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## **AN ANALYSIS OF STEREOTYPED BEHAVIOUR IN TETHERED SOWS**

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### **Résumé**

UNE ANALYSE DES COMPORTEMENTS STÉRÉOTYPES DES TRUIES ATTACHEES. — Le comportement de chacune de 36 truies Yorkshire × Landrace Néerlandais fut enregistré au moyen d'observations continues pendant onze intervalles de cinq minutes entre 10.00 et 14.00 h. Les truies étaient attachées par le cou dans des compartiments individuels dans la division pour truies non-allaitantes d'une porcherie commerciale de 250 truies. Les données comportementales ainsi obtenues furent analysées pour détecter la présence de cycles de comportements répétitifs sans fonction apparente. Quatre catégories de comportements stéréotypés furent reconnues : routines complètes fixes, sous-routines fixes, stéréotypies transitoires et stéréotypies lâches. Les comportements furent déployés durant 28,8 ; 12,9 ; 4,9 et 2,7 % du temps d'observation, respectivement. Quelques aspects des deux catégories de stéréotypies fixes étaient liés au stade de gestation, c'est-à-dire au nombre de jours passés à l'attache durant la présente gestation. La proportion du temps d'observation que les truies passèrent à déployer des stéréotypies fixes, ainsi que le nombre de stéréotypies fixes différents par truie, ont augmenté au cours de la gestation. Cependant la proportion du temps d'observation consacrée aux stéréotypies redescendit après le 80<sup>e</sup> jour de la gestation. Les stéréotypies parurent fort variables quant à la présence d'éléments particuliers, la durée de chaque élément, etc. Ceci suggère que la définition classique décrivant les comportements stéréotypés comme immuables ne peut pas s'appliquer dans cette situation et doit être restreinte aux environnements également immuables. L'emploi d'une méthode quantitative pour mesurer les stéréotypies que déploient des truies attachées fournit une base pour les recherches sur les causes et fonctions de ces comportements. De telles recherches sont indispensables pour élucider les rapports entre stéréotypies et bien-être de la truie.

The problems associated with the definition and discussion of stereotyped behaviour in man and animals have been elucidated by a number of authors (for example, Berkson, 1968; Kiley-Worthington, 1977; Ödberg, 1978; Thelen, 1979). Although Morris had emphasized the importance of investigations to quantify "abnormal behaviour rituals" in animals as early

as 1966, there exists little quantitative data or analyses of stereotyped behaviour in the literature particularly for farm animals. Recently, authors such as Van Putten (1981), Sambras (1981) and Wiepkema (1982) have emphasized the significance of ethological criteria for the assessment of farm animal welfare, and in particular, the interpretation of stereotyped behaviours. However,

without concrete quantitative data, the many questions being raised by scientists, producers and welfarists regarding the interpretation of stereotyped behaviours in animals housed under intensive conditions cannot be satisfactorily substantiated.

The aim of the present study was to record and analyse stereotyped behaviours in tethered sows in order to obtain a quantitative description of these behaviours. Such a quantification is necessary for a full understanding of the biological relevance of the phenomenon. Two aspects are immediately relevant: 1) the organization or structure of these behaviours — are there categories of these stereotypes? — is some classification of the different types possible? and 2) how do these classes or types of stereotypes occur in the individual animals per day and over longer periods of time? Such descriptions are absent in the existent literature. In order to assess the biological significance of stereotypes such a description is essential. With respect to tethered sows we may ask, which aspects are common and which are different in the various stereotypes performed by these animals. Moreover, how stereotyped are stereotypes; we really don't know!

Since it is apparent that some stereotypic behaviours have obvious functions e.g. predunging, agonistic, posture changing, etc., these behaviours will not be considered here.

The main aim of this paper therefore, is to present a description and classification of the seemingly non-functional stereotypes of tethered sows. In this paper we shall also present a first use of this description. This description will be derived from sows which had been tethered for different periods of time. No attention will be paid to an equally important point, namely, how did these stereotypes develop.

## Materials and Methods

Thirty-six Yorkshire × Netherlands Landrace sows were studied at a 250-sow, intensive piggy in the Netherlands. The sows were necktethered in partial stalls with solid front panels, on a concrete floor which was slatted behind the sows. At the study piggy weaned sows were tethered in the dry sow accommodation within a week of being inseminated. Commercial sow diet at the rate of 2.5 kg per sow was fed once daily at 07.45 h. Water was available from nipple drinkers during 2, one hour periods: from 09.00 and 17.00 h. An equal number of sows from each of 6 parity groups (second to seventh pregnancy, inclusive) were chosen at random from the available dry sows for inclusion in the study. Each individual sow was only observed during one of the nine observation days.

