The Behavior of Confined Calves Raised for Veal: Are These Animals Distressed?

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The behavior of 12 calves confined in crates was recorded at 1-minute intervals for 12-hour periods. These recordings were made at fortnightly intervals from approximately 2 to 16 weeks of age. In all, 864 hours of observations were recorded.

The activities that were performed and the amount of time spent doing each are outlined. Circadian rhythms were controlled largely by feeding time, although there was a difference between diurnal and nocturnal behavior. Individual calves varied in how they adapted to the restricted environment. Individual personality profiles and data on the ontogeny of behavior under these conditions are presented.

At 10 weeks of age, the calves were transferred to a different shed, where they were further restricted and yoked. This had a significant effect on most behaviors. The redistribution of time for the confined and restricted calves, as compared with calves who remain with mothers in fields, is discussed, along with other aspects of welfare. Seven possible criteria related to behavioral distress (defined in functional terms) are suggested and discussed in relation to these results.

Zusammenfassung

Das Verhalten von in Kastenständen eingeschlossenen Kälbern wurde in Intervallen von je einer Minute für eine Dauer von 12 Stunden aufgezeichnet. Solche Aufzeichnungen wurden an Kälbern im Alter von zwei bis 16 Wochen in 14-tägigen Abständen wiederholt. Im ganzen wurden Beobachtungen während 864 Stunden aufgezeichnet.

Die damit verbundenen Aktivitäten und die Zeit, die darauf verwendet wurde, sind hier umrissen. Zirkadische Rhythmen wurden hauptsächlich während der Zeit der Fütterung kontrolliert, obwohl sich dabei Unterschiede ergaben jeweils bei Tag oder Nacht. Die einzelnen Kälber unterschieden sich in der Art und Weise, in der sie

sich an die eingeschränkte Umgebung anpassten. Individuelle Presonalitätsprofile und Daten betreffend die Ontogenese des Verhaltens unter diesen Umständen sind in diesem Artikel festgehalten.

Im Alter von zehn Wochen wurden die Kälber in einen anderen Stall übersiedelt, wo sie räumlich noch mehr eingeschränkt waren und angebunden wurden. Dies hatte eine deutliche Wirkung auf das Verhalten der meisten von ihnen. Die Aufteilung der Zeit für die eingeschlossenen und eingeschränkten Kälber mit der von Kälbern, die mit den Muttertieren auf den Feldern verblieben, ist dargestellt zusammen mit anderen Aspekten des Wohlergehens. Sieben mögliche Kriterien im Bezug auf Verhaltensstress (definiert in funktionellen Begriffen) werden empfohlen and besprochen im Zusammenhang mit diesen Resultaten.

Introduction

Cattle spend much of their time searching for food, eating, and ruminating (about 12.5 hours per day; Hafez and Schein, 1962). The exact amount of time spent grazing depends, to an extent, on forage availability (Hardison *et al.*, 1954), although this variable may not be as important as was originally thought (*e.g.*, Lancashire and Keogh, 1966). Rumination depends on the characteristics of the forage, particularly the amount of fiber (Gordon, 1958). Kiley-Worthington and de la Plain (1983) found that cattle at pasture spent approximately 8 hours per day sleeping (lying with the eyes closed). This finding confirms Ruckenbusch and Bell's 1970 results with stalled animals. In addition, ½ hour a day is spent grooming, playing, investigating the environment, and in social interactions. The remaining 3 to 4 hours are spent "idling": standing about inactive.

A restrained and confined calf that is individually housed cannot move about, nor interact with its conspecifics in a normal way. It has its food presented to it and thus spends much less time looking for it. Often, the food is provided in a form that allows very rapid consumption (*e.g.*, liquid feeds and concentrates such as grains and chopped dried grass). Similarly, the food presented to cattle under modern agricultural conditions is often much lower in fiber than were their original natural diets. This reduces the amount of time that must be spent ruminating in order to digest it. For these reasons, the animals spend less time on behavior related to feeding. What then do they do with the "extra" time available? In some animals and humans, stereotypies may develop (Meyer-Holzapfel, 1968; Duncan and Wood-Gush, 1974; Kiley-Worthington, 1977), or other abnormal behavior such as an increase in aggression (Kiley-Worthington, 1977). Other species, such as swine, may spend more time sleeping (R. Ewbank, pers. comm., 1979).

In bovids, daily rhythms are largely controlled by sunrise and sunset (see, *e.g.*, Hughes and Reid, 1951). When these cues are reduced in darkened buildings, one can investigate whether circadian rhythms persist and what, if anything, beside light controls them.

The ontogeny of behavior of calves kept in restricted environments might also be expected to be different from that of mother-raised calves in the field. The questions addressed in this paper are, therefore: (1) How do calves from 2 to 16 weeks of age, a period of rapid physical and behavioral growth, adapt to the conditions of severe physical and social confinement? (2) How does this affect behavioral ontogeny? (3) What do they do with their "extra" or spare time? (4) How much individual variation can be found in their behavior?

