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Consistency of side choice in the milking parlour by Holstein-Friesian cows and its relationship with their reactivity and milk yield

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Abstract

Dairy cows often have to choose which of two sides to enter in the milking parlour. Some cows are very consistent in this choice, and it is common to assume that when these cows are more disturbed are being milked in their non-preferred side. Such disturbance might involve significantly poor welfare. In order to assess this assumption, we decided to study the behaviour and milk yield of dairy cows and their relationships with side preference in the milking parlour. The study was carried out at Cambridge University Farm, in a two-sided tandem milking parlour. The data collection followed the daily management routine. We recorded the side chosen by each cow (left or right) during 40 milking sessions. Data from 70 cows, which were present in at least 25 milking sessions (mode = 36), were included in the statistical analysis. Cows' reactivity (CR) during premilking udder preparation, time spent fitting the milking cluster (FT), milk yield (MY) and duration of milking (DM) were measured. There was evident individual variation in the consistency of side choice. Individual differences (ANOVA, $P < 0.001$) were also found in CR, FT, MY and DM; although these variables were not significantly affected by the side or the interaction animal \times side (ANOVA, $P > 0.05$). The comparison between left and right side means (paired t -test) of these variables did not show significant differences ($P > 0.05$). We concluded that there is no evidence that the cows were discomforted or stressed when milked in the non-preferred side of the milking parlour. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Welfare; Cattle-milking; Side preference; Individual differences; Temperament

1. Introduction

In their daily routine, animals often face situations where they have a choice. It is often assumed that, when animals are choosing some environmental feature, they are considering their needs and desires in the specific environmental context. As reported by Broom and Johnson (1993) and Fraser and Matthews (1997), the expression of such preferences could be used to assess what is important to the animals and hence how to improve animal welfare.

Dairy herds are usually managed using regular procedures, characterised by a daily routine in which the cows are milked twice, or sometimes three times, per day.

The milking routine itself seems to be an important factor for the cows' welfare, since their physiology and behaviour are adjusted to it (King, 1976; Soffié et al., 1976; Arave and Albright, 1981; Seabrook, 1984; Fraser and Broom, 1997). The choice of one side of the milking parlour is part of this routine for many dairy cows. There are some studies showing that some cows were very consistent in this choice, so they have a clear side preference (Gadbury, 1975; Tanner et al., 1994; Hopster et al., 1998).

It is common, among milking handlers, to assume that cows will be more disturbed when they are found themselves on the non-preferred side of the milking parlour. The behaviour in this circumstance could be used to evaluate the cow's reactivity. In order to assess cow's reactivity it is common to use a nominal scale, scoring every animal according to its behaviour under specific handling situations (Dickson et al., 1970; Morris, 1994; Burrow, 1997).

Thus, looking for more information about this subject we decided to study the consistency of side choice in the milking parlour by Holstein–Friesian cows and its relationships to their behaviour during premilking udder preparation and to milk yield. The study tests the hypothesis that, when cows have a high consistency in side choice, their welfare would be poorer when they were milked on the non-preferred side of the milking parlour.

2. Materials and methods

This study was carried out in the dairy unit of the Cambridge University Farm, where 20 cows were milked at same time in a two-sided tandem milking parlour, 10 in each side (Fig. 1).

During the study there was a variable number of milking cows, from 116 to 136 (mode = 121), divided into two groups, according to the milk yield level. We studied the high producing group, $n = 60–90$ (mode = 76). The data were collected under practical conditions, following the farm management routine between March and May 1999, during 40 milking sessions. During this period the cows studied were housed indoors, in a straw yard. The cows had free access to food and water at any time, except during milking sessions. The cows were milked twice a day (5:30 and 15:00 h), after being driven by the herdsman a short distance within the building to a waiting area adjacent to the milking parlour (Fig. 1).