In order to limit the potential range of stereotyped behaviours to those that seem to be non-functional, observations did not commence until feeding and drink-

ing were completed. Some details of the experimental plan are shown in figure 3. On days when observations were made, four sows in turn were observed during eleven, 5 min sessions commencing at about 10.00h. After 7 sessions had been recorded for each sow, the observer quietly left the room, returning 20 min later to complete the remaining 4 sessions per sow. During each session, the observer continuously recorded the behaviour of one sow via a numeric code scheme in an OS-3 event recorder (Observational Systems Inc., Seattle, Washington). Each code represented an element of behaviour and consisted of 4 digits, which simultaneously described 3 aspects pertaining to the sow: her posture, action and the substrate upon which the action was performed. The OS-3 stored the sequence and the time duration (tenths of seconds) of each behaviour element, and in association with a host computer, a hard copy of the data was obtained. From these data, it was possible to identify precisely the existence of some order, organization or structure in a sequence of elements.

After removing from the data all behaviour which was non-stereotyped (e.g. resting, random movements, etc.) and stereotypes that appeared to be functional (e.g. predunging and urinating behaviours) or were performed rarely and for short durations (e.g., fighting), only 11 actions and 5 substrates were used by the sows in the performance of stereotyped behaviours. This is despite approximately 50 distinct actions being recorded and 9 different substrates being available to the sows. As described by Schmidt (1982) all "abnormal" behaviours were oral activities. In addition, since none of the six distinct postures (standing through to side lying) recorded for sows in the present study were associated to a significant degree with the performance of the stereotyped behaviours under investigation, data relating to posture will not be included. The actions and substrates utilized in the performance of "seemingly non-functional" stereotyped behaviours are defined as follows:

### Actions:

- 1) chewing/biting: continuous and rhythmical opening and closing of the mouth, including "biting".
- 2) sucking: apparent sucking and subtle jaw moving while the mouth was closed usually with the cheeks slightly involuted and the front of the lower lip drawn into a V-shape.
- 3) mouth stretching: continuous and rhythmical mouth opening and closing, however the emphasis is on stretching the lower jaw whilst open, in either the vertical, horizontal or both planes, rather than on chewing.
- 4) palate grinding: continuous and rhythmical opening and closing of the mouth, however a squeaking noise is emitted as the mouth is closed.
- 5) tongue flicking: the tongue appears to be moving rapidly about inside the mouth while the sow performs continuous and rhythmical chewing but without opening her mouth much.
- 6) licking: a continuous and rhythmical action in which the tongue protrudes from the mouth and is then withdrawn.
- 7) nibbling: continuous and rhythmical biting by the sow, using the extreme forepart of the mouth and usually in a gentle manner.

8) nosing: pushing against or along an object with the bridge of the snout.

9) rooting: pressing and scraping the rooting disk against a surface.

10) pressing with rooting disk: pressing the rooting disk against a surface without rooting actions.

11) pause: fixed rest periods when no action was performed, for example between bursts of chewing actions.

*Substrates:*

1) trough: the feed trough, which occupied the entire width of the sow stalls and was 15 cm deep.

2) floor: the concrete surface under the sow.

3) bars and frontpanel: all the vertical fixed physical environment except for the trough and tether chain.

4) tether chain: the chain which attached the sow to her stall.

5) nil: used when an action was performed without an external substrate; e.g. sham chewing.

The combination of an action and a substrate was termed an element. Since these elements were performed in an ordered sequence before being repeated, such an unique sequence of elements was called a cycle. A series of identical cycles therefore formed a bout of stereotyped behaviour.

The registration of an element, however, did not differentiate the actual components forming the element. For example, if a sow was standing (1) while biting (33) on a bar (4), her behaviour element was coded: 1433. Although the element may appear to be always performed in a fixed manner between cycles, there is no indication of this from the OS-3 record. The fixedness of components forming elements (e.g., the number and orientation of individual bites in an element such as chewing/biting) was assessed from video recordings made on other occasions for 20 sows performing stereotyped behaviours. Therefore, for the code 1433, it was

possible to detect the variance of behavioural parameters of these components: e.g., the number of bites in the time recorded, which bar and at which location on a bar, the position of the bar in the mouth and the duration of the element.