An important reason for this work is a concern for animal welfare and the de-

velopment of well-founded legislation. Veal calves in Europe are raised in individual crates and usually fed exclusively on liquid milk-substitute. Often, diets are also low in iron, in order to ensure the palest flesh. In addition, the ability of the calves to move is extremely restricted, and this constriction increases as they grow. This particular system for raising calves has perhaps engendered more public concern on ethical grounds than any other recent development in intensive animal husbandry. Most veterinarians, ethologists, and philosophers, as well as others concerned with animal husbandry, will agree that obvious signs of physical ill-health cannot be the only criterion for assessing "cruelty" (e.g., Brambell, 1963; Ekesbo, 1978; Folsch, 1978; Singer, 1976; Dawkins, 1980). One approach to assessing whether an environment is acceptable to the animal is to allow it to choose its environment (e.g., Dawkins, 1977; Duncan, 1978; Dawkins, 1980). However, a more pragmatic approach is to assess to what extent the behavior of the animal in the confined environment differs from that of field-living animals. It is possible that some behavioral abnormalities could be used as an index of psychological ill-health (for example, stereotypies such as persistant self-grooming—(Kiley-Worthington, 1977) and, hence, of "distress." These indicators could then serve as guidelines for what limits should be placed on permissible husbandry conditions.

By comparing the data presented here, from detailed studies on confined veal calves, with that from mother-reared, field-living calves, it is possible to derive some guidelines as to the extent to which the behavior of the confined calves differs.

Methods

The calves were brought into the commercial veal unit where the study was done at 1 to 2 weeks of age. Eleven Friesian bull calves and one heifer were the subjects of the detailed study. They stayed in the unit for approximately 14 weeks, when they were loaded into lorries and taken to the abattoir. However, at 10 weeks they were moved from one veal shed to a second with a slightly different set-up (see below). This commericial unit was run according to recommendations made by the Ministry of Agriculture, Fisheries and Food, and within the limits of the Welfare Codes of Practice (1974).

The unit was organized into two sheds holding 40 crates each. Each crate measured 1 by 2 meters. There was one long window (2 meters by ½ meter, and 2½ meters high). The temperature was controlled by heaters and fans and maintained at around 40 °C. The natural light in the sheds was dim (too dark to read by), except at feeding times, when the overhead florescent lights were switched on. Recordings were made with the aid of a red 60-watt bulb located near the observers. In the first shed (the nursery shed), the calves were bedded on straw on top of slats, and could turn around, groom themselves, eat, and play with the straw. In the second shed (shed 2), they were tethered by the neck and were unable to turn around, lick, or scratch their rumps. In this shed, they stood directly on the wooden slats with no bedding. The back of the pen was open. They could therefore step back and fall off the slats with their hind legs.

The calves were fed a milk-substitute diet twice a day, at approximately 6.30 and 19.00 hours. They received 1.5 liters at each feeding when they came into the unit, and this increased to 6 to 8 liters before they left. No water was available for them to drink. The younger calves were given approximately 1 to 1.5 kg of straw per day; the older calves were provided approximately 500 g each. The urine and feces mostly fell through the slats onto the concrete floor, where it was swept down the drain by a high-pressure hose and broom after the morn-

ing feed. The shed smelt strongly of urine and feces to all of the humans who entered it. The humidity was always high because of the daily wetting of the floor.

Observations were made by two observers, who each watched 6 calves from a central gangway. Observations were begun at 13.00 hours and continued until 30 minutes or more after the evening feed (18.30 to 19.00 hours). They began again at 06.30 to 07.00 hours on the following morning and continued until 13.00 hours. The activities performed by each of the 12 calves were recorded once a minute by using a small timing device that gave an audible pulse every 10 seconds.

These recordings were repeated at 14-day intervals. Thus, 4 observational days were completed in shed 1, and 2 in shed 2. In addition, one 24-hour observational period was completed on six animals. In this way, a total of 69,120 observations were recorded in 96 observation hours. Because of the number of observations employed and the close time interval used in recording them, relatively infrequent events such as calling, moving around, licking the neighbor, *etc.*, were recorded sufficiently often to allow for statistical treatment. The detailed analysis was done on a computer using the SPSS package (Nie *et al.*, 1975). The statistical tests used were the t-test, the Kolmogorov-Smirnov two-sample test, and analysis of variance (Siegel, 1956), as indicated in the figures.

Results

Behaviors Performed

Table 1 gives a list of all the activities recorded and definitions for each.

The Time Spent in the Various Activities

The time spent engaged in the various activities is shown in Table 2. This represents an average for the 12 calves.

The confined calves spent an average of 5.1 minutes/hour chewing on the wood fitments; they also managed to suck each other's noses for short periods (0.05 minutes/hour). The time spent moving around was, to some extent, related to their size. Thus, in the first month they were able to turn around, but not thereafter (see the section "Differences Between the Two Sheds," below).

If all the activities that occurred for relatively short periods, such as licking, chewing, sniffing, calling, itching, sucking, and playing are summed ("other" activities, Table 1), we see that they then take up a considerable amount of time (12.5 minutes/hour).

Circadian Rhythms

Figures 1 and 2 show the frequency of the principal maintenance activities of the confined calves during one full 24-hour period. There is a difference between behavior that occurred during the day and that during the night. Most of the sleep was done at night, while during the day lying was often combined with ruminating. Although the lighting was at all times dim, it varied to some extent between day and night. However, it is clear that feeding times influence these activity cycles strongly. The periods of highest activity were focused around the two feeding times, when standing was most frequent, as were "other" activities, such as licking, calling, chewing, and behaviors directed at objects and neighbors (Fig. 1).