The time spent by each cow in the waiting area before milking varied according to the entrance order, from 15 to 60 min. After each group of 20 cows was milked, the waiting

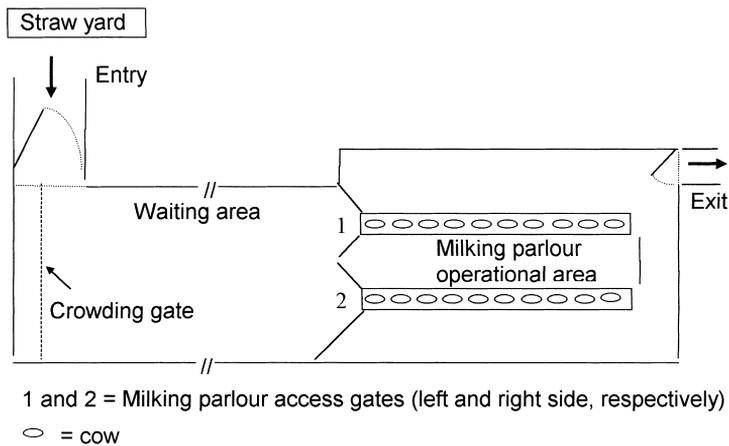


Fig. 1. Diagram of waiting area and milking parlour plan. The crowding gate and the gates 1 and 2 were operated by an electromechanical device controlled by the herdsman.

area was decreased by the movement of a crowding gate, controlled electromechanically by the herdsman. Hence, the cows were always kept close to the milking parlour entrance. The last two groups of cows only were driven through the milking parlour gates by direct action of the herdsman.

Once the cows were in the milking parlour the routine was: premilking udder preparation, fitting the milking cluster and milking. Premilking udder preparation included wiping the teats and brief hand milking to check the condition of the milk.

The behaviour of a cow was recorded by continuous observation, from entering the parlour until milking had started. For every cow the side chosen was recorded. Each cow's reactivity (CR) was assessed, by scoring reactions during premilking udder preparation following a scale based on that proposed by Dickson et al. (1970), where 0 = very quiet in the milking parlour, no leg movements; 1 = cow stands quietly, some slight leg movements; 2 = cow shows continual leg movements which are occasionally vigorous, but does not kick; and 3 = cow shows continual leg vigorous movements or kicking. The time spent by the herdsman fitting the milking cluster (FT) was recorded using a stopwatch.

Milk yield (MY) and duration of milking (DM) were recorded automatically (Alfa Laval Alpro System) for every cow in every milking session.

2.1. Data management and statistical analysis

Two different groups of data were used in the statistical analysis, both considering data from those cows who were present in at least 25 milking sessions (mode = 36), resulting in a sample of 70 cows and 2520 milking sessions.

In order to meet the requirements of normally distributed data, the score of reactivity (CR) was square root transformed after adding 0.5. For FT, MY and DM non-transformed data were used.

The original data file included every measurement of CR, FT, MY and DM. This file was used to perform an analysis of variance using a between and within-subject design

(Sampaio, 1998), considering the model:

$$Y_{ijkl} = M + A_i + S_j + AS_{ij} + C_k + \varepsilon_{ijkl}$$

where Y_{ijkl} = dependent variables (CR, FT, MY and DM); M = overall mean, A_i is the effects of the i th animal ($i = 1, \dots, 70$), S_j the effect of the j th side ($j = 1$ and 2), AS_{ij} the effect of the interactions between i th animal and j th side, C_k the effect of the data collection's session (which includes the within-subject variation) ($k = 1, \dots, 30$ for CR and $k = 1, \dots, 24$ for FT, MY and DM) and ε_{ijkl} the error (residual).

A further data file was constructed using the means. In this the cows were divided arbitrarily into the following groups: HC: cows showing high consistency in side choice (HC > 86%); SC: cows showing some consistency in the side choice (72 < SC < 86%); and NC: cows showing low consistency in the side choice (NC < 72%). The preference for left or right side was considered for the groups HC and SC.

