Ministry of Agriculture
National Institute
of Animal Science

# 28th International Congress of the ISAE

Research Centre Foulum
Denmark
3-6 August 1994

## Proceedings

Programme and Abstracts

# NATIONAL INSTITUTE OF ANIMAL SCIENCE, DENMARK

**Research Centre Foulum, P.O. Box 39, DK-8830 Tjele**
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### Programme and Abstracts

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# Programme

**Wednesday, 3 August 1994**

0800 Registration

0900 Director Dr. Anton Hjortshøj Nielsen, National Institute of Animal Science, Research Centre Foulum

Dr. Harold Gonyou, President of ISAE

Director Peter Mollerup, Danish Animal Welfare Society

0930 David Wood-Gush Memorial Lecture by Dr. Ian Duncan: An Applied Ethologist looks at the Question "WHY"

1030 Coffee break

## Session 1: Stress in relation to production

*Chairman and co-chairman: Donald Broom and Mette Giersing*

Lectures

1100 Key lecture: Eberhard von Borell
Neuroendocrine integration of stress and significance of stress for the performance of farm animals. L1.1

1140 Forkman, B. (Sweden)
Predictability and controllability, is there any difference? L1.2

1200 Friend, T.H., Lay, Jr., D.C. and Bushong, D. (USA)
Gestation in group pens improved productivity and adaptation to farrowing crates. L1.3

1220 Marchant, J.N., Broom, D.M. and Rudd, A.R. (UK)
Heart rate responses of group-housed sows to agonistic social interactions. L1.4

1240 Rushen, J., de Passillé, A.M., Ladewig, J. and Foxcroft, G. (Canada)
Effects of stress on maternal behaviour in pigs. L1.5

1300 Lunch

1400 Poster session

**Session 1, continued**

| | | |
|---|---|---|
| 1500 | Košťál, Ľ. and Savory, C.J. (Slovakia)<br>Involvement of serotonergic mechanisms in control of oral stereotyped behaviour in restricted-fed broiler breeders. | L1.6 |
| 1520 | Oskina, I.N. (Russia)<br>Ontogenesis of endocrine function in silver foxes under domestication. | L1.7 |
| 1540 | Coffee break | |
| 1610 | Bakken, M. (Norway)<br>The effects of an improved man-animal relationship on the reproductive performance, sex-ratio in the litters and on cub behaviour ontogeny of farmed silver fox vixens (Vulpes vulpes). | L1.8 |
| 1630 | Harri, M. (Finland)<br>Heart rate of blue fox (Alopex lagopus) in normal and simulated situations of farm life. | L1.9 |
| 1650 | Discussion | |
| 1700 | Workshops | |
| 1900 | Welcome Party at Research Centre Foulum | |

Posters

| | |
|---|---|
| de Jonge, F.H., Soede, N.M., Parmentier, H.K., Bokkers, E.A.M. and van Eeken, R.F. (The Netherlands)<br>Oestrous behaviour, ovulation and immune response in swine: Effects of housing condition. | P1.1 |
| Ferlazzo, A., Fazio, E., Medica, G., Murania, C. and Piccione, G. (Italy)<br>Adrenal response to physical activity in training and competing sport horses. | P1.2 |
| Geverink, N.A. and Lambooy, E. (The Netherlands)<br>Treatment of slaughterpigs during lairage in relation to behaviour and skin damage. | P1.3 |
| Marchant, J.N. and Broom, D.M. (UK)<br>The effects of dry sow housing conditions on heart rate responses to feeding and suckling in farrowing crates. | P1.4 |

## Session 1, continued

| | |
|---|---|
| Metz-Stefanowska, J. and Keen, A. (The Netherlands)<br>The heart rate of cows during their experiences in the automatic milking system. | P1.5 |
| Mononen, J., Rekilä, T. and Harri, M. (Finland)<br>Open field behaviour is not related to brain weight in farmed silver fox (Vulpes vulpes). | P1.6 |
| Schouten, W.G.P., Schrama, J.W., van der Veen, F.G. and Helmond, F.A. (The Netherlands)<br>Adaptation to transport in young calves. | P1.7 |
| Taschke, A.C. and Fölsch, D.W. (Switzerland)<br>Effects of stress and pain on behaviour from electrically dehorning calves and anatomical aspects of the innervation of the horn bud. | P1.8 |
| Tuchscherer, M., Puppe, B. and Tuchscherer, A. (Germany)<br>Influence of farrowing on physiological parameters of newborn piglets. | P1.9 |
| von Borell, E.H., Johnson, R.W. and Anderson, L.L. (USA)<br>Behavioural and physiological response to central corticotropin-releasing hormone (CRH) in pigs. | P1.10 |
| Zanella, A.J., Körtel, A., Lauer, S., Henke, J., Unshelm, J., Goldberg, M. and Erhardt, W. (Germany)<br>The responses of pigs to castration with or without $CO_2/O_2$ anaesthesia. | P1.11 |

## Thursday, 4 August 1994

| | |
|---|---|
| 0900 | Excursion<br>- Lindholm Høje (a viking settlement)<br>- the North Sea Centre, Hirtshals<br>- the Jutland west coast |
| 1800 | Return to Viborg |

**Friday, 5 August 1994**

## Session 2: Response of animals to environmental enrichment

*Chairman and co-chairman: P. Le Neindre and C.C. Krohn*

Lectures

| | | |
|---|---|---|
| 0800 | Key speaker: Ruth Newberry (Canada)<br>Environmental enrichment: bringing nature to captivity. | L2.1 |
| 0840 | Jeppesen, L.L. (Denmark)<br>Environmental enrichment in fox farming. | L2.2 |
| 0900 | McGreevy, P.D., Cripps, P.J., French, N.P., Green, L.E. and Nicol, C.J. (UK)<br>Management factors associated with stereotypic and redirected behaviour in the thoroughbred horse. | L2.3 |
| 0920 | Herrmann, H.-J. (Germany)<br>The influence of two types of environmental enrichment on the behaviour of farmed red deer. | L2.4 |
| 0940 | Coffee break | |
| 1010 | Poster session | |
| 1030 | Vandenheede, M. and Bouissou, M.F. (Belgium)<br>Effects of an enriched environment on subsequent fear reactions of lambs and of their mothers. | L2.5 |
| 1050 | Haskell, M., Wemelsfelder, F., Mendl, M.T., Calvert, S. and Lawrence, A.B. (UK)<br>The effect of barren and enriched housing environments on the interactive behaviour of pigs. | L2.6 |
| 1110 | Nørgaard-Nielsen, G. and Lawson, L.G. (Denmark)<br>Effects of the rearing environment on the development of dustbathing and feather pecking in domestic chickens. | L2.7 |
| 1130 | Discussion | |
| 1140 | Annual General Meeting | |
| 1300 | Lunch | |

**Session 2, continued**

Posters

| | |
|---|---|
| Arey, D.S. and Edwards, S.A. (UK)<br>Behaviour and performance of sows and piglets in confined and non-confined farrowing systems. | P2.1 |
| Brouček, J., Mihina, Š., Tančin, V., Uhrinčať, M., Harcek, Ľ. and Hetényi, L. (Slovakia)<br>Effect of suckler cow housing on nutritive activities in calves. | P2.2 |
| Bubier, N.E. and Bradshaw, R.H. (UK)<br>A comparison of the time budgets of laying hens housed in battery and free range systems. | P2.3 |
| Horrell, I. and A'Ness, P. (UK)<br>Enrichment that satisfies specific behavioural needs in early-weaned pigs. | P2.4 |
| Illmann, G., Špinka, M. and Štětková, Z. (Czechia)<br>A comparison of nursing and suckling behaviour of group and individually housed sows and their litters. | P2.5 |
| Jeppesen, L.L. (Denmark)<br>Photographs of different housing systems in fox farming (ref. L2.2). | P2.6 |
| Kaliste-Korhonen, E., Eskola, S., Rekilä, T., Mononen, J. and Nevalainen, T. (Finland)<br>Wooden blocks as enrichmental tools for rats. | P2.7 |
| Koene, P. and Bestman, M. (The Netherlands)<br>Food presentation and stereotypies in brown bears. | P2.8 |
| Korhonen, H. and Niemelä, P. (Finland)<br>Study on factors affecting platform use in blue and silver foxes. | P2.9 |
| Krohn, C.C. (Denmark)<br>Effect of housing systems and level of whole milk on the motivation of movements in calves. | P2.10 |
| Pajor, E.A., Fraser, D. and Kramer, D.L. (Canada)<br>Parent-offspring conflict in pigs. | P2.11 |
| Prayitno, D.S. and Phillips, C.J.C. (UK)<br>Equating brightness perception of blue and red lights and length of line discrimination with hens by psychophysical tests. | P2.12 |

## Session 2, continued

Rekilä, T., Mononen, J. and Harri, M. (Finland)
Effect of cage environment on temperament and general activity in blue fox (Aalopex lagopus). P2.13

Sherwin, C.M. and Nicol, C.J. (UK)
Quantifying the motivation of laboratory mice to feed by imposing natural obstacles. P2.14

Simonsen, H.B. (Denmark)
Effect of tail docking and ontogeny of "tail in mouth" behaviour in fattening pigs. P2.15

Varlyakov, I.S. and Nenkov, P. (Bulgaria)
Behavior of buffalo calves in period birth - 6 months and mother-calf relationships. P2.16

Zanella, A.J., Brunner, P. and Unshelm, J. (Germany)
Brain opioid receptor density in pigs kept in groups, socially isolated and mixed during transport. P2.17

**Friday, 5 August 1994**

## Session 3: Individual variation in response patterns

*Chairman and co-chairman: Anne Marie de Passillé and H.B. Simonsen*

Lectures

| | | |
|---|---|---|
| 1400 | Key speaker: Per Jensen (Sweden)<br>Individual variation in behaviour - noise or functional strategies? | L3.1 |
| 1440 | Markel, A.L. (Russia)<br>Expression of genetic variability in stressful environment. | L3.2 |
| 1500 | Randle, H.D. (UK)<br>Individual variation in bovine behaviour. | L3.3 |
| 1520 | Kjær, J.B. (Denmark)<br>Genetic variation in feather pecking behaviour in chickens. | L3.4 |
| 1540 | Coffee break | |
| 1610 | Keeling, L. and Jensen, P. (Sweden)<br>Do feather pecking and cannibalistic hens have different personalities? | L3.5 |
| 1630 | Cooper, J.J. and Appleby, M.C. (UK)<br>Individual variation in nesting motivation and the incidence of floor eggs. | L3.6 |
| 1650 | Špinka, M. and Algers, B. (Czechia)<br>Udder massage after milk release in pigs: Does it keep milk production steady and equally allocated? | L3.7 |
| 1710 | Nielsen, B.L. and Lawrence, A.B. (UK)<br>Effect of individual housing on the feeding behaviour of growing pigs. | L3.8 |
| 1730 | Lund, A. and Simonsen, H.B. (Denmark)<br>Stimulus directed activities and aggression in two breeds of slaughter pigs. | L3.9 |
| 1750 | Discussion | |
| 2000 | Congress Dinner | |

**Session 3, continued**

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Posters

Bilčík, B., Mahrla, B. and Košťál, Ľ. (Slovakia)
Bidirectional selection for stereotyped pacing in Japanese Quail
(Coturnix coturnix japonica) P3.1

Eddison, J. (UK)
Consistency in daily feeding patterns amongst sows newly-introduced into a group. P3.2

Hansen, S.W., Houbak, B. and Damgaard, B.M. (Denmark)
Effects of early handling on later behaviour and stress response in farm mink. P3.3

Ivanov, I.D. and Djorbineva, M. (Bulgaria)
Influence of the type of higher nervous activity over grazing behaviour
in milking ewes. P3.4

Jung, J., Lidfors, L. and de Passillé, A.M. (Sweden)
Temporal patterning of natural suckling behaviour of dairy calves. P3.5

Nielsen, P.F. and Vestergaard, K. (Denmark)
Dustbathing behaviour and feather pecking in two lines of laying hen. P3.6

Pinheiro Machado F, L.C. and Tennessen, T. (Brazil)
Grazing behaviour of three breeds of cattle under free-ranging conditions. P3.7

Plyusnina, I.Z. (Russia)
Changes of daily rhythm of locomotor activity in silver foxes (Vulpes vulpes)
during domestication. P3.8

Sasaki, O., Uetake, K. and Minezawa, M. (Japan)
Effect of adrenocorticotropin administration on plasma cortisol and metabolites
levels in calves. P3.9

Schmitz, S. (Germany)
Effects of domestication on the ontogeny of social relationship in ducklings. P3.10

Spoolder, H.A.M., Burbridge, J.A., Lawrence, A.B., Simmins, P.H. and
Edwards, S.A. (UK)
The relationship between individual temperament and the development of
abnormal oral stereotypies in food restricted sows. P3.11

Uetake, K., Kudo, Y. and Okamoto, T. (Japan)
The measurability of psychological excitement in calves using an audiovisual
method. P3.12

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**Saturday, 6 August 1994**

## Session 4: Teaching/training in applied ethology

*Chairman and co-chairman: Jeffrey Rushen and Leif Lau Jeppesen*

This session consists of a panel of speakers who will each present a brief account of the state of the art in their regions.

| | | |
|---|---|---|
| 0830 | Waran, N.K. and Appleby, M. - UK/Ireland | L4.1 |
| 0845 | Simonsen, H.B. - Scandinavia | L4.2 |
| 0900 | Schouten, W.G.P. and Ödberg, F. - Benelux | L4.3 |
| 0915 | Buchenauer, D. and Unshelm, J. - West Central Europe | L4.4 |
| 0930 | Špinka, M. - East Central Europe | L4.5 |
| 0945 | Coffee break | |
| 1015 | Mench, J. - USA | L4.6 |
| 1030 | Le Neindre, P. - France | L4.7 |
| 1045 | Verga, M. - Mediterranea | L4.8 |
| 1100 | Discussion | |
| 1130 | Lunch | |

Posters

Varlyakov, I.S. (Bulgaria)
Ethology in Bulgarian agricultural education. P4.1

**Saturday, 6 August 1994**

## Session 5: Free papers

*Chairman and co-chairman: Klaus Vestergaard and Anders Lund*

Lectures

| | | |
|---|---|---|
| 1230 | de Passillé, A.M., Rushen, J. and Martin, F. (Canada)<br>Interpreting the open-field test in calves: a factor analysis. | L5.1 |
| 1250 | Koene, P. and Urff, E. (The Netherlands)<br>Expression of frustration in a double runway by domestic hens. | L5.2 |
| 1310 | Manser, C.E. and Broom, D.M. (UK)<br>The use of a novel operant test to determine the strength of preference for flooring in laboratory rats. | L5.3 |
| 1330 | Widowski, T.M. and Duncan, I.J.H. (Canada)<br>Do domestic fowl form groups when resources are unlimited? | L5.4 |
| 1350 | Spensley, J.C., Wathes, C.M., Waran, N.K. and Lines, J. (UK)<br>Behavioural and physiological responses of piglets to naturally occurring sounds. | L5.5 |
| 1410 | Coffee break | |
| 1440 | Broom, D.M., Mendl, M.T. and Marchant, J.N. (UK)<br>Dry sow welfare throughout life in one of three housing conditions. | L5.6 |
| 1500 | Boivin, X. and Braastad, B.O. (Norway)<br>Influence of gentling at early weaning on the goat kid's later reaction to human presence and handling. | L5.7 |
| 1520 | Youssef, M.Y.I., Phillips, C.J.C and Metwally, M. (UK)<br>The effect of pre-weaning experience and presence of adult ewes on grazing behaviour of weaned lambs. | L5.8 |
| 1540 | Rind, M.I., Phillips, C.J.C. and Bassyouni, M.I. (UK)<br>The effect of frequency of feeding and disturbance to the feeding regime on the ingestive behaviour and productivity of dairy cows. | L5.9 |
| 1600 | Discussion | |
| 1620 | Closing of the congress | |

**Session 5, continued**

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Posters

Brouček, J., Mihina, Š., Uhrinčaľ, M., Tongeľ, P., Tančin, V. and
Hetényi, L. (Slovakia)
Adaptation of calves to drinking feeder. P5.1

Cagnetta, P., Vonghia, G. and Melodia, L. (Italy)
The influence of man's assistance at parturition on the neonatal behaviour
of Altamurana breed-population lambs. P5.2

Cooper, J.J. and Nicol, C.J. (UK)
The response of wild-caught and laboratory-bred bank voles (Clethrionymus
glareolus) to the cage environment. P5.3

Dybkjær, L., Møller, F., Giersing, A.M.H. and Pedersen, L.J. (Denmark)
Piglet mortality in a multi-suckling system: Identification of risk factors
with special emphasis on maternal behaviour. P5.4

Exner, C. and Unshelm, J. (Germany)
Influences of enclosures on the behaviour of cats of prey. P5.5

Hawthorne, A., Jackson, T. and Horrocks, L. (UK)
Homing success of labrador puppies following a puppy socialisation programme. P5.6

Heidenberger, E. (Germany)
Behaviour problems of cats - statements of their owners. P5.7

Hvozdík, A. (Slovakia)
Ethological study of maternal behaviour in pigs. P5.8

Jensen, H.F. (Denmark)
Low-stress outdoor system for pigs. P5.9

Jensen, M.B. (Denmark)
The behaviour of tethered and loose housed calves, and the influence of age
at tethering on behavioural responses to tethering. P5.10

Jones, R. and Nicol, C.J. (UK)
The importance to mice of having control over lighting within their environment. P5.11

Kennedy, M.J. and Broom, D.M. (UK)
A method of mixing gilts and sows which reduces aggression experienced by gilts. P5.12

Koene, P. and Urff, E. (The Netherlands)
Time-budgets of Zoo mammals in relation to housing. P5.13

**Session 5, continued**

Lindberg, A.C. and Nicol, C.J. (UK)
Group size preferences in laying hens. P5.14

Lisborg, L. and Vestergaard, K.S. (Denmark)
A possible method of preventing feather pecking in pheasants (Phasianus colchicus). P5.15

Mattiello, S., Bianchi, L., Canali, E. and Verga, M. (Italy)
Suckling behaviour of fallow deer in enclosure. P5.16

Mendl, M., Done, E. and Wheatley, S. (UK)
Feeding competition in pigs: individuals and the ideal free distribution. P5.17

Menke, C., Waiblinger, S. and Fölsch, D.W. (Switzerland)
Social behaviour of dairy cows in loose housing - A result of internal and external influencing factors. P5.18

Morici, R., Verga, M. and Ferrante, V. (Italy)
Kennel dog behaviour before and after adoption. P5.19

Morris, I.D. and Phillips, C.J.C. (UK)
An investigation into the walking behaviour of dairy cows on four different flooring surfaces. P5.20

Nowak, R., Lévy, F., Orgeur, P., Piketty, V., Porter, R.H. and Vénier, G. (France)
Lambs' attachment to their mother: Importance of the first sucking bouts. P5.21

Paul, E. (UK)
The representation of animals on children's television. P5.22

Podberscek, A.L. (UK)
Tales of the English Cocker Spaniel: Preliminary findings on aggressive behaviour. P5.23

Rind, M.I., Phillips, C.J.C. and Abdulla, H.S.A. (UK)
The effect of grazing dominant and subordinate cows together or apart and offering a hay supplement, on the ingestive behaviour and milk production of dairy cows. P5.24

Rudd, A., Broom, D. and Simmins, H. (UK)
Behavioural comparisons between farrowing crates and group farrowing systems. P5.25

Rutter, S.M., Beresford, N.A. and Roberts, G. (UK)
Use of a satellite tracking system to record the foraging behaviour of hill sheep. P5.26

Trapezov, O.V. (Russia)
Selection for domestic behaviour induced the arisal *de novo* of the new colour phases in the mink. P5.27

Voipio, H.-M., Björk, E., Hakumäki, M. and Nevalainen, T. (Finland)
Immediate reactions of laboratory rats to sound stimuli. P5.28

# AN APPLIED ETHOLOGIST LOOKS AT THE QUESTION "WHY?"

Ian J.H. Duncan, Department of Animal and Poultry Science,
University of Guelph, Guelph, Ontario, Canada N1G 2W1

According to Tinbergen (1963), the question "Why does an animal behave as it does?" can be answered in terms of ontogeny, function, phylogeny and causation. In this paper, I briefly review the achievements of applied ethology according to these four approaches and make an attempt to predict what the most fruitful avenues of research might be in the future.

## ONTOGENY

Applied ethology has a good record of ontogenic studies. Presumably in the early days of applied ethology, ontogenic studies of behaviour were viewed as a natural extension of the occupational concern of animal productionists with growth and development. Research on behavioural ontogeny has included studies on the development of social organization (e.g. Guhl, 1958; Rushen, 1982), the development of feeding behaviour (e.g. Fraser, 1978), the development of reproductive behaviour (e.g. Rietveld-Piepers, 1989) and even the development of abnormal behaviour (e.g. Blokhuis and Arkes, 1984; Cronin, 1985). In general, I think that developmental studies have received about the right amount of attention from applied ethologists and it is to be hoped that this will continue in the future.

## FUNCTION

Although mainstream ethology has always been interested in function (e.g. Lack, 1947; Curio, 1973), this approach received a tremendous boost with the development and application of optimality theory in the late 1970s and 1980s (e.g. Krebs and Davies, 1987). These developments were intellectually stimulating and very seductive for students of ethology to the extent that the best brains in the science adopted this approach. Throughout this period the topics of causation and motivation received much less attention than they were due; mainstream ethology was unbalanced. Applied ethologists ran into problems which could only be solved by advancements in causation and motivation theory and they themselves were forced into tackling these problems (e.g. Hughes and Duncan, 1988; Jensen and Toates, 1993) with some help from a few mainstream ethologists who had continued to study causation (e.g. Hogan, 1980; Houston, 1983; Toates, 1986).

There is debate as to whether or not this functional approach can ever really answer the question "Why?" (e.g. Pierce and Ollason, 1987). As Hinde (1982) has pointed out, proof of function (in the strict sense of the term and in contrast to 'beneficial consequence') is extremely difficult. Notwithstanding these criticisms, it must be admitted that this approach has been tremendously fertile in generating hypotheses, which predict behaviour sequences, which can be compared to actual behaviour, and any discrepancies can be used to reformulate the initial hypotheses. Moreover, a recent paper by Curio (1994) has emphasized the value of combining functional and causal approaches.

However, when it comes to applied ethology, I think that the functional approach has much less to offer. The functional approach is based on the thesis that natural selection has shaped behaviour so that behaviour which maximizes fitness will exist in nature. Can we assume that species that have been subjected to unnatural selection for 5,000-12,000 years will behave in the same way? Will a broiler forage optimally? Will an animal selected for fighting ability behave according to "hawk/dove" predictions"? There may be occasions when asking functional questions may be illuminating for applied ethologists - but I would caution against a large move in this direction. In any case, there are signs that mainstream ethology is regaining a balanced approach, and it would be ironic if applied ethology followed an outmoded fashion.

## PHYLOGENY

I am going to cheat slightly with regard to this category, which is concerned with the evolution of behaviour, and consider all aspects of behavioural genetics. The process of domestication itself should be of interest to applied ethologists. It has received some attention in the past (e.g. Mason, 1984) but two recent publications which emphasize the evolutionary nature of the process, in contrast to the 'interfering' innovations of human beings, might revolutionize the way it is viewed (Budiansky, 1992; Morey, 1994). A better understanding of domestication is essential, particularly with the stream of suggestions for 'using' other species.

A technological innovation, viz. genetic fingerprinting, holds great promise for future studies in applied ethology. The ancestry of domestic species may be investigated (e.g. Siegel et al., 1992) and paternity of offspring can be verified and compared to mating behaviour in large flocks and herds (e.g. Jones and Mench, 1991).

Selection for desirable and against undesirable behavioural traits has been flirted with in the past (e.g. Siegel, 1965). A recent study which shows great promise involves selection against feather pecking in laying hens (Craig and Muir, 1991, 1993). If the early promise is fulfilled and the technique adopted by primary breeding companies, then it should quickly obviate the need for de-beaking.

## CAUSATION

As might be expected, there has always been great interest from applied ethologists in the proximate factors controlling behaviour. David Wood-Gush's classic series of studies on the control and expression of nesting behaviour in domestic fowl is an excellent example (e.g. Wood-Gush, 1975). With the increasing demand for answers to animal welfare questions, causal and motivational studies have assumed even greater importance. Once again, I think that applied ethology has a good record with regard to this approach and there are so many good examples in recent years that it would be invidious to select some for mention. Instead, I would rather concentrate on areas where I believe there is potential for great progress in the future.

Undoubtedly, an integration of behavioural and physiological studies incorporating the latest techniques of neurphysiology (e.g. Kandel and Schwartz, 1985; Horn, 1990) will pay dividends. The advances made in recent years in getting to the root of stereotypies is impressive and has used a variety of behavioural and physiological techniques (e.g. Ladewig et al., 1993). However, there are still problems in applied ethology that will yield to a classical behavioural approach and it should not be thought that a move to physiology is necessary to solve every problem (e.g. Panning, 1994).

There is a desperate need for more studies on states of suffering in domestic animals, states such as fear, frustration, pain and (perhaps most urgent of all) boredom. We should also be considering studies of positive emotional states since there is an emerging view that welfare should be more than simply the absence of states of suffering.

The topic of motivation has received some attention from applied ethologists (e.g. Hughes and Duncan, 1988; Jensen and Toates, 1993). However, there are still many unanswered questions. These might yield to studies which try to integrate the techniques suggested by McFarland and colleagues (e.g. McFarland and Sibly, 1975) with some of the modern models of motivation.

Finally, I believe that studies of the cognitive abilities of domestic animals will pay dividends (e.g. Cerbulis, 1994; Shreyer, 1994) since I would argue that animal welfare depends ultimately on what animals feel and this is a rudimentary cognitive process (Duncan, 1993).

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# Session 1

## Stress in relation to production

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# NEUROENDOCRINE INTEGRATION OF STRESS AND SIGNIFICANCE OF STRESS FOR THE PERFORMANCE OF FARM ANIMALS

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## 1. INTRODUCTION

Stress is a broad term which implies a threat to which the body needs to adjust. Stress may be classified as physical, psychological, or interoceptive in nature, but usually contains components of all three classifications. For example, the stress of illness may begin as internal changes but the interpretation of the illness will influence ones physical and psychological condition. The adjustment to stress induces a broad range of neuroendocrine, physiological and behavioral changes to allow for a rapid recovery or adaptation to the change.

Stress in large domestic animals has mainly concentrated on descriptive behavioral studies using indicators presumed to be related to stress (abnormal behaviors), and the pituitary-adrenocortical release of ACTH and corticosteroids. Also, studies on the neuroendocrine system, or immune system have often been done in an isolated manner with a reductionist approach as to cause and effect at a cellular or neural level. Recent research has indicated the importance of studying all these systems in an integrated way. Such studies have shown that the neuroendocrine system and immune system communicate with each other and are ultimately influenced by the individual perception of the animal. Furthermore, behavioral changes also are correlated with the response of the neuroendocrine system or the immune system, especially in response to stress.

The following paper briefly discusses the integration of stress and related responses, and whether or not these responses are of significant magnitude to have deleterious effects on performance, health and well-being of farm animals.

## 2. PSYCHONEUROENDOCRINE INTEGRATION OF STRESS

Research during the past few years suggests that the endocrine, immune, and central nervous systems interact and respond to stressful stimuli in a coordinated manner. The presence of hormones, neurotransmitters, and receptors common to all three systems supports the view that bidirectional communication exists between the neuroendocrine and immune systems and between the immune and central nervous systems (DeSouza, 1993). The nervous system interprets signals which reflect impending stress, and cognitive brain centers such as the cerebral cortex perceive external threats and act to initiate response mechanisms. Also, non-cognitive centers of the brain and, in some cases, other tissues throughout the body detect adverse changes within the body that may pose problems related to normal functioning of various biological systems.

One hormone has appeared to be a central key to many of the observed effects during stress: corticotropin-releasing hormone (CRH). Since the isolation and characterization of CRH by Vale et al. (1981), it is becoming evident that this neuropeptide plays a key role in the activation of endocrine, physiological, neurochemical, and behavioral responses typically observed in stress situations (reviewed by Dunn and Berridge, 1990). CRH is synthesized in the hypothalamus, especially in neurons of the paraventricular nucleus. In response to stressful stimuli, CRH is released from the median eminence, and transported by the hypophyseal portal blood system to the anterior pituitary, where it increases the synthesis and secretion of ACTH. CRH not only activates the hypothalamic-pituitary-adrenal axis, it also has a neurotransmitter function in the brain. For example, the intracerebroventricular (ICV) administration of CRH activates the sympathetic and adrenomedullary system, resulting in elevations of plasma catecholamine concentrations and increases arterial pressure and heart rate (Fisher et al., 1982; Brown and Fisher, 1985). CRH receptors have been identified in several brain regions including areas involved in cognitive function as well as in limbic areas involved in emotion (De Souza et al., 1991). The limbic system of the brain includes structures like the hypothalamus, thalamic nuclei, the amygdala and hippocampus. Henry and Stephens (1977) hypothesized that the amygdala and hippocampus are involved in different coping processes which enable the animal to respond to threatening and frustrating stimuli. According to their theory, unpredictable or uncontrollable stimuli will activate the hippocampal pathway and the hypothalamo-pituitary-adrenocortical system leading to depression of behavior. The ability to adjust to some stressors (controllability), however, seems to be under the control of the amygdala through activation of the sympathetic nervous system and prepares the animal for fight and flight situations. The activation of one or the other system depends on many factors like genetic disposition, early experience, cognitive ability and on the stressor quality and quantity (Ladewig, 1994).

## 3. IMPACT OF STRESS ON PRODUCTION PERFORMANCE

### Stress and Health

The normal function of the neuroendocrine, and immune systems is to maintain homeostasis and health of an organism. It is therefore logical to theorize that alteration in one system may lead to disease. Correlational evidence supports a relationship between stress and disease susceptibility but does not necessarily provide a direct link between stress or mental state and the immune system. Evidence for the direct link can be found in controlled studies with humans which have indicated that depression, or major life stress can influence the immune system (Kiecolt-Glaser et al., 1984).

Studies performed in rats have indicated that compound stressors containing both physical and psychological components have successfully been used to investigate the link between stress, fear/anxiety and immune modulation. Those studies have demonstrated robust changes in several immune organs and cell types. For example, suppression of T-cell and B-cell blastogenesis, suppression of natural killer cell activity, and suppression of cytokine production (IL-2 and IFN-y) (Sonnenfeld et al., 1992). These studies indicate that changes in the CNS (caused by stress) can have profound affects on the immune system. The cytokine interleukin-1 (IL-1) is considered a key mediator of the immunological and pathological responses to stress and infections. IL-1 not only induce fever and reduce food intake, it also stimulates the hypothalamo-pituitary-adrenocortical axis and inhibits the hypothalamo-pituitary-gonadal axis. Evidence for effects of the immune system on the CNS in the bidirectional exchange are scant. One study in rats has demonstrated that during an active immune response (immunization with sheep red blood cells) animals were able to learn faster (Lysle et al., 1991).

Studies on disease resistance of domestic livestock has mainly concentrated on in vitro studies or pharmacological treatments of animals with stress hormones. The immunosuppressive and catabolic nature of glucocorticoids has been demonstrated in several studies (Westly and Kelley, 1984; Roth and Flaming, 1990). As opposed to cattle, the pig's immune system seems to be relatively resistant to chronic treatments of glucocorticoids (Brownlie et al., 1978; von Borell et al., 1992). However, the catabolic effect of corticosteroids is significant. Chronic treatment of grower pigs with corticosteroids resulted in a substantial suppression of animal growth (von Borell et al., 1992). Our recent research has demonstrated the ability of centrally administered CRH to suppress T-lymphocyte blastogenesis in pigs (Johnson et al., 1994). T-lymphocytes are key cells in the activation of other lymphocytes as well as protection from viral infection and tumors. Central administration of CRH at doses known to alter behavior also suppresses natural killer cell activity, a fast acting, and stress sensitive first defense mechanism against viral infections (Irvin et al., 1990). Exogenously applied ACTH to pigs has been demonstrated to stimulate natural killer cell activity (McGlone et al., 1991), although one might expect immunosuppression due to glucocorticoid stimulation. We have to consider that both, physical and psychological stressors are potent modulators of the immune system, however, the physical characteristics of the aversive stimuli are not as crucial as the subtle procedural factors which modify the ways the animal perceives the situation (Mormède et al., 1988).

Resistance to specific diseases may not only depend on antibody production. For example in chickens, resistance to Newcastle disease or Marek' disease is depressed in conditions of social stress (Gross and Colmano, 1965), while resistance to S. aureus, E. coli and parasite infestation increases (Gross, 1967).

## Stress and Reproduction

Reproductive processes are under neuroendocrine control and stress is known to influence these processes. Glucocorticosteroids are known to interact with reproductive hormones from a very early stage during the development of the neuroendocrine system. Several studies demonstrated that perinatal stress (during sensitive periods) may demasculinize male offspring and delay puberty in females (Ward, 1984).

Sexual behavior depends on the production of sexual hormones and may be therefore suppressed when stressors interfere with sexual hormones. Social stress plays an important role in the suppression of sexual activities. Sexual activities of low ranking animals are typically suppressed when dominant animals are present. For example, sexual inactivity in low ranking males is linked to a low production of testosterone, which might be caused by a glucocorticoid-induced testosterone suppression, a suppressed release of GnRH in the hypothalamus, or a reduced LH-sensitivity of the testosterone producing cells (Sapolsky, 1987). Low social ranking may also influence sexual behavior of female animals. Stress may interfere with the preovulatory LH-secretion leading to ovulation failure and lack of estrus behavior. Stress does not always influence reproductive performance negatively. Acute stress has been demonstrated to increase LH secretion through elevation of serum progesterone and corticosterone in estrogen-primed female rats (Brann and Mahesh, 1991). This stimulatory effect of acute stress (i.e., mixing of unfamiliar gilts) is used for estrus synchronization and induction of early puberty in gilts (Paterson and Pearce, 1989). The development and differentiation of the uterus during the first days of pregnancy strongly depends on the function of pituitary hormones, whereas these hormones are mainly produced locally at a later stage of pregnancy. It is therefore evident that there is a stress-sensitive period during the very first days of pregnancy, especially until implantation of the fetus. Animals are generally insensitive to stressors during late pregnancy.

Research conducted during the last years has examined the possibility that endogenous opioid peptides inhibit the secretion of gonadotropins during anovulatory periods. The release of ß-endorphin from the pituitary is associated with activation of the hypothalamo-pituitary-adrenal axis by various stressors. There is now evidence that the endogenous opioid system regulate the secretion of LH during periods of anestrus in pigs and cattle (Britt et al., 1993). Petherick et al. (1993) demonstrated that environmental stressors induce opiod-mediated inhibition of oxytocin secretion and parturition in sows. Comparisons between sows housed in farrowing crates or pens indicate that farrowing intervals were shorter when sows were allocated more space for locomotion in their farrowing environment (Biensen et al., 1994). In addition, it is well known that catecholamines and opioids reduce oxytocin production during lactation and may negatively influence milk ejection and yield (Schams et al., 1983).

Farm animals may experience stressful situations of both acute and chronic nature. So far, there is some evidence that acute stressors may impair reproductive function during critical periods of the reproductive cycle, early pregnancy and lactation. However, there is little evidence that housing conditions per se chronically impair reproductive function. It is therefore questionable if a constant (housing-) condition is perceived as chronically stressful by the individual. The physiological stress response depends on the individual psychological perception of the situation and emotional involvement. It is therefore more likely that some housing factors are intermittently perceived as stressful (by some individuals), depending on the intensity, duration, frequency and novelty aspect of the stimulus. Housing effects on reproductive performance of farm animals are mainly attributed to hygienic factors and specific management procedures (i.e., behavior and attitute of the manager toward his animals).

