

Primary Social Relationships and Cattle Behavior¹

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Abstract

Holstein and Holstein-Red Danish dairy calves were removed from their mothers within 30 minutes after birth and before nursing. Thirty-six calves were raised from birth until 18 weeks of age on 1 of 4 treatments: Group SS, fed individually-penned individually; Group ST, fed individually-penned in groups of three; Group TS, fed in group of three-penned individually; and Group TT, fed in groups of three-penned in groups of three. Animals were then maintained in one group on pasture until their first parturition. Subjects raised together were more vocal, ignored and did not protect their young, partially cleaned them and failed to allow nursing. Raised separately cows had few vocalizations, tended to fully clean, protected their calves and allowed nursing. At second calving all cows cleaned, nursed and protected their young. Those showing poor maternal behavior at first calving remained less efficient at second calving. There were no significant differences among the four groups as measured by ease of training to enter the milking parlor, frequency of kicking, temperament and milking ease.

SS Holsteins ($P < .05$) produced more milk than those fed and raised under other conditions. The variance within groups was tripled as early feeding-rearing conditions progressed from SS to TT.

Introduction

Within the herd, several social hierarchies are known to develop which function to define priority rights to food and water and leadership for each animal. At least three (dominance, leadership and entrance order into milking parlors) and perhaps four (submission) are distinct social orders which evolve among cows. The observed social order is a function of the test situation. A submissive order which is the readiness of an animal to defer to an attacking animal is distinct from the dominance order of the provoking cow which wins. Donaldson (4) showed both the dominance and submission tendencies of dairy calves could be altered by manipulating early feeding and rearing conditions. Calves that were reared together in groups of three with limited feeding space, regardless of whether they were fed separately or with other calves, were significantly more dominant than calves reared separately. Calves that were fed together, regardless of their rearing condition were significantly more submissive than calves fed separately. Fed separate-reared separate calves were significantly less

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dominant and less submissive than other calves while fed together—raised together calves were more dominant than calves from other feeding-rearing conditions.

These same calves were available for later observations as cows to ascertain what effects early experience had upon later social and maternal behavior as well as milk producing capabilities.

Methods

The subjects in this study (5) were 18 Holstein-Friesian heifer calves and 18 Holstein-Friesian X Red Danish crossbred heifer calves. On the basis of birth order, the first nine calves born were assigned to a group (SS), the second nine were allotted to a second group, etc. until all subjects were assigned to one of four treatment conditions. The 36 calves were raised from birth until 18 weeks of age on one of the following four treatments:

- 1) Group SS: fed separately—raised separately
- 2) Group ST: fed separately—raised together
- 3) Group TS: fed together—raised separately
- 4) Group TT: fed together—raised together

An attempt was made to remove the calves from their dams within 30 minutes after birth and before they nursed. As a consequence of late night births, however, several calves were with their mothers for 4 or 5 hours and they nursed at least once. Early removal from the dam may be an important point in this study, since J. P. Scott predicted earlier that if a group of calves were taken from their mothers at birth and put together they would form primary social relationships with each other (personal correspondence with T. H. Scott, 1956). Primary social relationships in some animals are formed within a matter of hours after birth (10).

The calves were placed either individually into a 3 feet x 6 feet x 5 feet pen (0.9 m x 1.8 m x 1.5 m) or three calves lived together in a 6 feet x 12 feet x 5 feet pen (1.9 m x 2.6 m x 1.5 m). The pens provided isolation and were constructed of 3/8 inch (9.5 min) plywood within an unheated, lighted barn. Four 6 feet x 12 feet (1.8 m x 2.6 m) feeding pens were constructed in the barn. One small 20 inch x 12 inch x 24 inch (0.50 m x 0.30 m x 0.60 m) feeder was in each feeding pen. These feeding and rearing techniques are a departure from recommended procedures at Purdue. Individual calves are normally reared and fed in a 4 feet x 7 feet pen where they can see one another. Following weaning, they are in small groups of 4-8 calves for approximately 1-2 months after which they are taken out of doors and placed in a large group of 30 heifers.

