



Effects of the early social environment on behavioral responses of dairy calves to novel events

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ABSTRACT

Providing young animals the opportunity to engage in more complex social interactions is hypothesized to improve their capacity to cope with changing environments. To test the effects of the early social environment on the behavioral responses of dairy calves to novelty we compared (1) individual with pair housing and (2) group housing with companions of similar age with group housing with a more experienced conspecific. Fifty-four dairy calves were separated from the cow soon after birth and housed individually ($n = 6$ calves) or in pairs ($n = 6$ pairs), or in pens composed of groups of 3 young calves ($n = 6$ groups) or groups of 2 young calves and an older calf ($n = 6$ groups). At 65 to 69 d of age, calf responses were tested in an environmental novelty test and a social novelty test. Individually housed calves were more active [i.e., spent less time standing (means $\pm$ SEM): 201.4 vs. 280.3 ± 30.5 s/test; and more time running: 83.2 vs. 57.3 ± 19.1 s/test] and more reactive (i.e., defecated more frequently; 1.3 vs. 0.6 ± 0.2 events/test) when tested in the novel arena, compared with pair-housed calves. During the social novelty test, individually housed calves spent less time running (51.8 vs. 96.4 ± 11.6 s/test), showed a longer latency to socially interact (111.1 vs. 20.4 ± 21.7 s/test), and spent more time involved in social interactions (130.7 vs. 79.7 ± 19.0 s/test) with the unfamiliar calf than did pair-housed calves. Individually housed calves were also more reactive to the presence of an unfamiliar calf as indicated by increased rates of defecation (2.3 vs. 0.7 ± 0.5 events/test) and kicking (2.2 vs. 0.7 ± 0.4 events/test) compared with pair-housed calves. Calves housed in groups with an older companion were more reactive to the novel environment than were calves housed in groups of similar age: they defecated (1.0 vs. 0.6 ± 0.2 events/test) and vocalized (23.6 vs. 15.3 ± 3.8 events/test) more during the test. These calves also spent less time exploring (266.3 vs.

355.0 ± 27.4 events/test) and had a lower frequency of kicking (0.1 vs. 2.0 ± 0.5 events/test) when tested with an unfamiliar calf. We conclude that calves housed individually are more reactive to environmental and social novelty when compared with calves housed in pairs and that calves housed with an older companion are less reactive to a novel calf when compared with calves housed in groups of similar age.

Key words: isolation, social bond, social learning, group housing

INTRODUCTION

In nature, calves' early social interactions are focused on the cow, but as lactation progresses the cow increases the time and distance away from her calf, allowing fewer suckling bouts and terminating these more rapidly (Price, 1985). Initially calves start grazing near the cow (Mirza and Provenza, 1992), but over the first few weeks of life, the calf increasingly distances itself from the dam and interacts with other calves (Vitale et al., 1986; Sato et al., 1987) and older cattle (e.g., Sato et al., 1987; Murphey et al., 2000). In contrast to this complex social environment that calves experience in more natural settings, on many dairy farms calves are separated from the dam soon after birth and housed individually in pens or in hutches.

Providing calves the opportunity to engage in social interactions may allow for the development of better cognitive and social abilities. Research on other species has shown that social isolation of neonates can increase aggressive behavior, increase cognitive errors during discrimination tasks, and decrease brain development and plasticity (e.g., Schrijver and Würbel, 2001; Fowler et al., 2002; Lipkind et al., 2002; Schrijver et al., 2002). Animals that have been reared in social isolation tend to be more reactive, anxious, and emotional and thus are less likely to respond to novel environmental stimuli appropriately than are animals raised with a companion (e.g., Koch and Arnold, 1972; Sahakian et al., 1977).

Existing evidence suggests that early social experiences can influence calf responses to novelty. For example, individually housed calves vocalize more at

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weaning from milk, take longer to learn to use automatic systems, and experience a more severe growth check when moved to a large group pen than do calves housed in pairs (De Paula Vieira et al., 2010). Individually housed calves also show stronger fear responses to novel situations (Jensen et al., 1997). The simplest possible group is a pair of similarly aged calves; thus, the first objective of this study was to test if calf responses to environmental and social novelty are reduced in pair-housed compared with individually housed calves.