## Stress, Behavior and Welfare

Stress in general is believed to be characterized by the occurrence of conflict behavior (i.e., displacement and redirected behavior), destructive or injurious behavior, stereotypic behavior (monotonous and seemingly purposeless repetitive activities) and behavioral inactivity (lethargy). As for the physiological measurements, the occurrence and interpretation of these behaviors are not consistent among studies. For example, in the case of stereotypic behaviors, not all animals within the population perform stereotypies in the same environment (von Borell and Hurnik, 1991a), and this behavior has been interpreted as a result of experienced frustration (Appleby, 1991), or as a coping response that involves opioids (Cronin, 1985) and brain dopamine metabolites (von Borell and Hurnik, 1991b). The current understanding is that stereotypies are not simple coping responses, and that there is some evidence from the underlying physiology that some stereotyping animals are stressed (Duncan et al., 1993).

With the exception of destructive behaviors (i.e., self-mutilation, feather-pecking, tail-biting), studies on the direct relationship between behavior in stress situations and production performance are rare. In most cases, those relationships are correlational and do not provide evidence for a direct link between behavior and performance (i.e., von Borell and Hurnik, 1990). In the case of stereotypic behavior there is some evidence that increased behavioral activity in the form of stereotypies cost energy as measured by increased metabolic rate in these sows (Cronin et al., 1986). On the other hand, Wiepkema et al. (1987) reported that individual veal calves showing stereotypic behavior had a lower incidence of abomasal ulceration. The impact of social stress on production performance is, however, unquestionable and often underestimated. As an example, mixing of unfamiliar animals and crowding are potent stressors, causing substantial growth depression (Douglas et al., 1993, Moore et al., 1994). The behavior and attitude of the stockperson is another underestimated and important factor for the performance and well-being of farm animals as demonstrated by Hemsworth and Seabrook in numerous studies.

It would be naive to evaluate and explain stress by observing or identifying one single irregular behavioral phenomena or physiological alteration (Dantzer and Mormède, 1983, Ladewig and von Borell, 1988). Considering that welfare is characterized through the absence of suffering, and health through the absence of sickness we cannot expect a state of absolute welfare (or health). This means that stress, suffering or sickness cannot be identified by observing or measuring single symptoms. As a consequence, the evaluation of a possible stress situation under various production -and management systems should include multiple criteria, namely ethological, physiological, health, production, and reproduction criteria.

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# Predictability and controllability, is there any difference?

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The concepts of controllability and predictability have been central to stress research ever since Weiss (1971). In his studies he showed that a rat that receives a signalled chock will have less gastrointestinal wounds than one that receives the same amount of chock without any signal. The same was later shown to hold true for situations in which the animal could control the chock through fleeing or through an operant response.

I will attempt to show that the difference between controllability and predictability is only a matter of degree, not of kind.

The reason for why predictability reduces stress is not completely clear. Even though there in some species, e.g. the rat, may be an analgesic effect which actually diminishes the perceived force of the chock, this does not explain the function of this preference nor why animals generally prefer predictable events. In studies on observing response ($R_0$) animals of the species studied (mainly rats, pigeons and macaques) preferred not only a signalled chock over a non signalled chock but also signalled food over non signalled food and signalled water over non signalled water. The number of observing responses performed was also strongest for the most unpredictable situations.

In a natural situation, i.e. one to which the animal is adapted, a predictable event is often a controllable one, the animal may for example avoid the scent of a predator, fatten itself in response to a predictable food shortage etc. If the situation is unpredictable the animal has to maintain a higher level of preparedness than otherwise, i.e. use a higher level of stress hormones. In fact, stress may be seen as a preparation to avoid or regulate a situation that is perceived as being dangerous by the animal. The more dangerous the situation is perceived to be, the stronger would the stress be.

If the situation is predictable the animal knows (in an evolutionary sense) that its chances of controlling the situation are higher and it is therefor less stressed. This line of reasoning is supported by the results of several studies done on rats and pigeons that show that they prefer a situation in which they may choose several times before reaching the reinforcer (in most studies food), to either being forced to choose a given alternative or to have only one possibility to choose. (The choice made by the animals did not affect the probability of obtaining the reinforcer.)

If the animals are managing their situation through their behaviour in a controllable situation and through a psychological/physiological response in a predictable situation then the difference between predictability and controllability ends up being a quantitative difference rather than a qualitative one, i.e. two ends of a continuum. The completely predictable would be the *internally controllable* whereas what has traditionally been called controllable would be the *externally controllable.*

# GESTATION IN GROUP PENS IMPROVED PRODUCTIVITY AND ADAPTATION TO FARROWING CRATES.

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DeKalb gilts were randomly assigned to either an individual crate ($n = 38$) or a group pen ($n = 39$) breeding and gestation system for three parities. The group pens housed three to five females and were bedded with straw inside (3.7 x 3.1 m) and had a concrete outside dunging area (2.4 x 3.1 m). Two to three days prior to their expected farrowing dates the sows were placed in "finger" type farrowing crates. Trained observers recorded the incidence of excitement displays (movement of one hindleg, vocalizations, rooting, barbiting, pushing bars, chomping, chewing, pawing, climbing) and the duration and incidence of body positions (standing, kneeling, sitting and lying) for the first 30 min after the females were placed in the farrowing crates. More crated sows were culled than penned sows (22 vs. 9, $P < .006$) because of failure to breed or premature farrowing while housed in the gestation treatment. The incidence of excitement displays increased in the crated sows and decreased in the penned sows with increasing parity ($P < .04$), with the crated sows having more excitement displays overall ($234 \pm 20$ vs. $183 \pm 15$, $P < .02$). The more excited crated subjects also spent fewer minutes lying ($9.7 \pm 1.0$ vs. $12.4 \pm .79$, $P < .03$). Movement of one hindleg ($P < .0001$) and vocalizations ($P < .05$) decreased for both treatments with increasing parity. Crated subjects had fewer live born piglets ($8.9 \pm .32$ vs. $9.9 \pm .25$, $P < .01$), but piglets born dead, crushing and other causes of piglet mortality were not influenced by treatments ($P > .20$). These data indicate that pen breeding and gestation can increase some aspects of productivity and can reduce the excitement displayed by sows after being placed in farrowing crates when compared to sows gestating in a crate system.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

NATIONAL INSTITUTE OF ANIMAL SCIENCE

# HEART RATE RESPONSES OF GROUP-HOUSED SOWS TO AGONISTIC SOCIAL INTERACTIONS.

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Many commercial producers report inter-sow aggression to be a major problem when keeping sows in group housing systems. Aggression appears to be especially prevalent during mixing of sows and at time of feeding and can have a severe effect on welfare and production. The aim of this experiment was to determine the effect of different types of agonistic social interaction on sows using heart rate as an indicator of the short-term stress response. The heart rates of 9 Large White X Landrace sows housed in a large group with an electronic sow feeder system, were monitored using a Polar SportTester during social interactions at the feeder entrance. Interactions were categorised into: 1) interactions involving physical contact, 2) non-physical interactions involving visual threat only. Each encounter outcome was also recorded as win or loss, giving a total of four possible encounter types. The behavioural and graphical data were analysed to give the peak heart rate value during the encounter and also the change in heart rate from the average value prior to the encounter to the peak value during the encounter. Statistical comparisons were carried out using a Wilcoxon signed-rank test. Sows involved in physical encounters had higher peak heart rate values and change in heart rate values (140.4 beats per minute [b.p.m.], +63.5 b.p.m.) compared with sows involved in threat encounters (110.0 b.p.m, +35.8 b.p.m. - both $p<0.005$). Also, sows which lost an encounter tended to have higher heart rates (132.7 b.p.m., +58.1 b.p.m) than sows which won an encounter (114.0 b.p.m., +41.8 b.p.m. - both $p<0.1$). When analysed in terms of encounter type, sows which lost a physical encounter had significantly higher heart rates (150.2 b.p.m., +75.5 b.p.m. - both $p<0.001$) than sows involved in the other three encounter types. The results show that all sows involved in agonistic encounters of any type show an acute response indicated by a rise in heart rate. However, the rise is greatest for sows which lose a physical encounter. Although the responses of single agonistic interactions are very transient, if such encounters are persistent and there is little opportunity of avoidance, the stress response may become chronic and the welfare of the individual may be substantially affected. In group housing systems that employ competitive group feeding, subordinate sows will either be subjected to high levels of aggression or may not gain sufficient ration and thus, their welfare may be particularly poor.

# EFFECTS OF STRESS ON MATERNAL BEHAVIOUR IN PIGS

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Little is known of how stress affects maternal behaviour in pigs. Many nursings are unsuccesful and piglets get no milk. Stress is often considered the cause, but there is little evidence. We examined if lactating sows in novel environments have more unsuccessful nursings. Six sows (3-14d postpartum) were either placed with their piglets for 2h in a different farrowing pen, or were driven into the new pen and immediately returned to their own (control). All sows were subject to both treatments over two days, with the order of treatments being balanced. Nursings were recorded as successful if there was increased rate of grunting by the sow and rapid sucking by the piglets. Blood was sampled every 10 min and assayed for ACTH and cortisol. Placing the sow in the novel pen did not significantly increase the latency to the first nursing attempt, but the proportion of nursings that failed was much higher (51% versus 8% $p<.01$), and the latency to the first successful nursing was longer than in the home pen($p<.01$). Cortisol and ACTH concentrations were not increased in the novel environment ($p>0.10$), and neither cortisol nor ACTH were higher before an unsuccessful nursing than before a successful one ($p>0.10$). An unfamiliar environment increases the chance that a nursing will fail to lead to milk ejection, thus demonstrating that some unsuccessful nursings result from stress, but the effect is not mediated by hypothalamo-pituitary-adreno-cortical (HPA) activity, throwing doubt on the value of this traditional index of stress. To determine the role of opioid peptides in stress-induced inhibition of nursing, 10 sows (3-7d postpartum), had their piglets removed for 2h, and were treated as follows. 1. No treatment, 2. Nose-snare restraint for 20 min., 3. Naloxone injections (i.v. 2mg/kg), 4. Snare + naloxone. After the treatment, the piglets were returned, milk ejections were timed, and the sows' blood sampled every 10 min. for cortisol, GH and prolactin assays. Restraint increased cortisol ($p<.05$) but did not delay the first milk ejection or reduce the frequency of nursings. No unsuccessful nursings were observed and successful milk ejections occurred when cortisol levels were elevated. Piglet removal increased cortisol and decreased prolactin and GH($p<.05$). The rise in GH when piglets were returned was prevented by the combination of restraint and naloxone, but not by restraint alone. Opioids protect lactogenic hormones against behavioural stress, but stress-induced HPA activity does not inhibit milk ejection in the pig. Stress is often considered a nonspecific HPA reaction to environmental challenges but the concept should be broadened to include specific disruptions of biological functions via other neuroendocrine pathways.

# INVOLVEMENT OF SEROTONERGIC MECHANISMS IN CONTROL OF ORAL STEREOTYPED BEHAVIOUR IN RESTRICTED-FED BROILER BREEDERS

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The aim of two experiments was to study effects of pharmacological manipulation with preferential antagonists and agonists of central serotonin 5-HT$_{1A}$, 5-HT$_2$ and 5-HT$_3$ receptor subtypes on expression of oral stereotypies induced by chronic food restriction in broiler breeders. In each experiment, 10 immature female birds were caged individually and given a daily ration according to a commercial food restriction programme. They received 10 intravenous injection treatments (3 drugs at 3 doses and 1 saline control) on 10 days over 5 weeks, each bird receiving different treatment on each day according to a Latin square design. Feeding time was 09.00 h, injections were 1 h after feeding, and behaviour was recorded on video for 3 h after injection. Measurements were made from the videorecordings in alternate 15-min periods by noting each bird's behaviour every minute, according to one of six categories: sitting, standing, pacing, preening, object pecking, or drinker directed activity. The last two activities were stereotyped in form. The 5-HT antagonist treatments, with NAN-190 (5-HT$_{1A}$), ketanserin (5-HT$_2$) and MDL-7222 (5-HT$_3$), all caused some inhibition of the oral stereotypies, whereas the 5-HT agonists 8-OH-DPAT (5-HT$_{1A}$), $\alpha$-methylserotonin (5-HT$_2$) and *m*-CPBG (5-HT$_3$), tended to stimulate the stereotypies, or a related activity preening, after initial inhibition which may have been due to sedation. In general, both stereotypies responded in a similar manner, although activation of 5-HT$_{1A}$ receptors with 8-OH-DPAT affected drinker directed activity (and preening) more than object pecking, and activation of 5-HT$_2$ and 5-HT$_3$ receptors with $\alpha$-methylserotonin and *m*-CPBG had the opposite effect. It is suggested that 5-HT$_{1A}$, 5-HT$_2$ and 5-HT$_3$ receptors could all be involved in serotonergic mechanisms contributing to expression of environmentally-induced abnormal behaviour, and that such mechanisms could be mediated indirectly via serotonin-induced dopamine activity.

# ONTOGENESIS OF ENDOCRINE FUNCTION IN SILVER FOXES UNDER DOMESTICATION.

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For decades, a model experiment with silver foxes (*Vulpes vulpes*) selected for defensive behavior has been carried out at this Institute. Certain hormonal systems and their underlying mechanisms were altered in these foxes. The changes concerned pituitary-adrenal and reproduction functions. In the present study we took account of the fact that the status of steroid hormones in the developing organism has an influence on many reproductive characteristics persisting through puberty and manifest in adulthood. We compared the function of the adrenals and gonads during development in females selected for domestic pattern of behavior (16 tame animals) and enhanced defense responses to man (13 aggressive animals). Plasma cortisol was significantly lower in tame than aggressive counterparts aged 2–8 months ($p < .01$). The differences in the course of changes in plasma progesterone between tame and aggressive foxes were similar as in the case of cortisol, although smaller, during 2–8 months of life. The pattern of changes for plasma estradiol were reverse. In tame females, its content was significantly higher as early as at 3 months ($p < .05$), and its rise was more sharp in during puberty. As a result, the level of plasma estradiol was 2-fold higher in tame than aggressive foxes at the ages of 6, 7 and 8 months ($p < .01$). Thus selection of foxes for domestic behavior has affected the time course of establishment of the function of the gonads and adrenals during development.

L1.8

**28th International Congress of the ISAE**
**Research Centre Foulum, Denmark**
**3 - 6 August 1994**

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# The effects of an improved man-animal relationship on the reproductive performance, sex-ratio in the litters and on cub behaviour ontogeny of farmed silver fox vixens (Vulpes vulpes).

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Many studies have shown that environmental effects can affect mammalian reproduction, both in relation to number of offspring raised and in relation to sex ratio in the litters. Perhaps, almost as important in relation to farmed animals, it is also demonstrated that the environmental effects during pregnancy and delivery need not be restricted to the effects on the mother but also affects cub behaviour ontogeny and later reproduction. This paper presents results on sex ratio in litters, and growth and behaviour differences between cubs from two groups of multiparae farmed silver fox vixens treated in two different ways in relation to human contact: group 1 (G1, N=14) got a tidbit two times a week during pregnancy, while group 2 (G2, N=14) got the same amount of human contact without any tidbit. Earlier experiments indicate that the silver foxes fear of humans is reduced with use of tidbits. Number and sex of cubs were recorded during the first hours after delivery. The cubs were weighed at delivery, at thirty days of age and at weaning (49 days old). Behaviour tests were done when the cubs were 30 days of age with the same methods as presented in Bakken (1992). There were no differences between the two groups of vixens (G1, G2) in relation to number of cubs born (4.9±0.3 versus 4.8±0.5, NS) or number of cubs at weaning (4.1±0.4 versus 3.8±0.4, NS), but the G1 vixens had a significantly higher proportion of male cubs in their litter both at delivery (64%♂ versus 51%♂, $p<0.05$) and at weaning (68%♂ versus 56%♂, $p<0.05$) than G2. At delivery there were no significant weight differences between the cubs from the two groups or between the male and female cubs. But at weaning the female cubs from G2 were lighter than the male cubs from both groups ($p<0.05$) and the female cubs from G1. At weaning there were no significant weight differences between the female cubs from G1 and their brothers or the male cubs from G2. At thirty days of age the female cubs from G1 were more active ($p<0.05$) and less fearful ($p<0.05$) than the female cubs from G2. Corresponding differences were not found between the male cubs. These results indicate that reduced fear of humans or reduced human stress during pregnancy affects both the silver fox vixens parental investment in male and female cubs and, perhaps most importantly, the female cubs growth and behaviour ontogeny. Seen in relation to earlier findings that active female cubs at thirty days of age wean more cubs during their first parity and are less often infanticide than inactive cubs, this result indicates that environmental effects during pregnancy don't only affect the farmed silver fox vixens own reproduction but also their female cubs during their first parity.

L1.9

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Research Centre Foulum, Denmark
3 - 6 August 1994

# HEART RATE OF BLUE FOX (*ALOPEX LAGOPUS*) IN NORMAL AND SIMULATED SITUATIONS OF FARM LIFE

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Heart rate (HR) is affected by animal's activity, metabolic rate and emotional state. Because of the short latency between stimulus and response, HR can provide valuable information about the aversiveness of a particular situation as experienced by an animal. We measured HR of five adult farmbred blue fox females with unrestrained radiotelemetry. We recorded the basic HR values for the total daily 24-h periods to characterize the range of HR during different "normal" behavioural states. As expected, HR increased with increasing locomotor activity from 70-90 bpm of a sleeping animal to the highest value of 150-175 bpm during the most vigorous walking observed. However, higher and variable HRs were recorded during behavioural states which, accordinding to man's evaluation, were neutral and not necessarily associated with any major locomotion: grooming (150-200 bpm), circling before lying down (160-220 bpm), scrathing the cage (170-230 bpm), alert observing (175-225 bpm), and standing on hindlegs (175-260, max 355 bpm). Furthermore, we recorded the responses of HR to situations supposed to be pleasant (feeding) or unpleasant (capture with neck tongs, man standing in front of the cage) to the foxes. Each situation was replicated several times. This was extremely important as the reactions were very variable both interindividually and intraindividually. Feed delivery and the following eating and capturing with neck tongs induced variable and always short-lasting changes in HR. Sometimes the approach of feeder stimulated HR more than the actual feed delivery and eating. A man unknown to the animal stimulated HR more than the one the fox knew. The responses were dependent on starting situation. For instance, during two test situations HR of fox C was about 120-130 bpm initially and rose to about 140 bpm for the whole 30 min when the unknown man stand in front of its cage. In the third test, fox C was sleeping before the test with its HR about 80 bpm; its HR rose to about 140 bpm when the man positioned himself in front of the cage. But after 14 mins, HR of fox C slowed down to below 80 bpm and it fell asleep despite the man still standing in front of it for another 16 mins. For comparison, HR of fox C exeeded 200 bpm prior to and after feed delivery, and rose to 240 bpm when a titmouse was flying inside the shed house. The results stress that caution should be used when applying HR as an indication of welfare in farmed foxes.

## OESTROUS BEHAVIOUR, OVULATION AND IMMUNE RESPONSE IN SWINE: EFFECTS OF HOUSING CONDITION.

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Effects of housing condition on post-weaning oestrous behaviour and ovulation were studied in the sow. Subsequently, effects on developmental aspects of the offspring were studied. Two groups of inseminated sows were housed either tethered (TETHERED,n=6) or in a 1.0ha enclosure containing half-open farrowing crates (FREE,n=7). One month after weaning (at 6 weeks), the occurrence of ovulation (rectal echography) and aspects of oestrous behaviour were registered twice daily with a teaser boar under standard test conditions. Peak levels of proceptivity (percentage testing time standing immobile) occurred 6h before ovulation in the FREE-group and 18h before ovulation in the TETHERED-group ($p<0.05$). No effects on receptivity (back pressure test) were observed. Male offspring from TETHERED mothers showed less sexual play behavior ($n=24,p<0.05$), were treated more often for inflammatory diseases ($n=24,p<0.01$) and responded with higher serum titers of IgM ($n=29,p<0.05$), but not IgG to BSA-antigen-injection. Female offspring from TETHERED mothers, but not from FREE mothers, developed instable dominance-submission-relationships being expressed in lower body weights ($n=24,p<0.01$) and later age of first behavioural oestrous ($n=24,p<0.05$) in the subbmissive ones. The results indicate that housing condition in early ontogeny or adulthood may have long lasting effects on swine. It is suggested in particular that tethering stress may desynchronize the temporal organization of proceptive behaviour and ovulation.

P1.2

# ADRENAL RESPONSE TO PHYSICAL ACTIVITY IN TRAINING AND COMPETING SPORT HORSES

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The incidence of motivational aspects and psychological stressors connected to competition on adaptative response of hypothalamic-pituitary-adrenal axis to exercise-associated stress has been investigated in No.31 trained horses, by comparing the effect of different psychic excitements on serum cortisol levels (by immunoenzymatic method) in trained resting horses (8),in training horses,usually competing (6) or not (5),before and after (5,15, 30, 60 min) a single training session (1 h of a routine of light exercise) and in sport horses (12) before and after (15-30,90 min,24 and 48 h) an official national show jumping competition. Results obtained showed lower basal serum cortisol levels in resting and training competitive horses before physical activity, but a pattern of adrenocortical response to exercise comparable in both groups subjected to training,represented by an increase (20-25%) suddenly after exercise, more rapidly compensated in competitive horses,by a decrease which is statistically significative (P<.05) at 60 min.In sport horses a significative increase (34%; P<.02) of cortisol levels 15-30 min after the competition,a decrease in 90 min and a compensation in 24 h have been recorded.Values of serum cortisol at 48 h after the exercise are reduced with respect to basal levels and comparable to basal levels of resting and non competitive horses.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# TREATMENT OF SLAUGHTERPIGS DURING LAIRAGE IN RELATION TO BEHAVIOUR AND SKIN DAMAGE

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In five Dutch slaughterhouses, the following was studied in the mild winter '93/'94: 1) lairage design and handling, 2) agonistic interactions between pigs and individual differences in agonistic behaviour, and 3) skin damage after slaughter using a 4-point scale. In all slaughterhouses, brooms and/or electric goads were used to move the pigs. In one abattoir, rough handling resulted in severe skin damage. In only one slaughterhouse, animals were gently moved. The number of pigs in holding pens ranged from 27 to 90. The density in holding pens varied from 1.0 to 2.7 pigs/m$^2$. In all slaughterhouses, the pigs were showered continuously during resting time. Resting time varied between none (pigs were slaughtered immediately after arrival) and three hours. In general, a peak in agonistic interactions occurred after half an hour in lairage. Large individual differences in aggression were observed. The percentage of resting animals increased steadily up to 87% and remained fairly constant after one hour. Skin damage was usually higher in the front region (related to agonistic behaviour) than in the middle and hind region (related to handling). Skin damage was positively correlated with resting time and density. Received aggression was positively correlated with skin damage in the front region. It is suggested that to decrease aggression and skin damage, pigs should be slaughtered immediately after arrival.

# THE EFFECTS OF DRY SOW HOUSING CONDITIONS ON HEART RATE RESPONSES TO FEEDING AND SUCKLING IN FARROWING CRATES.

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Confined housing systems greatly modify the sow's behaviour and it has been shown previously that sows housed in long-term confinement have an increased sympathetic nervous response and higher heart rate at feeding than loose-housed sows. Confinement in a farrowing crate probably occurs at a time when the freedom of movement is most important for the sow in order to carry out maternal behaviour. The aim of this study was to determine the effects of short-term confinement in farrowing crates on heart rate responses of sows from different dry sow systems to feeding and suckling. The study was carried out on fourteen Large White X Landrace sows housed during gestation in two different dry sow systems; 1) permanent stalls (n=7), 2) large group (n=7), all farrowing in commercial crates. Heart rate and behaviour were recorded continuously for $2^{1}/_{2}$ hours starting 30 minutes before feeding on four consecutive days during lactation. Peak and average heart rate values during feeding and suckling were obtained, together with change in heart rate from average values prior to the measured behaviour to peak value during the behaviour. Statistical comparisons were carried out using a Student's t-test. Peak and average heart rate values and the change in heart rate values at feeding were similar for stall-housed sows and group-housed sows, whereas in the dry sow systems, heart rate responses of stall-housed sows at feeding had been higher. During suckling, group-housed sows had higher heart rates than stall-housed sows in terms of peak values (122.3 beats per minute [b.p.m.] vs. 107.9 b.p.m., $p<0.05$), average values (112.7 b.p.m. vs. 100.4 b.p.m., $p<0.05$) and heart rate change (+34.4 b.p.m. vs. +24.7 b.p.m., $p<0.05$). The feeding results indicate that previously group-housed sows show an increased sympathetic nervous stimulation in response to short-term confinement in farrowing crates. The differences in heart rate responses to suckling may be due to a general unresponsiveness in stalled sows or to a high reactivity to the suckling event in group sows caused by a higher degree of frustration of the mother-infant interaction. These are further indicators that the welfare of sows is poor during short-term confinement in farrowing crates, especially if they have previously gestated in an open environment.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

NATIONAL INSTITUTE OF ANIMAL SCIENCE

# THE HEART RATE OF COWS DURING THEIR EXPERIENCES IN THE AUTOMATIC MILKING SYSTEM

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The heart rate of 23 cows (divided into three subgroups: A - 6 heifers, B - 8 older cows with previous experience with automatic milking, C - 9 older cows without such experience) was measured during their first milking in automatic milking system (AMS) after calving. The measuring started in the calving stand, continued during moving to the AMS and milking and ended one hour after joining the herd.

There was large individual variation in the heart rate , but significant differences between the subgroups of cows were not found. Nevertheless there were significant increases in the heart rate in some places: during transfer from calving stand to the AMS, in the passage between selection unit and milking stand and during preparation for milking. In general, the heart rate remained increased after coming back to the herd. During confrontations with herdmates, the newcomers became sometimes victims (significant increase of heart rate) and sometimes agressors (only for some cows effect on heart rate). The measurements were repeated by 19 animals during second and third milking in the AMS.

Most stress (concluded on the basis of increased heart rate) occurred probably in the passage leading to the milking stand of the AMS and after closing the gate with cow inside for milking. Some technical and organisational improvement of the AMS is considered in the light of the well-being of cows. These results will be compared with the heart rate of cows milked for the first time in traditional milking parlour.

P1.6

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# OPEN FIELD BEHAVIOUR IS NOT RELATED TO BRAIN WEIGHT IN FARMED SILVER FOX (*VULPES VULPES*)

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Domestication leads to less reactive and more tolerant animals, i.e. the behaviour of a species gradually changes in the course of domestication. This change is due to the reductions in the information acquisition and processing systems of the animals. Brain size can be used as a rough measure of the efficiency of the latter (Hemmer 1990). In the present study, an attempt was made to find out whether there are relations between brain weight and behaviour in farmed silver foxes.

From six to eight months old silver foxes (27 males, 10 females) were tested for their behaviour in an open field (OF). The latency variables used were: the latency to enter the OF, to reach the furthest end of the 5 m long OF, to sniff the feed available in the farthest end of the OF and to start eating. In addition, the spatio-temporal activity in the OF was measured (originally 40 variables). The brain weights and the lengths of the left tibia (as a measure of body size) of the foxes were measured after pelting at the age of nine to ten months.

There was a correlation between the brain weight and the tibia length: $r=+0.47$, $p<0.01$ (Pearson's correlation). The males were bigger, and, thus, tended to have bigger brains than the females (Table 1.).

Table 1. Tibia length and brain weight (mean±SD) in male (n=27) and female (n=10) silver foxes.

| | Males | Females | P | Statistical test |
|---|---|---|---|---|
| Tibia length (mm) | 153±6 | 147±6 | 0.02 | T-test |
| Brain weight (g) | 46.8±3.0 | 44.8±2.5 | 0.07 | T-test |
| | | | 0.37 | ANCOVA |

A factor analysis revealed that none of the variables measured in the open field test correlated with the brain weight. Of the males, 85 % and 50 % of the females sniffed the feed available in the open field ($p<0.05$, Chi-square-test). This was the only difference in the open field behaviour between the sexes.

The variation in the open field behaviour could not be explained by the brain size.

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**28th International Congress of the ISAE**
**Research Centre Foulum, Denmark**
**3 - 6 August 1994**

# ADAPTATION TO TRANSPORT IN YOUNG CALVES

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Young calves, to be reared for veal, are transferred to the rearing unit during the first 2 wks of live. This transfer consists of several transports, which are regarded stressful for these calves. The effects of successive transports on behaviour and heart-rate were studied in 5-d-old calves.

Twenty-two Holstein-Friesian male calves were assigned to a 2X2 factorial design of treatments. Half of the number of calves was transported four times for 75 min.. The other calves were controls. Two feeding levels were applied, 0.75 and 1.10 times maintenance. During transport, the calves' behaviour was video-taped and heart-rate was measured.

Transported calves stood more than controls, 79.3±11.6 versus 13.0±9.0% ($p<.0001$) only during the first transport. Only during transport 1, average heart-rate was higher in transported calves than in controls, 110.9±2.6 versus 89.3±2.1[bpm] ($p<.0001$). Heart-rate of transported calves decreased after transport 1 and did not differ between the next three transports or from the heart-rate in the control calves. In the control animals no difference in heart-rate over the transport periods were found. Feeding level equally affected heart-rate in transport and control calves. Only during transport 1, heart rate differed between feeding levels (high 105.7±2.2[bpm] low feeding level 94.5±2.5[bpm]).

The first transport of young calves is highly stressful shown by the continuous high heart-rate during the transportation. However, the following 3 transports had no effect on behaviour nor heart-rate of the calves. Apparently young calves adapt very quickly to transport.

# EFFECTS OF STRESS AND PAIN ON BEHAVIOUR FROM ELECTRICALLY DEHORNING CALVES AND ANATOMICAL ASPECTS OF THE INNERVATION OF THE HORN BUD

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The effects of dehorning and simulated dehorning were studied in calves 3 to 8 weeks of age by observing changes in behaviour during and after the intervention. Calves were dehorned without anaesthesia using an electrical dehorner. For simulation an unheated dehorner was used. During dehorning calves (n= 73) showed significantly (p< 0,001) more often distinct escape, pain and stress reactions such as rearing, tripping with the forelegs, forcing ahead, falling down, and tail wagging then during simulated dehorning (n= 61). Although burning time was longer in older calves with bigger horns, they showed no stronger stress reactions than younger calves during dehorning. In the first three hours after dehorning calves (n= 28) displayed significantly (p< 0,001) more often signs of pain and irritation like running backwards, scratching with the hind leg towards the wound and head shaking than after simulated dehorning. The dehorned calves showed significantly (p= 0,005) more restlessness (increased frequencies of standing and laying), a decline in normal behaviour (p< 0,001) and a typical standing position with the head held low (p< 0,001). Many aspects of their normal behaviour, like social behaviour, feeding behaviour, resting behaviour were significantly affected up to 12 hours after dehorning. In the horn area and under the horn bud we found a well developed innervation in newborn (n= 5), 1-4 week old (n=5), 5 week old (n=5) and 3-4 month old (n=5) calves. In comparison to the elder calves, there were no signs of an under-developed innervation of the horn in younger calves. In summary we conclude that electrical dehorning of calves without anaesthesia causes stress and obviously pain. Therefore we recommend using anaesthesia for dehorning calves whenever possible.

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# INFLUENCE OF FARROWING ON PHYSIOLOGICAL PARAMETERS OF NEWBORN PIGLETS

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The perinatal period is of decisive importance for sows and piglets. A number of reactions for functional adaptation were found to occur in this period, and birth also affects survival and postnatal development of the piglets. The aim of this study was to investigate the effects of parturition strain on physiological and biochemical parameters of newborn piglets. 933 piglets from 85 litters of German Landrace gilts housed in commercial farrowing crates were included.

Duration of farrowing, duration of parturition per piglet, birth weight, rectal temperature of piglets and time until first milk intake have been observed. Additionally, blood samples were taken from newborn unsuckled piglets by puncture of vena cava cranialis to determine levels of glucose, free fatty acids, total protein and urea.

The following main results were obtained.

Duration of farrowing ranged from 46 to 655 min and litter sizes varied from 5 to 17 piglets. Duration of parturition (DP) per piglet (intervals between the birth of the first and the second piglet, the first and the third piglet, etc.) took 94 min (SEM=2.83) on the average, and the interval between expulsion of two consecutive piglets (IE) was approximately 18 min (SEM=0.98). Longer DP resulted in longer IE ($r=0.44$; $p=0.001$).

Relations between IE or DP and birth weight have been shown (e.g. piglets with IE $\leq 30$ min had significantly ($p=0.045$) higher birth weights than piglets with IE $\geq 120$ min). Neither DP nor IE had a significant influence on the time until first milk intake. The average time until first milk intake was 37 min (SEM=1.45). Longer DP or IE were connected with higher rectal temperatures (RT) of the piglets (i.e. IE$\Leftrightarrow$RT: $r=0.22$; $p=0.016$ and DP$\Leftrightarrow$RT: $r=0.24$; $p=0.008$).

Blood glucose and urea levels before colostrum intake were higher in newborn piglets with larger DP or IE (e.g. piglets with IE $\leq 30$ min had significantly lower levels of glucose ($p=0.0001$) and of urea ($p=0.023$) than piglets with IE $\geq 120$ min).

However, piglets with shorter DP or IE had higher concentrations of free fatty acids in tendency. The correlations between IE and the biochemical blood parameters analysed were higher than those between DP and these blood parameters.

The blood content of total protein was not significantly influenced by DP or IE.

Sex did not have any significant influence on the parameters investigated by this study.

Finally, suggest that the duration of parturition per piglet (DP) and the interval between expulsion of two consecutive piglets (IE) may be used as characteristics to define the strain of birth. The results also suggest that longer duration of parturition has a negative influence on the energy metabolism and the thermoregulation of newborn piglets.

# BEHAVIOURAL AND PHYSIOLOGICAL RESPONSE TO CENTRAL CORTICOTROPIN-RELEASING HORMONE (CRH) IN PIGS.

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A growing body of evidence suggest that CRH initiates and coordinates many different physiological and behavioural responses following stress. Besides the well documented effects on the autonomic and neuroendocrine system, CRH inhibits food intake and exploratory behaviour, and initiates anxiety and arousal in rodents. Little is known about the role of central CRH in mediating stress-related behaviours in farm animals. To extend this concept to pigs we examined the effects of injecting porcine CRH intracerebroventricularly on stress-associated responses. Six pigs received either CRH (15, 50, and 150 $\mu$g) or a vehicle in a Latin-square design, with animal and day serving as blocks. Serial blood samples for physiological responses were collected via jugular catheters. Following treatment with CRH, 5 of 6 pigs were aroused and vocalized within 15 min. A significant main effect of both treatment ($P < .001$) and time ($P < .05$) was detected for behavioural activation. Motor activity (time spent standing and sitting) was initiated from 0 to 30 min and peaked from 30 to 60 min. These behavioural responses were accompanied by an abrupt increase in plasma ACTH ($P < .001$) and an immediate suppression of lymphocyte proliferation in response to the mitogen concanavalin A (Con A; $P < .05$). These findings indicate that CRH mediates the pig's behavioural, endocrine, and immune response to stress and can provide valuable information on stress-related consequences for the performance, health and well-being.