For every variable in every consistency group and side preference, side comparisons were performed by paired t -test, using the means data file. It was also used in order to estimate the Pearson correlation coefficients between the left and right side means of CR, FT, MY and DM.

The statistical analyses were done using the SAS and SPSS software packages.

3. Results

Twenty three cows (32.9%) were classified as showing high consistency (HC) in side choice (visiting one side in more than 86% of the milking sessions), 14 of them (60.9%)

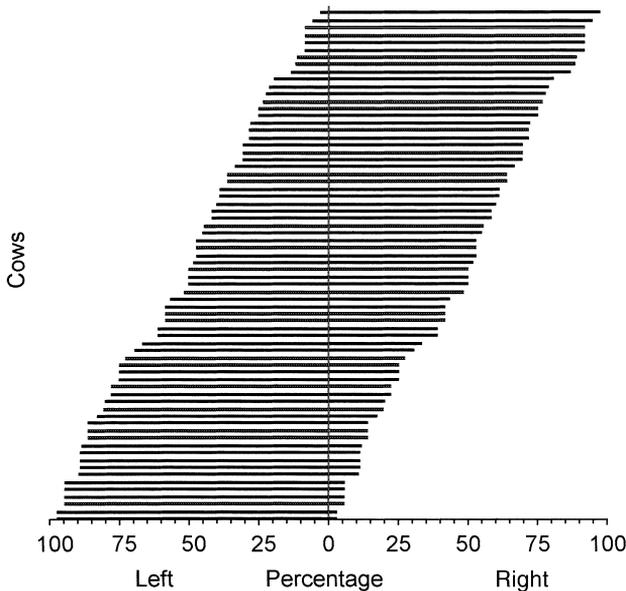


Fig. 2. Each cow's percentage choice of the left and right side in the milking parlour ($n = 70$).

Table 1

The results of an analysis of variance of cow reactivity (CR) during premilking udder preparation (transformed data), time spent fitting the milking cluster (FT), milk yield (MY) and duration of milking (DM)

Sources of variation	Variables							
	CR		FT		MY		DM	
	DF ^a	MS ^b	DF	MS	DF	MS	DF	MS
Animal	69	2.013**	69	9.201**	69	98.958**	69	41.154**
Side	1	0.001	1	0.0001	1	0.026	1	0.459
Animal × side	69	0.083	69	1.358	69	4.594	69	0.916
Session and within-subject	29	0.313**	23	0.991	23	259.574**	23	27.776**
Residual	1843	0.470	1299	1.769	1468	7.600	1468	0.965
C.V. ^c	26.41		29.90		15.87		19.23	
r ^{2d}	0.602		0.318		0.745		0.766	

^a DF: degrees of freedom.

^b MS: mean square.

^c CV: coefficient of variation.

^d r² = coefficient of determination.

** $P < 0.001$.

showed preference for the left and nine (39.1%) for the right side of the milking parlour ($X^2 = 1.087$, $P = 0.297$, $DF = 1$). Sixteen cows (22.8%) showed some consistency (SC) in this choice (visiting one side in 72–86%), again a slight majority of them preferred to be in the left than in the right side (56.3 and 43.7%, respectively; $X^2 = 0.25$, $P = 0.6176$, $DF = 1$). The other 31 cows (44.3%) were less consistent in visiting a specific side (<72%, NC).

There was a considerable variation amongst individuals in the consistency of side choice (Fig. 2).

Table 2

Correlation coefficients between the left and right side measurements^a

Groups variables	HC left ($n = 14$)	HC right ($n = 14$)	SC left ($n = 14$)	SC right ($n = 7$)	NC ($n = 31$)
CR	0.911 ($P < 0.001$)	0.9103 ($P = 0.001$)	0.9176 ($P < 0.001$)	0.8884 ($P = 0.008$)	0.9424 ($P < 0.001$)
FT (s)	0.3700 ($P = 0.193$)	0.0901 ($P = 0.818$)	0.5945 ($P = 0.091$)	0.1835 ($P = 0.694$)	0.8024 ($P < 0.001$)
MY (kg)	0.7491 ($P = 0.001$)	0.7246 ($P = 0.027$)	0.8710 ($P = 0.002$)	0.7645 ($P = 0.045$)	0.8899 ($P < 0.001$)
DM (min)	0.7804 ($P = 0.001$)	0.9377 ($P < 0.001$)	0.9350 ($P < 0.001$)	0.9435 ($P = 0.001$)	0.9706 ($P < 0.001$)