During the day, between the two feeding times, the animals remained relatively inactive. However, the evening feed appeared to be anticipated for periods of up to an hour—the animals became very active, getting up and performing activities related to feeding, such as licking and chewing objects.

Individual Differences in Behavior Between Confined Calves

Figure 3 shows the variation in behavior among a sample of five calves. Calf 17 lay down and slept more; "itched" (rubbing, scratching and licking of self), called, licked objects, chewed, and sniffed less than the average. It also paid less at-

tention to other objects, but more to its neighbors. Calf 19, on the other hand, lay down and slept less, and filled up the time by kicking, chewing, calling, itching, and paying attention to objects. Calf 12 also sniffed and "itched" itself more; it lay down less and paid more attention to its neighbors.

TABLE 1 Activities Scored for Confined and Field Calves and Their Definitions

Activity	Definition
Stand	Standing still on all four legs.
Lie	Lying either in fetal position or flat on side.
Sleep	Lying with eyes closed and head lowered to ground or on front legs. Not scored for field calves.
Move	Movement of the whole body back or forward in crate, or movement of all four legs in sequence. For field calves, different paces recorded.
Drink	
Urinate	
Defecate	
Eat	
Ruminate	Chewing of regurgitated food from the rumen.
Suck	Distinct sucking motion of mouth and lips. Only recorded in field calves when suckling mammae.
Lick	Repeated tongue movement over object/animal. Can lick self, objects, or neighbor, and for field calves, mothers.
Chew	Jaws placed around object/animal and teeth applied. Can be chewing self or object.
Sniff	Rapid inspirations and expirations with nose moved toward object/animal. Can sniff neighbor, object or, for field calves, mother.
Call	(1) Vocal noise with mouth shut, (2) "mm" call, (3) Two or three syllable vocal noise with mouth open (of greater amplitude than "mm"), (4) "men" call.
Head toss	Vertical upward movement of head over back; often accompanied by rapid expiration.
Head shake	Lateral repeated movement of head.
Kick	One or both hind legs lifted up and rapidly kicked backward.
Rub	A repeated rubbing of any part of the body against another animal or object.
Self-grooming	Licking, rubbing, and chewing self.
Play	All four legs off ground within 1 second.
"Other" activities	Chew, sniff, call, "itch," and play.
"Self directed"	All self-directed activities.
"Social contact"	All activities directed at other individuals.
"Object directed"	All object-directed activities.
"Itch"	Scratch, head-toss, head-shake, and kick.

TABLE 2 Time Spent in the Different Activities for Confined Calves*

Activity	$\bar{X}$ Minutes/hour	Variance
Lie	38.3	32.2
Stand	3.75	30.2
Eat	3.5	4.3
Move	1.25	0.41
Ruminate	7.8	17.79
Self-groom	2.3	3.14
Suck	0.05	0.013
Object-directed sniffing	1.75	0.94
Social contact	0.2	0.08
Play	2.3	0.80
Chew	5.1	0.94
Call (mean number of times per hour)	0.25	0.05
"Other" activities	12.5	4.84
Sleep	9.8	18.39

*Average duration of confinement, 14 weeks; total number of hours over which observations were made, 96; number of calves, 12; frequency of observation, every minute; total number of observations, 69,120.

The other profiles presented in Fig. 3 show that the animals varied in many ways. At one end of the continuum were those that adapted to the confined and restricted environmental conditions by lying and sleeping more (e.g., calves 10 and 17). At the other end were those that apparently adapt by "self-stimulation" of one form or another (e.g., calves 12, 19, 21), while others directed it to their neighbors (e.g., 17) and still others to objects in their environment (e.g., 19 and 21).

The Ontogeny of Behavior

Figure 4 shows the trends in the amount of time spent in performance of several different behaviors for the confined calves during their stay in the unit, and also whether this was significant. It shows whether there were significant trends in the same behaviors in a study on calves raised with their mothers in a field (Kiley-Worthington and de la Plain, 1983).

Lying. The confined calves showed a significant decrease in the amount of time spent lying down with age (Kolmogorov-Smirnov two-sample test, P 0.05). This was due, at least in part, to the transfer of the calves to the second shed at 10 weeks, where lying became more difficult. The field calves did not show any significant trend in this activity at ages of up to 16 weeks.

Standing. Standing, however, showed a significant increase with age in the confined calves. The increase from 1.5

to 9.45 minutes/hour occurred when the calves were transferred to the novel situation in the second shed. No significant change was shown in the amount of standing performed by the field calves over this age range.

Eating. The confined calves did not show any significant increase in eating with age, as is normal in field calves. This finding was presumably related to their not having sufficient hay or straw to eat.

Ruminating. As the rumen develops in the young field calf, there is an increase in the time spent ruminating with age. For the confined calves, however, this was not the case; more ruminating occurred in the confined calves between the second and sixth weeks. Then, after transfer to the more confined second shed, the ruminating decreased.

Moving. This behavior showed a significant decrease with age in the confined calves, which was, again, related to their increasing restriction. There was no significant change among similar field calves in this age range.

Self-grooming. This activity increased significantly in the field calves with age. Among the confined calves, it showed a dramatic peak at 8 weeks and then (perhaps because grooming became physically difficult because of tethering) diminished after transfer to the second shed.

Chewing. This activity increased with age. Throughout the period, it occurred much more frequently than in the field calves, where it showed no change with age.