# The responses of pigs to castration with or without $CO_2/O_2$ anaesthesia

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Castration of young male pigs, without anaesthesia, is a common practice in many countries. Although this procedure may not be justifiable on animal welfare and production grounds several aspects will prevent or at least delay a complete ban on this surgical intervention (Lauer et al. 1994). Given its characteristics $CO_2/O_2$ is a good candidate to be used as an anaesthetic on farms In order to investigate the possible application of $CO_2/O_2$ anaesthesia, 45, 3 to 4 weeks old, piglets were assigned to four treatments: **A**) castrated without anaesthesia, **B**) castrated with anaesthesia induced by 60% $CO_2$ /40% $O_2$, **C**) control 1, sham castrated plus $CO_2/O_2$ anaesthesia and **D**) control 2, sham castrated no $CO_2/O_2$. Behaviour observation was carried out to look at the piglets responses to the treatments under study. Blood samples were collected by means of indwelling jugular catheters before castration, and 5, 15, 30, 45, 60, 90, 120 minutes post castration (PC) and also 24 hours after the first blood sampling. Plasma cortisol levels were determined by radio immunoassay. Induction of anaesthesia with $CO_2/O_2$ took place within 90 to 120 seconds. There was large variation among individual pigs in their responses to the $CO_2/O_2$ anaesthesia, particularly regarding the excitations occuring as part of state II of anaesthesia. The degree of analgesia and relaxation was very good. Time for the surgical intervention was shorter for animals under $CO_2/O_2$ anaesthesia. Plasma cortisol levels were significantly higher for pigs castrated without anaesthesia in relation to the other treatments at 5, 15, 45, 60, 90 and 120 minutes PC. The mean cortisol peak occurred at 90 minutes PC and and the values were: **A**) 183.82 ng/ml (+- 19.19 SE) , **B**) 113.79 ng/ml (+- 11.602 SE), **C**) 107.47 ng/ml (+- 14.28 SE) and **D**) 111.75 ng/ml (+- 6.95 SE). (p= 0.0027, F= 5.76). Although plasma cortisol levels returned almost to basal levels 24 hours PC, pigs castrated without anaesthesia still had significantly higher levels than pigs which were castrated under $CO_2/O_2$ anaesthesia (46.075.ng/ml (+- 9.498 SE) and 20.527 (+- 2.917 SE).

Lauer, S.; Zanella, A., Körtel, A. ; Henke, J. ; Scharvogel, S.; Unshelm, J.; Goldberg, M.; Eichinger, H.; Petrowicz, O.; Brill, T. and Erhardt, W. 1994. Die $CO^2/O^2$-Anästhesia zur Kastration von männlichen Ferkeln (vorläufige Ergebnisse). Dtsch. tierärztl. Wschr. **101**, 110-113.

# Session 2

## Response of animals to environmental enrichment

L2.1

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# ENVIRONMENTAL ENRICHMENT: BRINGING NATURE TO CAPTIVITY

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## ABSTRACT

Environmental enrichment involves the addition of environmental features, or changes in their method of presentation, which increase the complexity of a captive animal environment, resulting in beneficial effects on behaviour and other aspects of biological functioning. An enriched environment presents animals with challenges to which they are evolutionarily adapted in an environment which enables them to respond in an adaptive manner. Objectives of environmental enrichment vary according to the reason for captivity and include promotion of natural behaviour, reduction of undesirable behaviour and improvement of survival skills, reproductive success, productivity and animal welfare. Attempts at environmental enrichment fail when the method used has little functional significance to the animals, is not sufficiently oriented to the particular problem encountered, does not account for effects of previous experience, substitutes one problem for another, is not readily availability, is too expensive or places excessive time demands on caretakers. An ideal environment for captive animals is likely to be one in which their behaviour falls within the range of behaviour of relatives living in the wild or, in the case of domesticated species, in semi-natural "island" environments. Techniques which stimulate foraging behaviour are particularly successful in reducing undesirable behaviour. Future improvements to captive environments depend upon a better understanding of key features of natural environments which channel animal behaviour.

## ENVIRONMENTAL ENRICHMENT - WHAT IS IT?

Environmental enrichment is a popular goal of research in the field of applied ethology. However, the concept of environmental enrichment is rather like the concepts of "animal welfare" and "stress" in that it evades precise definition, is used inconsistently by different authors, lacks a consistent starting point and precise end point, lacks a standardized method of assessment and is attempted by a wide variety of different environmental manipulations. For example, of seven papers at the 1993 Congress on Applied Ethology in Berlin which made explicit reference to enrichment, four compared "enriched" housing environments with "barren", "monotonous" or "impoverished" environments (Cooper et al., 1993; Erlebach, 1993; Hirt and Wechsler, 1993; Templin, 1993), one referred to "general enrichment" and "social enrichment" resulting from contact between neighbours through metal bars rather than complete social isolation (Wichtmann, 1993), one involved placing "spherical environmental enrichment objects" (balls) in the feed trough (Sherwin et al., 1993) and one provided wood chips or straw as a method of "behavioural enrichment" in an "already well equipped environment" (Harigel, 1993). Thus, use of terminology was variable and the initial (control) environment varied in degree of complexity.

Methods of environmental enrichment range from addition of a single stimulus to an existing environment to incorporation of a multitude of different environmental features in a new housing system. In the seven Berlin papers, enrichment involved provision of one to four of the following attributes: materials such as straw, wood chips, twigs or branches (Cooper et al., 1993; Erlebach, 1993; Harigel, 1993; Hirt and Wechsler, 1993), access to soil and natural vegetation outdoors (Erlebach, 1993; Hirt and Wechsler, 1993), objects such as balls (Sherwin et al., 1993) or a wooden chamber, cardboard roll and paper ball (Templin, 1993), a water pool and tunnels (Erlebach, 1993), more space (Cooper et al., 1993; Erlebach, 1993; Hirt and Wechsler, 1993; Templin, 1993), social contact (Wichtmann, 1993) and an increased variety of food
types presented in different locations (Hirt and Wechsler, 1993). At least 18 other papers at the Berlin Congress compared environments with and without one or more of the above attributes but did not use the term "enrichment".

Enrichment implies an improvement. However, there is a lack of consistency in the measures used to identify the impact of environmental enrichment and the changes considered to indicate an improvement. In the seven Berlin papers, results proclaimed to indicate a positive effect of enrichment included a reduction in stereotyped locomotion (Cooper et al., 1993; Erlebach, 1993), increased play (Erlebach, 1993; Harigel, 1993), increased behavioural diversity (Hirt and Wechsler, 1993), changes in use of space (Wichtmann, 1993), increased time spent with the head over the feed trough (Sherwin et al., 1993), reduced ethanol consumption (Templin, 1993) and increased object manipulation (Harigel, 1993). These "improvements" represented changes of varying magnitude relative to the control treatment rather than attainment of a precise biological end point.

Despite the imprecise nature of environmental enrichment, certain general patterns emerge. Environmental enrichment entails the addition of environmental features (e.g. manipulable materials and objects, social companions), or changes in their method of presentation (e.g. scattering or hiding food items), which increase the complexity of a captive animal environment (Chamove et al., 1982; Chamove, 1989; Hubrecht, 1993), resulting in beneficial effects on behaviour and other aspects of biological functioning. An enriched environment presents animals with challenges (Moodie and Chamove, 1990; Shepherdson et al., 1993) to which they are evolutionarily adapted (e.g. locating food, escaping danger) in an environment which enables them to respond in an adaptive manner (e.g. finding food, finding cover). The animals are provided with increased opportunities to perform behaviour to attain goals and given increased control over their physical and social environment through opportunities to withdraw and seeking cover or approach and interact. Enrichment may result from provision of stimuli from both living and inanimate sources or from changes in the spatial or temporal arrangement of existing environmental features.

## OBJECTIVES OF ENVIRONMENTAL ENRICHMENT

Two main philosophical goals for environmental enrichment have been proposed, the first aimed at promoting behaviour typical of wild animals and the second aimed at improving animal welfare. These goals are not mutually exclusive and are also influenced by the use to which animals are being put.

### Natural Behaviour

Snowdon and Savage (1989) contend that captive animals should be maintained in environments which enable them to acquire and retain the behavioural skills they would need to cope successfully with the natural environment were they ever to be released into the wild. Similarly, Moodie and Chamove (1990) argue that the goal of enrichment should be to allow and encourage animals to show behaviour patterns which are within the normal range of their wild counterparts, and Gilloux et al. (1992) consider that the aim of environmental enrichment is to provide a captive environment in which abnormal behaviour is minimized and in which behaviour patterns resemble, as closely as possible, those of relatives in the wild. This goal is based on the premise that the physiology and behaviour of animals are evolutionarily co-adapted to particular environments. Animals deprived of the environmental stimuli which regulate their biological systems are expected to exhibit atypical physiological and behavioural responses, resulting in poor health and reproductive failure (Pereira et al., 1989). The maintenance of wild behaviour is an ideal for animals maintained in genetic conservation programmes or for research and education aimed at improving knowledge about wild animals. However, captive environments often vary from natural environments in animal density, space, opportunities for dispersal and immigration, food types and availability, weather conditions, predation pressure and many other factors, thereby favouring genetic traits different from those in natural environments. Environmental enrichment, incorporating key features of the natural environment from which a population originated, could improve survival and reproductive success and slow the shift in the genetic structure of captive populations.

In the case of domesticated animals subjected to artificial selection to enhance certain traits desired by humans, there is no intention for the animals to be able to survive in the wild or even necessarily to breed naturally and rear their own young in captivity (e.g. dairy cattle, domestic turkeys). Nevertheless, despite many generations of artifical selection, domestic species retain the behavioural repertoire shaped by natural selection during their evolutionary history and perform behaviour in a relatively goal directed manner when kept in complex semi-natural environments (Newberry and Wood-Gush, 1988; Stolba and Wood-Gush, 1989; Love, 1994). Farm animals show many adaptations typical of wild animals living on biogeographical islands (Newberry, 1993). Therefore, the range of behaviour shown by domestic animals in semi-natural "island" environments similar in ecology and social structure to the natural environments in which their progenitors evolved may provide an appropriate model for the "natural behaviour" of domestic species. These "islands" may include some food provisioning by humans as well as human control of immigration, emigration and predation, simulating the relationship between humans and these species which initially led to their domestication. By this reasoning, the philosophy of environmental enrichment to promote a full range of natural behaviour can be applied even to domestic animals. Achievement of this goal depends upon a thorough knowledge of behaviour under varying natural conditions and identification of significant features of natural environments to which the animals respond.

### Animal Welfare

A second general objective of environmental enrichment is the improvement of animal welfare. Environmental enrichment may be undertaken to reduce abnormal behaviour associated with captive environments, which is often taken as an indicator of reduced welfare (Broom, 1988; Kastelstein and Wiepkema, 1989; Bayne et al., 1992) although the relationship between abnormal behaviour such as stereotypies and animal welfare is often unclear (Mason, 1991). Environmental enrichment may also be aimed at reducing fearfulness and stress associated with exposure to novel stimuli (Jones and Waddington, 1992; Nicol, 1992), facilitating adaptation to environmental change (Snowdon and Savage, 1989; Wemelsfelder, 1991), reducing boredom and apathy postulated to result from housing in unstimulating captive environments (Wood-Gush and Vestergaard, 1989; Wemelsfelder, 1991) and reducing frustration which animals may experience when kept in environments which prevent the expression of behaviour patterns which they are strongly motivated to perform (Duncan, 1970; Gilloux et al., 1992). The observation that captive animals perform certain types of behaviour even when they are not necessary to meet physiological requirements has contributed to the hypothesis of "ethological needs", with its implication that animals suffer when unable to perform these behaviours (Hughes and Duncan, 1988; Jensen and Toates, 1993). It has also been argued that, because survival in the wild requires successful execution of goal directed behaviour, there are good evolutionary grounds for believing that performance of behaviour may provide animals with a rewarding experience (Dawkins, 1990; Shepherdson et al., 1989b), suggesting that welfare will be enhanced by environmental enrichment which enables animals to obtain positive stimulation from the performance of a full range of natural behaviour. A sense of control over the environment is considered to be a critical component of psychological well-being (Snowdon and Savage, 1989; Shepherdson, 1994). Thus, on welfare grounds, Shepherdson (1994) advocates the use of environmental enrichment to restore the contingency between performance of behaviour (e.g. foraging) and the appropriate consequence (e.g. finding food). A further goal of environmental enrichment may be to improve physical well-being by occupying animals in harmless activities instead of biting, chewing and pecking at pen mates (Feddes and Fraser, 1993; Norgaard-Nielsen et al., 1993; Gvaryahu et al., 1994), providing opportunities to avoid harmful aggression (Erwin et al., 1976), reducing escape responses during handling which increase the risk of injury (Reed et al., 1993) and promoting a wide range of movements to improve muscular (Chamove, 1989), skeletal (King and Norwood, 1989) and cardiovascular fitness.

## How Animals Are Used Affects Environmental Enrichment Goals

For animal used in research, concerns about the validity and applicability of research conducted on physiologically and psychologically impaired subjects may motivate the use of environmental enrichment as a means of obtaining subjects with more "normal" behaviour and physiology. For example, Bayne et al. (1992) state that the goal of an enrichment program is to improve the behavioural health of the animals and to provide a more refined animal model for the biomedical research community. O'Neill (1989) notes that exposure to stressors such as sensory deprivation and social isolation can hamper antibody responses to pathogens and points out that an animal with a suppressed immune function is not a suitable model for most biomedical research. Effects of environmental enrichment on such attributes of biological functioning as cortical thickness and dendritic branching (Carughi et al., 1989), learning capacity (Widman et al., 1992) and recovery after brain damage (Gentile and Beheshti, 1987) indicate that the housing environment of laboratory subjects may have far-reaching effects on the results of research using animal models. The social and physical complexity of housing units for research animals is constrained by a desire for human control over environmental factors and by the cost of replicating treatments over a number of independent units. However, due to concerns about laboratory animal welfare and the validity of animal research, environmental enrichment for research animals is now required or recommended in some countries (e.g. Canadian Council on Animal Care, 1993).

Some countries have also passed legislation stipulating environmental conditions for animal production with the intent of protecting animal welfare. In the absence of legislation, enrichment of farm animal environments must provide an economic incentive if it is to be widely practiced. Therefore, a common objective of research on environmental enrichment for farm animals is to identify techniques which enhance the economics of production, either by improving productivity parameters such as egg production (Church et al., 1993), growth rate and feed conversion efficiency (Gvaryahu et al., 1989; Curtis, 1993), or by reducing losses. For example, losses due to mortality, injuries, growth set-backs and poor meat quality may be reduced by methods which (1) enable animals to avoid or terminate fights, (2) reduce pecking, sucking and chewing at the body parts of pen mates and (3) reduce escape responses when animals are handled or moved to different environments. There is some evidence that methods which reduce stereotyped behaviour could improve productivity in some cases (von Borell and Hurnik, 1990). Environmental enrichment may also be aimed at improving the public image of animal production (Curtis, 1993) to maintain consumer confidence.

The degree of environmental enrichment undertaken at zoos tends to be more elaborate than that in research and farm animal facilities due to the high value of the animals, a desire to retain their wild characteristics and a high level of public scrutiny. Zoos use environmental enrichment techniques to promote the psychological and physical health of the animals (Chamove et al., 1982) and reduce the negative impact of visitors (Chamove et al., 1988). Zoos are also concerned with the "holding power" and educational value of exhibits, which are improved when animals are busily engaged in naturalistic behaviour rather than lying inactive or hiding out of sight (Shepherdson et al., 1989b, 1993) or engaging in abnormal behaviour considered disgusting by the public (Akers and Schildkraut, 1985). The most common objective of environmental enrichment in animal exhibits is the replacement of undesirable behaviour such as stereotyped locomotor patterns (Kastelein and Wiepkema, 1989; Carlstead, 1991; Carlstead et al., 1991; Shepherdson et al., 1993), inactivity (Shepherdson et al., 1993), regurgitation/reingestion and coprophagy (Akers and Schildkraut, 1985) and food begging from the public (Carlstead et al., 1991) with more natural behaviour. This is often achieved by techniques aimed at increasing the duration and complexity of foraging behaviour.

The most extensive efforts at environmental enrichment are reserved for threatened and endangered species in captive breeding programmes (e.g. Pereira et al., 1989), with the objective of facilitating the reproduction and maintenance of genetically viable captive populations, the conservation of culturally determined repertoires of behaviour and the reintroduction of captive bred animals to the wild (Shepherdson, 1994). Environmental enrichment is designed to enable animals in successive generations to rear most of their own young successfully and to reproduce salient features of the wild environment which enable animals to develop skills needed for survival in the wild (Snowdon and Savage, 1989). Survival skills are enhanced by providing animals with opportunities to learn the characteristics of natural food items and predators at appropriate stages of development (Miller et al., 1990) and opportunities to develop behavioural flexibility in response to a dynamic environment (Shepherdson, 1994).

## DOES IT REALLY WORK?

Attempts at environmental enrichment may fail if the environmental features provided have little functional significance to the animals, are not sufficiently focused to meet a specific objective or are based on an incorrect hypothesis regarding the causation and mechanisms underlying a problem. Environmental enrichment efforts may also be unsuccessful if the animals do not have sufficient control over their exposure to the added stimuli or if previous experience affects the animals' capacity to adapt to the environmental manipulation.

## Toys - A Question of Relevance

Toys are often recommended as sources of environmental enrichment (e.g. Canadian Council on Animal Care, 1993). However, the term toys is a catch-all for a wide variety of objects, some of which may have properties much more relevant to the behaviour of the animals than others. It is not uncommon to find reports on toys in which a variety of objects have been provided and responses to all of the objects have been lumped together to indicate "the effect of the toys", or in which no mention was made of the behaviour directed towards each object and individual differences in responses. Some studies lack a focused hypothesis about how a specific type of object, presented in a specific manner, could contribute to achieving a specific goal. The matter is further complicated by differences between studies in the degree of novelty of objects, which may be provided permanently or replaced or rotated between groups at various intervals, and the numbers of each object, since limited numbers can promote competition for access (Hubrecht, 1993). Furthermore, the term "toys" implies that the motivation underlying use of the objects is play whereas, in reality, the behaviour directed towards different objects, and the motivational state underlying the behaviour, will vary according to the specific design features of each object, the age of the animals and the novelty of the objects. In view of these problems, it is perhaps not surprising that results obtained from providing toys are variable and sometimes difficult to interpret.

For example, both Grandin (1989) and Pearce and Paterson (1993) provided pigs with narrow hanging toys and obtained opposite results which were both interpreted as positive effects. Grandin (1989) reported that pigs provided with continuously available hanging "rubber hose toys" were more likely to approach people than pigs without toys, which she interpreted as evidence that the toys reduced fear and prevented detrimental effects of sensory restriction on the central nervous system. By contrast, Pearce and Paterson (1993) observed that pigs reared with "toys", including hanging chains and cloth strips which were alternated weekly, were slower to approach people and novel objects than pigs reared without toys, which they interpreted as a positive sign that the pigs were less reactive to novel stimuli. However, it is possible that the real relevance of these objects to pigs was in providing an opportunity for foraging behaviour which, in the absence of a more appropriate substrate (Fraser et al., 1991), would otherwise be directed towards the tails of pen-mates. Fraser (1987) observed that the main behaviours directed towards hanging cotton braids were chewing and biting, which he considered most likely resulted from a lack of foraging materials in pens without bedding. Feddes and Fraser (1993) discovered that chewing on narrow hanging strips was enhanced if the pigs were able to destroy them, which would be the normal outcome of natural foraging behaviour. The strips would likely have been even more attractive had they provided stimuli associated with nutritional value, as suggested by Fraser's (1987) finding that cotton braids soaked in a salt solution or in blood were chewed much more than unflavoured braids. This idea is supported by Hubrecht's (1993) observation that dogs spent much more time chewing a destructable, flavoured toy than a "plastic pipe toy". Furthermore, Sherwin (1993) found that hens in cages with nipple drinkers were much more likely to activate a switch that resulted in water being added to the feed trough, which may have improved the palatability of the feed, than a switch that activated a motorized device with a bell and piece of blue plastic, to which the hens rapidly habituated.

Schaefer et al. (1990) provided pigs in established groups with a "tire and chain toy" (car tyre suspended by a chain), a "pig pacifier toy" (sugar-mineral block suspended in a metal basket), a "teeter-totter toy" (pivoting metal bar suspended horizontally between two pens, with a rubber belt hanging from each end) or no device (control). The toys were intended to enrich the environment by diverting and reducing aggression and providing an opportunity for play or exploratory behaviour. Pigs in pens with toys performed fewer head-head knocks than those in control pens whereas forceful replacements of other pigs at the feeder or water spigot occurred more often in pens with teeter-totters, and for a longer duration in pens with a tyre, than in control pens. Much of the aggression occurred at the feed trough, aggression which could be reduced by placing partitions between feeding sites (Simonsen, 1990). The toys were not specifically designed to enable a pig to conceal itself or avoid another pig. McGlone and Curtis (1985) designed boxes to allow pigs to hide their heads, thus cutting off visual stimuli from the head region which elicit further attack. The boxes were effective in reducing injuries following mixing of unfamiliar pigs (McGlone and Curtis, 1985) but rarely used by established groups (Curtis, 1993). Novelty is an important stimulus for exploration and play by pigs (Wood-Gush and Vestergaard, 1991) and objects used in play by piglets are usually small items which are picked up and carried or shaken vigorously (Newberry et al., 1988). The toys used by Schaefer et al. (1990) were permanent fixtures and were too large to carry but the teeter-totter did provide a rubber strip which could have been tugged and shaken. The main behaviour directed towards the tyre was chewing, suggesting that the primary relevance of the objects to the pigs may have been as substrates for foraging behaviour. If so, focussing on the properties of foraging materials, the range of behaviour performed during foraging under natural conditions (Stolba and Wood-Gush, 1989), the searching and handling time involved in foraging and the contingency between foraging behaviour and obtaining food should assist in designing effective methods of environmental enrichment for pigs.

For caged laying hens, Gvaryahu et al. (1994) advocated hanging a patented plastic "environmental enrichment device" or toy in the cages on a long-term basis as a means of reducing "social pressure". Although providing this device reduced mortality in some trials, the mechanism for this effect is unclear. They observed fewer aggressive head pecks in cages with the device in one 5-month study but did not indicate the context in which the aggressive head pecks, or pecks at the device, occurred. F.E. Robinson (1994, personal communication) observed higher rates of pecking at these devices by feed-restricted than full fed chicks housed in battery brooders, suggesting that feeding motivation, rather than aggression, underlied the use of the devices. A.A. Taylor, G.I. Hurnik and J.F. Hurnik (1994, personal communication) found no impact of these devices on mortality of adult hens but did observe a rise in pecking at the device after five months in the cages. Nevertheless, the maximum use was still only about two pecks per hour. In a study with rhesus monkeys, Bayne et al. (1992) reported that one monkey, which had been performing high levels of repetitive picking at its cage, tranferred a proportion of this behaviour to a set of "enrichment devices", including toys, added to the cage. Thus, toys should not be viewed as a panacea for meeting environmental enrichment goals and are often lacking in sufficient relevance or complexity to present animals with challenges to which they are evolutionarily adapted.

## Music, Radio and Television

Several studies have incorporated music recordings or radio broadcasts in environmental enrichment treatments but the value remains unclear because (1) the sound was provided simultaneously with other environmental manipulations (Gvaryahu et al., 1989; Nicol, 1992; Reed et al., 1993), (2) there was no control population for comparison (Markowitz and Line, 1989; O'Neill, 1989), (3) there was no significant effect (McAdie et al., 1993) or (4) interpretation of the results is unclear. For example, Novak and Drewson (1989) observed increased "affiliative" behaviour in rhesus monkeys when given access to a music box but no significant effects on other behavioural measures or on cortisol levels. Ladd et al. (1992) reported that caged laying hens exposed to radio broadcasts (country station or classical/jazz station) performed more head shaking, less grooming and had no effect on nervousness compared with "no radio" controls. The country station, but not the classical/jazz station, was associated with increased feeding time and reduced heterophil:lymphocyte ratios.

A concern with the addition of music or radio sound to captive animal environments is that they are often already extremely noisy due to high stocking densities, forced-air ventilation and poor acoustics resulting from construction with non-porous materials. Noisy environments may cause hearing impairment and hamper vocal communication between animals. Algers and Jensen (1985, 1991) provided evidence that continuous fan noise disrupted communication between sows and piglets during nursing, thereby reducing massaging by piglets, sow milk production and piglet growth. Therefore, addition of music or radio sounds may actually be harmful in an already noisy environment, especially if the animals have no control over the sound, such as to the ability to move to a quieter location or switch off the sound. Both Novak and Drewson (1989) and Markowitz and Line (1989) noted that rhesus monkeys given the opportunity to switch music on and off did so frequently.

The relevance of music and human vocal communication to other species must also be questioned. Even sounds of the natural habitat from which a captive population originated may have little meaning unless the animals have had an opportunity to learn how to interpret the sounds. Furthermore, as with music, the sounds of natural environments are complex and variable and animal responses to a general recording of "natural sounds" will be difficult to interpret without prior knowledge of the characteristics of sounds having signal value to the animals and the expected responses to those sounds. Thus, Ogden et al. (1994) found no clear-cut benefit from playing a recording of tropical rain forest sounds to captive lowland gorillas. The adults responded with increased locomotion, which was interpreted as a negative effect indicating agitation. The infants responded with reduced clinging, which was interpreted as a positive sign that the sounds masked other noises in the captive environment. However, a masking effect does not signify environmental enrichment in the sense of providing challenges to which animals are evolutionarily adapted.

A more promising method of auditory environmental enrichment may be the playback of vocalizations in a manner known to be relevant based on observations of the species in the wild. Shepherdson et al. (1989a) broadcast the territorial song duet of a gibbon pair to a captive group, simulating the singing of a neigbouring group in the wild. The playbacks stimulated locomotion and singing by the captive group, an effect specific to the playing of certain species of gibbon song and still evident after seven months. They suggested that the auditory stimulus played a positive role based on evidence that (1) the gibbon duet is important for formation and maintenance of the pair bond, (2) wild gibbons also respond to song playbacks and (3) the opportunity to hear and respond to song duets can be used as a reward in an operant conditioning paradigm.

The question of relevance must also be raised regarding the use of television broadcasts as a means of environmental enrichment. Rumbaugh et al. (1989) noted that a television can be a source of environmental enrichment for chimpanzees only if they perceive the relevance of the images on the screen. Most can learn to do this by watching real-world events on the screen and at the same time witnessing these events directly. They described an occasion when chimpanzees were frightened by the sound of chain saws outdoors. Fear turned to fascination when they were able to observe the activities associated with the sound on closed-circuit television, indicating that the television images had some value in allowing them to monitor events in their surroundings. Domestic chickens will respond to video images of chickens (Keeling and Hurnik, 1993), suggesting that televised playback of specific behavioural events known to have signal value could be used to add challenges to the lives of captive animals providing that they detect the images and can use the information in an adaptive manner.

### Development, Learning and Previous Experience

Future food, mate and habitat preferences can be influenced by previous experience. Attempts at environmental enrichment by increasing food variety (Mastika and Cumming, 1987) or adding other environmental features may be less effective if initiated after preferences and habits have developed. In some cases, a strong effect of early experience on future behaviour may occur at a particular stage in ontogeny. For example, feather pecking by hens may arise as a consequence of imprinting on feathers as a dust bathing material (Norgaard-Nielsen et al.,1993) or forage (Blokhuis and Van der Haar, 1992) at a young age, especially if reared without appropriate dust bathing and foraging materials. If so, it may be difficult to prevent feather pecking later on despite subsequent housing in an enriched environment. In addition, environmental complexity influences brain development and spatial learning ability (Carughi et al., 1989; Widman et al., 1992). Animals transferred to an enriched environment presenting choices and challenges after having been reared in a barren environment may have difficulty locating food (Steinruck et al., 1990), judging landings after flying or leaping, and otherwise adapting to the new environment. A lack of opportunity to learn social skills and mothering skills when young may also result in maladaptive behaviour when later housed in a more appropriate social environment. For example, Berman (1990) provided evidence suggesting that young female rhesus monkeys learn maternal skills through association with their mother after infancy and observation of her interactions with their younger siblings. Without this opportunity for learning, females may display fearful, rejecting or neglectful behaviour towards their infants.

Removal of environmental enrichment features or transfer to an environment lacking these features can also have adverse effects. For example, Bayne et al. (1992) noted a rebound effect when enrichment devices were removed from singly housed rhesus monkeys. Some monkeys showed higher levels of stereotyped behaviour for at least a month after removal of the enrichment devices than they had done in the period prior to enrichment, suggesting that an enrichment program should be maintained routinely after instigation. Although rearing in a more complex environment can reduce fear when later exposed to novelty (Gvaryahu et al., 1989; Jones and Waddington, 1992; Reed et al., 1993), Nicol (1992) observed greater fear responses by broiler chickens following catching and transportation if they had been reared in pens containing a variety of objects and habituated to gentle handling than if reared without these added stimuli. She suggested that the "enriched" broilers may have been more aware of the aversive catching procedure due to enhanced perception, learning and memory abilities. Alternatively, the aversive catching experience may have destroyed a learnt expectancy that handling was "safe".

## CONSTRAINTS ON ENVIRONMENTAL ENRICHMENT

Environmental enrichment may be constrained by concerns about disease transmission associated with social housing, increased contact with excreta and the difficulty of cleaning and disinfecting enclosures containing soil, natural vegetation, logs and other porous materials. Different environments favour different diseases and care must be taken that attempts at environmental enrichment result in a net benefit for the animals rather than merely substituting one problem for another. Nevertheless, some concerns have proved unfounded. For example, Chamove et al. (1982) reported that wood chip litter in monkey enclosures was more hygienic than faeces and urine on bare concrete as well as providing a major environmental enrichment benefit.

For an enrichment method to be successful, not only must it result in a measurable improvement in behavioural or physiological functioning but it must be practical. Adoption of an enrichment method will be inhibited by difficulty in obtaining specialized supplies, excessive cost of supplies and equipment and excessive time demands upon staff. Thus, Shepherdson et al. (1989b) recommended a simple, "low-tech" feed dispenser with a strong environmental enrichment effect over sophisticated electromechanical feed dispensers with microchip controllers, which are expensive and difficult to maintain. Chamove (1989) noted that the time taken to bait tree stump feeders for tamarins was so great that the device would not be used despite some benefits. A cost-benefit analysis is useful to assess the relative value of one method over another (Chamove, 1989; King and Norwood, 1989; Hubrecht, 1993; Love, 1994). Environmental enrichment may also be constrained by human safety concerns, such as fears of being bitten or scratched when entering a complex environment containing a number of animals able to move rapidly in the horizontal and vertical plane. However, practical solutions can be developed, such as using holding cages as tunnels to link enclosures, in which animals can be easily caught (J.A. Love, 1994, personal communiction), or training primates to present body parts for biological samples (Pereira et al., 1989).

Moral constraints on environmental enrichment centre around public attitudes to the provision of live prey. Providing live prey can have a highly enriching effect on predators. For example, compared with presenting monkey chow in a bowl, providing captive squirrel monkeys with the opportunity to catch live fish markedly increased the time, effort, concentration and skill required to procure food and stimulated more complex social behaviour, possibly influencing dominance, cooperation, imitative learning, food sharing, social roles and patterns of attentiveness (King and Norwood, 1989). Presenting a fishing cat with live fish reduced sleeping and increased behavioural diversity and enclosure utilization (Shepherdson et al., 1993). However, there is a moral dilemma between promoting the natural behaviour and well-being of predators and causing suffering to prey animals which are unable to escape. Providing prey species lower on the food chain, such as meal worms (Shepherdson et al., 1989b) or crickets (Carlstead, 1991), may ease this dilemma although, ideally, enclosures would be sufficiently complex to allow a sustainable prey population to co-exist in the predator enclosure.

## METHODS OF ENVIRONMENTAL ENRICHMENT

### What's on the Menu and How is it Presented?

In natural environments, many species consume a wide variety of food types whereas in captivity, only one or a few food types are provided. One environmental enrichment technique involves increasing the diversity of food types. This technique has mainly been applied to primates as a means of reducing boredom and has not, as yet, been rigorously assessed. However, physical fitness may be improved if a greater diversity of behaviours is required to procure and process different foods. Providing a variety of foods allows individuals greater control over their nutrient intake and may improve nutritional balance

(Pereira et al., 1989), especially when requirements are changing due to temperature fluctuations and developmental changes (Scott and Belnave, 1988).

Another typical feature of captive environments is that the feed requires different, or fewer, feeding actions than would be required when feeding under natural conditions. However, animals may still attempt to perform their natural feeding behaviour and, in the absence of a more suitable substrate, may direct this behaviour to pen mates or pen fixtures (Hutton and Wood-Gush, 1984). This type of undesirable behaviour can be reduced by environmental enrichment which provides an opportunity to perform elements of feeding behaviour in less harmful and more natural ways. A.M.B. de Passille (1994, personal communication) found that group housed veal calves provided with dummy teats after bucket feeding preferred to suck the dummy teats than each other. Furthermore, there was evidence that the sucking behaviour had a functional consequence. Singly housed calves given a teat to suck after bucket feeding had higher levels of insulin and other digestive hormones in the blood than calves without a teat (de Passille et al., 1994). Earth and straw have also been provided as a means of reducing apparent feeding actions directed towards pen mates with varying degrees of success. Appleby and Wood-Gush (1988) observed that rooting in an earth trough by young pigs diminished over time and was not linked in functional sequences with other feeding activities whereas Fraser (1991) obtained good results with straw, which was renewed daily. The novelty of the straw, and its greater palatability, may have contributed to this difference. It is unlikely that an inedible material will continue to sustain high levels of investigation if it is not renewed and if the behaviour directed towards it never results in a functional consequence, such as the occasional discovery of food.

Another common feature of captive environments is the provision of food in a limited quantity once or twice a day. The food is typically provided in highly predictable locations within a restricted area requiring minimal searching time and is presented in a form requiring minimal handling time prior to consumption. Thus, whereas under natural conditions a major portion of the behavioural time budget is devoted to foraging, under captive conditions, food is rapidly located and consumed (Newberry, 1993). Under these conditions, animals may develop certain forms of stereotyped behaviour (Rushen, 1984; Terlouw et al., 1991). Providing a higher level of the same food with the same method of presentation reduces food-related stereotyped behaviour (Terlouw et al., 1991; Lawrence and Terlouw, 1993) but may lead to obesity-related health and reproductive problems. Therefore, a variety of environmental enrichment techniques have been used with the aim of reducing stereotypies and/or promoting a more natural activity budget with varying degrees of success. These include scattering and hiding food (or the food hiding itself) in unpredictable locations (Chamove et al., 1982; Carlstead et al., 1991; Shepherdson et al., 1989b, 1993), increasing the time and skill required to catch or extract food (Kastelein and Wiepkema, 1989; King and Norwood, 1989; Carlstead et al., 1991; Gilloux et al., 1992; Shepherdson et al., 1993; Reinhardt, 1994; Young et al., 1994), providing smaller, more frequent meals (Shepherdson et al., 1993), increasing the time required to process and ingest food (Chamove et al., 1982; King and Norwood, 1989; Robert et al., 1993; Shepherdson et al., 1993; Brouns et al., 1994) and increasing the fibre content of the diet to promote satiety (Robert et al., 1993; Brouns et al., 1994).

It is difficult to obtain a clear picture of the relative effectiveness of these different techniques because they have frequently been (1) combined in various combinations, (2) confounded with increased or altered nutritional value, (3) applied concurrently with, separately from, or in place of, the standard diet, (4) tested on only one or a few animals, (5) applied sequentially for short periods, with possible confounding by residual effects of previous treatments and (6) assessed by a variety of different measures. Not all stereotypies are feed-related. Stereotyped pacing by Fennec foxes appeared to be more related to lack of cover than method of food presentation although providing food in smaller pieces did have some benefit (Carlstead, 1991). Different techniques may be more or less effective depending on the feeding habits and intellect of different species and individuals at different ages, and the influence of social dynamics on access to food (Chamove et al., 1982). However, features of importance in stimulating foraging behaviour appear to include reduced predictability of food location, a contingency between the performance of behaviour and a functional consequence, and opportunities to develop and maintain complex foraging skills. There is a clear need for more research in this area.