The relationships between the performance and the characteristics of stereotyped behaviours, and parity number, stage of pregnancy (which was closely correlated with time spent tethered in the current pregnancy) and time of day were examined.

## Results

Although 11 distinct stereotyped actions were recorded for all sows, on average, individual sows performed only 3.7 actions (range 1-7) on 2.0 substrates (range 1-4) in bouts of stereotyped behaviour (SB). These elements (combinations of actions and substrates) formed sequences which recurred in a cyclic manner. As a first approximation, the following criteria were used to define a stereotyped cycle:

— the cycle contained a fixed number of elements (e.g. ABCD);

— the elements occurred in the same order in successive cycles (e.g. ABCDABCDABCD...);

— the time duration of elements, and therefore of cycles, was relatively constant; and

— non-stereotyped elements did not occur between cycles.

A behaviour was considered to be stereotyped if it consisted of a sequence of such cycles. An inventory of these elements and their frequency of occurrence are shown in table 1. In 55 % of SB, all

Table 1. — Inventory of the actions performed and the substrates utilized by sows in stereotyped behaviours. (frequency of combinations shown). (n: 36 sows)

Actions	Substrates				
	nil	trough	floor	bars/ front panel	tether chain
chewing/biting	32	1	...	7	9
sucking	12	...	...	...	...
mouth stretching	9	...	...	...	...
palate grinding	2	...	...	...	...
tongue flicking	2	...	...	7	...
licking	2	3	8	...	2
sniffing	...	...	...	2	...
nosing	...	...	...	2	6
rooting	...	...	...	8	...
pressing with rooting disk	...	...	1	2	...
pause	21	...	...	...	...



sows to perform continually less FCR SB. Over the period of the day when observations were made, the mean proportion of time that sows performed FCR SB tended to increase (fig. 3). The performance of FSR SB, however, tended to increase over the first few sessions, when the FCR SB were performed at a relatively constant level, but in the last sessions of the day, both classes of SB were performed at increasing levels with time. The number of elements per cycle of FCR SB was lower, but not significantly lower, for sows in the day 1-20 pregnancy stage compared with sows in the remaining stages of pregnancy (1.9 and 2.4, respectively).

## Discussion

The quantitative approach taken in the present study to measure stereotypes in tethered sows revealed a quantifiable rigidity and flexibility in performance of these behaviours. For example, a sow might perform a FCR in a rigid manner: the sequence of cycles contains identically-ordered elements and components performed for characteristic durations and in specific orientations. Alternatively, she may be flexible in some of these aspects and perform FSR, transitory or loose stereotypes. The measurability of these cycles, elements and components is a prerequisite for the quantitative and qualitative analysis of cause and function of stereotypes. Once the causation and function have been satisfactorily described, adequate measures can be taken to improve welfare status of the animals involved, and by this, a better control over their production and reproduction.

The present study further showed that stereotypes in tethered sows are less fixed or stereotyped than has been suggested for other animals (Hediger, 1950; Morris, 1966; Ödberg, 1978). It is of interest to briefly speculate on this variability. However, one must not lose sight of the fact that the rigid, fixedness of the stereotypes was the most preponderant feature of the sows' behaviour. Compared with the situations in which very stereotyped behaviours have been described, the situation of the tethered sows differs from that described for studies reported in the literature in 2 important aspects: 1) the environment of tethered sows potentially contains an unexpected high level of "natural" variation, certainly more than presumably exists for wild-captured animals in the classic zoo environment. For example, while sows may remain continuously tethered in the same stall for 15 weeks, neighbouring sows may be removed or replaced, or the herdsman may perform other non-routine activities. In addition, the management of breeding sows involves movement to farrowing crates or weaning pens, and

interaction with piglets and boars in these environments. Exposure to this environmental variability may contribute to the variability observed for stereotypes in the present study. 2) By comparison with the present study, the studies described in the literature mostly concern wild or zoo animals in confinement. Sows are less likely to be disturbed in confinement than wild animals, since sows have been selected for, and are more adapted to, confinement. If we speculate that the eventual rigidity of a stereotype reflects the level of original or current conflict due to confinement (e.g. caging a wild bear or tethering a domestic sow), then it is probable that the degree of variability in the stereotype of a tethered sow will be greater than that of a wild animal. If this is true, then it would be worthwhile to relate the eventual degree of stereotype rigidity with the level of conflict experienced by sows, for instance at the beginning of confinement, demonstrated by the amount of conflict behaviour shown in that period. Integration of both these points may substantially improve our understanding of the biological significance of stereotyped behaviour.