Sleeping. This behavior decreased with age of the calf and transfer to the

TABLE 3 Differences Between Field Calves* and Confined Calves in the Ontogeny of Several Behaviors

	Significant Trends†	
Activity	**Field Calves**	**Confined Calves**
Lie	No change	Decrease ($P < 0.001$)
Stand	No change	Increase ($P < 0.01$)
Eat	Increase ($P < 0.01$)	No change
Ruminate	Increase ($P < 0.01$)	No change
Move	No change	Decrease ($P < 0.01$)
Self-groom	No change	No change
Chew object	No change	Increase ($P < 0.05$)
Sleep	No change	Decrease ($P < 0.01$)
Call	No change	No change
Social contact	No change	No change
Play	No change	No change
Head-shake, head-toss, kick, and scratch	No change	Increase ($P < 0.01$)
Urinate	No change	Increase ($P < 0.05$)

*Field calf data from Kiley-Worthington and de la Plain (1983).
†Analyzed by the Kolmogorov-Smirnov two-sample test.

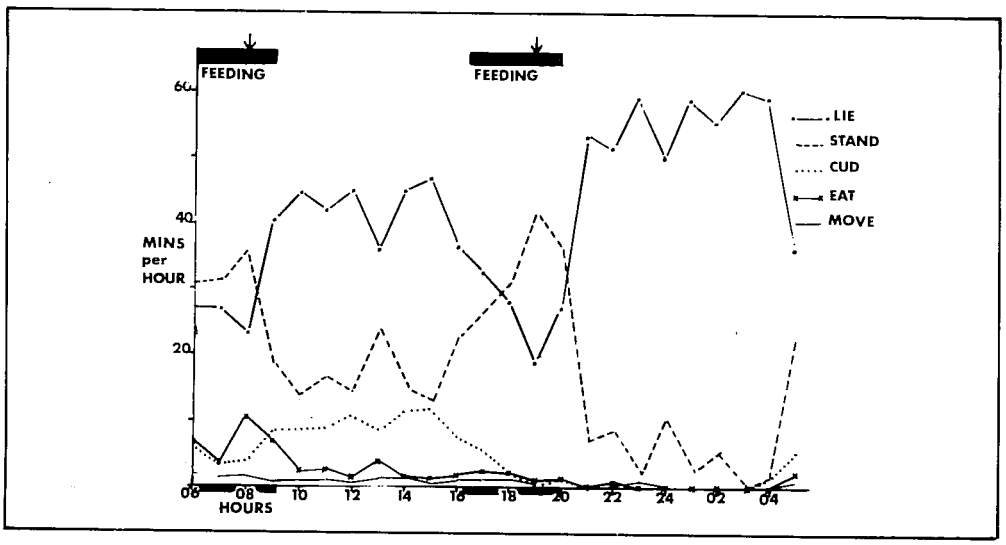

FIGURE 1 Circadian rhythm in the performance of different activities by confined calves: lie, stand, cud, eat, and move. The feed times are marked on the hour axis with a dark line; the time of dawn and dusk is shown below the axis.

second shed.

Calling. This behavior showed no significant trend with age in either group. When the calves were initially confined in the veal unit, they called almost continuously for approximately 12 hours. Similarly, when they were transferred to the second shed, there was an increase in calling, for the first 3 hours.

Social contact, sniffing, and playing. There was no significant trend with age in these activities.

Head-shaking, head tossing, kicking, and scratching. There was a marked increase in these activities when the animals were moved to the second shed.

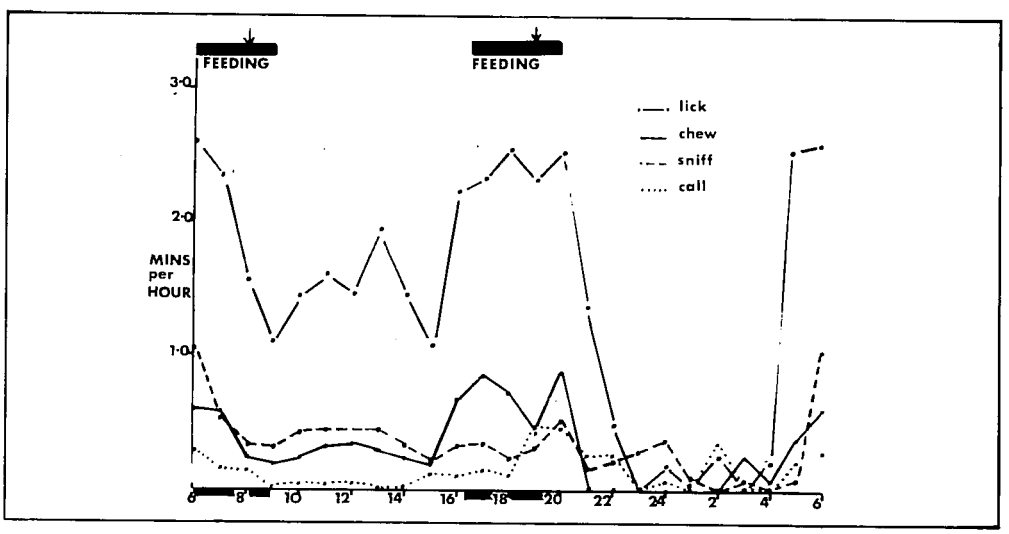

FIGURE 2 Circadian rhythm in the performance of different activities by confined calves: lick, chew, sniff, and call. The feed times are marked on the hour axis with a dark line; the time of dawn and dusk is shown below the axis.