### The Physical Structure of the Environment

Captive environments are often characterised by flat, featureless walls and floors and an absence of internal structure. The complexity of the physical environment can be increased by adding an upper tier (Fraser et al., 1986) or vertical partitions (Simonsen, 1990) to divide the space into different functional areas and by adding biologically relevant features, such as perching and dust bathing sites for chickens (Newberry, 1993). Access to alternate enclosures indoors or outdoors can provide increased opportunities for exploration, patrolling and choice of social companions (Rumbaugh et al., 1989; Newberry, 1993). Walls may be made more inhabitable for some species by providing ledges and climbing holds, and a feeling of security may be enhanced by providing opportunities for camouflage and hiding. For example, chickens rested and preened more when near vertical partitions which provided partial visual cover than when near opaque or transparent partitions (R.C. Newberry and D.M. Shackleton, 1994, in prep.). Further discussion on the physical dimensions and structural design of animal enclosures can be found in Chamove (1989) and Newberry (1993).

### The External Environment - What's Beyond the Four Walls?

Environmental enrichment efforts should be directed not only to the internal environment of the enclosure but also to the surrounding area within the animals' sensory range. For some species, the outlook from captive environments may affect health, as observed in human patients who recovered more rapidly from surgery in rooms with, than without, a window (Ulrich, 1984). Dogs (Hubrecht, 1993) and silver foxes (Mononen et al., 1993) will use a raised platform in their cage as a look-out if it affords a view of neighbouring animals and the approach of people. O'Neill (1989) relates an observation that single-housed monkeys showed less abnormal behaviour when located in a cage next to a window. However, a view of large numbers of human visitors at a zoo may not be beneficial. Chamove et al. (1988) concluded that visitors were a source of stressful excitement rather than environmental enrichment based on increased aggressiveness, activity and stereotyped locomotion associated with the presence of visitors, especially when the number of visitors increased, when visitors appeared larger and when they attempted to interact with the animals. They suggested that the negative impact of visitors could be reduced by designing exhibits so that visitors appeared smaller or less visible.

## CONCLUSIONS

I suggest that the following steps be taken in the development of environmental enrichment for captive animals.

(1) Clearly identify the problem to be solved and the goal of environmental enrichment.

(2) Develop and test hypotheses to explain the causation and development of the problem. If the aim of environmental enrichment is to reduce a behaviour considered undesirable, knowledge of the motivational state underlying the behaviour will assist in identifying appropriate methods to solve the problem.

(3) Once a reasonable understanding of the mechanisms underlying the problem has been reached, design environmental enrichment techniques to test specific hypotheses about how the problem can be solved. Knowledge of the natural behaviour of the animals and the signal value (Guildford and Dawkins, 1991) of different stimuli in their natural habitat and social environment is likely to be the most effective method of identifying relevant stimuli or opportunities missing from captive animal environments which could be used as sources of environmental enrichment.

(4) Incorporate sufficient complexity to avoid channelling of behaviour into simple, repetitive movements (Lawrence and Terlouw, 1993). Minor increases in the complexity of a barren environment will not generate a complex behavioural repertoire.

(5) Apply the enrichment techniques in a systematic manner. Research in which a large number of variables are changed at the same time makes results difficult to interpret and may result in methods which are less effective and more costly than necessary.

(6) Take into account the effects of previous experience and learning ability on ability to adapt to an enriched environment. Residual effects of enrichment following withdrawal of enriching stimuli or movement to a new environment should also be addressed.

(7) Carefully describe animal responses to the stimuli provided. It is not sufficient to refer simply to "use" of a device. If a device elicits atypical stereotyped behaviour, it could not be considered an appropriate form of environmental enrichment.

(8) Ensure that the animals are able to control the type and level of environmental stimulation which they receive. The environmental design should enable animals to respond to challenges with adaptive responses, such as being able to move rapidly to cover if an alarming object suddenly appears (Moodie and Chamove, 1990).

(9) Conduct a cost-benefit analysis to identify the most effective method of enrichment to meet the specified goal.

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# ENVIRONMENTAL ENRICHMENT IN FOX FARMING

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Fox farming is widely criticized for many reasons. Some of the reasons concerns the welfare of the farm fox. Since the early eighties welfare has been the subject of a great number of scientific studies, especially in the scandinavian countries.

The present communication reviews some of these studies and presents new data from choice experiments. The review include the following subjects: Effects of whole year shelters, improvement of breeding boxes, man-animal relationships including early handling, and animal-animal relationships. The choice experiments concern aspects of the cage environment. During a series of long lasting experiments the percentage of scanning observations spent near or in a certain cage equipment was measured as an expression of preference. In this way the experiments showed that adults from both species preferred a nest box in a high position as compared to a low position, and a nest box with more rooms as compared to one room. In spite of this general preference adult silver foxes spent more time in a cage in which one nest box room was substituted by an observation platform. Blue foxes did not behave this way. Adults from both species did not differentiate significantly between nest boxes with transparent versus solid roof, or between cages with wire net versus solid floor. Cubs from both species clearly avoided wire net floors with conventional mesh size. As cubs grew older this avoidance was reduced, especially in blue foxes.

Many studies suggest means of improving the welfare of farm foxes, and these means are now tried out under practical farm conditions in the form of a comparison of three different housing systems: (I) The traditional cage system, (II) an enriched cage system, and (III) an enriched enclosure system with concrete floor. The two alternative systems include whole year nest boxes designed to facilitate proper early experience, observation platforms and resting shelves. They differ with respect to size and floor type. The first results of the testing of the three different housing systems will be communicated.

L2.3

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# MANAGEMENT FACTORS ASSOCIATED WITH STEREOTYPIC AND REDIRECTED BEHAVIOUR IN THE THOROUGHBRED HORSE

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There has been much debate about the causes of unwelcome behaviours in the stabled horse. Heritability has been shown to play a role in the frequency of stereotypies. Frustrated motivation is thought to be another cause possibly arising from a lack of of social contact, insufficient roughage, erratic mangement, inconsistent training methods or the horse's loss of control over its environment. The aim of the current work was to establish the importance of 22 such management practices as they related to the prevalence of three stereotypies; weaving, box-walking and wind-sucking/crib-biting, and the redirected behaviour; wood-chewing. This survey sampled the largest relatively uniform population of horses (n=2946) yet to be studied and is the first to have investigated any correlation with management factors using stepwise unconditional logistic regression. Of the factors found to be linked to an increase in the prevalence of abnormal behaviour ($p<0.05$), the majority pertained to the management of young horses in training. The risk of horses performing abnormal behaviour increased as the amount of forage offered fell below 6.8 kg per day (Odds Ratio OR 2.5), when bedding types other than straw were used (OR 1.9 with a Pearson chi-squared=12.3 $p<0.0005$), when the total number of horses on the yard was fewer than 75 (OR 1.3), and in box designs that minimised contact between neighbouring horses (OR 1.7).

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# The influence of two types of environmental enrichment on the behaviour of farmed red deer

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Deer Farming is a growing industry in the moment. However, research concerning the welfare of farmed deer has been until recently only a minor research topic. The most popular species for farming is red deer (*cervus elaphus*). The paddock usually used differs little if at all from a normal paddock for other farm animals with the exception of a higher fence. However, from our knowledge about the natural history of red deer we know that it is a woodland - edge species. Thus shelter seemed to be a basic need for red deer to avoid predators and to overcome thermal distress.
Therefore a study was carried out to assess the effects of environmental enrichment on the behaviour of farmed red deer. Eighteen farmed hinds were kept in three groups of six animals in three different paddocks. Paddock A was featureless, in paddock B the animals had access to a stripe of thick forest and in paddock C an artificial shelter was provided. The animals were exposed to three different levels of disturbance. The behaviour and the spatial distribution of the individual animals were recorded and with the behaviour in the control treatment (no disturbance) compared. The data were recorded on a checksheet every five minutes using scan sampling technique.
For the spatial distribution of the animals aversive effects of the farm area nearby and the attempt of being close to fellows were evaluated as influential factors. Sections close to the stripe of forest were significantly less occupied. During the treatments the animals spent more time ($p < 0.05$) behind the artificial shelter.
The analysis of the behavioural observation concentrated on lying and standing behaviour and on disturbance reactions. During the experiment (six weeks) no tendency for habituation was recognizable. Older animals showed significantly ($p<0.05$) more disturbance reactions indicating that long term habituation to humanes does not play an important role. Artificial shelter caused a significant decrease ($p < 0.001$) in disturbance reactions.
In addition increased disturbance reactions were to a great extent expressed as fence pacing. This behaviour has a stereotypic nature and indicates a possible welfare problem.

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# EFFECTS OF AN ENRICHED ENVIRONMENT ON SUBSEQUENT FEAR REACTIONS OF LAMBS AND OF THEIR MOTHERS

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It is well documented, in many species, that environmental enrichment during early life affects subsequent behaviour of the animals including a reduction of emotional reactivity.

In previous studies of fear reactions in domestic sheep, we have demonstrated that mother–reared animals are more fearful than artificially–reared ones. In an attempt to reduce fearfulness of the former, 20 lambs (2 groups of 10) were reared by their mother in an enriched environment (E) from birth to weaning (3 months of age). This included visual stimuli (coloured mobile objects hanging from the ceiling and a rotating painted disk activated 10 min per hour) plus the permanent presence of a human–like model (dressed with the typical overalls worn by the stock person in charge of the animals) whose position was changed every day.

Fear reactions of these lambs were compared, when they were 8 months old, with those of 18 control lambs reared by their mothers in normal husbandry conditions (C). Fear reactions of the mothers were also studied, using the same tests, just after weaning of their young (groups 1 and 2)and 5 months later (group 2). The previously validated behavioural tests involved isolation, surprise effect and presence of a human. Fearfulness scores, calculated from 26 behavioural items related to fear, were used: the higher the score, the more fearful the animal.

No effect of an enriched environment was found for young animals, as reflected by the fearfulness scores: isolation test (E: 19.9 ± 5.0 Vs C: 18.1 ± 5.0), surprise test (E: 19.7 ± Vs C: 18.3 ± 4.6) and human test (E: 19.5 ± 4.1 Vs C: 18.5 ± 4.9). On the contrary, fear reactions of adult females placed in the enriched environment soon after parturition and during rearing of their young were reduced in the surprise test and in the human test, as compared with controls (respectively 18.6 ± 3.6 Vs 22.4 ± 4.7, P=0.02; 18.2 ± 4.1 Vs 21.8 ± 2.9, P=0.01). This effect was still observed 5 months later.

Several hypotheses can be made to explain the fact that no effect of an enriched environment was found in young animals:

- there is only a transient effect, so we did not see it because the lambs were tested 5 months after the end of the enriched period (fear tests being validated for animals over 8 months of age). However, a long lasting effect was found in their mothers.
- the level of fear of the young was so high that we could not detect differences between E and C ("ceiling effect").
- the enriched environment is ineffective in lambs because of the strong bond with their dams which minimises its impact.

The long lasting effect of the enriched environment in adult females, and not in young is surprising. Another hypothesis could be that around parturition, and/or during lactation, ewes are particularly reactive to their environment. Effectively, adult cyclic ewes (N = 10) placed for 3 months in the same conditions did not present reduced fear reactions as compared with controls.

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# The effect of barren and enriched housing environments on the interactive behaviour of pigs

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Pigs are often housed in conditions that are barren and which provide few stimuli to motivate the animal to explore and to interact with the physical environment. These environmentally impoverished conditions may lead to an increase in behavioural problems. This may arise as the animal has fewer opportunities to interact in an active manner with objects of motivational significance. It is possible that animals may respond to these conditions by withdrawing and being unresponsive to the stimuli present or, alternatively, by being overly persistent and tending towards self-organization. To test the effect of barren or enriched housing environments on the behaviour of growing pigs, twenty-six female pigs were housed individually from about 10 weeks of age in barren or enriched pens, with thirteen pigs in each treatment, for a period of five months. All pens were 2 m x 4 m with a concrete floor and contained a feed trough and drinker bowl. Enriched pens also contained straw, forest bark and branches. The pigs were fed *ad libitum* on a diet appropriate to their age. In each month each pig was observed in its home pen on one day, and on two other test days presented with a novel object in a test arena attached to the home cage and with a different novel object in the home pen. Results from the home pen observations without novel object will be given here. The behaviour of each pig was focal sampled for 15 mins each in the periods before feeding, after feeding and after cleaning, and for 60 mins between 1300 and 1500 hours. Posture, behaviour pattern and substrate were recorded, and rates, bout lengths and proportion of time spent in each behaviour pattern were calculated. The enriched pigs moved about more ($P<0.05$) although there was no difference in the total time spent lying down. Barren pigs spent a larger proportion of time sitting, standing and lying idle ($P<0.001$) and chewing with no substrate in mouth ($P<0.05$). Barren pigs spent a larger proportion of time interacting with the feed trough ($P<0.05$), floor ($P<0.001$) and bars of the pen ($P<0.05$), and initiated more bouts of floor-directed activity ($P<0.001$) that enriched pigs. Barren pigs also tended to spend longer interacting with the pig in the neighbouring pen ($P=0.09$). There was no difference between treatments in the bout lengths of nosing or licking at the available substrates, but enriched pigs performed longer bouts of chewing ($P<0.001$) and barren pigs longer bouts of rooting of substrates ($P<0.05$). However, enriched pigs spent a larger proportion of time interacting with the substrates available to them ($P<0.001$) and tended to initiate more bouts of interaction than barren pigs ($P<0.07$), perhaps because they had more substrates to interact with. It appears that barren pigs direct their manipulation at the substrates that are available to them, which may include the manipulation of other pigs. The 'vacuum' chewing which was performed by barren pigs may be the precursor of a stereotypic activity. As fewer substrates were available to barren pigs this may explain why the total duration of interaction was less than for the pigs with access to a greater variety of substrate. Despite this, the barren pigs did not completely compensate by interacting more with the substrates in the barren pens. The substrates in barren pens may have been of a lower manipulative quality, or the pigs had a lower motivation to interact with them. These results will be related to the behaviour of these pigs in the novel object tests.

L2.7

# EFFECTS OF THE REARING ENVIRONMENT ON THE DEVELOPMENT OF DUSTBATHING AND FEATHER PECKING IN DOMESTIC CHICKENS.

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The influence of environmental factors during ontogeny often impose dramatic effects on later behaviour. In this experiment it was investigated whether lack of sand during early stages of development will lead to an increase in feather pecking and later problems in the initiation of dustbathing behaviour. Eight groups of 10 female white leghorn chicks were kept in wire floor cages (45x45x50 cm) from day old to 5 weeks of age. From 2 days of age four of the groups had continuous access to a wooden tray with dark dry sand, while a wooden frame of the same size was placed on the wire floor in the other four cages. Light at a low intensity (10 lux) was on for 16 h each day, but intensity was raised daily to 250 lux for $1^1/_2$ h from 5 h after light on. The birds were observed on 21 observation days during the first hour with high intensity light . During this hour no significant differences in the dustbathing activity and the number of feather pecks received by the dustbathing birds were seen. There was a tendency for more feather pecks directed at the feathers of cage mates by the "dustbathing" birds without sand (22.0 ± 19.2/h) compared to the birds with access to sand (6.5 ± 11.1/h) ($p<0.08$, Mann-Whitney U-test, one-tailed). Time lapse video recordings round the clock revealed that birds with no access to sand showed less bouts of dustbathing ($p<0.01$, Sign test). A plumage scoring at 5 weeks of age showed that birds without access to sand had a significantly more deteriorated plumage ($p<0.02$, Mann-Whitney U-test). At 6 weeks of age the birds were allocated to 24 groups of 3 birds, and all were given continuous access to sand for some days. Following one day of deprivation, the birds were then tested by giving them access to sand and their dustbathing and feather pecking behaviour were recorded. The chicks reared without sand performed more vertical wing-shakes compared to the chicks reared with sand ($p<0.002$, Mann-Whitney U-test). No significant differences were revealed in latency to dustbathing as well as feather pecking. It is concluded that lack of access to sand during rearing leads to less bouts of dustbathing behaviour and increased plumage deterioration, but when later given access to sand it does not seem to affect feather pecking during dustbathing or ability to perform normal dustbathing in young chicks.

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# BEHAVIOUR AND PERFORMANCE OF SOWS AND PIGLETS IN CONFINED AND NON-CONFINED FARROWING SYSTEMS.

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Work is being undertaken to modify the family pen system (Stolba and Wood-Gush, 1994) and design new pen layouts which fulfil the original functions whilst attempting to improve on piglet mortality, dung management and consistency of lactational oestrus. The aim of the following study was to determine the effect of an enriched environment on the maternal behaviour of the sow and on the behavioural development of the piglets.

The behaviour of 24 sows and litters was recorded during daytime on days 1,3,5,7,14,21,28 postpartum. They were housed in 3 groups of 4 in a family system (FS) and in conventional farrowing crates with wood-shavings (FC). FS consisted of straw-bedded, voluntary-accessed farrowing pens with heated creep areas and a communal outer area. Occupancy of the farrowing pens in FS by the sows and piglets fell from 92.5% and 100% on day 1 to 35.5% and 75.3% by day 28. FS sows were more active (53.1% v 40.2%), showed more substrate-directed behaviour (11.3% v 2.2%) and tended to show less pen-directed behaviour than FC sows. FS sows spent more time lying with their udder exposed (57.9% v 42.8%) and more time suckling (18.1% v 13.8%). FS piglets spent more time lying on their sides (50.7% v 31.5%), playing (0.9% v 0.1%) and less time in pen-directed behaviour (0.2% v 0.8%); they tended to show more suckling, more substrate-directed behaviour and spent less time chewing the sow than FC piglets.

Overall piglet survival per litter to 4 weeks was slightly higher in FS (9.3 v 8.8). The incidence of losses up to 2 weeks tended to be higher in FS while the incidence of stillbirths tended to be higher in FC.

The study indicated that the provision of straw bedding and more space may improve maternal behaviour and reduce the development of anomalous behaviour such as the chewing of pen fittings and other pigs which become established at a very early age. Unwanted attention by the piglets and increasing motivation to move away from the nest area are important factors which may affect the welfare of the confined farrowing sow.

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# EFFECT OF SUCKLER COW HOUSING ON NUTRITIVE ACTIVITIES IN CALVES

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Objective of this study were to quantify changes of behaviour of the calves fed by nursing cows. Cows were from the second week after freshening suckled of three to four calves. The number of the calves per one cow was directed according to milk yield, one calf having 5 kg milk. Nursing cows with the calves were kept in loose housing with straw bedding and concrete exercise yard, but the motion of the cows was limited by a longer tying chain. Twelve calves were used in 14 weeks experiment. The average age and body weight of calves was 6 days and 36 kg at the beginning of the experiment. Five ethological observations were carried out, from 15th to 80th day of life. The behavioral activities were recorded of each calf individually during 24 h observation periods. Number of suckling was the highest on 15th day of age (24) and on 22th day (20). The highest time of suckling was assessed on 15th day (109 min) and the lowest time on 36th and 56th days (58 min, 61 min). Frequency of eating of concentrate, alfalfa hay, litter straw and feeds from manger of cows were higher on 36th day in comparison with 15th, 22th and 56th days of life. Time of eating these feeds had a similarly course, the highest times were assessed after weaning at 80th day.Frequency of suckling during 24 h estimated in time series were the highest between 6-9 h a.m. and 4-7 h p.m. at age 15 and 22 days. On the other hand, frequency of suckling at age 36 and 56 day had four to seven peaks, which were almost regularly divided during 24 h period.

P2.3

# A comparison of the time budgets of laying hens housed in battery and free range systems.

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Duration and frequency data were recorded for 24 behaviours performed by laying hens over a 7 week period housed at two battery and four free range farms. In the two battery conditions hens were housed 6 per cage (allowing 480 $cm^2$ per hen) and 4 per cage respectively (allowing 335 $cm^2$ per hen). Data were collected from one focal hen from a video tape recording taken from the front of a cage (chosen each day). In each of the four free range farms behaviours were collected by direct observation of individual hens. Observing the same hen throughout the day proved impossible and data were therefore taken from different hens for each hour. In all cases data were collected for 20 minutes in each hour all day (3:00 to 17:00 for battery; 5:00 to 20.00 for free range). Data from free range farms, over the seven week duration of the study, were pooled and compared with similar pooled data for battery farms (Mann Witney U test).

*Dustbathing, wing flapping, head shaking and neck stretching.* Dustbathing (or vacuum dustbathing) was virtually non-existent in the battery condition and significantly greater in free range ($p < 0.05$ for durations; $p < 0.01$ for frequencies). More wing flapping occurred in the free range condition ($p < 0.01$ for durations; $p < 0.05$ for frequencies) while head shaking was greater in free range ($p < 0.05$ for durations; $p < 0.01$ for frequencies), the latter being viewed as a stereotypy and indicator of stress. Time spent neck stretching was significantly greater in the battery condition ($p < 0.01$) and was identified as a possible vigilance behaviour.

*Aggressive (and related) behaviours.* More pushing (a non-aggressive behaviour) occurred in the battery condition ($p < 0.01$ for durations; $p < 0.001$ for frequencies) but the duration and frequencies of aggressive behaviour did not significantly differ between the two conditions (with the exception of the frequency, but not the duration, of threat/avoid - $p< 0.05$). No fighting was recorded for the battery condition and only two fights in the free range.

*Feeding (and related) behaviours.* Feeding occupied the largest proportion of time in both conditions (15.85% for battery; 11.02% for free range). Duration of pecking the ground (or cage floor) was greater in the free range condition ($p < 0.01$) and feeding (from the trough) was greater in the battery condition ($p < 0.05$). Time spent feeding and pecking/scratching (combined) did not significantly differ between the two conditions (33.16% for battery; 32.06% for free range) suggesting this behaviour is of high priority to laying hens. Drinking took place five times longer ($p < 0.01$) and was more frequent ($p < 0.001$) in the battery condition and may have occurred in excess to fill available time (a possible indication of frustration).

P2.4

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# ENRICHMENT THAT SATISFIES SPECIFIC BEHAVIOURAL NEEDS IN EARLY-WEANED PIGS

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Abnormal aggression, chewing of ears and tails, and belly-nosing are common vices in early weaned pigs. To reduce boredom and divert pigs, weaner pens are commonly enriched with balls, chains and tyres. But it seems more appropriate to provide opportunities to satisfy the thwarted behavioural needs, such as sucking and rooting, that may lie behind these vices. Two pens of 23-26 4-week-weaned pigs were observed over 2 weeks from weaning under each of 3 conditions: (i) in standard flat decks (controls: C); (ii) with a tyre, balls, and hanging chains ('toys': T) added; (iii) ethologically enriched (EE) with a peat-filled rooting tray and an 'udder board' (a vertical carpetted board, with 4 protruding rubber tubes). Pigs sniffed and nosed other pigs ($p<.05$), belly-nosed ($p<.01$), and chewed ears and tails ($p<.05$) significantly less in EE than in C pens. Only chewing of piglets was reduced in T pens compared to C ($p<.05$). In T pens, pigs spent 10 times as long (1.24 min/h/pig) chewing chains as they did interacting with either tyres or balls. In EE pens, pigs spent more time rooting in the tray (5.37 min/h/pig) than interacting with the udder board ($p<.05$), but each was used more than all toys in T pens combined.

Two further experiments gave weaners, in flatdecks ($N = 198\text{-}202$/pen), simultaneous access to different rooting media or chew objects. Turf was rooted at more than peat (mean: 2.63 vs 1.13 min/h/pig respectively over 1.5 h morning observations: $p<.001$), but the peat-filled rooting tray was used more overall, due to its wide-spread adoption as a lying area. A carpeted tray was used no more than one of bare board. A vertically hanging rope was chewed more than each of three artificial dog-bones, which, in turn, received more attention than vertically hanging chains (2.08 vs 0.85 vs 0.18 min/h/item/pig respectively; $p<.001$). Chewing was directed twice as much at the twine to which the bones were tied than at the bones themselves.

P2.5

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

NATIONAL INSTITUTE OF ANIMAL SCIENCE

# A COMPARISON OF NURSING AND SUCKLING BEHAVIOUR OF GROUP AND INDIVIDUALLY HOUSED SOWS AND THEIR LITTERS

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Nursing and suckling behaviour in relation to weight change of piglets were studied during the first 4 weeks after birth in group and individual housing in a pilot study. Thirteen litters were housed in individual farrowing crates for the first 10 days and then they were introduced in 3 groups (5, 5 and 3 litters in one group). Five control sows with litters were housed in individual farrowing crates. Litters were observed during two successive nursings with milk ejection once every week.

The following differences in suckling behaviour were observed between the two systems. The proportion of piglets which missed nursing was higher in group housing (average 20%) than in individual crates (average 4%, Mann-Whitney U-Test, $p=0.002$) between weeks 2 and 4. The number of missed nursings of individual piglets correlated with their weight gain in group housing ($r_s = -0.27$, $n=108$, $p<0.01$). Grouping of sows between weeks 1 and 2 was associated with a decline in teat fidelity from 79% to 33%. The teat fidelity was lower in group housing in comparison with individual housing at week 2 (33% vs. 75%, Mann-Whitney U-Test, $p=0.25$), week 3 (38% vs. 100%, Mann-Whitney U-test, $p=0.06$) and week 4 (50% vs. 89%, Mann-Whitney U-test, $p=0.02$). Nursing without milk ejection was more common in group housing (average 25%) than in individual farrowing crates (average 4%, Mann-Whitney U-test, $p=0.03$). Cross-suckling was observed in 9 of 13 sows in group housing and was more common in large litters ($r_s = 0.57$, $p<0.01$).

Daily weight gain of piglets from week 2 to week 4 tended to be higher from the second week in individual crates (0.20 kg) than in group housing (0.15 kg, Mann-Whitney U-test, $p=0,06$). Using the forward selection method, linear regression models were identified that predicted weight gain of litters and of individual piglets at best. Individual weight gain between days 0 and 7 was most closely associated with sucking position ($p=0.0027$). Litter weight gain between days 0 and 7 was dependent on litter birth weight ($p=0.036$). In group housing, litter weight gain between week 2 and week 4 was influenced by the proportion of nursings without milk let-down ($p=0.042$). In spite of changes in sucking behaviour after grouping, no other behavioural variables were found to have a significant influence on weight gain in group housing.

# WOODEN BLOCKS AS ENRICHMENTAL TOOLS FOR RATS

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Laboratory rodent cages are considered too monotonous for the animals. In this study, wooden blocks were evaluated as environmental tools for rats. Han:WIST rats (52 males and 26 females) were housed after weaning in groups of 1, 2, 3 or 4 animals in stainless steel cages with aspen bedding. The females and half of the males had aspen wooden blocks (1 x 1 x 5 cm) in their cages. The behaviour of the males was tested in a five min open field test. At the age of 14 weeks the males were removed into the cages with wire mesh bottom without bedding. After four weeks housing in these cages the males were sacrificed and the adrenal, thymus and spleen weights were measured. The growth of the animals was followed up by weekly weighing.

In solid bottom cages with bedding, the animals dealt with the blocks only 0.5 – 3 minutes/day, the gnawing being the most intensive and long-lasting behaviour with the blocks. Accordingly, the weight loss of the blocks was used as an indicator of their use. The mean daily weight loss of the blocks was 0.2 ± 0.1 g / animal. The sex or age of the animals did not affect the use of the blocks, nor did the number of the animals in cage or the cage place in the rack. The presence of the blocks in the solid bottom cage did not influence the general activity, grooming, rearing, standing or defecation in the open field arena. The animals living alone were less active in the open field test than the animals living in groups. When the animals were removed into the cages with wire mesh bottom without bedding, the gnawing of the blocks increased to 3.5-fold. The number of the animals in the cage or the presence of the blocks in the cage did not have effect on the growth of the animals, nor did it affect the adrenal, thymus or spleen weights, the organs commonly used indicators of the stress.

In conclusion, in the absence of bedding material, the blocks may have some enrichment value. The possibility to use them did not, however, affect the physiological parameters measured in this study. With bedding, there was no obvious need for the blocks.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# FOOD PRESENTATION AND STEREOTYPIES IN BROWN BEARS

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In zoo animals environmental enrichment is an important aspect of increasing the well-being of animals. However, in most cases the number of subjects for doing research in environmental enrichment is not enough for normal statistical analysis. Single-case studies can be done using the appropriate design, set-up, and analysis. Results of single-case studies can be combined using meta-analysis. Especially the use of frequency analysis and log linear techniques is recommended recently for single-case studies (Bakeman et al., 1992). For experiments concerning feeding enrichment we studied a group of five brown bears, allowing for analysis per individual and over the total group. Four factors were manipulated in a hierarchical way (16 days of food presentations), i.e. Volume (small vs. large amount of food), Size (small vs. big pieces of food), Distribution (clumped vs. scattered presentation of food) and Whistle (food presentation not preceded and preceded by whistling). Furthermore, the data were split in two periods after feeding (an hour and a quarter each). The amount of stereotypies was affected by the different food presentations, i.e. a larger Volume of the food lowered the amount of stereotypies in one bear (p=0.000) in the second hour, but did not influence the others. The scattered Distribution of the food increased the duration of stereotypies in one bear (p=0.016), but again did not affect the others. The Whistle affected an other bear (increased stereotyping in the first and second period: p=0.000). The interindividual differences are so large that combining the results of the individuals showed that overall no factor was effective in reducing stereotypies. The animal that showed the most intense stereotypies reacts on the Volume and Distribution of the food. The possibility for experiments aimed at just one individual shows the large value of this approach for evaluating experiments concerning environmental enrichment in zoos.

Bakeman, Roger; Forthman, Debra L.; Perkins, Lorraine A. Time-budget data: log-linear and analysis of variance compared. Zoo Biology, 1992; 11: 271-284.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

NATIONAL INSTITUTE OF ANIMAL SCIENCE

# STUDY ON FACTORS AFFECTING PLATFORM USE IN BLUE AND SILVER FOXES

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European Convention has recommended that each fox should have a more enriched housing environment, including resting platforms. Factors affecting platform use were studied in silver (N=120) and blue foxes (N=300) by monitoring the animals either (1) with 24-hour video measurements or (2) daily visual scanning observations. Both year-round and 5-month-long seasonal experiments with various types of platforms were done. There was great individual variation in the amount of use ($p<0.001$). In both species, however, females used the platforms significantly more ($p<0.05$) than males. Previous platform experience and the platform ceiling influenced use ($p<0.05$) only dusiring the first two study months. Platform type affected useage significantly ($p<0.001$). The platform most favored was V-type, whose shape resembles that of the sleeping hole foxes use in the wild. Platform use varied significantly ($p<0.001$) year around, being the lowest during winter, and the highest in summer. During early winter, a significant regression was found between daily use (y) and air temperature (x) as follows: $y=0.43x + 24.1$ ($p<0.05$, silver foxes) and $y= 0.35x + 37.7$ ($p<0.05$, blue foxes). During this period, the heaviest foxes used the platforms most and vice versa. Platform use dramatically decreased after females were given whelping nestboxes as they preferred the nestbox roofs. The locomotor activity of platform foxes was somewhat less ($p<0.05$) than that of the controls. Platforms were most frequently utilized for sleeping and the least for jumping or other short-term visits. It seems obvious that the main function of platform use is not limited to that of an observation post alone. The question of whether platforms affect the temperament or wellbeing of foxes remained open.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# Effect of housing systems and level of whole milk on the motivation of movements in calves

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The aim of this study was to examine the need for physical activities during early life, and the affect of energy consumption on the activity level. As a part of a larger experiment the effect of housing and level of whole milk on the motivation of movements in calves were examined both in "home environment" and in an "open-field test".

During the first 3 months of life 50 Danish Holstein-Friesian calves were housed in either: 1. Open single box, 2. Closed single box, 3. Group box (5 calves/box), 4. Open single box, and 5. Group box (calves and cows together). Until 42 days of age calves on treatment 1, 2 and 3 were fed 4.6 kg whole milk per day, and calves on treatment 4 were offered whole milk ad libitum. Calves on treatment 5 could suckle their mothers during the three month period. At 3 months of age all calves were tethered.

The calves were videorecorded in their home environment from 1 hour before until 2 hours after the morning feeding on day 3 and in the 3rd, 6th and 10th week after parturition. Three open-field tests were carried out in the 2nd, 10th and 25th week of life, and the duration of each test was 15 minutes.

Calves in group boxes spent more time running, jumping and kicking than calves in open and closed single boxes. In the open-field test calves from open and closed single boxes tended to run for longer than calves from group boxes. In comparison with restricted milk, a high level of milk tended to increase running, jumping and kicking in the home environment. Furthermore, in the open-field test high level of milk resulted in more running.

Housing of calves in single boxes during the first 3 months seems to inhibit their physical activities. A high feeding level of whole milk increased the motivation for physical activity. The experiment continues with another 50 calves.

# PARENT-OFFSPRING CONFLICT IN PIGS.

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Parent-offspring conflict theory predicts that sows and piglets should be in conflict over the amount of parental investment (PI) in the litter as the lactation advances. We tested this hypothesis and examined potential tactics used by piglets to increase PI and potential counter-tactics by the sow. We assigned 40 multiparous sows and litters to either (1) a pen where the sow and litter were confined together throughout a 5 week lactation or (2) a "get-away" pen where the sow could leave the litter at will. In the confined treatment, sows lost more weight during lactation and took longer to return to oestrus after weaning. In the "get-away" treatment, piglets gained less weight, presumably because of lower milk production, but then ate more creep feed and suffered less set-back at weaning. Piglets whose mothers could leave, vocalized at the barrier to the absent mother and had a higher rate of contact with the sow when she was present. Sows in "get-away" pens gradually increase the amount of time they spent away from their offspring and gradually decreased their nursing frequency. Piglets of confined mothers spent more total time in contact with the sow, and sows lay on their udder more in an apparent attempt to reduce offspring stimulation. Thus piglets in confined pens and sows in "get-away" pens can bias milk production in their favour. This appears to be due to the amount of physical stimulation of the udder, presumably as mediated by endocrine events. Maternal control of milk output favours both farm animal welfare and production efficiency.

P2.12

# EQUATING BRIGHTNESS PERCEPTION OF BLUE AND RED LIGHTS AND LENGTH OF LINE DISCRIMINATION WITH HENS BY PSYCHOPHYSICAL TESTS

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Ten pullets of the Warren Studler 128 breed, aged approximately 18 weeks were used in three experiments using two identical chambers to determine the equivalent brightness perception of different colours (blue and red) in hens and their ability to compute a simple visual test. One half of the birds were initially trained to detect the brighter of two lights and the other half the dimmer. The first test, studied the brightness perception of hens using bright blue (24.140 x $10^{-23}$ photons) and dim red (0.66 x $10^{-23}$ photons); and the second test used bright red (32.372 x $10^{-23}$ photons) and dim blue (0.84 x $10^{-23}$ photons). In both tests, the brightness of the two colours of light were gradually brought together. The ability of hens to distinguish different brightness in the two colours was recorded over a number of presentations as percentage correct choice (>80% is taken as successful). The visual test was a length of line discrimination performed using equally bright red and blue lights (determined from the initial experiments), initially using a short line (10cm) and long line (30cm). The ability of hens to detect the longer or shorter line was decided by the percentage correct choice (>80%). In the first test the birds failed to distinguish the brightness of the two coloured lights at 11.20 x $10^{-23}$ and 3.07 x $10^{-23}$ photons for blue and red lights respectively (at ratio of 3.6 : 1.0). In the second test birds failed to distinguish the brightness of the two coloured lights at 2.53 x $10^{-23}$ and 7.84 x $10^{-23}$ photons for red and blue respectively ( a ratio of 3.1). At the mean ratio of 3.37 : 1.0 for blue to red, birds failed to discriminate lines 24cm and 16cm long, the same for both colours of light. It can be concluded that the chickens failed to differentiate the brightness of blue and red lights at a (photons) ratio 3.1-3.6 : 1.0. At this ratio chickens are not able to discriminate successfully a difference in the length of two lines of less than one third of its length.