Calves may also benefit from access to older social partners, in part because older social companions may provide more salient social cues. In a recent study (De Paula Vieira et al., 2012), we demonstrated that group housing with an older social companion increased solid feed intake preweaning and BW gains before and after weaning; these results suggested that calves housed with an older companion were better able to learn to consume solid feed and this, in turn, improved their responses to weaning from milk when compared with calves housed in groups of a similar age. Thus, the second objective of this study was to test if calf responses to environmental and social novelty are reduced when calves are housed with an older companion compared with housing with a group of similarly aged calves.

MATERIALS AND METHODS

This study used 54 Holstein dairy heifers housed at the University of British Columbia's (UBC) Dairy Education and Research Centre (Agassiz, BC, Canada). This animal use was approved by UBC's Animal Care Committee.

Pretesting

Calves were separated from their dams and fed colostrum within 8 h of birth. To assess the efficiency of passive immune transfer, blood samples were collected from the jugular vein 24 h after the first feeding of colostrum, and serum was analyzed using a Reichert AR 200 digital hand-held refractometer (Reichert Inc., Depew, NY). Only calves having a serum protein level >5.5 g/dL were included in the study. After colostrum feeding, the umbilical cord was treated with a 7% iodine solution. Calves were sedated and dehorned at 4 d of age using caustic paste (see Vickers et al., 2005).

Prior to 9 d of age, all calves were housed individually with free access to water, hay, and starter. Calves were then assigned to 1 of 4 treatments: (1) individual housing ($n = 6$ calves), (2) pair housing ($n = 6$ pairs), (3) group housing in groups of 3 young calves ($n = 6$ groups), or (4) group housing in groups of 2 young

calves and an older calf ($n = 6$ groups). Older companions averaged 83 ± 5.4 d of age when mixed with the younger calves. Calves were assigned pseudo-randomly to treatment, balancing for BW on d 9. These weights averaged ($\pm$ SD) 44.9 ± 5.6 kg for individual housing, 44.8 ± 5.7 kg for pair housing, 45.9 ± 5.7 kg for groups of 3 young calves, and 46.4 ± 5.8 kg for the groups of 2 young calves housed with an older companion (weighing, on average, 120.4 ± 8.3 kg).

The individual pen measured 1.2×2.0 m and the pair pen measured 2.4×2.0 m. Group pens measured 7.0×5.0 m. The older companion calves had lived in the group pens for approximately 10 wk before assigning younger calves to this treatment.

All of the young calves were allowed access to 8 L/d of pasteurized whole milk (a mixture of saleable and nonsaleable milk) either by bottle (for calves housed individually and in pairs) or by a CF1000CS-Combi automatic feeder (DeLaval International AB, Tumba, Sweden) that also provided free access to a textured calf starter (for the 2 group treatments). Calves housed individually and in pairs received free access to starter via bucket. The starter offered for all calves (93% DM) contained 57.5% concentrate pellets, 14% flatted barley, 13% flatted oats, 10% steamrolled corn, and 3.5% molasses (Unifeed Ltd., Chilliwack, Canada). All calves had free access to water and chopped orchard grass hay (95% DM) with a mean particle size of 1.2 ± 0.4 cm as measured using the Penn State Particle Separator (Pennsylvania State University, University Park). Group-housed calves received water and hay automatically (Insentec BV, Marknesse, the Netherlands), whereas calves housed individually and in pairs received these via water buckets and individual hayracks suspended on the wall of the pen.

Calves were trained by a caretaker to use the bottle and milk feeders. This training was carried out in the morning and afternoon of each of the first 3 d of the experimental period. Weaning was carried out gradually starting on d 36, reducing milk volume by 1.6 L/d. From d 41 onward, milk was no longer provided.

Testing

Tests were chosen to measure calf reactivity to environmental and social novelty. Testing started when calves were approximately 65 d of age. Repeated exposure provides a method for assessing habituation to the test, so calves were tested daily (from 0900 to 1230 h) for 3 consecutive days for the environmental novelty test. The social novelty test was performed on the d 4 and 5 (from 1000 to 1030 h). Calves were examined by a veterinarian on a daily basis and none showed signs of disease on any test day. For all tests, calves were walked

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