^a CR: transformed data of reactivity during premilking udder preparation, FT: time spent fitting the milking cluster, MY: milk yield and DM: duration of milking, obtained on the left and right sides. Results are presented according to the consistency and side preference groups, where HC: high consistency for left and right side, respectively; SC: some consistency, for left and right side, respectively, and NC: non-consistent (no preference for left or right side).

There were individual differences ($P < 0.01$) in all variables (CR, FT, MY and DM), but no significant effects ($P > 0.05$) of side, or of the interaction animal \times side, on these variables were found. There were also statistical significance ($P < 0.01$) among the data collection sessions in CR, MY and DM. These include the within animal variation (Table 1).

The correlation between all the measurements taken on left and right side were high, positive and significant (CR = 0.898, FT = 0.654, MY = 0.781 and DM = 0.927; $P < 0.01$, $n = 70$ for each). When we considered each group separately, most of the correlation coefficients were still high, positive and statistically significant ($P < 0.01$), as

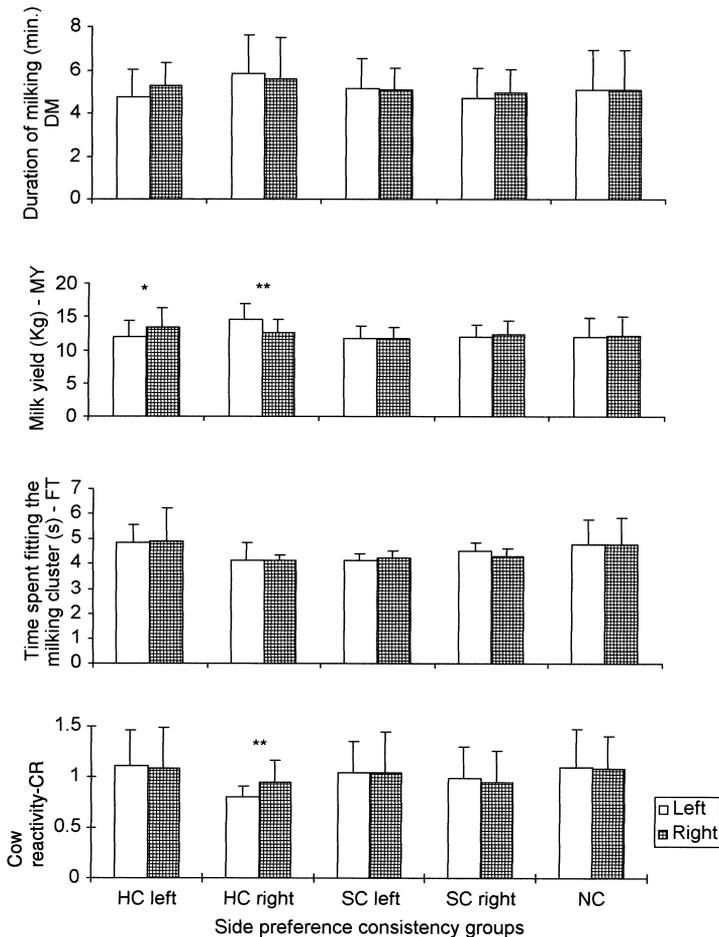


Fig. 3. Means and standard deviation of cows' reactivity during premilking udder preparation (transformed data, CR), time spent fitting the milking cluster (FT), milk yield (MY) and duration of milking (DM). Results are presented according to the consistency and side preference group, where group HC: high consistency (HC > 86% on left and right side preference, respectively); group { SC}: some consistency (72% < SC < 86%, for left and right side preference, respectively), and group NC: non-consistent (NC < 72%, no preference for left or right side). Means were compared using the paired *t*-test (* = $P < 0.05$, ** = $P < 0.01$).

presented in Table 2. The exception was FT, for which there was a significant correlation coefficient only in the NC group (Table 2).