The subjects were fed a conventional powdered milk replacer, calf starter diet and a mixture of timothy and alfalfa hay. Water was available *ad libitum* in the pens. After 18 weeks of age the heifers were maintained as a group on pasture until their first parturition.

When the heifers were 20 months old agonistic or conflict behavior was observed daily for 6 weeks. A Social Index

$$\left\{ \frac{\text{number of encounters initiated}}{\text{total number of encounters}} = \text{Social Index expressed as a \%} \right\}$$

was computed for each animal. The parturition sequence was observed through two calvings during which aspects of maternal behavior were recorded. The cows were rated on milking parlor behavior by two full-time milkers. Milk production was recorded daily and 4% fat-corrected, 305 day lactation milk records were also compared for each group.

Results and Discussion

There were wide differences among cows in maternal behavior with their first calf. Raised-together cows ignored their young or partially cleaned them and failed to allow nursing. Raised-separately cows fully cleaned their offspring and allowed nursing. Raised-together cows tended not to protect their young and were quite vocal toward them while raised-separately cows were protective and did not make many vocalizations. A Chi-square test was performed for group differences in care and cleaning the calf. Values approached significance ($P < .10$) in that animals raised separately cleaned their calves better than those raised together. There were significant group differences in nursing allowed within 4 hours after birth ($P < .025$) as well as in protection of the calf ($P < .01$) and approached significance in vocalization toward the calf ($P < .10$).

With their second calf, all cows cleaned, nursed and protected their young, but there was a difference in the degree to which these behaviors were performed. Cows that had not given proper care to their first calf were not nearly as maternal as those that had taken care of their first calf. It was concluded that early feeding and rearing experiences dramatically affect maternal behavior.

It is not uncommon for cows to reject their young. Russian workers (1) support the claim that high milk-producing dairy cows and productive hens are known to lose some degree of maternal instinct. Also, Selman and co-workers (11) in Scotland, under continuous observation of natural suckling in cattle (10 beef cows, 10 dairy cows and 10 dairy heifers) during the first 8 hours postpartum, found that teat sucking advances were rejected at some time by 15 of the 30 dams. These rejections consisted of either moving away from, or kicking at, their calves. However, in 13 of the 15 dams, rejections were seen only occasionally and usually occurred only when calves pushed vigorously at udders. This mild form of rejection inhibited only the weakest calves. When suckling eventually commenced, all 13 dams became very quiet. Two primiparous heifers rejected their calves' advances for 6-8 hours. These two mothers frequently ran away from their calves.

There was no statistically significant difference among the groups in milking parlor behavior as measured by the ease of training to enter the milking parlor initially and one month postpartum, as well as

frequency of kicking, temperament and milking ease. While differences existed for other behavioral traits, one might expect milking parlor behavioral differences. However, this was not the case. The milking parlor quickly becomes a routine where defined behaviors are rewarded and all others are disciplined early and oftentimes changed. In addition, being milked and having udder pressure reduced is, in itself, rewarding and thus conducive to having a cow conform to the routine (3).

The milk production records for each breed in each feeding-rearing condition are presented in Table 1, with SS Holsteins producing up to 3,500 lbs more milk than other groups while, TT crossbreds average about 2,000 lbs more milk than other groups. With the exception of TS crossbreds, the standard deviation within groups increased as a function of increased "together" contact during early calthood. For each breed the standard deviation is more than tripled as early feeding-rearing conditions progress from SS to TT. The TS crossbreds show the highest variance of all groups. Earlier, Donaldson (4) pointed out that the TS group (fed together—raised separately) was characterized by excessive amounts of non-nutritive sucking during their early experience, while other groups did not exhibit non-nutritive sucking after reaching 4 days of age. The only animals lost on this experiment were from group TS, one Holstein and one crossbred, who died at the age of 5 weeks.