Differences Between the Sheds

Table 3 shows that the transfer, at 10 weeks, to the second shed had an effect on almost every behavior. Standing and eating increased, whereas sleeping, moving, ruminating, calling, and lying decreased. The calves appeared to be performing more of those activities that they were still able to perform when yoked.

Other Behavior

Sexual behavior. On 15 occasions, calves were observed to have erections. On four occasions, there was thrusting and back-arching. On two occasions, the calves attempted to lick their erected penis. One calf gave bull-like roars at 14 weeks of age, and there were three occurrences of head-rubbing and posturing, typical bull behavior (Schloeth, 1958). In the field, only mounting, mutual genital smelling, and circling were recorded at these ages (Kiley-Worthington and de la Plain, 1983).

Injuries, falls, and walking difficulties. Severe falls in the pens were recorded on eight occasions during the observation period (1 fall every 3 hours/100 calves). These occurred among the yoked animals, usually while they were attempting to lick their backs and rear ends.

During the study, 6.7 percent of the 40 calves in the second shed developed swollen and stiff joints, and all the

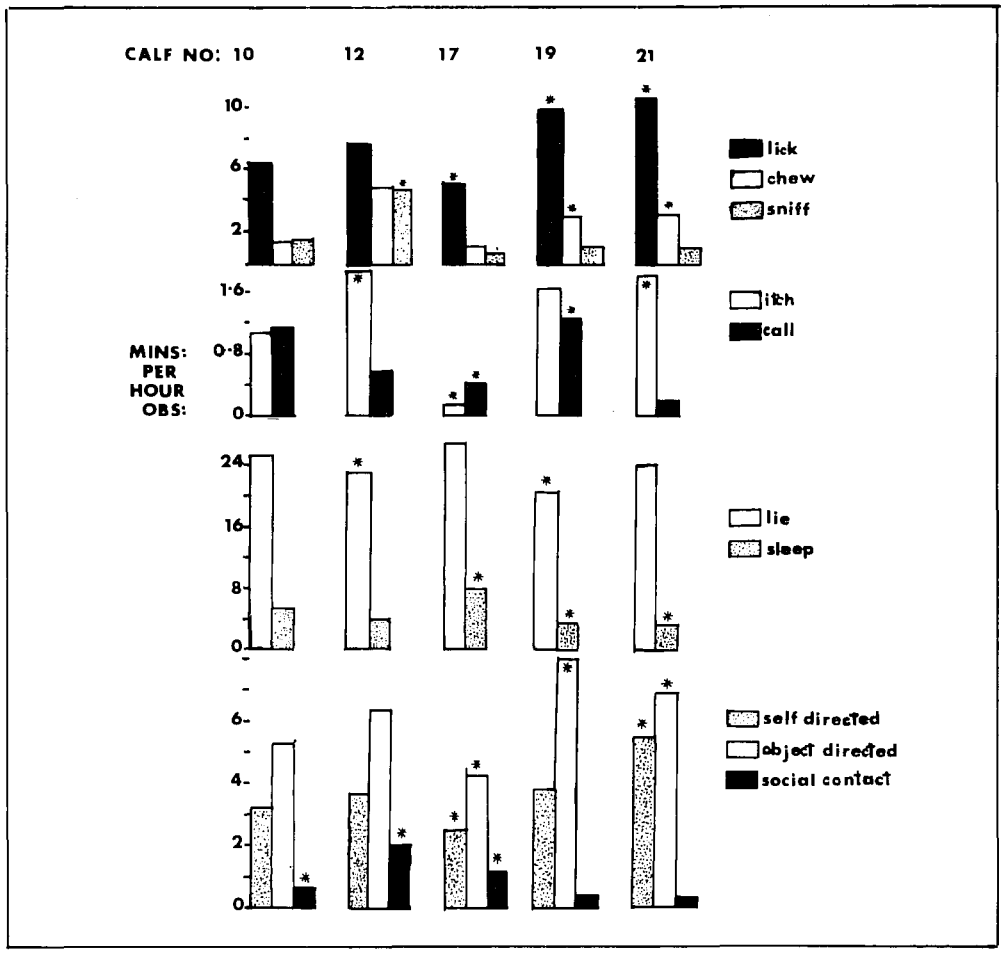

FIGURE 3 "Personality profiles" of five calves (to be read vertically). This shows the difference between the calves in the amount of time calves spent performing the various activities. The vertical axis indicates the number of minutes the activity was observed during each hour. The * sign indicates that the value is significantly different from the mean ($P < .05$).

