

## SHORT COMMUNICATION

# SKIN STIMULATED INDUCTION OF MOUTH MOVEMENTS IN CATTLE

H B Simonsen

Department of Animal Science and Animal Health, The Royal Veterinary and Agricultural University, Bülowsvej 13, 1870 Frederiksberg C, DK Denmark

### Abstract

*Animal Welfare* 1994, 3: 129-134

*Six animals in a free-ranging herd of ten Aberdeen Angus cattle showed mouth movements induced by skin stimulation by grooming of the sacro-coccygeal region with a horse grooming brush. Three of the animals reacted by mouth movements similar to stereotypic tongue rolling. Twenty-two (ie 37 %) of 59 animals at a cattle show reacted by mouth movements when firmly scratched by hand on the skin in the sacro-coccygeal region and among these animals, significantly more beef breed cattle reacted compared to dairy breeds ( $P < 0.02$ ).*

*Stereotypic mouth movements of cattle including tongue-rolling, bar-biting and bar-licking are regularly observed in dairy cows and calves. Although it is generally accepted that these kinds of behaviour are behavioural stress reactions, scientific evidence related to the mechanisms behind these oral movements is scarce. In relation to animal welfare science these behavioural stress reactions are important because knowledge of the aetiology of the abnormal behaviour is necessary for the prevention and cure of the symptoms. The present demonstration of skin stimulated induction of mouth movements in cattle, similar to tongue-rolling, therefore seems interesting, as the discovery of such a behaviour may be used in further research on oral stereotypies in cattle.*

**Keywords:** *animal welfare, cattle, induction of mouth movements, skin stimulation, stereotypies, tongue-rolling*

### Introduction

Normal mouth movements in cattle are mainly performed in relation to feeding behaviour including rumination, or social grooming (allogrooming) and self grooming. In dairy cows, other kinds of mouth movements such as tongue-rolling, bar-biting and certain types of licking and sucking behaviour may sometimes be observed. These types of oral movements are often called stereotypies as they are morphologically identical, repetitive movements without any known function.

Although stereotypies are well known in many farm animal species and mainly seen in animals kept in restrictive environments, the causal mechanism of this kind of behaviour is unknown. There is, however, growing evidence that motivational states that control normal behaviour may play a role in the development of stereotypies (Rushen *et al* 1993), and according to Kooyman *et al* (1991), lack of roughage supply for normal feeding and

rumination in veal calves increases the incidence of stereotypic oral behaviour. For many years it has been known that abnormal oral movements can be induced in cattle, sheep and pigs by the administration of apomorphine (Feser 1875; Sharman & Stephens 1974), indicating a link between the abnormal behaviour and neurochemical brain mechanisms. In support of this indication, Cronin *et al* (1986) convincingly demonstrated a possible relationship between stereotypies in tethered sows and release of endorphins. These authors demonstrated a reducing effect on abnormal oral activities by naloxone. Furthermore, Redbo (1992) found that heifers displaying tongue-rolling had significantly higher plasma levels of the endogenous opioid peptide leu-enkephalin-arg compared to heifers without the stereotypies. According to Dodman *et al* (1988), overproduction of endogenous opioids in response to stressors may affect the brain's narcotic and dopamine receptors with resultant behavioural disturbances. Accordingly Dodman *et al* (1987) found that the well-known vice crib-biting in horses could be reduced by treatment with narcotic antagonists. The involvement of opioid systems in the display of aberrant grooming reminiscent of stereotypic behaviour is extensively discussed by Spruijt *et al* (1992), and according to Dodman *et al* (1988) stereotypic self-licking, self-chewing, and scratching behaviours in dogs were significantly reduced by treatment with a narcotic antagonist.

Stereotypic mouth movements in dairy cows, especially tongue-rolling, have been of significance in the farm animal welfare debate for more than a decade as these abnormal movements are probably behavioural stress reactions. However, little research on aetiology, prevention and treatment has been carried out in relation to these kinds of abnormalities in dairy cattle. This is perhaps because of the seemingly insignificant economical importance of this type of vice as well as its rather sporadic and unforeseeable manifestation. On this background it seems interesting that mouth movements in some cattle may be induced by firm rubbing of the skin in the region above the sacrum and first coccygeal vertebrae. The reaction was accidentally observed during a pilot study on social grooming in a herd of Aberdeen Angus cattle.