When we considered all the animals together ($n = 70$) we did not find any significant difference between left and right side means of all variables:

$$\text{Cr} = 1.04 \pm 0.34 \text{ and } 1.04 \pm 0.33, \quad t = 0.28, \quad P = 0.781;$$

$$\text{FT} = 4.61 \pm 0.82 \text{ and } 4.61 \pm 0.96 \text{ s}, \quad t = 0.00, \quad P = 0.996;$$

$$\text{MY} = 12.33 \pm 2.57 \text{ and } 12.41 \pm 2.62 \text{ kg}, \quad t = -0.40, \quad P = 0.687;$$

$$\text{DM} = 5.10 \pm 1.60 \text{ and } 5.18 \pm 1.52 \text{ min}, \quad t = -0.05, \quad P = 0.297.$$

The results were slightly different when we compared the left and right side means of these variables for each group. As shown in Fig. 3, there were significant differences ($P < 0.05$) between left and right side means for CR in the HC right group, where the mean was higher when the cows were in the right and preferred side, and for MY in the groups HC left and HC right. In both cases MY means were higher when they were in the non-preferred side.

4. Discussion

4.1. Side choice and its consistency

A majority of the 70 cows studied in detail (55.7%) chose consistently (>72% of the choices) a specific side in the milking parlour, and the left side was preferred by a slight majority of these cows (61.5%). This demonstration of side choice confirms the few previous studies assessing this subject. Gadbury (1975) worked with 200 cows from three different herds. She found that 79 cows (39.5%) showed high consistency in choosing a specific side in the milking parlour. Tanner et al. (1994) studied the side preference in the milking parlour in a commercial herd with 1379 cows during 90 milking sessions. They reported that 741 cows (53.7%) did not show side preference, whereas the others (46.3%) showed strong side preference.

In one study Hopster et al. (1998) analysed data from 89 cows, collected automatically during 28 successive months. A strong side preference (>75% of the milking sessions) was shown by 25.8% of cows. In a second study, Hopster et al. (1998) selected eight cows showing strong consistency in side choice and eight non-consistent cows. When tested alone for side choice in the milking parlour, only one cow changed the preferred side. The authors concluded that "... a substantial proportion of cows show a distinct individual side preference in the milking parlour, which persists over time despite changes in group size, group composition, stage of lactation and time of year. Accordingly, side preference seems to be a stable characteristic of an individual dairy cow." Our results support this statement.

Factors which could be related to the side choice in the milking parlour by dairy cows and its consistency include aspects of the cows' neurological development (Tanner et al., 1994), social behaviour (Hopster et al., 1998), the interactions of humans and cows during the daily routine management (Seabrook, 1984), the predictability of the daily management routine (Albright and Arave, 1997) and the milking technology (Zucs et al., 1992). It could be that a cow exhibiting side preference in the milking parlour is using associative

learning, choosing the side where she had previously received some reward and avoiding that where there was some source of punishment. This idea is partially supported by some results (Bailey et al., 1989; Hosoi et al., 1995; Prescott et al., 1998), however, it is not completely in agreement with others (Arave et al., 1992; Grandin et al., 1994).

The milking parlour design and the management strategies, could also interfere with the definition of side choice and its consistency. In our study the lack of symmetry in the milking parlour (see Fig. 1), where the exit gate was closer to the left than to the right side, could explain the tendency of the majority of the cows to be on the left rather than on the right side. Hopster et al. (1998), said that the left and right side of the milking parlour were identical in their studies but it is easy to find at least two differences between them: the exit gate was close to the right side, and the cubicle barn, where their experimental cows were kept, was closer to the left side. Other environmental conditions (e.g. noise and lighting levels and stray voltages), and management actions (e.g. feeding cows in the milking parlour, tubing for mastitis and fitting a kicking bar), should be also considered.