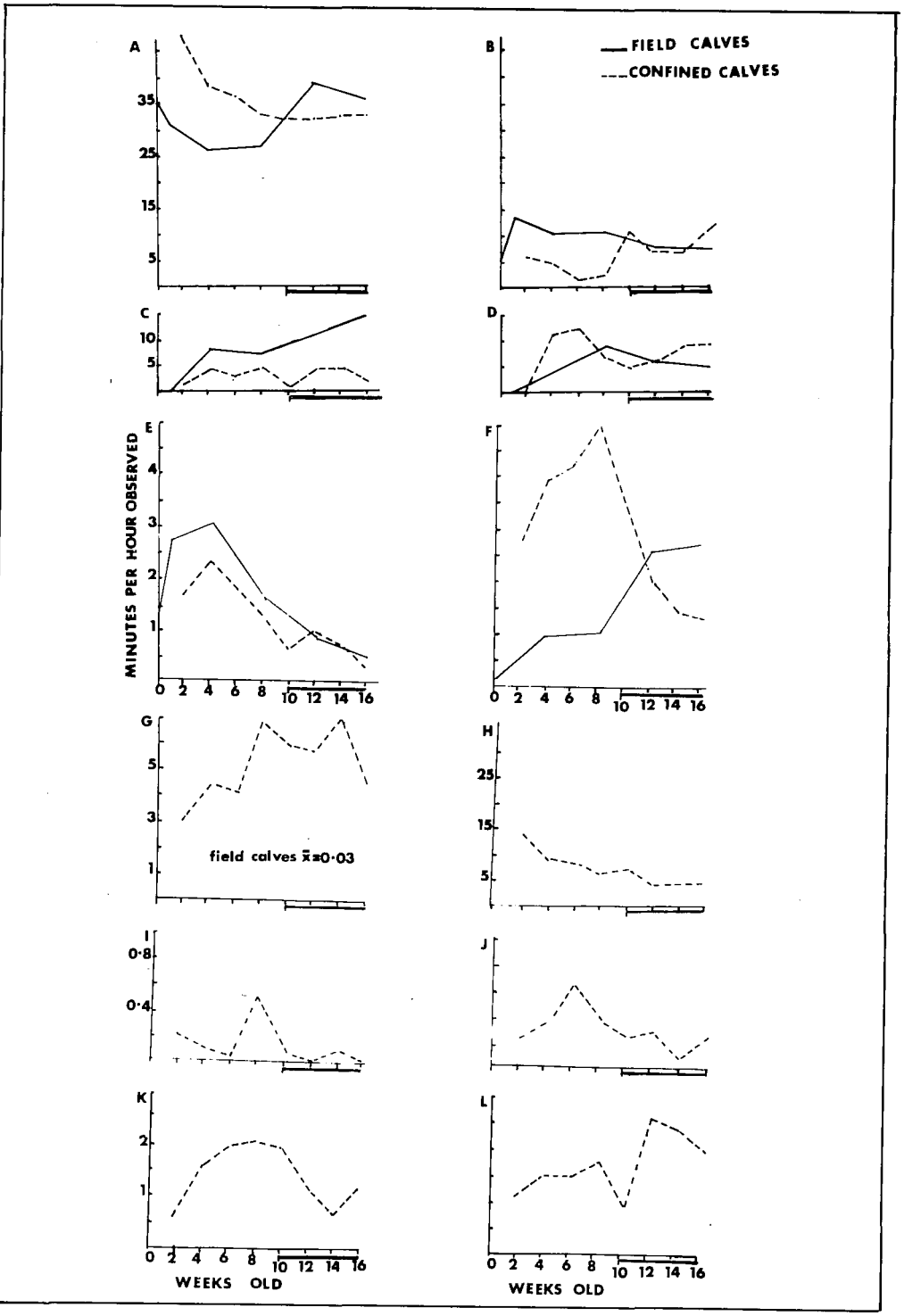

FIGURE 4. The ontogeny of different behaviors in the confined calves. Graphs of values for field calves are also provided for comparison (from Kiley-Worthington and de la Plain, 1983). The vertical axis indicates the number of minutes the activity was observed per hour; the horizontal axis shows the age of the calves (12 confined calves; 8 field calves). The bar that begins at the 10-week mark indicates the time spent in the second shed.

calves had difficulty standing up in the second shed.

When let out of the pens to be loaded into trucks to go to slaughter, the confined calves moved in an uncoordinated way, which resembled the walking and leaping of calves newly born (Kiley-Worthington and de la Plain, 1983).

Discussion and Conclusion

One of the aims of this study was to discover what confined calves—which were provided with all the necessities for sustaining life, and physically prevented by restriction from performing more activities (e.g., running around, investigating the environment, sucking, and social activities such as mutual grooming, smelling, and rubbing and fighting)—would do with their "extra" or "spare" time.

Before we can answer this question, it is necessary first to look at how the mother-reared, free-range calf distributes its time. Data on this question come from several recent studies (e.g., Kiley-Worthington and de la Plain, 1983). A comparison with these findings is interesting. For example, it seems that rather less time was spent by the field calves in lying down than by the confined animals. What is particularly interesting, however, is that despite the restricted amount of fiber in the diet of the confined calves, they spent rather more time ruminating (7.8 minutes/hour; field calves, 4.5 minutes/hour). It is possible that these confined calves may have been "pseudo-ruminating" (Gordon, 1958). This behavior could thus serve to use up "spare" time by increasing self-stimulation (Kiley-Worthington, 1977, p. 74). The confined calves also spent some time in self-grooming (1.2 minutes/hour). Hair-balling in the rumen as a consequence of this activity had previously become a problem in this unit. The proprietor had therefore decided to feed small amounts of straw to try and reduce it.