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[1] Paper presenter

# EFFECT OF CAGE ENVIRONMENT ON TEMPERAMENT AND GENERAL ACTIVITY IN BLUE FOX (*ALOPEX LAGOPUS*)

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Although experiments from domestic and laboratory animals have shown that the housing environment can have a major impact on animal's temperament, experiments on farmed furbearers are few and the results are controversial. In this study the effect of housing environment inside (nest box *vs* resting platform in the cage *vs* empty cage) and outside the wire-mesh cage on temperament and general activity was assessed in farmed blue foxes (n=45). The temperament of the animals was assessed in a novel environment (open field) and in a home cage (capture time, reaction when captured, latency to eat in the presence of man).

The results show that the environment of the cage interior neither had an effect on animals' temperament nor on their general activity. On the other hand, the environment outside the cage was more important. The animals nearest to the door of the animal hall were most active during the 24-h measurements in their home cage ($p<0.001$) and in the open field ($p<0.001$). The general activity in the home cage explained a significant proportion (30 %, $p<0.001$) of the variance of the activity in the open field. The animals near to the door also actively resisted the capture while the animals farther from the door were more submissive.

The present results demonstrate that, unexpectedly, the unintentional experimental set-up (environment outside the cage) affected the behaviour of the blue foxes whereas the intentional set-up (cage interior) did not. The importance of careful experimental design cannot be over-emphasized.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# QUANTIFYING THE MOTIVATION OF LABORATORY MICE TO FEED BY IMPOSING NATURAL OBSTACLES

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Motivation can be quantified by requiring an animal to pay a "cost" to gain access to a resource. The motivation of 12 laboratory mice to feed was quantified by placing one of four natural obstacles (wind, narrow gap, shallow (15mm) and deep (65mm) water) between a home cage and food. Meal patterning behaviour was monitored for several days before, during and after presentation of the obstacles. Daily food consumption remained constant (ANOVA: $P<0.05$), however, both water obstacles reduced ($P<0.05$) the number of feeding visits (shallow, 18.4 cf 12.3: deep, 22.3 cf 6.2) and feeding bouts (shallow, 22.9 cf 19.1: deep, 30.6 cf 14.3). Three of the obstacles reduced ($P<0.0001$) the number of visits to the feeding area (narrow gap, 69.4 cf 34.0: shallow water, 62.2 cf 17.3: deep water, 63.9 cf 6.6). The latency to visit the feed on the first day that the obstacles were presented was considerably increased by the water obstacles (shallow, 31.6 cf 417.4s: deep, 33.8 cf 1766.4s). Although daily feed consumption remained constant, mice overcoming water obstacles changed their behaviour substantially indicating these obstacles were perceived by the mice as a "cost". This evidence supports the suitability of water crossings as a method for quantifying motivation in studies using consumer demand theory.

**28th International Congress of the ISAE**
**Research Centre Foulum, Denmark**
**3 - 6 August 1994**

# EFFECT OF TAIL DOCKING AND ONTOGENY OF "TAIL IN MOUTH" BEHAVIOUR IN FATTENING PIGS.

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Oral manipulation of pen mate's tail is an abnormal behaviour which may lead to damaging tail biting. The behaviour is commmonly seen in piglets after weaning as well as during the fattening period. Although most piglets reared in intensive pig production are preventively docked, many still have tail wounds at slaughterhouse inspection. The docked tail is more sensitive than the intact tail which may be the reason for the positive effect of tail docking in relation to tail biting in pigs. It may however also be claimed, that an intact tail with a tuft of long hairs may be more attractive as an object for penmate's oral explorative activity as compared to a hairless amputation stump and therefore the intact tail may receive more biting than the docked tail. The objects of the present study was firstly to test the hypothesis that fattening pigs were more attracted to penmate's intact tails as compared to docked tails secondly to elucidate the ontogeny of "Tail in mouth" behaviour during the fattening period. 576 piglets provided from 8 commercial farms were housed in environmental rich experimental pens from an average live weight of approx. 33.5 kg. Half of the pigs from each farm were tail docked as day old by cutting approx. one third of the tail. From the age of approx. 3 months until slaughter at a liveweight of approx. 100 kg the "Tail in mouth" behaviour as well as other kinds of social nibbling and biting of 8 groups each of 36 pigs with intact tails were compared with the behaviour of 8 groups of pigs with docked tails. The pigs were observed in 8 days evenly distributed over the fattening period. On each day all occurrence of the specific behaviours was recorded during three 15 minutes periods for each group. The tail status had no effect on "Tail in mouth" behaviour over the eight days of observation ($p<0.95$. Repeated Measures ANOVA). The "Tail in mouth" behaviour however, increased during the observational period ($p<0.03$, Repeated Measures ANOVA). This increase in tail oriented behaviour contrasted the general social nibbling and biting activity which decreased during the observational period ($p<0.02$, Repeated Measures ANOVA).

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# BEHAVIOR OF BUFFALO CALVES IN PERIOD BIRTH - 6 MONTHS AND MOTHER-CALVE RELATIONSHIPS

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The aim of investigation is to be studied behavior of 17 buffalo calves (Murrah x Bulgarian buffalo) in 3 periods: birth - 72h (1-th), 20 days age (2-nd) and 6 months age (3-rd). The newborns are separated immediately after birth for 14 days in individual boxes. After that buffalo calves are housed in a group of 6 to 8. The method of visual chronometry (individual for 1-st period and group - for 2-nd and 3-th) is used.

It was found that buffaloes have good adaptation resources. The deprivatoin of mother immediately after calving don't lead to abnormal behavior. Critical period for adaptation of buffalo-calves are first 24 h after calving. In this period newborns demonstrate unrest and try to establish contact with the mother.

The typical behavioral patterns for 1-st period are: rest (90%), standing (9%) and suckling (1%). The newborns have stable equilibrium on 80-th min after birth. In 2-nd and 3-rd period biggest is part of time for rest. It significantly decreases ($p < .01$) with increasing of the age. The tendency for increasing is found for eating time ($p < .001$) and rumination ($p < .001$). There are demonstrated abnormal form of eating behavior for 2-nd and 3-rd period.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# Brain opioid receptor density in pigs kept in groups, socially isolated and mixed during transport.

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Endogenous opioids and their receptors have a wide variety of functions and they play an important role in the modulation of stress responses. Relationships between density of opioid receptor sites in the brain and both stereotypies and housing conditions in pigs were reported by Zanella et al. (1991). However the significance of the above mentioned findings is not clear without information on the time course of changes in opioid receptor density. The question of whether or not acute or chronic stress can modulate receptor sites by means of down or up regulation and how long it takes for these changes to take place is still unanswered. In the present experiment mu opioid receptor density and affinity was looked at in 15 adult gilts from five litters. Ten gilts remained with their littermates throughout their lifetime. One gilt from each litter (n=5) was randomly selected and housed in a pen which prevented visual and social contact with other pigs, for 5 weeks. Space allowance, pen design and environmental conditions were kept as similar as possible for both isolated and group housed gilts. At the end of the experimental period gilts were transported to a commercial slaughterhouse. Single housed gilts were not mixed during transport. Group housed pigs were either transported in familiar pairs (n=5) or mixed with unfamiliar gilts prior to transport (n=5). After a 45 minutes journey, isolated and group housed gilts were slaughtered immediately after their arrival at the slaughter plant. Not later than 20 minutes after death their brains were collected and frozen. Whole brain membranes were homogenized and kept in liquid nitrogen until assay. Mu receptor density (Bmax) and the affinity constant was determined by a saturation assay (Zanella, 1992) using [$^{3}$H] RX7833006 (Amersham) as a radiolabelled ligand. Analysis of variance showed that 5 weeks of social isolation but not mixing prior to transport altered mu receptor density (F=5.136, df=2, p=0.0245). Pigs kept in social isolation had significantly lower opioid receptor density in their brains than pigs kept in groups (n=5, mean= 36.628 fmoles/mg (+- 5.332 SE) and n=5, mean= 62.183 fmoles/mg protein (+- 7.546 SE) respectively. Mu receptor density for gilts which were mixed during transport was 51.294 fmoles/mg (+- 3.269 SE). There were no differences in the affinity constant among the three treatments. Further work is needed to assess other opioid receptor subtypes as well as to explore in more precise detail the brain areas where the changes took place.

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# Session 3

# Individual variation in response patterns

L3.1

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# INDIVIDUAL VARIATION IN BEHAVIOUR - NOISE OR FUNCTIONAL STRATEGIES?

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## ABSTRACT

Consistent individual variations in behaviour, creating within-species categories of individuals, is predicted from game theory and has been observed in studies of coping behaviour in rodents. I suggest that four properties of individual variation are of particular importance to clarify: (1) The inter-situational consistency, i e the behavioural consistency between different exposures to the same situation. (2) The intra-situational consistency, i e the consistency in reaction to different situations. (3) The distribution of individuals, i e whether it is normal or discontinuous. (4) The genetical base for the distribution. I suggest that the theoretically and practically interesting types of individual variation are those that show high intra- and inter-sitution consistency, have a bimodal distribution and are due to genotypic differences between groups of individuals. Reviewing some of the data within the field, I conclude that there are good indications of distinct behavioural types of individuals among rodents, but not among pigs. This can be explained by ecological differences between the species and/or by domestication effects. There is a strong need for increased theoretical and empirical work that tie functional and mechanistic aspects of individual variations together.

## INTRODUCTION

At first glance, the subject of this paper may seem utterly trivial: Of course, individuals vary in their behaviour, as anyone with any animal experience would confirm. However, what makes the issue interesting is actually the exact opposite, i e individual consistency. The fact that categories of individuals within a species, sex and age-group may show consistent intra-group variations is the major theoretical reason for the contemporary interest in this field of ethology.

Discontinuous within-species differences were emphasized as an important part of evolution already by Darwin (for a recent interpretation of Darwin's original writings, see Darwin, 1979). However, during the rise of ethology, focus came to change towards so called species-specific behaviour, and to a large extent, intra-specific variation was regarded as unwanted noise (Slater, 1981). There has been a tendency to regard variation as an obstacle on the path to understanding the typical patterns of a group and thereby to overlook important within-group variation (Martin and Kraemer, 1987).

The present interest in individual variation has two diffent backgrounds. First, the discovery in behavioural ecology that natural selection under many circumstances will favour the coexistence of at least two different types of behaviour patterns, referred to as 'strategies' (for example, Maynard Smith and Parker, 1976). This has led to a number of different theoretical and empirical studies within behavioural ecology on strategy differences in, e g fighting and reproduction (e g, Parker, 1978; Keeley and Grant, 1993). As pointed out by Wallace (1979), if there is no single optimal phenotype from a fitness point of view, selection will be disruptive and cause the occurrence of bi- or multimodal population distributions. Thus, we would expect few intermediates and the individuals utilising different strategies may constitute separate categories.

The second background stems from stress and coping theory, where it was discovered in the seventies that individuals vary in their physiological and behavioural responses to challenging situations (Henry and Stephens, 1977). In a series of experiments, the width of these different coping patterns have been investigated in rodents by a group in Groningen (for a review, see Benus et al, 1991).

Unfortunately, these two background lines appear not to have been joined by any theoretical work. Whereas the coping theorists refer to functional arguments in attempts to explain some aspects of their findings (van Oortmerssen et al, 1985), the behavioural ecology literature appears free from any reference to coping theory, despite its apparent relevance.

Within applied ethology, it seems to be the tentative importance to stress theory that has prompted the most interest in individual variation. In the present paper, I will therefore mainly be concerned with the 'coping approach' to individual variation, although acknowledging the relevance and significance of the functional approach. My aims with the presentation are:

(1) To examine the evidence that there are discrete categories of individuals within species, in particular in rodents and pigs.
(2) To examine the possible backgrounds of such categories.
(3) To make some suggestions about future research directions.

## ARE THERE DISCRETE CATEGORIES OF INDIVIDUALS?

The most convincing data supporting the existence of discrete categories of individuals stem from mice and rats (Benus et al, 1991). Heritable variation in an array of inter-corelated behavioural reactions have been demonstrated. Thus, individuals that tend to attack intruders most readily also perform differently in different learning and extinction tasks and in the physiological reaction patterns compared to slow attackers. Whereas the most aggressive individuals ('active copers') show a predominant sympathetic reaction, the less aggressive 'passive copers' show a predominant para-sympathetic activation.

Von Holst et al (1983) found that male tree shrews (Tupaia belangeri) reacted upon being placed in a cage with a territory holder in one of two completely different ways. One category of individuals submitted to the dominant and continued to live as a second-ranked individual. The other never managed to cope and form a social relationship to the dominant and eventually died after a period of continuous hyperactivity in adrenocortical functions.

In domestic animals, it is mainly pigs that have attracted attention in the context of individual variation (but see Keeling and Jensen in this volume regarding hens and Manteca and Deag, 1993 regarding cattle. See also Mendl and Harcourt, 1988, for an excellent general review focused at cats). Individual variation in pigs is well known, although poorly understood (Appleby et al, 1992). Whereas some studies have failed to find any consistent categories of individuals (Lawrence et al, 1991; Jensen, 1994 a; Jensen et al, 1994 a), others have suggested some consistency between different measurements (Terlouw et al, 1991; Mendl et al, 1992).

Yet others have claimed to have demonstrated distinct coping patterns in much the same way as in rodents (Hessing et al, 1993; Hessing et al, 1994).

The studies highlight some important aspects of individual variation which must be taken into account when attempting to understand its background and implications:

(1) What is the intra-situation consistency in the individual variation, i e, how well can the behaviour in a given situation be predicted from observing the animal in the same situation on earlier occassions? If individual variation reflects true constitutional differences between individuals and not only measurement errors, a high intra-situation consistency should be expected.

(2) What is the inter-situation consistency? Constitutional differences of the kind reported for differently coping rodents should be associated with high inter-situation consistency. From observing the behaviour in one situation, one should be able to predict the behaviour in a different, biologically unrelated situation.

(3) What is the population distribution of the individuals? Whereas noise and measurement errors are likely to cause normal or poisson-like distributions, the existence of different categories of individuals should reveal bimodal or multimodal distributions.

(4) What is the genetical base for the distribution? A certain distribution of reaction patterns can be caused by genetic differences or be a result of differences acquired in a given situation (for example in the dominance position of a given group). Constitutional differences will probably have a strong genetical base.

I will argue that the interesting individual variations are those that exhibit high inter- and intra-situation consistency, are bimodally distributed and can be attributed to genetical differences between categories. The less these requirements are fulfilled, the greater the possibility that the variation is due to noise or measurement error.

In the following, I will review the evidence that these requirements are fulfilled in the species that have attracted most attention, mainly pigs and rodents.

## INTRA-SITUATION CONSISTENCY

There is plenty of circumstantial evidence for animals behaving in a consistent manner in comparable situations. From field studies, it is known that males may exhibit quite different mating strategies, for example in ruff (Philomachos pugnax) (van Rhijn, 1974) and sea elephants (Le Boeuf, 1974), where some males adopt a satellite position, refraining from overt competition but nevertheless managing to achieve copulations. Also in patterns of feeding, individuals may vary in a consistent and replicable manner (Slater, 1974; Clifton, 1979).

Under laboratory conditions, some tests reveal individually consistent results from one observation to another. For example, in the open-field test for rats and mice, some behaviour patterns are well correlated between test situations, whereas others are not (Ivinskis, 1968). Further in rodents, the latency to attack an intruder and an array of other behavioural reactions have been demonstrated to show a high consistency (Benus et al, 1991).

In pigs, Lawrence et al (1991) found very variable degrees of consistencies in different measures of reactions on handling. They also noted between-test similarities in individual behaviour in a social competition test, although no data to support this were given. Jensen et al (1994 a) found that the behaviour in an open field/novel environment test was well correlated between different test instances. However, when recording the undisturbed behaviour of piglets in the home pen with the sow at two different ages, no consistent behaviour patterns were observable between the recording instances. The same authors found no correlations between repeated pair-wise staged encounters in the tendency to fight.

Hessing et al (1993), however, claimed to have found high individual consistencies in two different test situations: A so called back test, where a piglet was manually restrained on its back and its escape attempts were recorded, and a social interaction test, where four to six piglets were allowed to interact and their aggressive behaviour recorded. However, the way in which these tests were performed has been strongly critisized (Jensen et al, 1994 b) and in our own experiments on similarly aged animals, we have failed to replicate the reported consistency both in the back test (Forkman et al, in prep) and in social confrontations (Jensen et al, 1994 a).

An important factor when judging intra-situation consistency is the time-scale. Of course, the shorter the interval between the tests or observations, the higher the chance that the agreement will be good. There is no immediate solution to this problem, but clearly more research on developmental changes are needed.

In conclusion, there appears to be at least some evidence of intra-situational consistency in some behavioural reactions, at least over a limited time scale. However, the variation between behavioural systems seems large, and each behaviour has to be judged in its own right, after separate testing.

## INTER-SITUATION CONSISTENCY

If variation between individuals reflects constitutionally different categories, we should expect some inter-situation consistencies. For example, if a certain individual tends to react in a generally active and resistant manner when confronted with a non-social challenge, we might expect this individual to be similarly active in a social challenge situation. In this context, I also treat correlations between physiological and behavioural variation, although it may sometimes be questioned whether this is intra- or inter-situational consistency.

There are some methodological problems in this context. When deciding which situations and variables to compare, it is essential that the researcher has some knowledge of the functional and motivational significance of the situations and reactions. The reason for this is that we want to compare situations and variables that are not only different reflections of the same type of behavioural reaction. As a trivial example: if one exposes an animal to a novelty test containing a novel object 'A' and subsequently to another novelty test with object 'B', any correlation between the reactions are likely to stem from intra-situation, rather than inter-situation consistency. Or more general: reactions on different occassions involving the same motivational systems should be judged as intra-situation consistency.

Whereas this may seem self-evident, the possibilities for pitfalls are several. As an example, Hessing et al (1993) used a so called back test as one situation and a social challenge test as another. In the back test, pigs were restrained on their backs for two minutes and their reactions were scored. The authors found that severely resisting individuals were more aggressive in the social encounter test. However, as pointed out by Jensen et al (1994 b), it could be questioned whether this is a demonstration of intra- or inter-sitution consistency. The motivational background of the resistance to restraint are not clear. Since a typical natural situation where a piglet can be found restrained is during a fight, it can not be excluded that the back test is only a different measure of the degree of activity in a social encounter.

The example illustrates the care that must be taken in deciding the types of situations that are used in studies. In particular in this area of research there is a frequent use of artificial test situations. I urge for greatest care in the motivational evaluation of the tests.

The coping literature contains some interesting demonstrations of inter-situation consistency. Male tree shrews that survived being placed in a cage with a resident dominant male also differed in a large number of physiological variables from males that were not able to cope with the situation (Von Holst et al, 1983). Mice that show short attack latencies against intruders also are less sensitive to minor changes in a labyrinth after they have learnt the correct path and respond slower to a reversal of the night-day cycle (Benus et al, 1991).

In pigs, however, the results are less persuasive. Lawrence et al (1991) and our group (Jensen, 1994 a; Jensen et al, 1994 a) failed to find any correlation between reactions in social and non-social situations. Mendl et al (1992) demonstrated individual differences in social behaviour within groups of sows and showed some physiological differences between these groups. Mendl et al were also able to demonstrate some fitness effects of the different behavioural types, but did not really attempt to demonstrate any inter-situation consistency. Hessing et al (1993) claimed to have demonstrated correlations between reactions in a non-social and a social test; however, as mentioned above, serious criticism can be raised against the way the tests were performed as well as the statistical treatment of the data (see further on in this paper) (Jensen et al, 1994 b).

In conclusion, the only really persuasive data supporting inter-situation consistency stem from rodents. In pigs, such effects have not been satisfactory demonstrated.

## DISTRIBUTION OF INDIVIDUALS

If there are different categories of individuals within a population, we expect bimodal (or multimodal, if there are more than two categories) distributions of individual reaction patterns. Some might find it acceptable to distinguish the extremes in a continuous distribution as separate categories given that they show inter-situation consistency, i e they are found in an extreme end of the distribution on several different test variables. However, this introduces three problems: (1) Where to set the limit between categories along a continuous distribution. (2) How to treat the intermediate individuals (do they represent noise or an intermediate category?). (3) Because of the statistical properties of the normal distribution, there will always tend to be more intermediate than classified individuals, which may be perceived as a theoretical problem for any categorisation of individuals.

It should be noted that the predictions from behavioural ecology and game theory are clearly that there will be non-continuous distributions (see, e g Maynard Smith and Price, 1973).

The actual distribution of individuals have rarely been adequately tested. In rodents, data indicate that the populations may be divided into short attack latency and long attack latency individuals in a bimodal manner (Benus et al, 1991). However, it has not been properly excluded that the populations are actually showing a poisson-like distribution, with a very long tail.

In pigs, no available data allow the conclusion that tested populations show non-normal distributions. In fact, where distribution data have been analysed, they clearly indicate normality (Lawrence et al, 1991; Jensen et al, 1994 a).

There is a danger in assuming non-normality and imposing more or less arbitrary cut-off points on the data. This procedure may create the impression that there are real categories of individuals. To some extent, this criticism can be raised against most research where individual variation has been studied. For example, Von Holst et al (1983) divided their tree shrews into those surviving less than eight days and those surviving longer and then treated these groups as two distinct categories in the further analysis. Benus et al (1991) interpreted those individuals that did not show any attacks on intruders in two or three tests as one category of slow attackers as opposed to the category that attacked already in the first test. Lawrence et al (1991) selected eight low responding and eight high-responding pigs and treated these as categories. Mendl et al (1992) divided their sows into three categories, based on arbitrary cut-off points in a 'social success index'.

The danger of this approach is evident in the study of Hessing et al (1993). Here, observers classified individual pigs as either 'aggresive' or 'non-aggressive' based on subjective impressions. Since the aim of the study was to find out whether there are different categories of inividuals in pigs, the circularity is obvious when such categories are assumed from the beginning.

In conclusion, it is doubtful whether any deviations from normal distribution in populations have been demonstrated in any case. The most promising candidates for bimodal distributions seem to be the rodents studied by Benus et al (1991).

## GENETICAL INFLUENCE ON DISTRIBUTION

Within group variations in reaction pattern may be a result of genotypical or phenotypical variations. Whereas this may seem less interesting than the actual nature of the variation, it certainly makes a difference for the conclusions one is able to draw. For example, Mendl et al (1992) demonstrated that aggressive sows which were not able to displace other sows and therefore had low 'social success' appeared to suffer more fitness costs than sows refraining from involvement in aggression. However, whether this was a constitutional difference or not was not investigated and it remains possible that the individuals would have behaved differently in a different group. Any statement on constitutional differences requires some analysis of the genetical background of the variation.

It may also be pointed out that phenotypical differences may be more or less irreversible in the same way as genotypical, e g through experiences at different stages of the life cycle (Whimbey and Denenberg, 1967; Jackson, 1988), even prenatally (Lucion et al, 1994).

In rodents, genetical effects on the type of coping patterns utilised has been clearly demonstrated by selection and back-crossings (Benus et al, 1991). In pigs, the effects have rarely been analysed for. However, Jensen et al (1994 a) found significant sow effects on several reaction variables and Jensen (1994 b) found both sow and boar effects on some measures of social affiliation and weaning in free-ranging piglets.

In conclusion, genetical bases for individual variation has only been demonstrated in rodents, whereas some studies may indicate similar effects in pigs.

## WHY SHOULD THERE BE INDIVIDUAL DIFFERENCES?

Having reviewed the evidence so far, the support for the existence of different categories of individuals are rather disappointing except for in rodents. Is there any possible theoretical reason for the differences between rodents and pigs, or is it only a matter of poorly designed experiments among us pig researchers?

Slater (1981) gives two theoretical reasons for why one might expect selection to favour two distinct categories of individuals: (1) Sometimes it may be beneficial to individuals to communicate aspects of their identity, so that individual identification is possible. (2) The evolutionary stable strategy may be a so called mixed ESS, which is only stable when consisting certain proportions of individuals adopting different strategies.

Slater thereby provies a very important basis for further discussions: There must be a clear selective pressure for maintaining different strategies in a population if we should expect anything else than normal distributions. Van Oortmerssen et al (1985) provide a possible account for the selective forces acting upon mouse pupulations. Based on the performance of fast- and slow-attacking individuals in factors like exploratory behaviour and social interactions they suggest that the fitness of slow-attacking individuals is greater in unfamiliar environments, for example during migration, and the fitness of fast-attacking individuals is greater in familiar environments, such as in a stable territory. Since rodent populations are usually characterized by cyclical patterns of increase, migrations and crashes, one might imagine that natural selection will tend to retain both categories of individuals. However, there is a lack both in theoretical and empirical evidence to ascertain that this is the case.

However, if we accept this functional explanation for the ocurrence of different categories of individuals in mouse populations, we might ask what we would expect in other populations. Unlike rodents, pigs tend to live in stable populations with maternal groups as a central unit. Boars leave the herd at sexual maturity and form bachelor groups or live solitary (Mauget, 1991). This is a completely different ecological way of life than for rodents, and particularly for female pigs, it is difficult to see what selective forces may act to retain different coping patterns.

In ruff, there are plumage differences between satellite and territorial males, indicating genetical differences between the strategies (Van Rhijn, 1974). Thus, different mating strategies may cause the retainment of individual categories. In pigs, little is known about the strategies boars adopt in mate competition, but maybe this could be a fruitful starting point for predictions about individual variations. Also in hens, where there commonly is a dominating harem male and several others, reminding of the satellite types, there is a lack of knowledge concerning variation and stability in male strategies.

Another possibility is that domestication may have affected the distribution of individual variation. Since in rodents, the different coping patterns are possible to select upon, one might imagine that farm conditions have favoured one specific type of individual. In that case, we might not be able to detect any distinct categories in present-day domesticated breeds.

Slater (1981) suggests that we should treat moderate variation in a population as noise unless we have good reasons, evolutionary or others, to assume otherwise. The present review of evidence suggests that in pigs, we are dealing mainly with noise and normal variation.

## FUTURE RESEARCH DIRECTIONS

Of course, much of the evidence reviewed here is inconclusive. There is clearly a need for more systematic research before we understand the significance of individual variation in behaviour. In particular, there is an urge for theoretical work integrating the functional and mechanistic aspects of variation. For example, we need models and simulations for the precise ecological premises for selection to be disruptive and empirical data comparing populations with different life conditions.

I propose that the four points outlined in this paper could form a basis for future research and discussions on individual variation, i e what is the intra- and inter-situation consistency, what is the distribution of individuals like, and what is the genetical base for the distribution. It is important that we do not make a priori assumptions regarding distributions, for example by arbitrarily splitting data into categories. In order to avoid that, these studies will mostly require multivariate statistical treatments, and the use of factor analysis and similar methods are probably necessary.

## CONCLUCIONS

I conclude that while in rodents there is evidence to support the existence of discrete categories of individuals, this is not the case in pigs. There are also important functional reasons for not expecting similar categories of individuals among our domestic breeds. However, many important aspects of individual variation have not been adequately dealt with in the research and there is a need for more theoretical and empirical studies.

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# EXPRESSION OF GENETIC VARIABILITY IN STRESSFUL ENVIRONMENT.

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## ABSTRACT

Stress has been defined as a response of an organism to novel or extreme conditions (H.Selye). Hence, it may be suggested that the development of the stress response is an inevitable component of evolutionary changes. What is, then, the role of stress in evolution? In normal and stable environment, the main effect of stabilizing selection is to preserve the mean population range of variability. This is achieved by elimination of extreme deviants and by development of regulatory homeostatic systems maintaining the genetic variation in a silent state. This consideration prompted the idea that stress-induced changes in the regulatory mechanisms may promote the phenotypic expression of genetic variations and probably create some variations de novo. The effect of stressful stimulation on the expression of genetic variability in the function of main adaptive systems, behavioral, neuroendocrine and autonomous reactions, was studied in rat populations. Another examples of stress influences on genetic variations can be obtained from the long-term selection experiments directed to change the main homeostatic systems as it was during selection for some behavioral traits or stress-responsiveness. In conclusion, the data are discussed in light of the modern concept of genomic stress.

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# INDIVIDUAL VARIATION IN BOVINE BEHAVIOUR

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Despite increasing awareness of the importance of individual variation in relation to animal welfare, there has been very little work on individual differences in cattle. A series of studies were carried out to investigate bovine behaviour, including total social involvment (TSI) and ratio of enacting over reacting (En/Re) as measures of social behaviour, response to novel objects, familiar and unfamiliar humans, and problem solving ability. Subjects (60) were distributed over 4 age groups and 2 rearing conditions. Variation in the scores in each study could not be accounted for by age or rearing condition, except for response to the novel object (Age: $F_{30,66}=1.93$, $p<.05$). Individuals' responses to familiar and unfamiliar humans were consistent and significant ($p<.01$) for flight distance ($r=0.63$), cow-to-human score ($r=0.68$) and human-to-cow score ($r=0.77$). Separate Factor Analyses performed on the data from each study yielded the following factors: 'general object interest', 'wariness of objects', 'tolerance of humans', and 'distractability' and 'determination' in problem solving. A further factor analysis including TSI and En/Re resulted in three factors: 'social interactivity', 'wariness/reactivity' and 'outwardgoingness'. I suggest that the variation in observed responses is related to individual differences. Furthermore, it is possible to characterise bovine behaviour using social interactivity, wariness/reactivity and outwardgoingness and to construct individual personality profiles using this information.

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3 - 6 August 1994

# GENETIC VARIATION IN FEATHER PECKING BEHAVIOUR IN CHICKENS

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Feather pecking - characterized by gentle, non-aggressive pecks directed to the plumage of a conspecific - has been shown to be the main reason for deterioration of the plumage of laying hens housed in battery cages as well as in wire floor and aviary systems. A number of studies have demonstrated the influence of inheritance on feather pecking behaviour. Several authors have found strain differences in feather pecking behaviour based on observation of plumage condition. In the literature estimates of genetic variation in pecking behaviour based on direct observations are few and in general very low.

Individual pecking behaviour of White Leghorn chickens (310) were recorded during a 3-hour test at 6 weeks of age. The body parts receiving the peck(s) were defined as BODY, HEAD, TAG, and LEGS. The pecks were classified in non-aggressive and aggressive pecks. Variables analysed were: sum of pecks (PECKS) and sum of bouts (BOUTS).

Variance components were obtained by restricted maximum likelihood analysis of variance using a nested model. Presented estimates of heritability were calculated using the sire component ($h^2_S$). For performing non-aggressive pecking directed to BODY (= feather pecks) using variable PECKS, $h^2_S$ was zero while using variable BOUTS, $h^2_S$ was 0.28±0.18. Also for receiving non-aggressive pecks estimates were lower using variable PECKS ($h^2_S$ = 0.18±0.14) than using variable BOUTS ($h^2_S$ = 0.34±0.20).

Estimates of the size obtained here using variable BOUTS have not been reported earlier. The sum of bouts appears to give a more precise description of 'tendency to peck/being pecked' than the sum of pecks.

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# Do feather pecking and cannibalistic hens have different personalities?

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In this study we aimed to identify feather pecking and cannibalistic individuals within groups of loose-housed laying hens and then to determine whether these individuals differed in any other aspects of their behaviour. Identifying differences may allow us to identify and remove individuals likely to become feather peckers or cannibals in the future and so reduce the risk of outbreaks of these abnormal behaviours occurring.

All individuals in 3 groups of 70 and 3 groups of 13 laying hens, housed in floor pens with litter, perches and nest boxes were observed using focal animal observations. Observations were carried out when the birds were between 18 and 35 weeks of age with the intention of identifying interesting categories of individuals. Based on the results from all groups, 4 categories were identified. These were feather peckers (high rate of giving feather pecks) and cannibals (high rate of pecking at the cloaca of other birds), but also cannibalised birds (received pecks at the cloaca) and social birds (have significantly more neighbours within 0.5m than expected by chance). A control category (none of the previous categories) was also selected. Thirty-one individuals, all from the same large group to eliminate group effects, were then selected and tested separately. Each bird was subjected to each of 8 tests to investigate how they ranked on 4 different 'personality' traits. There were two tests to investigate each of the following traits: fearfulness, pecking, exploration and sociality.

Three to 5 variables from each test were entered in to a factor analysis and the individual scores on the extracted factors were subjected to an ANOVA, with bird category as an independent variable. Preliminary analysis indicates that there were no consistent differences in the personality traits between the different categories of birds and so clear 'personality profiles', typical of each category of bird, could not be identified.

Different possible explanations for these negative results can be discussed:-
(1) Other factors than the ones intended may have varied in an uncontrollable manner between the different tests and dominated the birds' responses. (2) The motivational state of the birds immediately prior to the test may have dictated how the birds reacted during the test. (3) The differences between the categories of birds in their home pen and group did not apply outside the home situation.

# Individual Variation in Nesting Motivation and the Incidence of Floor Eggs.

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The majority of floor eggs, in alternative laying systems, are laid by a small number of individual hens. These may fail to lay in nest-boxes, either because they have lower demand for nesting behaviour, or because they do not recognise the substrates in the artificial nest box as nesting cues. Eight hens that consistently laid in a nest-box and eight hens that occasionally floor laid were allowed to work to gain access to nest boxes to assess if there was any difference in their nesting motivation. These were singly housed in pens containing food, water and litter. Access to a single nest-box was restricted by a loaded push door and hens were trained to work for the nest over six days. Hens were then allowed to work to enter either an open or an enclosed nest-box over the following eight days. Each hen was tested at 80, 60, 40 and 20 minutes prior to expected time of oviposition on each day. Exposure to four different workloads (10, 20, 30, and 40 Ns) and two different nests were ordered systematically to control for experience. The time and rate of pushing were recorded for each test, and the time and site of oviposition recorded for each day.

Nest layers pushed harder than floor layers to gain access to both nest-boxes at 20 (Anova; $F = 12.3$, $df = 1$, $p < 0.001$) and 40 minutes before oviposition ($F = 6.8$, $p < 0.05$), but not beforehand. Both nest (Regression; $F = 6.63$, $p < 0.05$) and floor layers ($F = 4.38$, $p < 0.05$) pushed harder as oviposition approached, but the rise was sharper in nest layers for both the open (T-test on regression slopes; $t = 2.28$, $df = 15$, $p < 0.05$) and the enclosed nest ($t = 2.58$, $p < 0.05$). Nest layers pushed harder to enter the enclosed nest than to enter the open nest ($F = 4.20$, $df = 1$, $p < 0.05$), but floor layers did not ($F = 1.22$, $p > 0.05$). The demand for a nest-box was higher for nest layers, and the enclosed nest was a more attractive reward than the open nest box. Floor layers had a lower demand for the nests, either because their strength of nesting motivation was lower, or because they were less responsive to the nesting cues provided, or because they found the push door more aversive. There were no differences in the latency to approach the door (Anova; $F = 2.73$, $df = 1$, $p > 0.05$), or in the number of pushes between floor and nest layers ($F = 0.97$, $p > 0.05$), so floor layers do not appear to find the door any more aversive. Floor layers did not distinguish between the two types of nest, so the difference in work rate may represent the failure to respond to the nesting cues rather than differences in behavioural priorities.

# UDDER MASSAGE AFTER MILK RELEASE IN PIGS: DOES IT KEEP MILK PRODUCTION STEADY AND EQUALLY ALLOCATED?

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In the domestic pig, sow usually remains lying in the nursing position after milk let-down and piglets massage her teats vigorously. Why do piglets perform this final massage (FM) which dissipates up to 20% of energy received in milk and why does the sow accept FM, spending some 10% of her total time budget in vulnerable lateral recumbency? This is a question about function or evolutionary origin of this behavioural pattern. There is no established methodology how to study such questions about domestic animal behaviour. The present study attempts to use ideas borrowed from behavioural ecology in order to formulate specific hypotheses about the function of FM, and to test the resulting predictions against empirical data.