## Methods

### *Free-ranging animals*

Social grooming of cattle may be substituted by a human hand or a grooming brush (Brownlee 1951). Such substitutional social grooming was performed in autumn 1991 on a Danish free-ranging herd of ten Aberdeen Angus cattle consisting of seven cows, two heifers and an adult bull. The age of the animals ranged from 18 to 55 months. Each of the animals was approached by two persons, one of whom observed the animal while the other firmly groomed its sacro-coccygeal region using a horse grooming brush. According to Sambraus (1969) this region is regularly licked by conspecifics although social licking is more often directed at the neck and head. The reactions of the animals were recorded in a notebook by the observer as a one or zero event.

### *Show animals*

A further investigation of mouth movements induced by skin stimulation was performed on 59 animals exhibited at a cattle show in Denmark in the summer of 1992. Thirty-three dairy breed heifers and cows, 18 beef breed heifers and cows and eight beef breed bulls were

tested. The age of the animals ranged from 13 to 87 months and they were tethered by halter and rope on rows together with other show animals. All tethered show animals not lying, eating, drinking or chewing cud were tested. A 'groomer' firmly scratched the animal by hand on the spines of the sacro-coccygeal region while an observer standing in front of the animal closely observed its head. If any chewing movements or movements of lips or tongue were observed within a minute after the beginning of the stimulation the animal was scored as positive (one). Otherwise it was scored as negative (zero).

#### *Data analysis*

The data from the show animals were evaluated as a transformed approximative normal distribution of a binomial distribution at the 95 per cent confidence interval and tested at a probability of 50 per cent. Any association between mouth movements and breed was evaluated by the Pearson's  $\chi^2$  while any association with age was evaluated by the *t*-test. The coefficients were estimated and tested by the Wald's  $\chi^2$  of the logistic regression logit. The magnitude of the factor levels was evaluated by the odds ratio (OR).

#### **Results**

##### *Free-ranging animals*

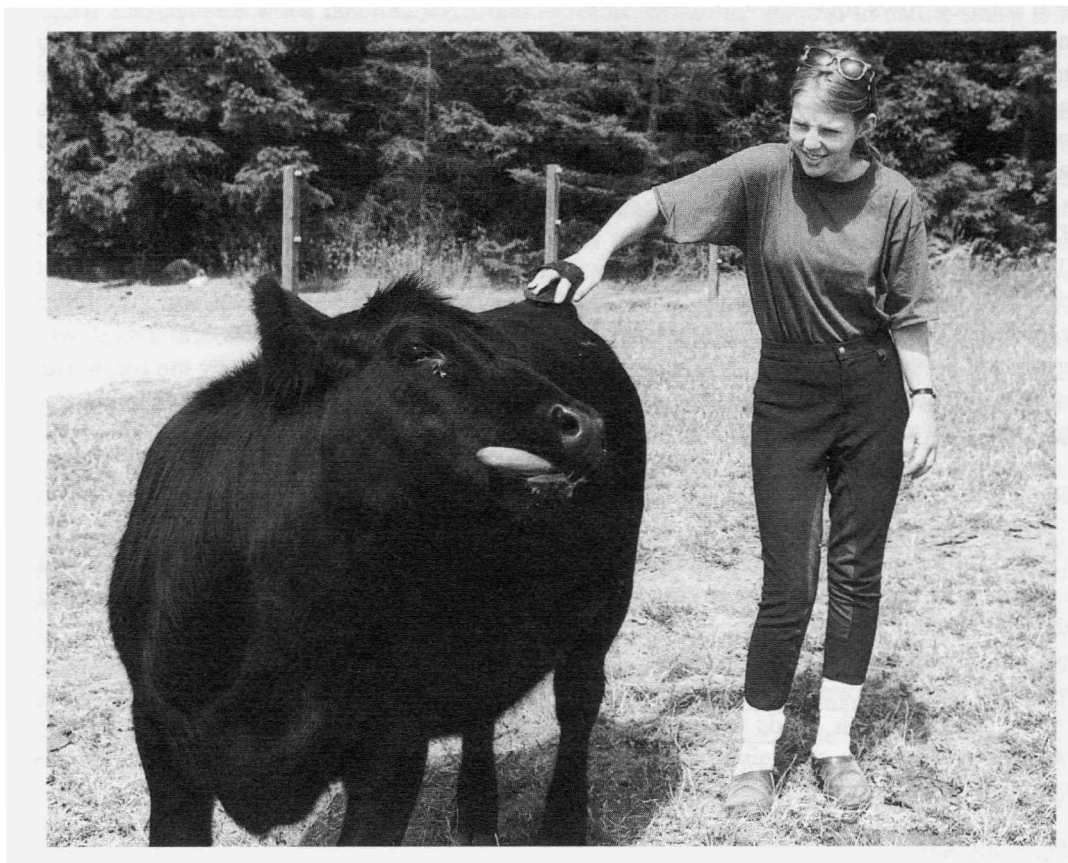
During grooming of the sacro-coccygeal region, six of the ten animals showed oral movements, some of which were comparable to tongue-rolling (see Figure 1). Two cows and the bull reacted with small chewing movements while one cow and the two heifers reacted by oral movements similar to tongue-rolling. The animals moved their heads simultaneously with the mouth movements: some bent their heads upwards and backwards or sideways, others stretched their heads forwards and downwards towards the ground. Of the animals which reacted to the grooming, some did so almost immediately after the beginning of the stimulation while others reacted within less than a minute.

