dwyer C. How can we assess positive welfare in ruminants? *Animals.* 2019;9:758.
10. McConnachie E, Smid AMC, Thompson AJ, Weary DM, Gaworski MA, von Keyserlingk MAG. Cows are highly motivated to access a grooming substrate. *Biol Lett.* 2018;14:20180303.
11. Paul ES, Mendel MT. Animal emotion: Descriptive and prescriptive definitions and their implications for a comparative perspective. *Appl Anim Behav Sci.* 2018;205:202-209.
12. Perttu RK, Ventura BA, Endres MI. Youth and adult public views of dairy calf housing options. *J Dairy Sci.* 2020;103:8507-8517.
13. Proudfoot KL, Weary DM, von Keyserlingk MAG. Maternal isolation behavior of Holstein dairy cows kept indoors. *J Anim Sci.* 2014;92:277-281.
14. Proudfoot KL. Maternal behavior and design of the maternity pen. *Vet Clin N Am Food Anim Pract.* 2019;35:111-124.
15. Rault JL, Hintze S, Camerlink I, Yee JR. Positive welfare and the like: Distinct views and a proposed framework. *Front Vet Sci.* 2020;7:370.
16. Reuscher KJ, Salter RS, da Silva TE, Van Os JMC. Comparison of behavior, thermoregulation, and growth of pair-housed versus individually housed calves in outdoor hutches during continental wintertime. *J Dairy Sci.* 2024;107:2268-2283.
17. Reyes FS, Gimenez AR, Anderson, KM, Miller-Cushon EK, Dorea JR, Van Os JMC. Impact of stationary brush quantity on brush use in group-housed dairy heifers. *Animals.* 2022;12:972.
18. Salter RS, Reuscher KJ, Van Os JMC. Milk- and starter-feeding strategies to reduce cross sucking in pair-housed calves in outdoor hutches. *J Dairy Sci.* 2021;104:6096-6112.
19. Sirovica LV, Ritter C, Hendricks J, Weary DM, Gulati S, von Keyserlingk MAG. Public attitude toward and perceptions of dairy cattle welfare in cow-calf management systems differing in type of social and maternal contact. *J Dairy Sci.* 2022;105:3248-3268.
20. Smid AMC, Weary DM, Costa JHC, von Keyserlingk MAG. Dairy cow preference for different types of outdoor access. *J Dairy Sci.* 2018;101:1448-1455.
21. Smid AMC, Burgers EEA, Weary DM, Bokkers EAM, von Keyserlingk MAG. Dairy cow preference for access to an outdoor pack in summer and winter. *J Dairy Sci.* 2019;102:1551-1558.
22. Taylor PS, Schrobback P, Verdon M, Lee C. An effective environmental enrichment framework for the continual improvement of production animal welfare. *Anim Welf.* 2023;32:1-11.
23. Van Os J, Reuscher K, Dado-Senn B, Laporta J. Symposium review: Effects of thermal stress on calf welfare. *J Dairy Sci Commu.* 2024;5:253-258.
24. Van Os JMC, Goldstein SA, Weary DM, von Keyserlingk MAG. Stationary brush use in naïve dairy heifers. *J Dairy Sci.* 2024;104:12019-12029.
25. Van Os JMC, Mintline EM, DeVries TJ, Tucker CB. Domestic cattle (*Bos taurus taurus*) are motivated to obtain forage and demonstrate contrafreeloading. *PLoS ONE.* 2018;13:e0193109.
26. Veissier I, Lesimple C, Brunet V, Aubé L, Botreau R. Review: Rethinking environmental enrichment as providing opportunities to acquire information. *Animal.* 2024;18:101251.