Most authors consider that stereotypes develop in animals as a response to, and therefore are indicative of, a suboptimal environment (see reviews by Kiley-Worthington, 1977; Ödberg, 1978). Other authors such as Sambras (1981), Van Putten (1981) and Wiepkema (1982) extrapolate on this theme to suggest that stereotypes are ethological indicators of welfare status. However, the functions of the behaviours remain obscured through lack of quantitative data. Unlike behaviours such as feeding, drinking or comfort behaviours, which may also be performed in a stereotyped manner, the stereotypes described in the present study seemingly lacked function. Kiley-Worthington (1977) suggests that stereotypes may act as coping behaviours to buffer the level of incoming stimuli and thus maintain a balanced Umwelt under adverse conditions (Wiepkema, 1981) or frustration (Duncan and Wood-Gush, 1972, 1974). Alternatively, they may initially be learning behaviours, as suggested by Wolff (1968) and Thelen (1979), in subjects which fail to progress to the next level of behavioural development. Further, Garrigues *et al.* (1982) suggest that some stereotypes may serve as means of non-verbal communication, while Fentress (1976) argues that their repetitive nature will lead to fixation by which an overloading of the neural processing mechanisms may be avoided.

The observation that different classes of stereotyped behaviour exist may help in determining some aspects of their function. "Loose" stereotypes, for example, may be learning behaviours, in which the sow tests the suitability of new elements or sequences in order to establish, or

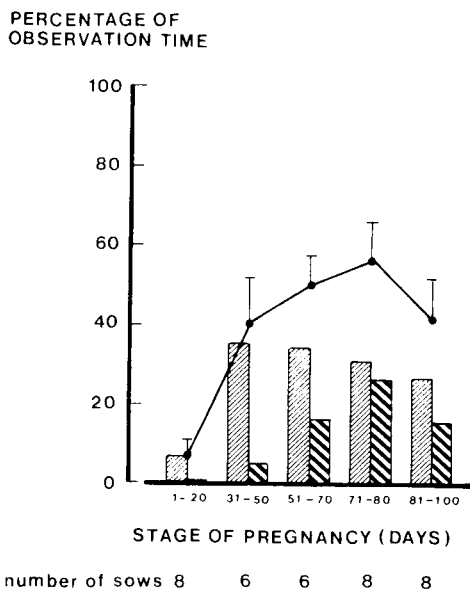
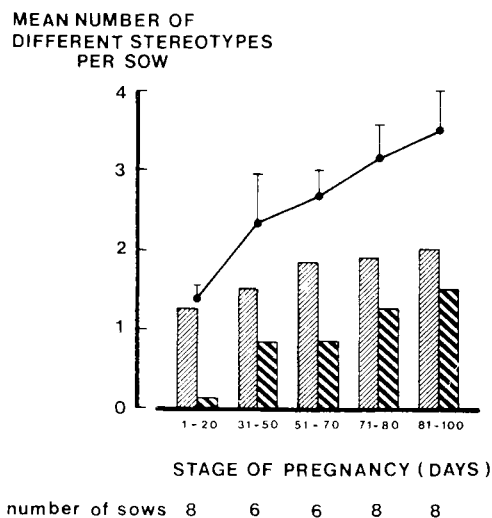


Fig. 1. — The number of different FCR and FSR stereotypes per sow (fine and heavy hatched columns) and the total of both classes (●) in relation to pregnancy stage. Vertical lines represent + S.E.

Fig. 2. — Percentage of observation time that sows performed FCR and FSR stereotypes (fine and heavy hatched columns) and the total of both classes (●) in relation to pregnancy stage. Vertical lines represent + S.E.