##### *Show animals*

From Table 1 it can be seen that skin stimulated mouth movements were induced in approximately one third of the show animals. The null hypothesis ( $H_0$ ) of no association between incidence of induced mouth movements and breed gave a  $\chi^2$  value of 5.450 with a *P* value of 0.020.

**Table 1** Incidence of skin stimulated induction of mouth movements in beef and dairy cattle at a show.

Breed	Mouth movements		Total
	Yes	No	
<i>Beef</i>	14	12	26
<i>Dairy</i>	8	25	33
<i>Total</i>	22	37	59



**Figure 1** Skin stimulated induction of mouth movements similar to tongue-rolling in an Aberdeen Angus heifer.

The  $H_0$  of no association between induced mouth movements and age gave the  $t$  value 1.3977 with a  $P$  value of 0.170 (unequal variances). The univariate estimated coefficient for breed was 1.294 with  $P = 0.022$ ; OR = 3.65. The estimated coefficient for age was -0.001 with  $P = 0.936$ . The data did not justify rejection of the  $H_0$  that presence of induced mouth movements could be as high as 50 per cent in cattle ( $P = 0.051$ ).

Thus the data indicated an association between breed and incidence of induced mouth movements, but did not indicate an association between stimulated mouth movements and age. These results were supported by the univariate logistic regression. The estimated coefficient results mean that while breed indicated a significant effect ( $P = 0.022$ ) on induced mouth movements, age was not shown to have any effect ( $P = 0.936$ ). The estimated OR for breed means that the incidence of induced mouth movements in beef cattle was 3.65 times higher than in dairy cattle.

## Discussion

Although for the moment it is impossible to explain the relationship between skin stimulation and mouth movements in cattle it can be suggested that neurophysiological mechanisms including the brain's dopamine receptors are involved in the reaction. Although the main original function of both self grooming and social grooming (allogrooming) is care of the body surface, grooming behaviour including licking may also be seen as displacement behaviour as well as tension-reducing social behaviour (for an extensive review see Spruijt *et al* 1992). It has been demonstrated that tension-reducing social grooming in monkeys can increase the concentration of beta-endorphins in the cerebrospinal fluid (Keverne *et al* 1989). This reaction in monkeys may support the view that brain opioids play an important role in social attachment in these social animals.

Domestic cattle are also social animals which regularly perform social grooming (eg Sambraus 1969; Simonsen 1979) and it has been suggested by Sato *et al* (1991) that social licking in cattle may have a tension-reducing effect. It is interesting that during premounting behaviour the bull rests his chin on the cow's back, especially in the sacro-coccygeal region, and rubs the chin back and forth (Phillips 1993). Oestrous cows may respond to this chin-resting behaviour by standing (Hafez & Bouissou 1975) and it may be considered as a kind of tension-reducing behaviour; as in monkeys this may be caused by elevation of beta-endorphins. Artificial grooming-like stimulation of the skin may, similarly to chronic environmental stressors, induce an abnormal level of endogenous opioids followed by abnormal oral behaviour. This hypothesis needs further investigation, however, including demonstration of a positive correlation between cutaneous stimulation and the concentration of beta-endorphins in plasma and/or cerebrospinal fluid, as well as a demonstration of a naloxone blocking effect on the skin stimulation induction of mouth movements.