Another possibility is that some cows have a side preference due to a natural laterality. Arave and Albright (1981) described how cows tend to exhibit left-side laterality when lying-down, and Tanner et al. (1994) found that 27% of their cows showed strong side preference associated with the presence of a hair whorl in the middle of the forehead, which is determined before birth. However, some studies using maze tests did not show any evidence of laterality in side choice (Bailey et al., 1989; Arave et al., 1992) and Hosoi et al. (1995) considered laterality as a 'maze behaviour' without biological importance. The slight tendency to prefer the left side found in this study could have arisen at random, but it could also reveal some quality of the cow.

All of these possibilities should be considered as potential effects on the definition of side choice and its consistency, and the individual differences in this characteristic could result from a specific combination of them. Nevertheless, a particular consistency of choice could be an indicator of animal temperament. In a specific context, there may be some animals which are very predictable but others which are not.

4.2. Effects of parlour side on a cow's reactivity, milk yield and duration of milking

It is advisable during milking procedures, in order to avoid aversive conditions which could affect the welfare of cows and milk yield, that dairy cows should be milked in a quiet and predictable way (Fraser and Broom, 1997). Evidence for this comes from practical experience and scientific studies (Seabrook, 1984; Bruckmaier et al., 1996; Lewis and Hurnik, 1998; Rushen et al., 1999).

When a cow is in the waiting area before milking, attempts to enter in the left or right side may be blocked by the presence or actions of other cows, or by the action of farm staff or the movement of crowding gates. Some cows appears to make considerable efforts to go to a particular side but others do not or cannot.

Zucs et al. (1992) have described that presenting side preference which showed a tendency to decrease milk yield when milked at the opposite side of the parlour. The effects of milking cows on their non-preferred side were also studied by Hopster et al. (1998). Their results were complicated by a general negative effect of being on the left side in the milking parlour on the latency to enter, heart rate and milk production, perhaps because of

factors not considered by the authors, e.g. different functioning of the milking clusters on the two sides or, as discussed previously, because there was lack of symmetry in the milking parlour. However, they also found that cows showing a side preference were more reluctant to enter their non-preferred side, and showed differences in behaviour and heart rate during milking, perhaps because the experimenter had driven the cows to the non-preferred side in the milking parlour. Using the heart rate and milk yield as indicators they found no evidence of stress when the cows were milked on their non-preferred side in the milking parlour, but considered that the cows probably found it uncomfortable.

In our study in addition to milk yield (MY) the reactivity of cows during premilking udder preparation (CR), the time to fit the milking cluster (FT) and the duration of milking (DM) have been used as sensitive indicators of any adverse effects on the cows. Only normal milking procedures were used but these did lead to being on the non-preferred side.

We did not find any negative effect of cows being milked on their non-preferred side, there being no significant effects of side or of the interactions animal \times side on CR, FT, MY and DM. Furthermore, the coefficients of correlation between the left and right sides of CR, MY and DM, showed that cows were consistent in these characteristics when milked in one or the other side, even those in the HC groups. The coefficients of correlation of FT, on the other hand, were variable in animals which showed a side preference. However, this may just indicate that there are more factors which can affect this measure, as suggested by the low coefficient of determination ($r^2 = 0.318$). These uncontrolled factors affecting FT were not related to the data collection session or to within-animal variation, since this effect was not statistically significant. On the other hand, the expression of CR, MY and DM were dependent on the data collection session and within-animal variation. This source of variation could result from many possible factor combinations, but we did not find any specific factor to explain them.

We conclude that there was no evidence that cows, subjected to normal premilking management, are discomforted when milked on a non-preferred side of the milking parlour; poor welfare was not indicated even in cows showing high consistency in side preference.

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