FM in piglets resembles food solicitation in nestling birds in several respects. Therefore, extensive modelling research done on the function of bird begging was used to derive the following five hypotheses about the function of FM. *A*. FM helps to level off nursing-to-nursing fluctuations in milk production, at the teat or udder level; *B*. FM enables left-behind piglets to signal to the sow their needs and get larger share of milk in reward; *C*. FM is used by larger, more promising piglets to increase further their portion in the milk production; *D*. slowly growing litters massage more increasing thereby their chances for compensatory growth; *E*. strong litters stimulate the udder more sustaining thereby superior milk production in their dams.

The hypotheses were tested by recording FM and milk intake of individual piglets in 12 litters during three 6-h sessions on days 1-3 post partum. Relationships between milk production and FM were very weak on days 1 and 2. On day 3, hypothesis *A* was supported: FM intensity of a piglet on a given nursing correlated negatively with its weight gain during the preceding two nursings ($r=-.31$, $p<.001$) and milk output of a teat during a nursing correlated with the intensity of FM received during the preceding two nursings ($r=.28$, $p<.05$). The total milk transfer on a nursing was dependent on duration of FM during last two nursings ($r=0.47$, $p<0{,}001$). Hypotheses *B* and *D* were partly supported in that piglets which gained less weight between days 1 and 3 massaged more intensely on day 3 ($r=-.23$, $p<0.05$), and litters which grew more slowly between days 1 and 3 performed longer FM on day 3 ($r=-.78$, $p<0.001$). Hypotheses *C* and *E* were rejected by the latter two correlations.

In conclusion: by day 3 after parturition, udder massage after milk let-down seems to act against milk output fluctuations and against augmentation of milk income differences, both within and between litters.

# EFFECT OF INDIVIDUAL HOUSING ON THE FEEDING BEHAVIOUR OF GROWING PIGS

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Pigs housed individually generally have a higher number of visits to the feeding trough than group housed pigs, and the variation in feeding behaviour seen in group housed pigs is thought to be a consequence of the social environment. To investigate the nature of this variation thirty crossbred male pigs (Cotswold Pig Development Co. Ltd) were housed in three groups of ten (initial liveweight = 29.3±0.6 kg) with access to one computerized single-space feeder (FIRE, Hunday Electronics Ltd) per group and a space allowance of $1.3 m^2$/pig. After 14 days (period 1) twelve pigs (four from each group) were chosen: six which showed a high (H-pigs; 20.8±2.2 visits/d) and six which showed a low (L-pigs; 10.4±0.9 visits/d) number of daily feeder visits. These animals were housed individually for 14 days (period 2) in pens identical to the group pens. It was expected that L-pigs would increase their number of feeder visits in period 2 to reach the level of the H-pigs as a result of the individual housing and lack of competition around the feeder. In period 1 L- and H-pigs differed not only in number of feeder visits but with regard to other feeding behaviour variables as well: H-pigs spent less time per visit (3.2±0.4 vs 5.4±0.6 min/visit; $p<0.01$), had a lower feed intake per visit (82±6 vs 137±13 g/visit; $p<0.001$) but still had a higher daily feed intake (1627±62 vs 1371±72 g/d; $p<0.05$) than L-pigs, the latter due to the higher frequency of feeder visits. Contrary to expectations the difference between L- and H-pigs in number of daily feeder visits was unchanged in period 2 as both L- and H-pigs increased their number of daily feeder visits by 3.1±0.9 visits/d. Due to the difference between L- and H-pigs in feed intake per visit, a variable that did not change from period 1 to 2, the daily feed intake increased by 38% for the L-pigs and by 10% for the H-pigs leading to no significant difference in daily feed intake between L- and H-pigs in period 2. Daily liveweight gain increased accordingly (L-pigs: 684 to 869 g/d; H-pigs: 698 to 758 g/d; period 1 to 2 respectively) but there was no significant difference between L- and H-pigs in this measure. These results suggest that L-pigs were disadvantaged in terms of daily feed intake rather than number of feeder visits when group housed.

# STIMULUS DIRECTED ACTIVITIES AND AGGRESSION IN TWO BREEDS OF SLAUGHTER PIGS.

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Four groups of each 5 Danish Land race gilts (L) and four groups of each 5 Duroc gilts (D) were put in eight multi-activity pens. The pigs' use of 3 specific stimuli: Straw in straw rack, logs suspended in chains and a 12 kg stone placed on the floor was observed twice weekly throughout three months. No difference between the two breeds in activity levels or activity patterns were observed. Aggression level however was significantly higher in the L pigs ($p < 0.001$). The use of the stone declined significantly ($p<0.001$) during the 10 minutes observation period while activities associated with the log did not change ($p=0.925$). The aggression declined significantly for both breeds during the three months of observation ($p<0.001$). A test on exploration related to a stretched forward hand of the observer, showed that the individual pigs' snout contact with the hand deviated significantly ($p<0.01$) from random. In a partial least square regression it was demonstrated, that the weight class of the individual pig could be well predicted by the measured behavioural patterns.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# BIDIRECTIONAL SELECTION FOR STEREOTYPED PACING IN JAPANESE QUAIL (*Coturnix coturnix japonica*)

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Stereotypies are considered to be an indicator of impoverished welfare. The two most prominent stereotyped behaviour patterns occurring in caged birds are stereotyped spot pecking and back-and-forward pacing (route-tracing). Stereotyped pacing in caged Japanese quail seems to be induced by restricted cage space. Undesirable welfare-related behaviours can be eliminated in two ways. The first is to identify and modify the aspects of housing system environment responsible for their induction. The second way is to try to adapt the behaviour genetically to intensive housing conditions. The aim of presented experiments was to test the possibility of direct genetic selection against stereotyped pacing in caged Japanese quail.

Selection for intensity of stereotyped pacing was carried out over two generations. 120 males from parental population were scored for duration of time spent by back-and-forward pacing during 1 hour test. Males were tested at 14 weeks of age and were caged individually for 9 weeks prior to testing. Measurements were made from the videorecordings. 20 males with the highest and 20 males with the lowest scores for pacing were then selected as parents of the first selected S+ and S- generations, respectively. Each male was then mated with a nonselected female. The same procedure was repeated by selecting 20 males with the highest and 20 males with the lowest stereotyped pacing scores from 60 male offspring of each line to produce second selected generation. There was large interindividual variation in the expression of pacing. Proportion of time spent by stereotyped pacing during 1 h test in F1 generation of S+ and S- line ranged from 0 to 70 % (CV = 1.36) and from 0 to 31 % (CV = 1.11), respectively. Selected trait responded to selection. Selection gain of S- line was higher (26.5 %) than that of S+ line (2.06 %). No significant differences in plasma corticosterone levels between S+ and S- line were found in F1 generation.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

**Title:** **Consistency in daily feeding patterns amongst sows newly-introduced into a group.**

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Several husbandry systems are available that enable sows to be kept in groups, one of which is based around electronic sow feeders. Earlier studies showed that, in this system, sows are able to express individuality in their daily feeding patterns: some sows taking a single meal while others spread their daily food intake across several smaller meals.

The addition of new individuals to an established group is known to disrupt social organisation in many species including pigs. Some disruption is inevitable in dynamic groups of sows as individuals return to the group after service. Furthermore, it has been suggested that older, more experienced sows in a group are more dominant. This study examined the consistency of feeding pattern of sows that had recently been introduced into a group. In particular, the effect of reproductive experience was investigated.

Visits to two electronic feeders were recorded over a period of 18 months in a commercial herd of 110 sows. Consistency of feeding pattern was measured by the coefficient of variation in the proportion of the total daily feed intake taken at the first feeding visit. In other words, a measure of the consistency of the feeding pattern of each sow in terms of the variation in the relative size of the first meal of each day. Analysis of variance showed that 2nd and 3rd parity sows were more consistent during the first two weeks after introduction into the group than 4th parity sows ($P<0.01$) and 9th parity sows ($P<0.05$). However, all differences had disappeared after two weeks.

One possible reason that could explain these differences is that younger, less experienced sows avoided conflict and only fed at unpopular times of day while, in contrast, 4th and 9th parity sows may have spent more time re-establishing themselves in the social hierarchy and, as a consequence, were unable to maintain similar consistency of feeding pattern. However, since other experienced sows (e.g. parities 5,6,7 and 8) did not show this inconsistency, this conclusion is equivocal. Further investigation continues into the underlying reasons for these differences.

The consistency of feeding pattern of established sows must be viewed in the context of sows being introduced on a weekly basis. These results show that it was only the newly-introduced sows that were significantly affected. After two weeks, sows of all parities displayed a variety of daily feeding patterns that remained consistent for each sow throughout the remainder of pregnancy.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# EFFECTS OF EARLY HANDLING ON LATER BEHAVIOUR AND STRESS RESPONSE IN FARM MINK

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The objective was to examine if increased human contact with mink kits would reduce the animals' later fear of man and their general sensitivity to stress. 118 kits from 22 litters were distributed on 3 groups and were from the age of 3 to 7 weeks given the following treatments: Group 1: Fondled twice daily for 5 min. Group 2: Moved individually to a closed, cooled box twice daily for 5 min. Group 3: Normal farm management. The response to human contact was tested by the "stick test" and their general sensitivity to stress was examined by a 10 min. open-field test or by a 10 min. stay in a mink trap. Blood samples were collected from half of the animals before the open-field or mink trap tests, and from all mink immediately after the test as well as 3 and 24 hours later. No difference in temperament could be found between fondled and isolated kits, but both handled groups were for a short period after handling less timid than the control group. However, two months after handling had stopped, no difference could be found. No difference in behaviour between handled and control mink in the open-field test could be found. Blood sampling immediately before the open-field test gave the result that the mink came faster and further forward in the open-field area, and had a higher cortisol level and a lower number of eosinophil leucocytes than mink from which no blood sample had been taken before the test. Blood sampling before testing blurs the effect of previous/later experimental treatments. If no blood sampling were collected before the test, the cortisol level was higher after open-field test than after staying in a mink trap, and handled mink had a lower cortisol level than control mink. In conclusion, by early handling of mink, habituation to human contact is accelerated, but no general reduction of fear towards new stimuli is found.

P3.4

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Research Centre Foulum, Denmark
3 - 6 August 1994

# INFLUENCE OF THE TYPE OF HIGHER NERVOUS ACTIVITY OVER GRAZING BEHAVIOUR IN MILKING EWES

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Machine milking behaviour of 46 Local Stara Zagora Ewes from the experimental farm of Institute of Cattle and Sheep Breeding were examined during the process of production over the milking period of 1992. The animals were of the same breed, age, date of lambing (± 10 days), number of lambs and type of udder. Six behavioural reactions were observed during machine milking: taking position into the milking parlour, feed reaction, activity towards the neighbours, feed reaction towards forage offered by hand, reaction towards positioning the teatcups, persistancy of taking place into the milking parlour. Individual observation and examination marks in relation to each reaction were carried out. Ewes were classified into four types of higher nervous activity by means of examination marks and differences between reactions: 1. Sanguinic type, 2. Choleric, 3. Phlegmatic and 4. Melancholic. Grazing behviour was studied during 7 serial days using the same animals and observing moving to the pasture, grazing and home-coming. It was distinguished 4 positions in the flock: 1. a front line (near by the shepherd), 2. in the middle of the flock, 3. out of the way, 4. at the rear of the flock. Conclusions: Behavioural reactions observed are reliable to determine the type of higher nervous activity. A large proportion of ewes are melancholic type - 34.8%, following by Choleric - 26.1%, Sanguinic - 21.7% and Phlegmatic - 17.4%. Grazing behaviour in the ewes is influenced by the type of higher nervous activity. Sanguinic type ewes move and graze on the pasture - 75% a front line (near by the shepherd). Melancholic - 62-74% and Phlegmatic - 49-64% at the rear of the flock. Results in Choleric are intermediate.

P3.5

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# TEMPORAL PATTERNING OF NATURAL SUCKLING BEHAVIOUR OF DAIRY CALVES

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The aim of this study was to examine the temporal patterning of suckling behaviour in dairy cattle and cross-breed calves suckling on their own high yielding dairy mothers. Twelve female calves were videotaped at 7, 14 and 28 days of age on two suckling bouts per day. Milk samples were taken from each teat on each observation day to measure the cell count. Six of the calves were pure dairy breeds and six were offspring of a dairy cow and a Limousin bull. Mother and young were kept together in a herd of 98 dairy cows in an uninsulated loose housing system on deep litter with access to a meadow.

Video recordings started when the calf first contacted the udder and continued for two minutes after last udder contact. Within a suckling bout, time spent sucking, teat manipulation, muzzle close to teat and sucking rate (jaw movements per minute) were recorded continuously for each teat and every minute. The occurrence of licking, teat-releasing during sucking, teat-change, and different types of butting were also recorded.

The duration of suckling bouts and sucking at the teat increased significantly with age. Time spent sucking per minute increased significantly with age and decreased with time since sucking had started. Most calves sucked from the front teat closest to the calf, and usually sucked only from one or two teats. Teat-change occurred mostly at the very beginning and at the end of the suckling bouts, and decreased significantly with age. The frequency of butting decreased significantly with age. Teat-release during sucking was significantly more common at day 28. Sucking rate varied significantly between calves, ages and time since sucking had started. All suckling behaviours differed more between individuals than they changed with age or time since sucking had started. The front teats were sucked more often, for a longer time, and had a lower cell count than the rear teats.

The conclusion of this study is that calves from high yielding cows, unlike beef cattle calves, do not usually suck from all teats during a suckling bout. This may be caused by the fact that the mother has more milk than the calf can ingest.

## DUSTBATHING BEHAVIOUR AND FEATHER PECKING IN TWO LINES OF LAYING HEN.

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Differences in the development of dustbathing behaviour and feather pecking were studied in two genetic lines of laying hen (line 1 & 2), which are known to show different propensities for feather pecking. Line 1 being the "low feather pecking" line and line 2 the "high feather pecking" line, respectively. The experiment was carried out as a blinded trial.

Eight pairs of the chicks of each line were kept in wire floored cages. They were trained to dustbathe on a skin of feathers during one hour daily training sessions from day 3 of life until the age of 21 - 22 days. By day 21 - 22 the chicks from line 1 and 2 pecked, scratched and dustbathed (nos of "vertical wingshakes") equally much on feathers. Furthermore, there was no difference between lines in amount of feather pecking towards cagemates. From day 23 - 30 sand and feathers were presented simultaneously to all the chicks in 4 consecutive choice tests. In between tests all chicks had access to sand. Observations were made during choice test 1, 3 and 4. No differences in behaviour were found between lines during the 1st choice test and the majority of each of the behaviours was directed towards feathers (>75%). During the 3rd and 4th choice test all chicks continued to perform most of each behaviour on feathers (>50%), however, during the 4th choice test 80 % of all vertical wingshaking in line 1 was performed on sand. During the 3rd and 4st choice test the chicks from line 1 dustbathed significantly ($p<0.05$) more on sand than the chicks from line 2. Furthermore, during the 3rd choice test the chicks from line 1 performed significantly ($p<0.05$) more vertical wingshaking in total and had a significantly ($p<0.05$) shorter latency to first vertical wingshake compared to the chicks from line 2. In constrast the chicks from line 2 feather pecked their cagemates significantly more than the chicks from line 1 during the 3rd and 4th choice test ($p<0.05$).

The results showed that the chicks which feather pecked cagemates failed to dustbathe on sand, and hence supporting the view that feather pecking is associated with the development of dustbathing behaviour.

P3.7

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# GRAZING BEHAVIOUR OF THREE BREEDS OF CATTLE UNDER FREE-RANGING CONDITIONS

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The grazing behaviour of Crioulo Lageano (CL), Nelore (NE), and Charolais (CH), and the effect of seasonality in this behaviour was studied under free-ranging conditions in southern Brazil for two years: 1989-90 (Y1) and 1990-91 (Y2). Cows of each breed were simultaneously observed in 8 hour periods (0 - 8h, 8 - 16h, 16 - 24h). In Y1, 8 cows per breed were scanned every 30 min for a total of 72 h of observation/season during Winter (WI), Spring (SP), Summer (SU), and Fall (FA). In Y2, 7 cows/breed were scanned each 15 min for 48 h/season, but just in WI and SU. Each year was analyzed separately. Grazing time (GT) and ruminating time (RT) were analyzed by analysis of variance. The interaction breed*season was significant ($P \leq 0.0001$) in both years. A contrast comparison was applied over LS means (min over a 24 h period) for each variable in each season x breed combination. Differences between breeds within seasons (a,b,c) and within breeds between seasons (x,y,z), are shown ($P \leq 0.01$). GT and RT were respectively in Y1: WI, CL: $632^{a,x}$ and $536^{a,x}$, NE: $541^{b,y}$ and $429^{b,y}$, CH: $661^{a,y}$ and $514^{a,x}$; SP, CL: $636^{b,x}$ and $561^{a,x}$, NE: $621^{b,x}$ and $470^{b,y}$, CH: $716^{a,x}$ and $431^{b,y}$; SU, CL: $453^{c,y}$ and $548^{a,x}$, NE: $550^{b,x}$ and $537^{a,x}$, CH: $596^{a,z}$ and $528^{a,x}$; FA, CL: $599^{a,x}$ and $455^{b,y}$, NE: $521^{b,y}$ and $574^{a,x}$, CH: $628^{a,yz}$ and $371^{c,z}$. In Y2: WI, CL: $591^{a,y}$ and $419^{a,y}$, NE: $479^{b,y}$ and $311^{b,y}$, CH: $464^{b,y}$ and $453^{a,y}$; SU, CL: $639^{a,x}$ and $570^{b,x}$, NE: $525^{c,x}$ and $601^{ab,x}$, CH: $590^{b,x}$ and $630^{a,x}$. The interaction showed that the breeds responded differently for a given condition of the pasture, which varies according to the season. Differences between years were probably due to different pasture responses to seasonality in these two years. A smaller GT and RT in WI for NE in both years, plus shaking observed during colder hours, led us to suspect that this breed is not well adapted to the cool winter conditions of the planalto of southern Brazil.

P3.8

# CHANGES OF DAILY RHYTHM OF LOCOMOTOR ACTIVITY IN SILVER FOXES (VULPES VULPES) DURING DOMESTICATION.

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Little is known about the modifications of daily rhythms, including the rhythms of motor activity, in the process of domestication. The aim of this study was to compare the daily rhythms of motor activity in foxes selected for domesticated behavior (22 animals), those selected for aggressive behavior (18 animals), and those unselected from the population bred for commercial purposes (8 animals). The motor activity was recorded by a fully automatic method in 8 animals simultaneously in summer and was determined within every 10-minutes interval during 24 hours, and estimated by the percentage of time when the animal was moving. Three groups of animals were found: foxes having a sharply expressed phase of motor activity (at the level of 80–100%), moderately expressed (up to 50%) and arhythmical ones (those without any periodicity in locomotion), among aggressive and unselected foxes. No animals with sharply expressed nocturnal phase of locomotion were discovered and a clear tendency was found for the number of arhythmical animals to increase among the domesticated foxes (63.7%). The aggressive and unselected foxes did not differ in all the characteristics of nocturnal phase but they had differences in the time of beginning of locomotion and its duration from domesticated foxes ($P < 0.05$). In the latter the phase began earlier and was prolonged.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# EFFECT OF ADRENOCORTICOTROPIN ADMINISTRATION ON PLASMA CORTISOL AND METABOLITES LEVELS IN CALVES.

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Accelalation of cortisol synthesis and releasing, induced by adrenocorticotropin (ACTH), are one of the remarkable responses to external stress. Intravenous administration of ACTH results in elevation of plasma level of cortisol. In this experiment, a single injection of three levels of ACTH, 2.2 IU/MBS (metabolic body size), 4.4 IU/MBS and 6.0 IU/MBS, is adopted as a substitution for different external stress levels. Four Holstein females aged five months were used for the ACTH trials. The concentrations of cortisol and six metabolites in plasma were measured before and after administration of ACTH . Cortisol levels increased after administration of ACTH. The cortisol response areas for the 120 min after administration was correlated with ACTH levels ($r=.86$ $p<.001$), and were different among the individuals ($p<.001$) and showed ACTH level X individuals interaction ($p<.001$). The response areas for 120 min of free fatty acid showed a correlation with ACTH levels ($r=.61$ $p<.001$), but difference among the individuals and showed ACTH level X individuals interaction were not observed. The response areas for 60 min of glucose, triglyceride and urea nitrogen correlated with ACTH level ($r=.48$ $p<.001$, $r=.65$ $p<.001$, $r=-.57$ $p<.001$, respectively). They also revealed differences among individuals ($p<.001$) and between ACTH levels and individuals ($p<.001$). These results suggest the possible existence of differences among individual calves in responsiveness to external stress.

# EFFECTS OF DOMESTICATION ON THE ONTOGENY OF SOCIAL RELATIONSHIP IN DUCKLINGS

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Effects of domestication on the development of social behavior in the early ontogeny in mallard and peking ducklings have been demonstrated in imprinting experiments.

109 mallard and 133 peking ducklings were imprinted on the first two days after hatching in one or two imprinting sessions (20 min each) on stuffed female mallard or peking ducks. Time following the imprinting or test object, first and following decisions, changing between the test objects and the overall behavior in a new testing apparature was recorded in three tests (5 min each) on day three to five. Reverse imprinting on the mallard and peking duck (or vice versa) were carried out and tested in the same manner.

Imprinting in mallard ducklings was faster and more stable than in peking ducklings. In domestic ducklings the success and stability of the filial imprinting depended upon the duration and frequency of stimulus performance. In mallard ducklings it was nearly impossible to reverse imprinting from the mallard to the peking duck. Peking ducklings needed a longer period of time to develop a stable stimulus preference and showed good success in reverse imprinting experiments. In result of domestication these animals need a great amount of environmental input and a long period of learning to attain stable social bonds. In wild ducklings endogenous dispositions support these social learning processes.

Intensive housing during the early ontogeny causes social unsecurity in the animals, which is reflected in the motivational system. This may cause long-termed disturbencies in social behavior.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# THE RELATIONSHIP BETWEEN INDIVIDUAL TEMPERAMENT AND THE DEVELOPMENT OF ABNORMAL ORAL STEREOTYPIES IN FOOD RESTRICTED SOWS.

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Individual variation in the development of stereotypies is still poorly understood. A large experiment (N=96) demonstrated that food restricted sows without a foraging substrate develop excessive levels of chain manipulation (Burbidge et al., 1993). Levels of chain manipulation (CH) in parity 2 were high (up to 60% of time) but varied widely between individuals. To determine whether this was associated with individual temperament, behavioural characteristics were determined in 4 groups of 6 gilts (weight 80, s.d. 15.9kg) before puberty in 3 test situations. In the "open field" test the response to a novel object was recorded in a strawed kennelled test pen. In the "food motivation" test hungry individuals were offered a known amount of food in an open field situation. Finally, social status was determined whilst gilts competed with pen mates over food. After service groups were loose-housed in pens with individual stalls and fed 1.8kg/23MJ DE once daily. Chain loops were attached in each stall and in the dunging areas. Behaviour was recorded over 2 parities during the 2 hours after the start of feeding. In the second parity there was a positive correlation between CH and standing (ST), ($r=.729$, $p<.001$). The time gilts spent in the kennel (TK) in the open field test was negatively correlated with CH ($r=-.567$, $p<.01$). No correlations between behaviours during the food motivation test and behaviours in parity 2 were found. Dominance rank (DR) correlated with ST ($r=.665$, $p<.01$), but not with CH. We conclude that fearfulness in an open field situation but not necessarily motivation to feed or social rank may characterise gilts in their adaptation strategies in later life.

## Reference

Burbidge, J.A., Spoolder, H.A.M., Lawrence, A.B., Simmins, P.H. and Edwards, S.A., 1993. The effect of feeding regime and the provision of a foraging substrate on the development of behaviour in group housed sows. In: M. Nichelman, H.K. Wierenga and S. Braun (Editors), Proceedings of the International Congress on Applied Ethology, Berlin 1993, 104-107.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# THE MEASURABILITY OF PSYCHOLOGICAL EXCITEMENT IN CALVES USING AN AUDIOVISUAL METHOD.

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* Former chief researcher

When animals suffer a change in their surroundings, their heart rate (HR) often changes. So we investigated HR changes in calves while they watched videotaped handling scenes and we examined the effectiveness of this method to screen excitable individuals from the group. Six Holstein calves aged 6 months were each tethered to a stall (120 × 160 cm) surrounded by 180-cm-wide, 130-cm-high planks, and were monitored their HRs with the A-B lead method. A 74-cm-wide television was set just in front of them to show the following 5 scenes: resting (R), feeding (F), outdoor exercise (E), dehorning (D) and receiving an electric shock (S). HRs were measured with once every second during these scenes, which were each shown for 4 min. in rotation. The behavioral response to each scene was also observed. The HRs during F, E, D and S relative to the HRs during R (100%) were 115.1 ± 3.3 (P<.01), 110.7 ± 3.5 (P<.05), 110.8 ± 3.5 (P<.05) and 106.0 ± 2.6 (means ± s.e.) in calf no. 1; 110.3 ± 4.4, 107.1 ± 6.2, 110.1 ± 8.1 and 117.7 ± 8.5 (P<.05) in calf no. 2; 97.4 ± 0.7, 99.5 ± 2.4, 91.3 ± 1.0 (P<.01) and 98.3 ± 1.8 in calf no. 3; 82.1 ± 4.6 (P<.01), 90.6 ± 5.1, 107.4 ± 4.2 and 96.2 ± 3.6 in calf no. 4; 91.7 ± 2.7, 86.8 ± 0.6 (P<.01), 91.6 ± 3.4 and 102.5 ± 3.4 in calf no. 5; and 96.9 ± 5.2, 93.0 ± 10.9, 85.1 ± 12.1 and 116.1 ± 8.9 in calf no. 6. The lying probability in each calf during R was 0.6 (P<.06), 0.4, 0.2, 0.6 (P<.06), 0.2 and 0.0, respectively. These results indicate that calf no.1 can be evaluated as more excitable and susceptible to its surroundings than the others.

# Session 4

## Teaching/training in applied ethology

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# Teaching applied ethology in the United Kingdom and Eire

Natalie K. Waran and Michael C. Appleby
*University of Edinburgh, Institute of Ecology and Resource Management,*
*School of Agriculture, West Mains Road, Edinburgh, Scotland*

Applied ethology is the study of animal behaviour conducted primarily for utilitarian purposes. This involves the study of animals in their environment, natural or otherwise, with the intention of drawing conclusions about how animals interact with that environment allowing us to solve practical problems from both the human and animal perspective. In order to teach this subject it is necessary to ensure that students have a good grounding in basic ethology as well as an appreciation of the different ways that animals are utilised by humans. The way in which this subject is taught in the UK and Eire is dependent upon two things: a) what it is considered that students should know and b) what we have the ability and motivation to teach them. The approach that is taken by those that teach applied ethology depends on the subject area that is being taught and the research interests of the lecturers in a particular department. There are four main subjects where applied ethology may be taught: Biology, Psychology, Veterinary science and Agriculture. Biologists are concerned primarily with the behaviour of animals in their natural environment and where applications are mentioned (eg. wildlife management) they may not be emphasised unless a member of staff has a particular area of interest. In this instance the course will be called ethology or animal behaviour. Psychologists are more likely to stress the application of behaviour to the study of human problems (eg. human maternal behaviour or cognition) with courses being called animal behaviour. Veterinarians teach applied ethology as part of their animal husbandry courses with the emphasis on diagnosis of ill health or pain. More recently they have started to teach about the importance of behaviour in the assessment of animal welfare. Agriculturalists are interested in production and more recently welfare and where applied ethology is taught it is usually as part of a course such as nutrition or reproduction.

The different approaches to the teaching of applied ethology may lead to confusion since where applied ethology is taught it is usually linked with another subject such as welfare, and students may therefore be excused for thinking that they are the same thing. Another problem is the apparent short term nature of the applied approach, applied ethologists often strive to solve particular problems without always trying to understand the underlying mechanisms involved. Therefore when teaching applied ethology it is important that students are made aware of the fundamental science underpinning applied research.

# Teaching/Training in applied ethology in the nordic countries.

H.B.Simonsen.
Department of Animal Science and Animal Health,
Royal Veterinary and Agricultural University,
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In the nordic countries teaching in applied ethology takes place in Denmark at The University of Copenhagen and at The Royal Veterinary and Agricultural University, Copenhagen, in Finland at The College of Veterinary Medicine, Helsinki, in Norway at The Agricultural University, Aas and at The College of Veterinary Medicine, Oslo, and in Sweden at The Swedish University of Agricultural Sciences, Skara and Uppsala.

In all countries the teaching curriculum covers a combination of fundamental and applied ethology and the agricultural as well as the veterinary students can attend the courses in ethology. The courses may be free choice or compulsory.

There is of course a great variation in the content of the courses in the different countries and for different categories of students. Main themes however seems to be motivation, development of behaviour, communication, learning, conflict behaviour, domestication, normal behaviour in domestic animals, stress, abnormal behaviour and assessment of welfare.

The number of teaching hours as well as the place of the courses in the respective educational programmes varies a great deal between the nordic countries.

Persons responsible for the teaching in the nordic countries are the following:

Denmark.
University of Copenhagen: K.E.Heller and L.L.Jeppesen
Royal Veterinary and Agicultural University: G.Nørgaard-Nielsen, H.B.Simonsen and K.Vestergaard.

Finland.
College of Veterinary Medicine: H.Castrén.

Norway.
Agricultural University: M.Bakken, B.Braastad, K.Bøe.
College of Veterinary Medicine: M.Bakken, B.Braastad, K.Bøe and H.P.Kjæstad.

Sweden.
Swedish University of Agricultural Sciences: P.Jensen and M. Rundgren.

L4.3

**28th International Congress of the ISAE**
**Research Centre Foulum, Denmark**
**3 - 6 August 1994**

NATIONAL INSTITUTE OF ANIMAL SCIENCE

# TEACHING AND TRAINING IN APPLIED ETHOLOGY IN BELGIUM AND THE NETHERLANDS.

Schouten, W.G.P., Ödberg, F.. Dept. of Animal Husbandry, Agricultural University of Wageningen. (The Netherlands). Faculty of Veterinary Medicine, University of Gent. (Belgium).

In Belgium and the Netherlands the target groups for teaching and training applied ethology are (1) biologists (2) zoo technicians and (3) veterinary students. In Belgium applied ethology is lectured to veterinary students at 5 universities in the first or second year of the study. The total amount of lecture time varies between 10 and 38 hours. There are no practical courses on applied ethology in Belgium.

In the Netherlands applied ethology is lectured at the Agricultural University of Wageningen and at the Veterinary Department of the Utrecht University. The applied ethology of companion animals is lectured by staff members of the Utrecht University while the ethology of farm animals is lectured by the staff of the Agricultural University of Wageningen.

The veterinary students of the Utrecht University get an introduction in ethology in 24 lectures in their first year. In their second year the veterinary students get another 6 lectures in applied ethology followed by 2 days practical course covering the cat and dog, chicken and pig. During their last clinical year the veterinary students follow four hours ethology on stress and adaptation followed by a round table discussion on animal husbandry and welfare.

The students of the Wageningen University, biologists and zoo-technicians, get an introduction in ethology in their second year. This course of 24 lectures covers fundaments of ethology and applied ethology. In their third year the Wageningen student can follow an "integration course ethology". In this course a special topic e.g. ontogeny or communication is studied in depth, during 8 lectures and 4 round table discussions in groups of 10 to 15 students. These lectures are followed by a 2 week practical course. During the first day of this course the student learn when and how to use different observational methods with the aid of an interactive video recording. The students, working in pairs, have to plan a small experiment, taking observation and analyse their data. At the end of the 2 week period the students have to make a poster give an oral presentation and have to write a small thesis about their experiment. In their last year the students have the possibility to participate in a research project as part of their master degree.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# APPLIED ETHOLOGY AND ANIMAL PROTECTION AS TAUGHT AT GERMAN UNIVERSITIES

D. Buchenauer, Institut für Tierzucht und Vererbungsforschung der Tierärztlichen Hochschule Hannover and J. Unshelm, Institut für Tierhygiene, Verhaltenskunde und Tierschutz der Ludwig-Maximilians-Universität, München, Germany

The teaching of applied ethology and animal welfare has been established during the last 20 years with different intensities in the veterinary and agricultural faculties.

Whilst the former German animal protection law, passed by the legislative in 1972, was being prepared, an enormous demand for research in ethology applied to farm animals and pets became evident. Investigations in this field were intensified. These research efforts were embodied in teaching activities. In the last few years the situation has changed again. On the one hand there now exist relatively large, specialized, intensive working farms, and on the other hand are developing rapidly extensive and ecological husbandry methods. Furthermore some farmers try niche productions with exotic species. Veterinarians in addition have to face the fact that changes of peoples life style have consequences for pets and that an increasing number of wild, laboratory, and exotic species are being kept as pets. To anticipate these situations additional well-founded knowlegde in ethology and animal welfare is needed.

To survey the present situation of teaching the 5 veterinary and 8 agricultural faculties in Germany were asked: 1. represents the subject a special institution or is it integrated in others, 2. content of teaching, 3. number of hours in the curriculum, 4. type of lecture, 5. emphasis of research. The answers differed widely and will be represented in detail.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

NATIONAL INSTITUTE
OF ANIMAL SCIENCE

# Some remarks on teaching and training applied ethology in Eastern European countries

*Marek Špinka, Research Institute of Animal Production, Prague, Czechia*

Any generalization about teaching and training of applied ethology in the region Eastern and East-Central Europe (EECE) is extremely difficult. This is because the use of animals by man differs a lot between the countries, according to their economical, sociological, geographical and ecological status. These differences in background result in dissimilar demands upon and varying conditions for education in applied ethology. Nevertheless, some general trends may be noted, compared to the position of applied ethology at the universities Western Europe, Northern Europe or North America (WNENA).

In the courses for undergraduates at the EECE universities, applied ethology often has a weak position among other subjects. In more than a half of the agricultural and veterinary universities, farm animal behaviour is only mentioned, sometimes in a very brief form, within subjects such as animal husbandry, animal breeding, animal hygiene etc. Where applied ethology is a separate subject, it usually is voluntary. On some universities (e.g., Gödöllö in Hungary, Nitra in Slovakia), though, applied ethology has a tradition and a strong and stable position in the teaching. An indication of a positive trend in the region is that in a number of universities, courses of applied ethology have been started in last two years or are being prepared.

The extent of postdoctoral training in applied ethology and carrying research on farm animal behaviour for obtaining M.Sc. or Ph.D. degree varies a lot. In some countries, research is concentrated in so called research institutes, while the staff of the universities are almost fully occupied by teaching. This personal separation may hamper the feed-back between research and teaching.

Compared to WNENA universities, the emphasis during the courses is more on the behaviour of the most important farm animal species, in some countries also on game animal species. Companion animal behaviour is given little attention. The students learn more about the role of behaviour in the production than about the welfare questions during the courses.

There are several ways in which ISAE can promote teaching of applied ethology in EECE countries. First, the contacts between teachers within and beyond the EECE countries should be supported by providing information about persons, about teaching programs and about funds to support contacts. Postdoctoral stays of EECE students at universities abroad are important for future development of teaching. Second, the level of teaching could be upgraded by a more easy access to teaching materials like videos, computer programs etc. Third, ISAE can explicitly address agricultural and veterinary universities encouraging them to include regular courses in applied ethology into the students' curriculums.

L4.6

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# ANIMALS, SCIENCE AND SOCIETY: TEACHING A UNIVERSITY-LEVEL COURSE ON ANIMAL WELFARE.

Joy A. Mench, Dept. of Poultry Science, University of Maryland, College Park, MD, 20742, (USA).