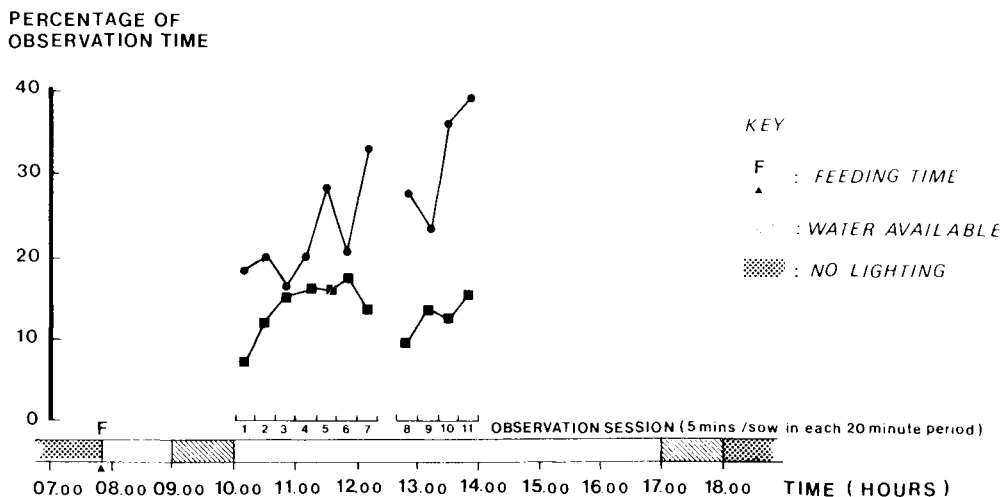


Fig. 3. — Changes in the percentage of time spent performing FCR (●) and FSR (■) stereotypes in relation to observation session, time of day and the availability of food, water and lighting.

improve the level of contingency over her environment (Mason, 1978). The performance of FSR, being a reduction of FCR stereotypes, by sows may be a strategy to conserve energy use and, or neural processes underlying these stereotypes. In the latter case, the performance of shorter-cycle routines may allow additional mental processes to occur simultaneously with the performance of stereotypes.

The high proportion of stereotyped behaviours and elements which were sham behaviours, that is, behaviours not directed at the sow's external environment, is an interesting finding. Substrates in the external environment may be less attractive (e.g. side bars) in that they are also accessible to neighbouring sows or may be included in the "personal" space of neighbours, whereas sham substrates (teeth, tongue, saliva, etc.) remain under the sole control of the individual. The interpretation of sham behaviours in relation to welfare status is as yet not possible, but further research may enable grading on the basis of the elements involved. Different elements or stereotyped cycles may have different functions, but until more data are gained, such general preferences may not be recognized. Unpublished data from observations in our stables suggest that chains are attractive substrates for tethered sows, and are utilized post-feeding but not pre-feeding. In addition, thin rather than heavy gauge chains are preferred for chewing, an observation which may explain the low proportion of tether chain stereotypes recorded at the study piggery.

In the present study, the number of stereotypes per sow, and their performance time, increased with time spent tethered. After day 80 of pregnancy, however, there was a negative asso-

ciation with the proportion of time that sows spent performing stereotyped behaviour, but not with the number of stereotypes per sow. It is feasible that the longer a sow remains confined in the same environment, the more adverse the situation becomes, producing a positive relationship therefore between the increased adversity and the number and duration of stereotypes performed. If this is so, this strongly supports the suggestion that stereotyped behaviours are indicative of negative welfare or negative environmental aspects. By seeking a balance with their adverse environment, sows increase the number of behaviours which are stereotyped.

In conclusion, through the use of quantitative measurement techniques, advances in the study of stereotyped behaviours in tethered sows can be achieved. Classical stereotyped behaviour, however, may only exist under real stereotyped conditions.

*CEC Roundtable on Welfare of confined sows, May 26-27, 1983, Rennes, France*

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### **Summary**

The behaviour of 36 Yorkshire × Netherlands Landrace sows was individually and continuously recorded during eleven, 5-min periods commencing at 10.00 h. The sows were neck tethered in partial stalls in the dry sow accommodation of a 250-sow, commercial herd. The recorded behaviour data were analysed for cycles of repetitive behaviour which appeared to be non-functional. Four classes of stereotyped behaviour were recognized: fixed complete routines, fixed subroutines, transitory and loose. They were performed during 25.8, 12.9, 4.9 and 2.7 % of the observation time, respectively. Some aspects of the two fixed-class stereotypes were found to be related to stage of pregnancy, that is, time spent tethered in the current pregnancy. The proportion of observation time that sows performed fixed stereotypes, and the number of fixed stereotypes, increased per sow with increase in stage of pregnancy, although in the former instance, less time was spent performing the stereotypes after day 80 of pregnancy. Considerable variability was recorded in the stereotypes in terms of use of particular elements, duration of element use, etc., suggesting that the classical definition of stereotyped behaviour may only hold in situations where the environment is totally unchanging. The use of a quantitative approach to measure stereotypes in tethered sows provides the basis for investigation of cause and function of these behaviours, and therefore the interpretation of stereotypes in terms of sow welfare.

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