TABLE 1. *Mean and standard deviation of milk production records of the first lactation for each breed in each feeding-rearing condition.*

Condition	Holstein-	S.D.	Crossbreds	S.D.
	Friesian			
SS	13,381	427	10,186	546
ST	12,936	1,540	10,417	578
TS	12,068	1,307	10,453	2,614
TT	9,861	1,775	12,253	1,648
Average	12,061		10,827	

Regarding milk production, assuming a fixed model with an unweighted mean, an analysis of variance was computed. A summary of this analysis in Table 2 shows a significant difference for the breed main effect (C) with Holsteins averaging more milk produced (12,061 lbs) than crossbreds (10,827 lbs) during the first lactation. This finding was not unexpected in that purebred Holsteins have been bred and maintained for their high milk production. The crossbreds gave more milk than the smaller Red Danish, but still were not as large or capable of producing as much milk as the Holstein.

Table 2 also reveals a significant interaction of feeding by breed. An examination of the data shows that the feeding condition affected the breeds differentially. For Holsteins the fed-separate Holsteins averaged 13,158 lbs of milk while fed-together Holsteins averaged 10,964 lbs of milk. On the other hand, for crossbreds, the fed-together condi-

TABLE 2. *Analysis of variance summary for milk production.*

Source	df	MS	F	P
A (feeding)	1	2060829	.95	
B (rearing)	1	28231	.01	
C (breed)	1	9619095	4.46	.04
AB (feeding X rearing)	1	463923	.21	
AC (feeding X breed)	1	1662857	7.71	.01
BC (rearing X breed)	1	5680317	2.63	.11
ABC (feeding X rearing X breed)	1	7031519	3.26	.08
Within cell	21	2156054		

tion was more conducive to higher milk production. Fed-together crossbreds averaged 11,353 lbs of milk while fed-separate crossbreds averaged about 1,000 lbs less (10,301 lbs) of milk. By chance, higher-quality dams were used to produce the crossbred calves that filled the fed-together groups. They averaged 13,177 lbs of milk while the fed-separate calves came from dams averaging 10,800 lbs of milk.

By combining the data (ABC interaction, $P < .08$) it appears that certain conditions maximize milk production for Holsteins as well as for crossbreds.

Cows that experienced competitive raising had a higher average Social Index and were more domineering and aggressive within a herd and rejected their young at first parturition. Cows that were raised individually tended to be low ranking in the herd and accepted their young at first parturition.

The importance of "contact comfort" has been demonstrated for dogs (8, 9) and for monkeys (7). Presumably, in the absence of any type of species interaction, the SS group developed and maintained a high drive for contact which could be most fully expressed when their calves were born. If this is true, one would expect cows that have been raised individually to actively seek more contact within the herd and to maintain closer physical proximity to other animals than cows raised together. Unfortunately, such data are not available.

On the other hand, three of the groups had enriching, almost to the point of stressing, experiences in their competition for food and living space. The competitive animals experienced, in effect, an over-exaggeration of a learned behavior pattern with the ultimate effect of enhancing the frequency and efficiency of that behavior pattern.

Given that the competitive groups were inclined toward emotional disturbances due to maternal deprivation, while at the same time were prone to overreact with aggressiveness due to early experience, one can readily expect rejection of the young. Later, when other experiences had altered the effect of early experience, the second calf was accepted. In a similar hypothesis, Bronfenbrenner (2) proposes the "frustration of dependency drive" when mother-infant interactions are absent and

specifically predicts "initial fear, rejection of, and aggressiveness toward other social objects."

An alternative theory would be to ignore any deprivation during the first 4 months and focus mainly upon the agonistic experience. Cows from the competitive groups had been conditioned since the first day of their lives to be constantly perceptive of social threat. Not surprisingly they treated their first calf as another animal and only after experiencing the non-threatening aspects of the situation could they accept the second. Conversely, the raised-individually group did not perceive or respond to threat from other cows and subsequently were able to exhibit the full range of maternal behavior correctly the first time.

It would be interesting to know how early feeding and rearing experiences affect other breeds of cattle and then investigate the economic feasibility of rearing each breed in a condition that behaviorally and physiologically promotes milk production. Since twin calves are known to stay together (6), an obvious experiment is to rear twins apart from each other. They would have to be separated very early as the primary social relationships are formed within a matter of hours, *i.e.*, sheep and goats (10). It would be very interesting to see if the twins, when brought back together, would tend to stay together and imitate or mimic their behavior as they ordinarily do. The close behavioral link between twins reared together at present tends to increase the resemblance between twins in such items as grazing behavior and milk production.

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