The observed significant difference between breeds in skin stimulated induction of mouth movements suggests a genetically different tension-reducing capacity due to selection of dairy breeds with only minor weight placed on the social behaviour capacity which may be much more important in free-ranging beef breeds.

## *Animal welfare implications*

The discovery of skin stimulated induction of mouth movements in cattle, similar to oral stereotypies, is a valuable tool in the future research of abnormal oral behaviour in cattle. Oral stereotypies in cattle are presumably of little significant economical importance. They may however be very significant for the evaluation of cattle welfare, as stereotypies are considered by most researchers as environmentally-induced behavioural stress reactions.

## Acknowledgements

The valuable comments from Dr A Randrup, International Center for Interdisciplinary Research in Psychiatry are highly appreciated. Also thanks to Lartey Lawson who skilfully performed the data analysis.

**References**

- Brownlee A** 1951 Studies in the behaviour of domestic cattle. *Veterinary Record* 63: 443 (Abstract)
- Cronin G M, Wiepkema P R and van Ree J M** 1986 Endorphins implicated in stereotypies of tethered sows. *Experientia* 42: 198-199
- Dodman N H, Shuster L, Court M H and Dixon R** 1987 Investigation into the use of narcotic antagonists in the treatment of a stereotypic behavior pattern (crib-biting) in the horse. *American Journal of Veterinary Research* 48: 311-319
- Dodman N H, Shuster L, White S D, Court M H, Parker D and Dixon R** 1988 Use of narcotic antagonists to modify stereotypic self-licking, self-chewing, and scratching behavior in dogs. *Journal of the American Veterinary Association* 193: 815-819
- Feser P** 1875 Apomorphinum hydrochloratum, ein Heilmittel gegen die sog. Lecksucht der Rinder, Schafe und Schweine. *Zeit-schrift für praktische veterinärwissenschaft*: 111-113
- Hafez E S E and Bouissou M F** 1975 The behaviour of cattle. In Hafez E S E (ed) *The Behaviour of Domestic Animals, 3rd edition* pp 203-245. Baillière Tindall: London
- Keverne E B, Martensz N D and Tuite B** 1989 Beta-endorphin concentrations in cerebrospinal fluid of monkeys are influenced by grooming relationships. *Psychoneuroendocrinology* 14 (1 and 2): 155-161
- Kooyman J, Wierenga H K and Wiepkema P R** 1991 Development of abnormal oral behaviour in group housed veal calves: effects of roughage supply. In Metz J H M and Groenstein C M (eds) *New Trends in Veal Calf Production* pp 54-58. Pudoc: Wageningen
- Phillips C J C** 1993 *Cattle Behaviour* pp 137-140. Farming Press: Ipswich
- Redbo I** 1992 *Stereotypies in Dairy Cattle and their Relation to Confinement, Production-related Factors, Physiological Reactions, and Adjoining Behaviours*. PhD thesis, Swedish University of Agricultural Sciences, Stockholm
- Rushen J, Lawrence A B and Terlouw E M C** 1993 The motivational basis of stereotypies. In Lawrence A B and Rushen J (eds) *Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare* pp 41-64. CAB International: Wallingford
- Samraus H H** 1969 Das soziale Lecken des Rindes. *Zeitschrift für Tierpsychologie* 26: 805-810
- Sato S, Sako S and Maeda A** 1991 Social licking patterns in cattle (*Bos taurus*): influence of environmental and social factors. *Applied Animal Behaviour Science* 32: 3-12
- Sharman D F and Stephens D B** 1974 The effect of apomorphine on the behaviour of farm animals. *Journal of Physiology (London)* 242: Proceedings 25P-27P
- Simonsen H B** 1979 Grooming behaviour of domestic cattle. *Scandinavian Journal of Veterinary Science* 31: 1-5
- Spruijt B M, van Hooff J A R A M and Gispen W H** 1992 Ethology and neurobiology of grooming behaviour. *Physiological Reviews* 72: 825-852