The confined calves also spent a considerable amount of time chewing objects, usually the sides of the pen (5.1 minutes/hour), an activity that hardly ever occurs in the field. This is a well-documented phenomenon among confined and restricted animals, and frequently develops into a sterotypy termed "crib-biting" (e.g., Kiley-Worthington, 1977). Intersucking among calves can also become one of these sterotypies, but in these animals it was almost entirely prevented by individual housing. The amount of time spent standing and eating was lower than for the field calves. The increased standing observed among the field calves may be related to the amount of time they spend standing and looking around them, an activity likely to be reduced where there is a very restricted visual field. Confined calves spent little time investigating the environment (1.75 minutes/hour; field calves, 3.5 minutes/hour), probably for the same reason.

Finally, the confined calves performed activities such as head-tossing, head-shaking, leaping around, rubbing, and scratching more frequently than did the field calves. These activities are often associated with frustration (e.g., Duncan and Wood-Gush, 1974; Konorski, 1967; Bergson, 1967; Berlyne, 1960).

Individual Differences in Behavior

This analysis shows that individuals have different strategies for adapting to a restricted environment. Thus, some calves spend most of the time lying down and sleeping, while others spend more time scratching themselves, or doing more of those activities that they are still able to do within the confines of their situation. The amount of individual variation is considerable; it is therefore more appropriate to construct individual personality profiles than to make generalizations about their behavior.

Certain calves (such as no. 17) adapt to the confined environment by lying and sleeping more, and when

TABLE 4 Differences in Behavior Between Sheds

Activity	Duration of Activity (Minutes/Hour)		
	Nursery shed (2-10 weeks old)	Second shed (10-16 weeks old)	Significant at $P < .01$ level?
Stand	21	26.16	Yes
Lie	39.96	32.88	Yes
Eat	2.96	3.68	Yes
Move	1.16	0.72	Yes
Sleep	0.88	0.2	Yes
Ruminate	6.92	5.64	Yes
Suck	0.6	0.88	Yes
Lick	7.4	5.92	Yes
Chew	1.6	1.24	Yes
Sniff	1.56	1.08	Yes
Itch	3.16	1.36	Yes
Social contact	0.32	0.28	No
Urinate	6.2	3.4	Yes
Leap (times/hour)	13.3	11.28	No
Call (times/hour)	0.48	0.08	Yes

awake are very social. Others (no. 19) show evidence of possible stereotyped behavior, which is often characteristic of frustration and attempts at self-stimulation (e.g., kicking, scratching, rubbing, chewing). One could argue that this animal is less well adapted to the conditions than calf 17, and that perhaps the latter group should therefore be selected for breeding programs. However, we have *no* indication at present as to what extent such individual adaptive strategies might be inherited.

Ontogeny of Behavior

Various changes in behavior with age are to be expected in calves. However, much of the ontogeny of behavior of the confined calves in this study did not parallel that of the field calves. These differences were emphasized in the second, more confined shed. For example, standing was seen to increase significantly with age. Also, activities often associated with frustration, such as chewing, rubbing, scratching, head-tossing, and head-shaking, increase with age among confined calves; this is not true in the field calves.

Some or all of these differences in behavioral ontogeny may be related to the change to the more restricted second shed. A comparison shows that almost every behavior demonstrates a significant change between the two sheds.

Circadian Rhythms

Among the field calves, day length, the weather, and age of the calf can affect activity rhythms to the point where

patterns are difficult to discern (Hafez and Schein, 1962; Kiley-Worthington and de la Plain, 1983). Even within the dark buildings of the confinement shed, daylight did have some effect on calf activity, since the calves were more active during the day. However, the time of feeding had the greatest effect on these rhythms. This is also true of ration-fed cattle (Kiley-Worthington and de la Plain, 1983), so perhaps this finding is not surprising.

Animal Welfare and the Confined Calf: Toward Measurements of "Distress"

The limits of acceptability of intensive animal husbandry today depend to a great extent on the demonstration of animal suffering or "distress" in particular units. As Ekesbo (1978) and many others have pointed out, although the animals are productive and apparently in good physical health in many of the intensive units, this does not necessarily indicate that they are not suffering or distressed. Thus, in addition to physical criteria, ethological criteria that assess the animals' psychological welfare must be considered. Some steps have recently been taken along this line (e.g., Wood-Gush, 1973; Duncan and Wood-Gush, 1974; Kiley-Worthington, 1977). However, the debate remains confused, as Dawkins (1980) points out.

It is suggested here that a comparison of behavior between a field population and a confined population furnishes some direction to practical approaches toward assessing animal suffering or "distress" in a farm situation. The criteria that might be used to assess the potential acceptability of a particular type of unit might be itemized as follows although, of course, further research is necessary before any definitive guidelines can be suggested.

1. *The numbers and types of activities that normally occur in species and age group, but which are prevented from being performed as a result of confinement or isolation* (e.g., in this study, in the first unit—mutual playing, forward movement, investigation of a changing environment, sucking; in the second shed—inability to turn around, to groom all parts of the body, to stand up and lie down with facility, easy social interaction).

This argument was first made by Brambell (1963), when he suggested that animals have "behavioral needs." This assertion remains controversial (see, e.g., Dawkins, 1980), but perhaps it should be further discussed from a functional point of view.