Students are increasingly confronted with situations that require them to make decisions about the role and treatment of animals in contemporary society. I teach a semester-long course that is designed to educate undergraduates from diverse backgrounds about animal welfare and animal rights. In the first part of the course, students are introduced to differing views about human obligations toward animals, placed in the perspective of historical and philosophical traditions in Western culture. The second part of the course deals with the scientific assessment of animal welfare, and includes discussion about behavioral needs and motivation, stereotypies, abnormal behaviors, environmental enrichment, animal emotion and cognition, pain and suffering, stress, and euthanasia. Welfare issues associated with wildlife management, agriculture, scientific experimentation and companion animals are addressed in the final part of the course. Because the exchange of views is an essential component of decision-making and consensus building, small group learning techniques rather than lectures are employed. Group assignments range from analyzing articles to conducting debates, reviewing animal care protocols, and designing experiments to assess particular aspects of welfare. The overall goal of the course is to help students to develop a personal ethical standard which is based on an informed understanding of the issues.

L4.7

# Teaching and Training in Applied Ethology in France

P. Le Neindre, Laboratoire Adaptation des Herbivores aux Milieux, INRA Clermont-Ferrand Theix, 63122 Saint Genès Champanelle, France

This abstract is the first attempt to detail where students and professionals have opportunities to learn about Welfare and Applied Ethology in France.

Only two of the agricultural schools offer specific programs on welfare to the under 18 year age group but about 3000 agricultural students per year have training on handling and applied ethology from a technical institute (Institut de l'élevage).

At the University level, few units (2) have specific programs on Applied Ethology. Students in Tertiairy Agricultural Colleges do not have any programs on Applied Ethology but they often have opportunities to attend lectures given by scientists working on this subject. Of the four veterinary schools, three of them have specific programs on Applied Ethology: for all first year students or all second year students in two schools and for some of the final year students in the three schools.

Specific training is given to the future veterinary inspectors. The 1988 regulations imply that training should be given to everybody working on research on animals. Three levels are defined - level 3: Maintenance staff (30 hours) - level 2: Technical staff (35 hours) - level 1: Scientific staff (80 hours). 36 different schools can give this training. Other training on handling, behaviour and welfare is given by a technical institute (Institut de l'élevage) to truck drivers (150 people had a 3 days training), abattoir staff (100 people had a 3 days training) and farmers (about 1500 people have a one day training per year).

Great improvement can still be done in the future on the teaching and training on Applied Ethology in France.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# TEACHING AND TRAINING IN APPLIED ETHOLOGY IN ITALY AND OTHER COUNTRIES

Verga M. - Institute of Zootechnics, Faculty of Veterinary Medicine, University of Milan, Milan (Italy)

Applied Ethology, and its relationships to animal welfare, is a discipline of growing interest and concern in Italy and other Mediterranean Countries and it is related both to farm animals and to companion animals management. In Italy, Applied Ethology is officially taught both to Veterinary Medicine and to Animal Science students, and it is termed respectively: "Ethology and Animal Protection" and "Applied Ethology in Animal Husbandry". In the Faculties of Veterinary Medicine (in Italy they are many!), a course of Ethology is not always present; in this case, this discipline is included in the courses of Animal Physiology. Also in Animal Science courses, Applied Ethology is not always taught, as it depends on the curricula established by each Faculty.

Sometimes, some topics of Applied Ethology are also taught in some Faculties of Agricultural Sciences, Food Technologies and Biological Sciences.

Moreover, it is worthwhile to remember that in the new reorganised study planning for Veterinary Medicine students, Applied Ethology and Animal Welfare are theoretically considered important topics, both in relation to farm animals and to pets.

In other Mediterranean Countries, Applied Ethology is included in the study curricula of different Faculties. For example, in Spain this discipline is taught to Veterinary Medicine and Biological Sciences students; in Portugal, it is taught both to Veterinary Medicine and Applied Psychology students.

In general, topics related to Applied Ethology and Animal Welfare are included in different study curricula, e.g. in Veterinary Medicine, Animal Production, Biology, Agricultural and Psychological Sciences, and a multidisciplinary approach is perhaps the best way in order to teach the different scientific aspects of this really very important matter, both from the theoretical and practical point of view.

**28th International Congress of the ISAE**
**Research Centre Foulum, Denmark**
**3 - 6 August 1994**

# ETHOLOGY IN BULGARIAN AGRICULTURAL EDUCATION

*Varlyakov, I.S., Dept. of Animal Physiology, University of Agriculture, Stara Zagora, (Bulgaria)*

From 1991 at Agricultural University in Stara Zagora is started a course in Ethology of farm animal. This is result of growing interest for achieving of more and cheaper animal production in new economical situation. The continuance of the course is 60h for full-time study and 18h for part-time study.

The teaching is carried out by lectures and practical exercises. The lectures provide students with information on: physiological basis of behavior, evolution of behavior, behavioral mechanisms, neural regulation of behavior, filtration of stimulus, learning, conflict, communication, management of behavior and emotions; group behavior, moving, rest, eating, grassing, milking behavior, sexual behavior; behavioral changes in industrial conditions.

Through the practical exercises the students are introduced to the classic and modern methods for investigation of behavior: group and individual chronometry, usage of photo-, TV- and video-camera. Working in a group of 4-6 students are carried out 12 hours continuous observations on behavior of cattle, sheep, swine, poultry etc. There are: registrated the basic parameters of eating behavior of large and small ruminants with special equipment; ivestigated the effect of diet content and structure on eating behavior; determinated social dominance, antagonism, individual distance, etc. The next step is mathematical and statistical analyses of results. The purpose is in the practice to be applied the knowledge from theory and to be made conclusions and recommendations for practice.

# Session 5

## Free papers

## INTERPRETING THE OPEN-FIELD TEST IN CALVES: A FACTOR ANALYSIS.

Anne Marie de Passillé (1), Jeffrey Rushen (1), François Martin (2)
1. Research Station, Agriculture Canada, Lennoxville, Québec, CANADA, J1M 1Z3. 2. Department of Psychology, University of Québec at Montreal, Montreal, Québec, CANADA.

The open-field test is commonly used but there have been different interpretations of the responses. Activity is said to reflect locomotory motivation or fear in response to novelty. To clarify the interpretation, 16 female Holstein X Friesian calves were tested alone for 15 min. in an open-field to determine how their behavioural and heart rate responses were affected by the novelty of the enclosure, previous exercise, and the presence of an unfamiliar person. The novelty of the enclosure was reduced for half the calves by allowing them to explore it for 15 min on the 3d prior to testing (4 and 15 w of age), and by adding a large novel object (w 15). The amount of previous exercise was varied by allowing the calves to run freely for 30 min in another large pen prior to testing (5 and 14 w). The effect of familiarity of the person was tested by having a person stand in the pen with the calves. Half of the calves were acquainted with the person, while the other half were not (6 w). During the open-field test, the calves behaviour was recorded continuously and mean heart rate each 5 s. was recorded by radio-telemetry. Factor analysis revealed three weakly correlated factors: 1- opposing sniffing and licking with immobility (SNIFF-LICK), 2- running and jumping (RUN-JUMP) and 3-walking, defecating and vocalizing (WALK-DEF-VOCAL). Factor scores were continuously rather than bimodally distributed. Scores for RUN-JUMP increased, and those for WALK-DEF-VOCAL decreased with age ($p<.05$). Prior exploration of the open-field decreased scores on SNIFF-LICK ($p<.10$) and WALK-DEF-VOCAL ($p<.05$), but did not affect RUN-JUMP. Adding a novel object increased scores for SNIFF-LICK ($p<.05$). When the test was repeated over two consecutive days, scores for RUN-JUMP were higher on d1 than on d2 ($p<.05$), but were not reduced by a preceeding period of exercise on either day. Heart rate increased during the test and the rise was correlated with RUN-JUMP ($r=.55$ $p<.05$). Heart rate was unaffected by age, prior exploration or prior exercise. Bouts of contact were shorter with an unknown person ($p<.10$), but factor scores did not differ. Calves with high scores on WALK-DEF-VOCAL had a longer duration of contact with the person ($r=.52$ $p<.05$). Behaviour in the open-field reflects several motivations: sniffing and licking are exploratory behaviours in response to the novel area; defecation and vocalization, with walking, may represent fearful responses to novelty and social separation; while running and jumping are elicited the first time the animals are allowed to run free in large area, but may not reflect endogenous sources of locomotory motivation. Multivariate statitics can be useful in separating out the different motivations but the open-field test should not be used until the validity has been experimentally determined.

## INTERPRETING THE OPEN-FIELD TEST IN CALVES: A FACTOR ANALYSIS.

Anne Marie de Passillé (1), Jeffrey Rushen (1), François Martin (2)
1. Research Station, Agriculture Canada, Lennoxville, Québec, CANADA, J1M 1Z3. 2. Department of Psychology, University of Québec at Montreal, Montreal, Québec, CANADA.

The open-field test is commonly used but there have been different interpretations of the responses. Activity is said to reflect locomotory motivation or fear in response to novelty. To clarify the interpretation, 16 female Holstein X Friesian calves were tested alone for 15 min. in an open-field to determine how their behavioural and heart rate responses were affected by the novelty of the enclosure, previous exercise, and the presence of an unfamiliar person. The novelty of the enclosure was reduced for half the calves by allowing them to explore it for 15 min on the 3d prior to testing (4 and 15 w of age), and by adding a large novel object (w 15). The amount of previous exercise was varied by allowing the calves to run freely for 30 min in another large pen prior to testing (5 and 14 w). The effect of familiarity of the person was tested by having a person stand in the pen with the calves. Half of the calves were acquainted with the person, while the other half were not (6 w). During the open-field test, the calves behaviour was recorded continuously and mean heart rate each 5 s. was recorded by radio-telemetry. Factor analysis revealed three weakly correlated factors: 1- opposing sniffing and licking with immobility (SNIFF-LICK), 2- running and jumping (RUN-JUMP) and 3-walking, defecating and vocalizing (WALK-DEF-VOCAL). Factor scores were continuously rather than bimodally distributed. Scores for RUN-JUMP increased, and those for WALK-DEF-VOCAL decreased with age ($p<.05$). Prior exploration of the open-field decreased scores on SNIFF-LICK ($p<.10$) and WALK-DEF-VOCAL ($p<.05$), but did not affect RUN-JUMP. Adding a novel object increased scores for SNIFF-LICK ($p<.05$). When the test was repeated over two consecutive days, scores for RUN-JUMP were higher on d1 than on d2 ($p<.05$), but were not reduced by a preceeding period of exercise on either day. Heart rate increased during the test and the rise was correlated with RUN-JUMP ($r=.55$ $p<.05$). Heart rate was unaffected by age, prior exploration or prior exercise. Bouts of contact were shorter with an unknown person ($p<.10$), but factor scores did not differ. Calves with high scores on WALK-DEF-VOCAL had a longer duration of contact with the person ($r=.52$ $p<.05$). Behaviour in the open-field reflects several motivations: sniffing and licking are exploratory behaviours in response to the novel area; defecation and vocalization, with walking, may represent fearful responses to novelty and social separation; while running and jumping are elicited the first time the animals are allowed to run free in large area, but may not reflect endogenous sources of locomotory motivation. Multivariate statitics can be useful in separating out the different motivations but the open-field test should not be used until the validity has been experimentally determined.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

NATIONAL INSTITUTE OF ANIMAL SCIENCE

# The Use of a Novel Operant test to determine the Strength of Preference for Flooring in Laboratory rats

Caroline E. Manser, D.M.Broom, Dept. of Clinical Veterinary Medicine,
University of Cambridge, and H.Elliott, SmithKline Beecham Pharmaceuticals
The Frythe, Welwyn, Herts.

In a study of laboratory housing, rats showed a preference for dwelling on a solid floor rather than a grid one. They spent 88% of their resting time on the solid floor but only showed a slight preference ( 55%) for the solid floor when active. The rats were observed to seek out a resting place on a solid floor soon after lights came on. However these results did not show the importance to the rats of this preference for resting on a solid floor. A further trial using a quantifiable operant was therefore carried out using eight rats. The test apparatus consisted of two cages, one with a grid floor and one with a solid floor, joined by perspex tubes to a central perspex box containing a barrier whose height from the floor and weight were adjustable. The rats had to lift the barrier in order to pass through the centre box and during pilot trials it was found that the rats would lift considerable weights in order to explore the novel environment provided by the apparatus. The weight which each rat would lift in order to reach a solid floor for resting was compared with that which it lifted so as to explore a novel environment. The rats were tested individually and by repeating trials, it was possible to find a maximum weight which each rat would lift either to explore or to reach the solid floor at lights-on. There were no significant differences between the weight lifted by each rat either to explore the test system or to reach the solid floor at lights-on. Thus it appears that the rats were prepared to make as great an effort to reach the solid floor at lights-out as they were to explore a novel environment, the latter being an activity which is important for survival. A further trial is being carried out in order to determine whether rats will work to reach a grid floor from a solid one. The results obtained so far from these studies indicate that laboratory rats should be housed in solid-floored rather than grid-floored cages wherever possible.

**28th International Congress of the ISAE**
**Research Centre Foulum, Denmark**
**3 - 6 August 1994**

# DO DOMESTIC FOWL FORM GROUPS WHEN RESOURCES ARE UNLIMITED?

Widowski, T.M. and I.J.H. Duncan, Dept. of Animal and Poultry Science, University of Guelph, Guelph, Ontario (Canada)

This experiment attempted to determine the preferred group size of hens in single and mixed-sex flocks by allowing groups to form in a setting that we predicted would facilitate segregation of birds. Two flocks of fifty medium hybrid hens and two flocks of fifty hens plus ten roosters were housed in large pens (5.5 m x 6.75 m) with litter floors from one day of age. Each pen was divided into three small "rooms" (1.83 m x 2.45 m), and two larger "rooms" (1.85 m x 5.5 m and 2.45 m x 5.5 m). All five rooms were furnished with feeder(s), drinker(s), roost(s) and nestboxes so that birds could obtain all necessary resources in a single room, and could pass freely among rooms. Individual hens did not confine their movement within rooms. Instantaneous samples (3119) collected from 14-25 weeks of age indicated that 21.5% of hens were sighted in all five rooms, 54.5% in four rooms and 19.5% in three. Roosters did not defend "territories" and were often observed together. Hens in flocks with roosters formed larger clusters as defined by aggregations of birds in space. In hen-only flocks, the percentage of observations of birds in clusters of 1, 2-5, 6-9, and >10 were 16.6%, 47.4%, 22.4% and 13.6%, respectively, compared with 16.0%, 32.6%, 25.6% and 25.8%, respectively, for flocks with roosters ($\chi^2 = 37.5$, $P<.001$). Hens did not organize themselves into groups with regard to specific individuals or specific location(s).

# Behavioural and physiological responses of piglets to naturally occurring sounds.

Janet C. Spensley[a],Christopher M. Wathes[a], Natalie K. Waran[b] and Jeff Lines[a].
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This study investigated how piglets respond to environmental sounds which they would normally experience during production, transport and slaughter. Eight piglets (approximately 20 kg at the beginning of the experiment) were individually exposed for 20 minutes to four separate sounds over a period of four weeks, while in an open field arena to which they had been habituated. Behaviour and heart rate of the piglets were recorded using remote video and telemetry, pre, during and post- exposure to the four sounds (slatted fattening pen;Leq 85dB(c), livestock container;Leq 85dB(c), abattoir pre-stun pen;Leq 85dB(c) and white noise;Leq 95dB(c)). No differences were found between the four treatments for any of the measured parameters ($p<0.05$) and so data were subsequently pooled. The percentage increase in peak heart rate following sound stimulation showed a large individual variation 3.7% to 65.5%, which was significantly different ($p<0.001$) from the change observed during absence of sound exposure. The time budgets of the piglets when exposed to sound stimulation were also significantly different from similar periods without stimulation. Behaviours that are indicative of aural perception and response eg,pricked ears in the direction of the noise source and frantic running around the pen, were significantly more common during sound exposure ($p<0.05$); while other behaviours, such as rooting and inattention while lying standing or rooting, were less frequent ($p<0.05$). These results illustrate that sounds normally encountered by piglets during production elicit responses normally associated with stress. In the future when assessing potential sources of stress to piglets, the acoustic environment should be taken into consideration.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# DRY SOW WELFARE THROUGHOUT LIFE IN ONE OF THREE HOUSING CONDITIONS.

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A wide range of welfare indicators were measured during the lives of sows housed during pregnancy in stalls, small groups with feeding stalls, or a large group with an electronic sow feeder in identical sections of a building. When first in the conditions, only sows in the large group were observed fighting and sows in stalls showed the least agonistic interactions. However sows in stalls had more unresolved conflicts and more high levels of aggression. By the fourth pregnancy, stall-housed sows spent 44% of time showing stereotypies or activities, like drinking and rooting or chewing at pen fittings, which were sometimes stereotyped. Comparable figures for group-housed sows were < 3% and < 7%. The body weights of stall-housed sows were lower by the fourth parity. Sows in stalls had less control over their lying movements than sows in groups. After slaughter they had different proportions of muscles and considerably lower leg bone breaking strengths than group-housed sows. Both muscle and bone strength effects were presumably due to lack of exercise in stalls. Confinement in stalls resulted in substantially more indications of poor welfare than either of the group-housing sytems.

# Influence of gentling at early weaning on the goat kid's later reaction to human presence and handling

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Goats, like other dairy animals, have close contacts with humans. Usually the kids are artificially fed and caretakers are associated with the milk supply. Goats are well-known to be "fond of humans". However this imprinting-like process is not well investigated. The present experiment was designed to investigate the effects of gentling at early weaning compared to a later gentling on the ontogenesis of the human-goat relationship. Twenty-seven Norwegian dairy male and female kids (single breed) were weaned one week after birth and put together in pens isolated from human activities. They were fed twice a day with milk from fixed buckets with nipples until 8 weeks of age. At three months of age, animals were sent to a large isolated pasture where they received no food or water from humans. The animals were allocated into three equal groups. H0 animals were the control and received no additional contacts than those described above. H1 animals were gentled at weaning. H6 animals were gentled at six weeks of age. The gentling procedure, which took five minutes, was performed on each individual twice a day for ten days during two successive weeks. Each animal was caught by the handler in the rearing pen and put into a separate pen. Here the handler seated, spoke to the kid and tried to touch and stroke it but did not touch the kid if it resisted gentling. Subsequently at 5 and 7.5 months of age which was before and after a stay on a mountain pasture, each kid was twice subjected to two different test procedures. The first one ("encounter test"), included successively isolation, isolation with a seated familiar handler calling and stroking if the animal approached, isolation with a moving human trying to stroke the kid, and catching the kid. The second one ("choice test") isolated the tested animal from the human and other tied kids first by solid blind walls, then by wire netting, and lastly allowed the kid to approach either of them. Gentling treatments made H1 and H6 animals significantly less active (less sniffing and more motionless) than H0 animals when together with the human in the first test at 5 months of age. They also spent significantly more time close to the human and interacted more with the human ($P<0.01$) than did H0 animals in the second test. However only H1 animals vocalised less ($P<0.05$), spent significantly more time close to the human in all parts of the tests and were more quickly caught in the last part of the first test ($P<0.05$) than did H0 animals. H6 animals showed reactions to the human which were intermediate between the reactions of H0 and H1 animals. It is noteworthy that H1 animals vocalised less while alone in the testing pen than did H0 or H6 animals. This difference is significant in the first part of the second test. At 7.5 months old, differences between groups still persisted in the reaction towards the human. This experiment showed that artificial suckling associated with the presence of human being is not sufficient to provide a good human-animal relationship. In the tests, kids only sought human contact if they previously had been gentled. Gentling at weaning seems effective for the establishment of a durable friendly human-animal relationship.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# The effect of pre-weaning experience and presence of adult ewes on grazing behaviour of weaned lambs.

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The effects of pre-weaning experience of pasture and the presence of adult were examined on the grazing behaviour of weaned lambs. Forty freshly weaned lambs, aged 3 months and 10 ewes were used in this study, 20 of the lambs were grazed with their dams until weaning (at the 3 rd month of age), the other 20 lambs having been kept indoors and reared on artificial milk from buckets supplemented with hay and concentrate pellets. The adult ewes were divided into two groups, five ewes with ten of the experienced lambs and five ewes with ten of the inexperienced lambs, the other half of the experienced and inexperienced lambs groups grazed without the presence of any adult ewes. The grazing time, biting rate and the rumination time of lambs were observed for 16 h (daylight hours) weekly for the duration of the seven weeks trial. The Experienced lambs and the lambs grazed with ewes after weaning had increased grazing times (experienced 511.5 v. inexperienced 471.1; with ewes 499.7 v. without ewes 482.9 S.E.D. 4.39 min./16h). The experienced lambs had a faster biting rate during grazing (40.20 v. 33.91 S.E.D. 0.227 bites/min.), but the presence of ewes did not significantly affected the biting rate of lambs. The experienced lambs and those grazed with ewes after weaning had a greater rumination time (experienced 339.3 v.inexperienced 284.4; with ewes 319.9 v. without ewes 303.8 S.E.D. 3.96 min./16h). It can be concluded that the pre-weaning experience of lambs and to a lesser extent the presence of ewes with lambs after weaning increases their grazing time and rumination time which should be reflected in their performance.

# THE EFFECT OF FREQUENCY OF FEEDING AND DISTURBANCE TO THE FEEDING REGIME ON THE INGESTIVE BEHAVIOUR AND PRODUCTIVITY OF DAIRY COWS.

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The experiment investigated whether infrequently fed cows perform like frequently fed cows by allelomimetic behaviour if housed together and whether disturbance to the feeding regime adversely affects feeding behaviour and milk production. Sixteen cows were allocated to three treatments: 1) frequently fed (06, 10, 14 and 19h), treatment 2) infrequently fed (06h) (both treatments 1 and 2 were housed together and the feeding regime changedover for each cow every 3 weeks) and treatment 3) infrequently fed (06h) cows housed alone with no changeover of feeding (FT, IFT and IFA respectively). Cows were individually offered a mixed silage: concentrate diet. IFA cows licked and groomed themselves more often (licking FT 5, IFT 5.2, IFA 7.5/d $p<.05$ and grooming self FT 7.1, IFT 8.6, IFA 11.5/d $p<.05$) but performed less allogrooming (FT 12.0, IFT 10.3, IFA 8.0/d $p=.11$). Total grooming was not affected by treatment (FT 17.0, IFT 15.4, IFA 15.5/d $p>.10$). Treatment had no influence on feeding, ruminating lying or ruminating rate. Ruminating standing and total ruminating time were more for IFT (FT 352, IFT 448, IFA 348 min/d $p=.05$; FT 597, IFT 620, IFA 559 min/d $p<.05$ respectively). Eating biting rate and total bites per day were more for disturbed cows (FT 21.8, IFT 22.2, IFA 18.8 bites/min $p<.01$; FT 46580, IFT 47778, IFA 43025 bites/d $p<.05$). IFA cows stood in the feeding passage longer (FT 91, IFT 70, IFA 125 min/d $p<.01$), while prehension chewing bites was less for IFT (FT 39.7, IFT 33.8, IFA 37.5 bites/min $p<.05$). IFA cows, intake and milk yield were greater than the other two treatments (FT 14.85, IFT 15.57, IFA 15.84 kgDM/d $p=.06$; FT 24.49, IFT 24.42, IFA 25.72 kg/d $p=.06$). It is concluded that frequency of feeding is not a significant influence on most feeding behaviours. Disturbing the feeding regime every three weeks increased the rate of eating and the number of bites, but reduced the DM intake and the time standing in the feeding passage. These and the increase in mutual grooming at the expense of self grooming seem responsible for the reduction in milk yield in cows with the disturbed feeding regime.

P5.1

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# ADAPTATION OF CALVES TO DRINKING FEEDER

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Two experiments were carried out in which 90 calves were used. The aim of the 1st experiment was to determine an optimum drinking interval.The calves in experiment group received milk replacer from feeder in four-hour or six-hour drinking intervals, calves of control group received milk replacer from buckets in 12-hour intervals. All animals received 6 kg drink per day. We assessed significant differences in lying and rumination time in a comparison of experimental calves. These parameters were higher in calves receiving milk in six-hour intervals in all observations. On the contrary, the frequency of standing in drinking box of the feeder and the frequency of the subsequent waiting for another dose were significantly higher in calves receiving milk in four-hour intervals. The results showed that six-hour interval of drinking is the most optimum for welfare of calves. The purpose of the 2nd experiment was to find the age at which the animals can learn fastest to receive milk from computer - controlled drinking feeder. We used calves which had sucked nursing cows milk since their birth. The animals were divided according to the age to three groups (9, 32, 45 days). 93 % calves from the 1st group drank voluntarily in 25th to 30th hour after the start of experiment, but the adaptation to drinking feeder was slower in other groups. The consuming of milk replacer was in 25th to 30th hour in 2nd group 64 % and in 3rd group only 40 %. That means the best age of calves for learning to drink from automatic feeder is 9 days.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# THE INFLUENCE OF MAN'S ASSISTANCE AT PARTURITION ON THE NEONATAL BEHAVIOUR OF ALTAMURANA BREED-POPULATION LAMBS.

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The neonatal behaviour of 30 single-born lambs from primiparous ewes belonging to Altamurana breed population was investigated.

The trial aimed at comparing naturally born lambs with lambs born with man's assistance. Human intervention was applied to 16 cases where the labour time was longer than 1 hour.

The weight at birth of the lambs and the durantion of sheep pregnancy resulted to be significantly greater in assisted deliveries than in natural ones, with values 4.489 vs 3.932 kg ($P<0.01$) and 148.3 vs 149.3 ($P<0.05$) respectively.

The observation of lamb behaviour, with the help of a videocamera, revealed that the lapse between birth and the main postnatal behavioural attitudes (first rising, stable rising, first suckling) proved to be slightly earlier, though not statistically significant, for assisted births than for natural ones.

The average daily sucklig (1084 vs 955 gr; $P<0.05$) and the weight at the 10th day (6.541 vs 5.607; $P<0.01$) were significantly greater in assisted births, stressing the invaluableness of human intervention allowing the lambs, in case of difficult births, to develop at the best their production performances and to reduce at the same time death hazard due to the lack of assistance at delivery.

P5.3

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# The Response of Wild-Caught and Laboratory-Bred Bank Voles (Clethrionymus glareolus) to the Cage Environment.

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Stereotypic behaviour has rarely been described in free-living animals. Stereotypies are, however, commonly found in captive animals maintained in restrictive environments, where some activities may be thwarted, either by physical prevention, or lack of appropriate external focus. The difference between captive and wild populations may be due to their genetic predisposition, since selection may have increased the propensity to develop a repetitive response to the environment, or simply due to experience of different external factors in the two environments. To investigate genetic and environmental factors, we compared the behaviour of 12 wild caught voles and their 9 pups with that of 12 laboratory reared voles and 14 laboratory bred pups. All voles were observed twice, firstly after 10 days exposure to a laboratory cage, containing food, water, sawdust and hay, and again after 60 days exposure. Behaviour was recorded in two ways: by instantaneous scan sampling of each vole in the home cage once every ten minutes for four hours on each day; and by an hour long focal sample of each vole, following introduction to an unfamiliar cage with no hay.

Locomotor stereotypies were observed in seven laboratory adults, but in none of the wild caught voles, which spent less time on all locomotor activities (Lab., 50% of scans; Wild, 17%; $t = 5.7$, $p < 0.001$) and more time under cover than laboratory voles (Lab., 51%; Wild, 18%; $t = 5.8$, $p < 0.001$). There was no difference in mortality or fecundity of laboratory and wild caught voles, so there appeared to be no selective advantage to stereotyping. There was no significant difference in the behaviour of wild and laboratory pups, with 7 out of 14 laboratory and 3 out of 9 wild pups observed stereotyping. Therefore, early environmental experience of the cage environment, rather than parental background was an important factor in the development of locomotor stereotypies in this species. There was a correlation between the time spent active at ten days and the incidence of stereotypies in the home cage at 60 days in the pups (Correlation, $r = 0.841$, $n = 23$, $p < 0.001$). Pups that were performing stereotypies at 60 days spent more time on active following introduction to the test cage (33.6 mins) than pups that did not develop stereotypies (12.7 mins; $t = 8.3$, $p < 0.001$). They were also more likely to flee (as opposed to freeze, Fisher exact test; $p < 0.05$), immediately following introduction. Stereotypic behaviour, therefore, appeared to have been derived from persistence of locomotor behaviour. Wild caught voles may have failed to develop locomotor stereotypies, because they did not perform a locomotor response to captivity.

# PIGLET MORTALITY IN A MULTI-SUCKLING SYSTEM: IDENTIFICATION OF RISK FACTORS WITH SPECIAL EMPHASIS ON MATERNAL BEHAVIOUR.

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During the last few years ethical concern about the welfare of pigs has increased the interest in multi-suckling systems for lactating sows. It is common for new systems under development that problems arise, and they have to be solved before the systems can be accepted. Unduly high mortality rates in piglets of more than 10 days of age have been found in many tests of multi-suckling systems. The present study aims at identifying risk factors for the death of a piglet in a multi-suckling pen. In the system being investigated groups of six sows with piglets are installed approximately 10 days after farrowing in pens of 48 $m^2$, and the animals remain there until weaning when the piglets are 5 weeks old. During the first year of study the mean piglet mortality in the multi-suckling pen was 5.9 %, the maximum being 12.1 % (n = 13 groups). In order to establish the exact causes of death, post-mortem has been performed routinely since April 1994 on all dead piglets. Traumatic lesions, starvation, arthritis and diarrhoea as well as other findings are recorded systematically. Obviously, the maternal behaviour of the sows has a crucial influence on the survival of the piglets in multi-suckling systems. Measurements of maternal behaviour are therefore recorded by means of video observations, direct observations and tests. Special attention is paid to the suckling behaviour and the lying-down behaviour of the sows, including their responsiveness to piglet distress calls. Other possible risk factors, such as characteristics of the individual piglets, the litter and the level of cross-suckling in the pen are also included in the study. Data collection is continued, and the results will be presented at the conference.

# INFLUENCES OF ENCLOSURES ON THE BEHAVIOUR OF CATS OF PREY

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Free living cats of prey need large territories and cover long distances for hunting. Their enclosures in zoos are small and the design of pens does not allow the animals to perform their natural behaviour patterns.

During 15 months 33 lions, 30 tigers, 31 leopards and 20 cheethas in nine different zoos were observed. Over a period of 10 days at all, divided in fife visits, each animal was observed for 25 minutes per day. This time was subdivided in two blocks of ten minutes and five blocks of one minute. Activities like sitting, lying, sleeping, walking and the animal´s resting place were recorded. Data on the 57 enclosures´ physical characteristics was collected.

The mean area, available for the animals, was: 1190 $m^2$ for cheethas, 462 $m^2$ for lions, 260 $m^2$ for tigers and 50 $m^2$ for leopards. 51% of the animals spend their life in pens smaller than 200 $m^2$. 12 animals (nearly 11%) had no possibility to lie down at a higher place or at board higher than 20 cm above the ground. In 30 outdoor pens and 42 indoor cages there were no extra trees to lie or sleep. In 18 outdoor and 42 indoor environments the animals had no possibility to hide away from the visitors.

During the observation lions lied for longer period and were more inactive than the other species ( lying (min)/walking (min): lion 108.6 / 41.1 ; cheetha 81.8 / 95.8 ; leopard 69.5 / 80.5 ; tiger 68.5 / 83.8 ; $p<0.01$). Cheethas and leopards did not sleep as long as lions or tigers (cheetha 45.1min ; leopard 50.4min ; ion 85.4min ; tiger 76.9min ; $p<0.01$). Given the opportunity leopards prefered heightend resting places (45.3% of their resting time ; $p<0.01$) to the other cats. Leopards showed stereotypies more frequently than the other cats (63.18% of the active time; $p<0.01$). Male leopards ($n=15$) moved longer in a stereotypic way than the females ($n=16$) $p<0.05$. In enclosures below 200 $m^2$ animals showed stereotypic running for a longer period than in larger pens ( 44.6min / 6.9min ; $p<0.01$).

Leopards and cheethas were more active than the other big cats. Nevertheless the cages of leopards were smaller than those of the other species.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# HOMING SUCCESS OF LABRADOR PUPPIES FOLLOWING A PUPPY SOCIALISATION PROGRAMME

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Puppies which are brought up in environments devoid of stimulation can become nervous of people and other dogs and therefore are unsuitable as family pets. The most important time for puppies to receive such stimulation is between 5 and 12 weeks of age. At the WALTHAM Centre for Pet Nutrition (WCPN) we place most of our puppies with families. It is therefore important that they receive adequate stimulation and socialisation whilst in a working environment so that they fit into the home. This is achieved through regular interaction of the puppies with people, other puppies and an adult dog. In addition great emphasis is placed on the use of coloured clothing, toys and exercise on grass lawns so that puppies are familiar with aspects of home life. All puppies are treated as pets, this allows each to be considered as an individual and therefore matched carefully with their new owner. This socialisation and homing programme has resulted in a high success rate. Between 1992 and 1994 144 Labrador puppies were successfully homed from WCPN.

International Society for Applied Ethology

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

NATIONAL INSTITUTE OF ANIMAL SCIENCE

P5.7

# BEHAVIOUR PROBLEMS OF CATS - STATEMENTS OF THEIR OWNERS

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Cats kept as pets have to adjust with the living conditions prepared from their owners. Different needs of humans and cats may leed to difficulties which result in problems reported by cat owners.

Using a call in an animal journal cat owners were asked for their help. 550 owners answered detailed questions on their 1177 cats. Information on the animal, its history, the owner and his family, the feeding and housing-situation, the quality of the human-animal relationship, kind of problems and their reasons, description and therapy were looked at. The relationship between the occurance of behavioural problems and animal, owner-, and housing related factors was analysed by $\chi^2$ - test statistic.

For 644 cats (54.72% of n=reported 1177 cats) the owners complained to have problems with them. The most marked problem was that cats showed symptoms of anxiety (197 cats, 16.74% of n), like running away, ducking and hiding for example when strange people come for a visit (110 cases). Other problems were scratching on furniture (179 cats,15.21% of n), feeding problems (128 cats,10.88% of n) like searching for food and eating to much in 64 cases or reduced and selective eating in 51 cases, aggression against humans or cats (124 cats, 10.54% of n), inappropriate urination and spraying (96 cats,8.16% of n) and defecation in the house (60 cats, 5.10% of n). For example sex and castration of the cats was connected with the appearance of problems (f=3, p=0.02). Neutered females were the group which performed most often problems. The family situation of the owners was also related with the frequency of problems: people in a household without children (84.91% of 550 owners with 901 cats) keep more often cats than others, but they also complained more often about their pets than people with children do (f=3,p=0.03). The human-pet relationship was relevant for the appearance of problems: people who interact several hours (f=7,p=0.01) and equally spread over the day with their cats (f=11, p=0.03) complained less often problems with them. Also experienced owners (defined as who had at least 4 cats or more before) described not so often difficulties (f=13,p=0.01). Keeping conditions like group size (f=9,p=0.03) and allowance to run free (f=6,p=0.01) can influence problem behaviour: Cats kept in groups of two or three together show more often problems than others. Cats which were only seldomly or only depending on good weather allowed to go outside tend to show more often problems. In 568 cats (88.20% of 644 cats with problems and 48.26% of n) the owners tried to treat the behavioural problems. States of anxiety caused relatively fewer attempts of therapy as aggression or house-soiling.

The results suggest that there are different important factors influencing the occurence of behavioural problems. The owners are very often not able to solve problems on their own. To prevent those cats from being a steady reason of trouble, to be abandoned or even euthanasied veterinary surgeons and behavioural specialists should support people with behaviour problems of their cats.