All normal species-specific behavior is, in the long term, adaptive (Darwin, 1871; Wilson, 1975). It can thus be argued that the elimination of behaviors from the behavioral repertoire, or large-scale changes in the amount of time allotted to these behaviors or their distribution, may be maladaptive and, because of this, distressing. "Distress," and its physiological equivalent, "stress," are of course also adaptive; their function is to motivate the animal to make physiological or behavioral changes and thus to return it to an adaptive equilibrium (Selye, 1950).

It has been argued that, by selective breeding, we have created domestic animals that are genetically very different from their wild ancestors, and that they therefore no longer have similar "behavioral needs" (Beilharz and Zeeb, 1981). Good evidence for this is not available at present. Certainly there are some differences in behavior between wild and domestic species, and we have indeed selected for wide variations in certain types of behavior. One example is the differences we see in the behavior of a sheep dog as compared with a retriever. These authors, however, confuse the issue by suggesting that such genetic changes can be directly related to *all* behaviors. The point is that both these breeds behave differently, to the extent that the sheep dog tends to use vision more than the retriever in performing its

duties. However, both breeds have a well-developed olfactory system, and a large part of their brains is devoted to analysis of the information that is input through this system. There is no physiological evidence that this capacity has declined in the sheep dog. And until we breed a dog without an olfactory system, we cannot conclude that dogs have no "behavioral need" to exercise this system. Thus, to keep a dog in an environment lacking in olfactory stimuli, where he cannot exercise these facilities may, for this functional reason, be considered "distressing."

The extent to which domestication has changed underlying behaviors that have evolved over millions of years, as a requirement for survival, is very small, as far as the currently available evidence goes. The social organization, feeding habits, and sexual behavior of chickens, dogs, horses, pigs, and cattle, when given an opportunity to be performed (in feral groups, for example) remains very similar to that of their extant wild ancestors or close relatives (for a summary of the evidence, see Kiley-Worthington, 1977).

Thus, although in theory we may (given enough time) be able to breed a chicken or calf that cannot and "need" not walk, groom itself, and so on, at present the natural set of both social and maintenance activities are behavioral needs, although these can be modified by the animal's life experiences and its environment.

Therefore, on the basis of the present study, an ability to scratch or lick all parts of the body must be construed as a behavioral need. We know that this activity is necessary to maintain skin health, and we also know that unconfined calves are able to do this (Kiley-Worthington and de la Plain, 1983). Confinement in a situation where this is not possible causes irritation, reduces skin health, and is maladaptive (hence, distressing). Similarly, unconfined calves move around, and are able to get up and lie down at will and with facility. Restriction so that none of these activities is possible with ease may be considered maladaptive and therefore distressing. This is shown to be the case by the observation that the animals were unable to walk and balance in a way appropriate to their age at the end of their period of confinement. Mild hip damage and stiffness as a result of difficulties in standing and lying down were found in 4 percent of the calves from one shed.

Thus, to prevent such activities from being performed is to create a maladaptive and therefore distressing situation. It may be that such restrictions also give rise to physiological stress, but to date this has not been measured.

2. *The performance of behavioral pathologies, or abnormalities.* These include activities such as excessive self-licking (which has previously resulted in hair-balling in this unit) and stereotypies such as crib-biting, chewing, weaving, and pacing. (The latter two were not found in these calves.)

3. *Great differences in the distribution of time allotted to the activities that can still be performed within the confined environment.* For example, there was a great increase in self-stimulative, non-stereotypic movements such as chewing or rubbing. There was also an increase in standing in the second shed, and the increase in rumination noted among the confined calves is particularly interesting in this regard.

4. *An increase in activities often associated with frustration or conflict such as head-tossing, head-shaking, kicking, tail wagging, and scratching.*

5. *Great differences in the ontogeny of behavior, as compared with similar animals kept in a field situation.* For this criterion, the 16-week-old calves that walked like calves of only a few days old is the most obvious example. Other examples appear in Fig. 4 and Table 3.

6. *Abnormal behavior changes.* Such changes would include, for example, an increase in precocial aggression or sex-

ual behavior, or extensive rumination on a low-fiber diet. These kinds of changes occurred in the animals while they were kept in the second shed.

7. *One of the easiest indicators of a maladaptive and distressing environment—the use of drugs as prophylactic agents* (e.g., antibiotics in feed stuffs, tranquilizers and sedatives, etc.—even the use of hormones to ensure reproduction). If the unit cannot survive economically without such use, the necessity for this practice could be used as a simple indicator of behavioral distress within the unit, since we can conclude that the animals requiring this kind of treatment are not adapted to the environment.

How do the two sheds used on this study score on these various criteria, and could the calves within them be considered distressed and therefore suffering?

Although the calves in the first shed were isolated from nearly all contact with their peers and from their mother, were restricted, and were fed a diet that was principally liquid (although furnished with small amounts of straw), they nevertheless showed remarkably few behavioral changes or pathologies. They, however, did show a marked increase in self-grooming (criterion 2), early development of rumination (criterion 3), and an increase in activities that can be related to frustration (criterion 4). Thus, three of the seven criteria were fulfilled. It can be suggested, therefore, that according to these criteria, calves kept under this sort of system in this kind of unit were not distressed to a great degree, and therefore that such husbandry *might* be acceptable, from the welfare point of view.

In the second shed, however, all of the itemized criteria for distress were fulfilled, and I would suggest that keeping the calves isolated and yoked on slats, with restricted levels of dietary fiber and severe space restriction, causes considerable changes in behavior that can be related to behavioral distress.

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