# ETHOLOGICAL STUDY OF MATERNAL BEHAVIOUR IN PIGS

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The epimeletic manifestation in pigs, as the pattern of maternal behaviour, and their effects on piglets have been studied. Two categories of sows and their piglets were compared. The first group "A" consisted of primiparous sows with their piglets. The second group "B" consisted of the sows after the third delivery with their piglets. The mean index of sociability as a parameter of maternal behaviour of category "A" was represented by the value of $\bar{\bar{x}}A = 1.7$ and that of category "B", $\bar{\bar{x}}B = 2.0$. A similar difference has also been found in individual litters of these sows, category $\bar{\bar{\bar{x}}}A/a\text{-}g/ = 1.8$ and category $\bar{\bar{\bar{x}}}B/a\text{-}g/ = 2.0$. After overall evaluation the comparative analysis showed a positive correlation in favour of social adaptation of sows to piglets in the group "B" vs the category "A". Biological disposition of maternal behaviour of animals were markedly influenced by the previous reproduction experience as a form learning with a direct consequence upon their piglet behaviour. Within these conclusions there is necessary to seek for the risk of adverse experience of animals during their pregnancy with subsequent distress effect on piglets, but also on their further reproduction prognosis.

P5.9

# Low-stress Outdoor System for Pigs

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At National Institute of Agricultural Engineering (SjF) of Denmark an outdoor system for sows and growing pigs meeting most of the pigs' needs has been developed. With the object of reducing the stresss factors and making improved efforts to meet the actual animal needs the system is still being improved. The scientific method used is that of result oriented system research. In co-operation with institutes of basic science and applied science their know-how is used effectively for physical planning for the purpose of optimizing the outdoor pig rearing systems.

The sow herd is kept in a 24 ha permanent grassland area with hedges and wallows. The herd area is divided into three paddocks for pregnant sows, dry sows and boars, and one for farrowing sows, the latter with individually fenced huts. All groups of animals, except for lactating sows, are housed in big straw bale climate tents with double shaped transparent covering. The straw bedded tents will lead to secure animals and ensure high lying comfort. The sows have free access to grass land as do the growing pigs to straw outdoor areas which allow the pigs to regulate their body temperature. The outdoor areas furthermore allow for explorative behaviour and well filled stomacks, thus contributing to mimimizing explorative behaviour and vacuum activities of the pigs. When the animals are provided with sufficient space indoor as well as outdoor the individual distance of the animals is respected, and thereby most agressions are avoided. In respect of the natural behaviour of farrowing sows their farrowing huts are individually fenced, this ensuring a very peaceful environment. The pregnant sows are housed together with boars in order to minimize agressions. The non-transfer-non-mixing growing pig system would result in a well-established rang order and a low degree of aggression. By comparing the profitableness of conventional pig farming and that of the experimental herd the success of the outdoor rearing system has been estimated. Productivity results of 25 reared pigs/sow/year and a weaner mortality of less than one percent show that the sow herd system is a success.

Two pilot projects involving rearing of a total of 140 pigs in permanent groups without moving them to another accomodation in the period from weaning to slaugthering have resulted in a daily gain of 900 g per pig. Furthermore, no lung damages were found, and the pig mortality was zero in the growing period. This indicates that the system will be successful.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# The behaviour of tethered and loose housed calves, and the influence of age at tethering on behavioural responses to tethering.

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The aim of the study was to investigate the behavioural consequences of tethering and the behavioural changes in behaviour after tethering in calves of two different age groups. Thirty-six Danish Black and White heifer calves were housed in individual pens from birth. Eighteen calves were tethered in individual stalls at 12 weeks of age, and eighteen calves were tethered at 23 weeks of age. The calves assigned to late tethering were housed in groups of 3 in deep litter pens from 12 to 23 weeks of age. From 24-h video recordings, collected in the 1st, 2nd, 4th and 8th week of tethering in all calves, and in the 8th week after grouping in calves assigned to late tethering, the behaviour of individual calves were recorded instantaneously at 5 minute intervals. In addition, the number of lying bouts were counted. At the same age tethered calves spent more time lying down (61.8% *v.* 56.0%, $P<0.01$), and more time ruminating (34.7% *v.* 28.7%, $P<0.01$). Tethered calves also performed more barbiting (0.7% *v.* 0.0%, $P<0.001$), and more comfort behaviour (2.8% *v.* 1.9%, $P<0.01$). Analysis of behaviour in the 1st, 2nd, 4th and 8th week of tethering showed that the calves of the two age groups responded differently to tethering with respect to the number of lying bouts and the duration of lying down. In the calves tethered at 23 weeks of age the duration of lying down increased throughout the period of observation ($P<0.001$), as well as the number of lying bouts ($P<0.001$). In the calves tethered at 12 weeks of age the duration of lying down only increased from the 1st week until the 2nd week of tethering ($P<0.001$), and no change in the number of lying bouts was found in this group. The results on resting behaviour suggest that calves tethered at a late age have more initial problems changing position in the tie-stall, and suffer a reduction in lying time for longer than calves tethered at an early age. No difference between age groups in response to tethering was found for barbiting and comfort behaviour. The higher level of comfort behaviour in tethered animals may either reflect tethered calves inability to groom themselves satisfactory, or conflict behaviour. Inhibition of several behaviours may cause the development of barbiting. The results on barbiting and comfort behaviour suggest that independently of age at tethering, calves are inhibited by the tethering.

P5.1

**28th International Congress of the ISAE**
**Research Centre Foulum, Denmark**
**3 - 6 August 1994**

# THE IMPORTANCE TO MICE OF HAVING CONTROL OVER LIGHTING WITHIN THEIR ENVIRONMENT

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The provision for individuals to be given more control over their environment is advocated under the premise that it improves welfare. The opportunity to exert control over strongly appetative and aversive stimuli has shown to reduce the incidence of both behavioural and physiological indicators of stress. The current experiment used a model species to establish whether recommendations for providing widespread control over more neutral stimuli are justified on welfare grounds. Two replicates of 6 mice, were individually trained, over 9 consecutive days, to control lighting. Light onset was contingent on lever activation and resulted in 5 minutes illumination. Twice daily preference tests were then conducted on 10 consecutive days using a simple dichotomous T-maze. Individuals were given the choice between one chamber where lighting remained under operant control (O), and another in which it was computer controlled (N). Light was delivered randomly in (N) with a total average duration, per session, comparable to the mean value chosen by each subject in their training phase. Subjects were confined within their preferred chamber for 11 hours. A Wilcoxon signed rank test indicated a significant increase ($p>0.05$) in choices directed towards (N) when compared to previous data pertaining to each individual's inherent position preference. We conclude, that under the reinforcement schedules provided, mice do not prefer to have control. Providing such control is not, therefore, necessarily beneficial with regards to welfare.

P5.12

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# A METHOD OF MIXING GILTS AND SOWS WHICH REDUCES AGGRESSION EXPERIENCED BY GILTS

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In an experiment, the effects on stress and aggression levels of pre-exposure of gilts to the group into which they were to be mixed were studied. Three groups of five gilts were mixed into a group of c. 23 multiparous sows after five days pre-exposure to these sows in a pen within the group house. This treatment was alternated with three control groups of five gilts mixed without pre-exposure. Over a period of two weeks after mixing, control gilts received more total aggression (bites, knocks and threats), than pre-exposed gilts ($P < 0.01$). There were more differences between control and pre-exposed gilts in avoidance manoeuvres performed and in aggression received in the second week after mixing than in the first week. In the second week, control gilts performed more avoidance behaviours, both after interaction with resident sows ($P < 0.01$) and in situations where no interaction could be detected ($P < 0.05$). They also received more total aggression than pre-exposed gilts ($P < 0.01$). It appears that both contact through a gate, as in the pre-exposure situation, and full social interactions, like those during the first week, affect establishment of social order. Salivary cortisol, skin lesion and feeder usage data will be presented to support these behavioural data.

P5.13

# TIME-BUDGETS OF ZOO MAMMALS IN RELATION TO HOUSING.

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Time-budgets of animals are often influenced by the housing conditions. The time-budgets of different individuals of different species that are housed under different conditions are compared based on a subdivision of the behaviours according to their functions ('Funktionskreise'; Tembrock, 1980). The time budgets of 200 animals of a total of 15 species were compared. In each zoo the time-budgets of 6 to 8 animals were determined simultaneously by instantaneous scan sampling with a time-sampling interval of 20 minutes for at least three days. Data of all days were gathered in a database together with measurements of the housing and maintenance conditions. It was found that animals of one species showed a consistent time budget, i.e. not much variation in behaviour categories was found. However, individual differences in time-budgets are consistently related to different housing conditions in different zoos. Especially the use of correspondence analysis revealed that bears, cats and dogs showed the largest individual variation in time-budgets. This was partly due to the amount of time spent in stereotypic behaviour. Furthermore, analysis of the effect of the relative space available to the animals and the number of individuals of a certain species in the same enclosure on 12 functional behavioural categories revealed only two functional categories that are influenced. Spending time (lying, sitting, sleeping) is increased as the number of partners within an enclosure is larger. Time spend stereotyping decreased when the number of partners was larger ($p=0.000$). The method of comparing time-budgets by correspondence analysis shows differences between taxa, species and individuals and can be easily used to find and identify individuals with behavioural problems dependent on housing.

Tembrock, G. Grundriss der Verhaltenswissenschaften. Stuttgart: Gustav Fisher Verlag; 1980.

P5.14

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**Research Centre Foulum, Denmark**
**3 - 6 August 1994**

# GROUP SIZE PREFERENCES IN LAYING HENS.

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In modern colony systems, many hens may be forced into proximity with unfamiliar birds, making the formation of a stable social hierarchy difficult. We report an experiment investigating group preferences in deep-litter hens in two flocks of 80 birds. 10 marked test hens were released into one chamber and allowed to mix freely with 70 (non-test) "companion" hens from an interconnected chamber for 3 h, recording the dispersal of hens every 15 min. Secondly, we investigated the influence of familiarity on group preference by keeping Flock 1 test hens in a separate home room from their companion hens, thus reducing their familiarity. Flock 2 test hens remained with their companion hens outside testing sessions. Mann-Whitney tests showed a significant difference ($p<0.001$) between the two flocks, indicating that Flock 2 spread more evenly over the available area. Previous experiments offered a simple dichotomous choice in a T-maze and showed clear preferences for larger groups and larger spaces. Conversely, this "free choice" approach did not demand an single decision but allowed a fluctuating preference. In Flock 1, this resulted in a gradual change from initial clumping of the familiar test hens in a smaller group in the early trials, to a random distribution as familiarity increased. Flock 2 test hens showed no group size preference and spread randomly around the chambers.

# A POSSIBLE METHOD OF PREVENTING FEATHER PECKING IN PHEASANTS (*PHASIANUS COLCHICUS*).

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Feather pecking and cannibalism are the major problems in rearing of pheasants (*Phasianus colchicus*) under captivity. The problems are usually controlled by the use of bill-appendages (e.g. a ring placed between the upper and lower bill), bill-trimming or rearing in darkness. According to recent Danish legislation none of these methods are acceptable and should be faced out by 1998. Besides the pheasants are reared for release in nature as game for hunting, and consequently they should be as normal and intact as possible. A project was therefore started in order to develop a better and acceptable rearing method that would effectively do away with feather pecking and cannibalism. Cannibalism usually develops as a result of feather pecking. The working hypothesis of the project is that feather pecking develops in the young naive chicks because they become "imprinted" to perceive the feathers of their penmates as a substrate for dustbathing. Initially naive chicks prefer sand and peat for dustbathing. Imprinting on feathers, however, may happen as a result of pecking, scratching, and dustbathing directed at the penmates feathers when there is no access to preferred substrate or when the substrate is present but "hidden" because of crowding. We have, therefore, developed a rearing design that gives access to a sand area in bright light for dustbathing in one end of the pens and a dark hiding area under a heater in the opposite end of the pens. Crowding would then take place in darkness which is known to inhibit dustbathing, whereas the chicks would spread out in the well lit dustbathing area. This design was initially tested in a group of 160 chicks and compared to groups reared in the traditional way in low light and with the application of bill-rings. The result of this pilot project were promising because there was very little feather damage, especially the first three weeks, and no cannibalism occurred. Presently 8 groups of 300 chicks are reared in the new design and compared to 8 control groups reared in the traditional way.

# SUCKLING BEHAVIOUR OF FALLOW DEER IN ENCLOSURE

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A population of about 110 adult fallow deer kept in enclosure in a very intensive condition was observed for 12 h/day (from 8.00 a.m. to 8.00 p.m., divided into 3 time bands of 4 h each) for 17 days (divided into 3 periods) during the birth season, in order to study suckling behaviour and its modifications related to the intensive management. The analysis of variance (GLM) on the duration of 311 suckling bouts showed a significative effect of period ($P<.0001$) and time band ($P<.05$), while the area and the type of suckling (single, double or triple) had no significative effect. The average duration (± s.e.) of bouts decreased from 95.3 ± 7.7 s in the 1st period to 49.5 ± 3.6 s in the 3rd one, and it raised from 61.7 ± 4.8 s in the 1st time band to 83.9 ± 8.8 in the 3rd one. During the 1st period, only 2.6% of suckling bouts were observed in the most disturbed area, while this percentage raised to 59.1% in the 3rd one, meaning that, especially during the first days of life, the fawns need the presence of a quiet area. The percentages of double and triple suckling bouts rised respectively from 0.7% and 0% in the 1st period to 14.4% and 1% in the 3rd one. Allosuckling is rare in wild populations, but it had frequently been observed in fenced groups, possibly related to a weak instauration of mother-young relationship due to disturbance. Suckling in fallow deer seems to be an allelomimetic behaviour, as suckling bouts were concentrated into two or three short periods within each day, maybe as a strategy of defence. We might conclude that suckling behaviour in fallow deer can be affected by management conditions and this must be taken into account when farming this species.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# Feeding competition in pigs: individuals and the ideal free distribution

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Feeding competition occurs between pigs when a restricted amount of food is given to a group in an uncontrolled way, for example by dumping the feed in troughs or on the pen floor. If food is distributed unevenly between troughs or locations in the pen, then individuals will only receive equivalent amounts of food if they distribute themselves in direct proportion to the relative availability of food at each site (the ideal free distribution (IFD)), and if they are all of equal competitive ability. In this experiment, we examined whether pigs distributed themselves according to the IFD. A group of fifteen 20kg pigs was studied. Each feeding trial involved placing a total of 3kg of food in two troughs in the home pen, and was preceeded by 8h food deprivation. Two experiments were done. The first investigated the effect of food availability on pig distribution. Food was either distributed equally in the two same-sized troughs (4 trials) or twice as much was put in one as in the other (4 trials). In both cases, pigs initially distributed themselves roughly equally between the two troughs, irrespective of the amount of food available. In trials where the troughs contained the same amount of food, pigs hardly ever switched between troughs (0.3 switches per pig per trial). When food was unequally distributed, the smaller patch became depleted earlier and pigs then showed a lot of switching behaviour (2.7 switches per pig). Since the pigs appeared to distribute themselves according to trough size rather than food availability, a second experiment was conducted to examine the effect of trough size on distribution. In this experiment, one trough was made twice as long as the other, and food was either equally distributed (4 trials), or twice as much was put in the longer trough as in the shorter one (4 trials). In both types of trial, twice as many pigs initially went to the longer trough irrespective of the amount of food available. In trials where food distribution was equal, food in the longer trough was consumed faster, and pigs then moved across to the shorter trough. In trials where food distribution was proportional to trough length, food in the shorter trough was consumed faster and pigs then moved across to the longer trough. These results suggest that pigs selected sites according to trough length and not according to relative food availability. Furthermore, pigs rarely sampled the other site until food at their own site became depleted. This may be because sampling behaviour was costly; individuals who switched regularly between sites spent less time feeding (Trials 1-4; $r_S$=-0.66, p<0.01; Trials 5-8; $r_S$=-0.72, p<0.01). Analysis of individual behaviour showed that 11 of the 15 animals returned to the same trough at the start of each trial in over 70% of all trials. Thus, during feeding competition of the sort studied here, pigs do not monitor the relative food availability at different sites, as the IFD would predict, perhaps because the most effective strategy is to develop a specific site preference and stick with it until food is depleted. Uneven distribution of food in troughs may thus promote variation in food intake in a group.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# SOCIAL BEHAVIOUR OF DAIRY COWS IN LOOSE HOUSING - A RESULT OF INTERNAL AND EXTERNAL INFLUENCING FACTORS

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Loose housing of dairy cows is widespread. In the Netherlands more than 90% and in Germany more than 20% of the cows are kept in loose housing. In contrast to this, in Switzerland and in Austria the numbers are considerably smaller, only 3-5%. The cows in loose housing are usually dehorned, so that the consequence of agonistic social behaviour - especially superficial abrasions of hair and skin - can't be realized. In this project the social behaviour of 35 dairy herds with horns, living in loose housing, were investigated. In addition, the injuries that were caused by horns and the influencing factors were evaluated. The results show that there is no significant relationship between the agonistic (chase away, push away) and non-agonistic (licking) social behaviour. But a significant positive correlation between butting (without any effects of push away), horning on one side and licking on the other side was evident ($p<0.05$). Therefore it seems that butting and horning have a more non-agonistic character. The relationship between agonistic social behaviour and injuries were highly, positively significant ($p<0.001$). In contrast to this, injuries that were localised on the back part of the cows and with a circular extension had no significant correlation to agonistic social behaviour, but an inverse relationship to licking ($p<0.05$). The internal influencing factors on the social behaviour are connected with the attributes of the cows or the herd, for example age, breed, weight, form of horns, herd size and structure of age of the herd. The influence of external factors are fixed by the loose housing, the stable equipment, the herd-management and the human-animal-relationship. The internal factors had only a slightly significant correlation to the agonistic social behaviour or the frequent of injuries. The external factors were strongly correlated, especially of the herd-management and of the stable arrangement at the feeding rack and at the resting area ($p<0.01$). All the factors which were correlated to the agonistic social behaviour, were oppositely correlated to licking. In particular this applied to the factors of human-animal-relationship. It seems that the effect of human-animal-relationship to the agonistic behaviour and licking is highly contrary. In herds where the farmer shows an intimate contact to his cows, the frequency of agonistic behaviour is low and the frequency of licking is high. To determine the main influencing factors, step-wise regressions were conducted. The result of this evaluation shows that external and also internal factors (predictor variables) have a significant influence to the criteria variables (agonistic social behaviour, injuries).

# KENNEL DOG BEHAVIOUR BEFORE AND AFTER ADOPTION

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The phenomenon of stray dogs, particularly in great towns, may be associated with disturbed man-dog relationships, with appearance of behavioural disorders in the animals. This investigation aimed to examine the reactivity of kennel dogs and the feasibility of placing them with new families on the basis of: their behaviour in the kennel, the new environment and the behaviour of their new owners. Behaviour of 16 pure-bred and not pure-bred dogs (8 males, 8 females) was observed in the kennel during: a) the initial human approach to the animal pen; b) the initial veterinary examination; c) two 60 minute periods on consecutive days when the animal was alone in the pen. Moreover, the new owners completed questionnaires: two weeks, one and two months after adoption. Principal Component Analysis (PCA) indicates three main reaction patterns which explain 72.88% of total variance: 1) exploration/avoidance of new stimuli; 2) interaction with man; 3) dominant or submissiveness. Regularized Discriminant Analysis (RDA) showed that pedigree dogs (correct classification=81.25%) and females (correct classification=68.75%), more affected by slight pathologies than males, were more passive to new stimuli. The questionnaires showed that adaptation occurred during the first month. Most dogs were adopted as "companions" by childless families with no other animals. "House soiling" and "roaming and escaping" were the most frequent negative behaviours but could be blamed more on the new owner's training methods rather than the animals' behaviour prior to adoption. Dogs "less interested in man" in the kennel were less obedient with the new owners; the "hyperactive " animals tended towards disobedience and abnormal behaviour. Some behaviours were "owner sex-linked".

# An investigation into the walking behaviour of dairy cows on four different flooring surfaces.

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During the housing period the floor is the aspect of the environment with which cows have the most intimate contact. A smooth floor may lead to falls and splays whilst a rough floor may cause hoof injury which can result in clinical lameness. In either case locomotion may be inhibited. An experiment was carried out to investigate the effect of floor slip resistance on locomotive behaviour. A resin based floor surface with different aggregate sizes was tested. The coefficients of static friction (a measure of slip resistance) are: 1) no aggregate (0.34), 2) 0.5mm aggregate (0.42), 3) 1.2mm aggregate (0.49), 4) 2.5mm aggregate (0.74). Five British Friesian cows were video recorded as they walked on each surface. There were fifteen replications of each surface per cow. The angle of the fore leg at the elbow, carpal, metacarpophalangeal joints and foot:floor were measured at the start and end of the supporting phase of the stride. The corresponding angles of the hind leg were also measured. Step number, speed of walking and stepping rate were also recorded. Step length was greatest on 0.5mm aggregate (mean 1.372m, p=0.000, SED=0.04), and the foreleg showed the most confident stepping behaviour on this surface. The arc of movement of the hindleg was greatest on 1.2mm aggregate. It is suggested that the cow is less willing to put its forefeet on the more abrasive surface because the forefeet carry 55% of bodyweight, whereas she prefers the greater slip resistance of 1.2mm aggregate for the hindfeet because their primary function is in forward propulsion and so they are more likely to slip than the forefeet.

# LAMBS' ATTACHMENT TO THEIR MOTHER : IMPORTANCE OF THE FIRST SUCKING BOUTS

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In lambs, attachment to the mother occurs within 24 h after birth. The association of maternal cues with neonatal rewards is believed to provide the basis of this early bonding. In a first experiment we attempted to determine whether sucking was a potent reinforcer in the establishment of the attachment process by covering temporarily the udder of the ewes after parturition. Lambs were assigned to one of 3 treatments : they had free access to the udder (group 1) or were prevented from sucking either between 0-6 h (group 2) or 12-18 h after birth (group 3). When tested in a two-choice situation at 24 h of age, lambs from group 1 strongly preferred their mother, those from group 2 did not show any discrimination while lambs from group 3 clearly avoided their dam and preferred the alien ewe. When a second test was performed at 2 days of age, lambs from groups 1 and 3 chose their mother whereas those from group 2 made no consistent choice. In a second experiment we attempted to determine whether sucking was also rewarding in the maintenance of the attachment process. Lambs were assigned to one of 3 treatments : they had free access to the udder (group 1) or were prevented from sucking for 6 h either at birth (group 2) or at the age of 3 days when the bonding process is strongly established (group 3). Lambs from group 2 did not discriminate between their own and an alien dam when tested at 24 h of age, unlike those of groups 1 and 3. On the other hand when a second test was performed at 4 days of age, all the lambs chose their dam. We concluded that nutritive sucking has strong rewarding properties in the establishment of the attachment of the neonate to its mother. On the other hand the maintenance of this attachment does not rely as strongly on sucking, at least within the limits of our study.

# THE REPRESENTATION OF ANIMALS ON CHILDREN'S TELEVISION

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The welfare of animals depends, ultimately, on the attitudes and beliefs of the human beings who care for them. But people's attitudes towards non-human animals are notoriously complex and inconsistent (compare, for example, the relative treatment of farm animals and pets). To be able to hold such inconsistent views is an impressive psychological achievement, since it is generally accepted that people strive for balance and a lack of dissonance in their attitudes. The present study aimed to investigate one possible route by which attitudes to animals are formed during childhood - the ubiquitous medium of television. One hundred and ninety two children's television programs (55 hours 45 mins), representing two weeks of children's TV on all four of the terrestrial British channels, were subjected to content analysis. Structured coding sheets were used to record details of every instance of an animal, or animal related issue, being portrayed on each program. Animals were found to be an important subject area for children's TV: they appeared in 89% of the programs, and were a major focus of 62%. Two main themes concerning the portrayal of animals emerged. The first was a reinforcement of the notion of a phylogenetic hierarchy in animals' capacity to suffer; in general, fish and invertebrates were excluded from moral concern. Depictions of animal suffering were accompanied by expressions of concern on 89% of occasions when mammals were involved (n=18), but on no occasions when fish or invertebrates were involved (n=8). And when animal predation was shown (e.g. in wildlife programs or cat and mouse cartoons), 67% of mammal predations were unsuccessful (n=9), while 88% of fish and invertebrate predations were successful (n=26). The second theme was a marked avoidance of the issue of meat production. Farms were shown on eleven occasions: five depictions of idyllic mixed farms, four expositions of wool production, two of egg production, but none of meat production. This is despite the fact that other unpleasant and controversial issues such as human violence, illness or death (n=53), or the destruction of the natural environment (n=16) were tackled relatively frequently. The present findings are interpreted as expressions of adult society's discomfort with the paradox of advocating kindness to animals on one hand, but the acceptability of meat eating on the other. It is also suggested that such a selective presentation of animals in children's media may have an important effect in enabling the development of inconsistent attitudes.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

# TALES OF THE ENGLISH COCKER SPANIEL: PRELIMINARY FINDINGS ON AGGRESSIVE BEHAVIOUR

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During the early 1980s there were a number of reports in the British media about aggression in the English Cocker Spaniel. One article listed the breed as the most aggressive in Britain. A long term study has commenced to investigate such behaviour in the breed. Two thousand owners of purebred Cocker Spaniels were randomly selected through the Kennel Club (UK) and sent a questionnaire pertaining to aggressive behaviour in their dog/s. A total of 1008 (50.4%) replies were received, of which 932 (owning 1109 dogs) were suitable for analysis. The mean number of adults and children in the households was 2.3 and 0.7 respectively. The mean number of Cocker Spaniels owned was 1.2. Owners were asked to describe their dogs (age, sex, neuter status, coat colour) and to rate their dog's behaviour (on a 1 to 5 scale; 1 = never, or almost never, 5 = always) in 13 different situations. These included: aggression towards strange dogs (A1), towards strangers approaching the dog (A2), towards persons approaching/visiting the home (A3), towards persons approaching the owner away from home (A4), towards children in the household (A5), towards other dogs in the household (A6), when the owner gives attention to other persons or animals (A7), towards the owner or member of the owner's family (A8), when disciplined (A9), when reached for or handled (A10), when in restricted spaces (A11), at meal times/defending food (A12), and sudden and without apparent reason (A13). A Mann Whitney U test was used to look for differences in the 13 behaviours in relation to sex, neuter status, and coat colour of the dogs. Solid -coloured Cocker Spaniels were significantly more aggressive than parti-coloureds in situations A2 to A5 ($p< 0.001$), A6 ($p< 0.05$) and A7 to A13 ($p< 0.001$). The red/golden Cocker Spaniels were significantly more aggressive than the black variety in situations A1 ($p< 0.01$), A4 ($p< 0.01$), A5 ($p< 0.001$), A7 to A9 ($p< 0.001$), A10 ($p< 0.01$), and A11 to A13 ($p< 0.001$). Male spaniels were significantly more aggressive than females in situations A8 ($p< 0.05$), A9 ($p< 0.001$) and A10 ($p< 0.05$). Females were more aggressive than males in situation A6 ($p< 0.01$) only. Neutered females were more aggressive than entire females in situations A2 and A3 ($p< 0.05$), A4, A5, A8 ($p< 0.01$), A9, A10, A11 ($p< 0.001$), and A12 and A13 ($p< 0.05$). Neutered males were significantly more aggressive than entire males in situations A5, A8, A9, A10 ($p< 0.001$), A11 and A12 ($p< 0.01$) and A13 ($p< 0.001$).The bloodlines of solid-coloured and parti-coloured Cocker Spaniels are quite distinct and therefore there may be a genetic basis as to why solid-coloureds are more aggressive. The reasons why neutered dogs are more likely to be aggressive have not yet been fully explored but are being investigated at the present time.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# THE EFFECT OF GRAZING DOMINANT AND SUBORDINATE COWS TOGETHER OR APART AND OFFERING A HAY SUPPLEMENT, ON THE INGESTIVE BEHAVIOUR AND MILK PRODUCTION OF DAIRY COWS.

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In order to examine the social influences on the ingestive behaviour and production of dairy cows, seventy two spring calving cows were ranked on the basis of the dominance, lactation number, body weight and milk yield. The top 36 were selected as dominant and second 36 as subordinate cows and each group was divided into two subgroups. The dominant or subordinate cows (D/S) were then either grazed together or apart (T/A), with or without the provision of a hay supplement (+/-) indoors for 75 min/d. D cows had higher milk yields than S cows (D 15.9, S 13.9 kg/d $p<.001$), supplemented cows had higher milk yields than non-supplemented cows (+ 15.5, - 14.3 kg/d $p<.05$) especially when cows were grazed apart. Cows with no hay supplement had greater milk protein concentration (+ 30.1, - 31.2 g/kg$p<.001$) and fat concentration (+ 34.7, - 37.1 g/kg $p<.001$),particularly S cows when grazed apart. There were no other effects of D/S or T/A on milk production or composition. S cows grazed T had a greater hay intake (DT 2.5, DA 2.6, ST 2.8, SA 2.5 kgDM/d $p<.05$). The hay supplement decreased the grazing time of S cows more than D cows (D+ 559, D - 591, S+ 535, S-617 min/d $p<.05$). D cows grazed faster than S cows (66.8 vs 64.5 bites/min $p<.05$), masticated hay faster (64 vs 58 bites/min $p<.001$). Cows grazing together had an increased hay eating rate (16.0 vs 13.6 bites/min $p<.01$) and also increased hay feeding time (60 vs 55 min $p<.01$). D cows tended to enter the milking parlour later ($p<.08$), but both groups started to graze at the same time at the beginning of each grazing bout ($p = .51$). It is concluded that dominant cows may have used their superiority to obtain access to the best pasture, leaving subordinate cows rely more on the quality pasture and the supplement. This reduced the grazing time, milk and protein and fat contents of subordinates cows.

28th International Congress of the ISAE
Research Centre Foulum, Denmark
3 - 6 August 1994

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# BEHAVIOURAL COMPARISONS BETWEEN FARROWING CRATES AND GROUP FARROWING SYSTEMS.

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Studies of free-ranging pigs show that sows choose to leave their young at intervals. Freedom of movement and freedom to express normal behaviour are fundamental principles underlying most animal welfare guidelines. The objective of this study was to examine sow behaviour in three different farrowing systems. In two systems the sows were loose-housed and could move freely: five strawed pens (2.5m x 1.5m) with farrowing rail (Pen), and five crates modified to allow the sows to walk through (Free Crate). The third system consisted of five conventional farrowing crates (Crate). In each system, six groups of five sows were observed regularly over seven days between entry and weaning. Behaviour was recorded directly by instantaneous sampling. Sows in both loose-housed systems were able to exhibit a wider range of activities. The Crate limited not only the range of crated sow behaviours but also the extent to which some of these behaviours could be expressed. For example, manipulation of straw was possible in all treatments, however continued manipulation of straw in the crate system would often push the straw out of reach beyond the crate bars. Nesting behaviour was observed in all treatments, so long as nesting material remained within reach of the sow. Pen sows had a relatively large home area and used this area to exhibit higher levels ($P<0.05$) of nesting behaviour (0.8%) compared with other treatments (Crate, 0.15%; Free Crate, 0.38%). The proportion of observation time sows spent nursing was similar in the three systems; Crate 4.7%, Free Crate 4.0% & Pen 4.3%. Straw-chewing, bar-biting and drinking behaviour were observed in all systems, however levels for all three behaviours were higher ($P<0.05$) for Crate sows. Inactivity levels were similar between treatments; Crate 73.5%, Free Crate 78.5% and Pen 74.4%. Levels of panting were higher ($P<0.05$) in the Crate system (2.9%) as animals were unable to move away from hot areas of the room (Pen 0.1%, Free Crate 0.1%). It was particularly noticeable that sows in Crates nearest the window were more likely to pant, especially on sunny, summer afternoons. This study showed that confining the sow over the farrowing and lactation period restricts her repertoire of behaviour and so is detrimental to her welfare. However, when considering the continued use of a farrowing system, the sow's welfare must be balanced with welfare of the piglet and stockman.

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# USE OF A SATELLITE TRACKING SYSTEM TO RECORD THE FORAGING BEHAVIOUR OF HILL SHEEP

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Large areas of Europe are still contaminated with radiocaesium following the Chernobyl nuclear accident. In the UK, this necessitates restrictions on the movements of sheep in parts of Cumbria, Scotland, Wales and Northern Ireland. However, only a small proportion of the sheep in each flock are affected. The aim of this study was to assess the potential of using Global Positioning System (GPS) techniques to record the location of sheep and at the same time their grazing behaviour during the summer grazing period in upland West Cumbria.

Three adult Herdwick ewes were fitted with data-logging equipment that recorded their location (using a GPS receiver); their jaw activity (using a conductive rubber nose band) and whether the ewe was lying or standing. The animals were released onto the fell for one week. At the end of this period, the animals were gathered, the data-logging equipment removed and the recorded data analysed.

All three units successfully logged the movements of the ewes. Although there was evidence that hilly terrain did occasionally affect the function of the GPS receiver, this was for only 2.5% of the time in the worst case. The system allowed the animals home ranges, which varied between 2 and 7 ha, to be accurately determined.

The study clearly demonstrates that GPS can be successfully used to track animals, even in areas with hilly terrain. The technique could be used to identify the specific areas which give rise to sheep with high levels of radiocaesium.

# SELECTION FOR DOMESTIC BEHAVIOUR INDUCED THE ARISAL *de novo* OF THE NEW COLOUR PHASES IN THE MINK .

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Some data on polymorphism of the reaction towards man among the minks bred at farms and some selection-induce behaviour changes in these animals are presented. Three types among *32000* farming animals at the *6* month age both males and females were distinguished: with coward (*79%*), aggressive (*17%*) and calm (*4%*) exploratory reactions. The mean score of aggressive reaction increased during *11* years of selection from *-0.29+0.008* in the $S_0$ to *-2.22+0.04* (females) in $S_{11}$ and from *-0.14+0.008* ($S_0$) to *-2.23+0.04* (males) in $S_{11}$. In the group bred for domestic behaviour, the respective scores were *+2.79+0.2* in females and *+3.11+0.2* in males ($S_{11}$) against *-0.29+0.008* and *-0.14+0.008* ($S_0$). The consecuences of transformation of behaviour during selection for fur colour character variability among *15000* animals were analised. It was shown that in the course of selection for behavioural traits there was a noticeable increase in the amount of variants of piebald spotting. The offspring with domestic behaviour had the highest variation in piebald spotting and *4* new semi-dominant fur colour mutations (*"silvery", "black crystal", "star", "blue"*) were registrated. On the basis of these new mutations *8* new colour phases were synthesized.

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# IMMEDIATE REACTIONS OF LABORATORY RATS TO SOUND STIMULI

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Sound causes both behavioural and physiological changes in experimental animals. Twelve male Han:WIST rats, aged 28 weeks, were used. The rats were accustomed to the semi-anechoic sound proof chamber in groups of three for six days. Each group was exposed to sound stimulus in the chamber played out from tape recorder via tweeter speaker, frequency responses 2–50 kHz. The stimuli duration was 1 s, repeated every 30 seconds totally 10 times during one exposure period. Each rat group was exposed to one different sound per day, three hours after the onset of artificial light period, during four successive days. The sound stimuli used were 1) tearing paper (2–28 kHz), 2) square wave (10 kHz), 3) sine wave (10 kHz) and 4) noise (2–50 kHz). The sound pressure level weighted after the auditory sensitivity of albino rat was 60 dB(R). (R–weighting: –20 dB/2 kHz, –10 dB/4 kHz, 0 dB/8 kHz, –5 dB/16 kHz and –5 dB/32 kHz). The behaviour of the animals was stored on video recorder continuously before, during and after the exposure period. The reactions were classified as alert, startle, listning and no reaction. Sound 1 caused strongest response with longest duration, but the reactions were weaker with sounds 4, 2 and 3. In the course of each exposure period adaptation to the sound stimulus was obvious. Adaptation time was shortest with sounds 2 and 3, where reactions occurred only during the first four sounds of the sound stimulus group, and in two rat groups there were no reaction with sound 3. Restlessness was seen for some minutes after the stimulus 1 in three of the rat groups. It is apparent that sound 1 includes components which rats dislike. Further studies and sound analyses are needed to identify these components.

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