ISAE '98

International Society for Applied Ethology

ΗΘΟΣ

Proceedings of the 32nd Congress of the International Society for Applied Ethology

21-25 July 1998
Clermont-Ferrand, France

Edited by
Isabelle Veissier & Alain Boissy

INRA

The organisers thank Chantal Rambourdin for her technical assistance in editing the proceedings.

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Finally, we hope that you will get a lot of opportunities to discuss with each other during the excursions and the social events.

Isabelle VEISSIER and Alain BOISSY

Organiser

P. Le Neindre

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organiser of the session 'Ethics of animal use by humans'
M. Appleby

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J. Swanson

The reviewing procedure of all the abstracts submitted has involved 46 referees:

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We are grateful to them for having done this job so carefully.

We acknowledge the support of:

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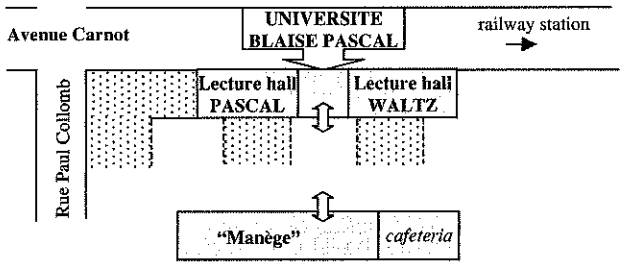

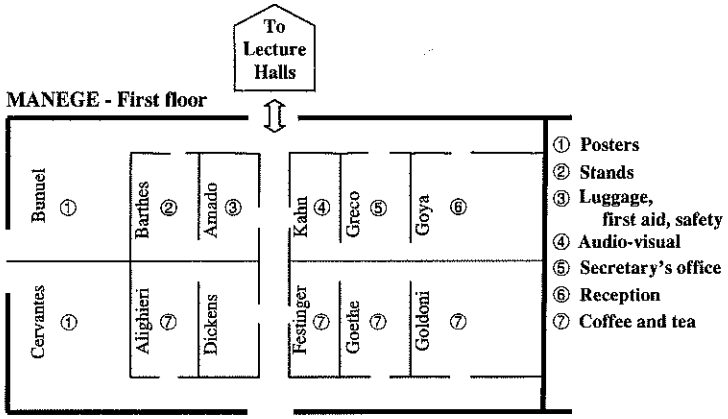

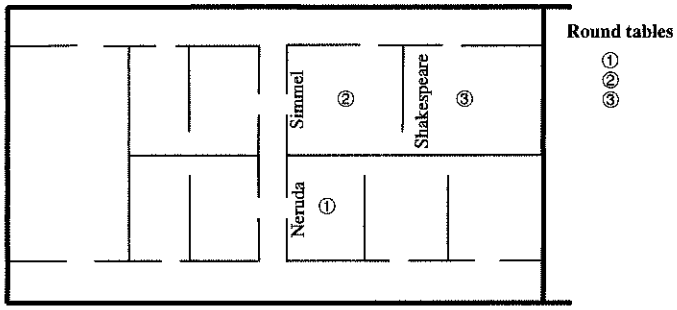

ISAE'98 Programme

Tuesday 21st July

14:00 – 21:00 **Registration & Posters installation** ***(Manège)***

19:00 **Dinner**

20:00 –20:30 **Welcome talk** ***(Lecture Hall PASCAL)***

20:30 **Welcome reception** ***(Manège)***

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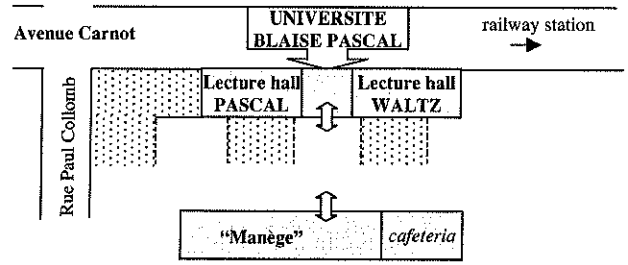

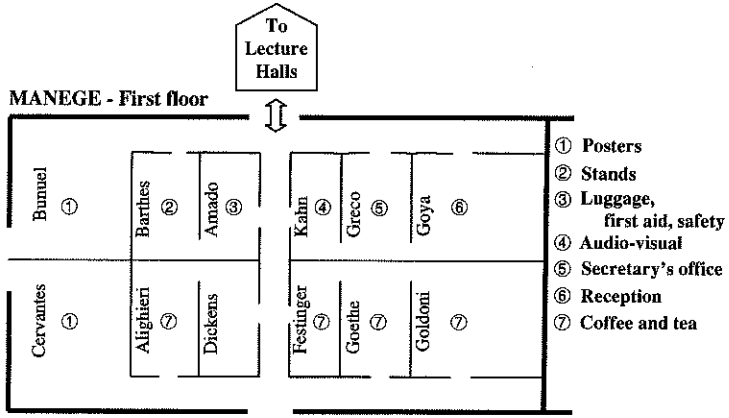

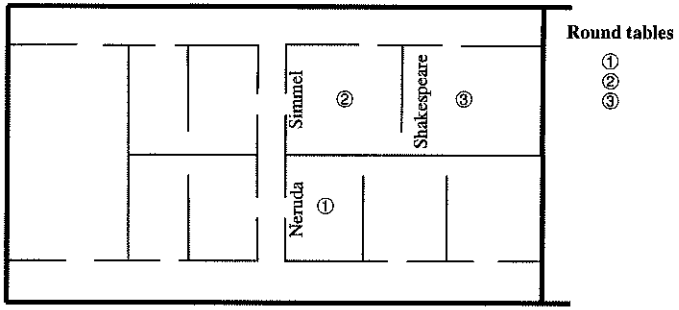

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20:00 –20:30 **Welcome talk** ***(Lecture Hall PASCAL)***

20:30 **Welcome reception** ***(Manège)***

Wednesday 22nd July

07:00 **Registration & Posters installation** (*Manège*)

09:00 **Opening of the Congress** (*Lecture hall PASCAL*)

PLENARY SESSION: SOCIAL BEHAVIOUR (chair: L. Keeling) *Lecture hall PASCAL*

09:20 ***G. Mason.*** Early social experience and lifelong responses to challenge: can we rear young animals to cope better with captivity ?

10:00 – 10:50 **POSTERS SESSION & Coffee break** *Manège (rooms Bunuel & Cervantes)*

Authors of odd numbered posters stay at their posters.

SESSION A: ABNORMAL BEHAVIOUR (chair: J. Mench) *Lecture hall PASCAL*

10:50 ***C.J. Savory.*** Stereotyped pecking after feeding by restricted-fed fowls is influenced by meal size.

11:15 ***C.M. Sherwin.*** The effects of environmental enrichment and lighting on injurious pecking by male, domestic turkeys.

11:40 ***B. Wechsler, B. Huber-Eicher, V. Aerni, H. El-lethey, T.W. Jungi.*** Motivational and physiological aspects of feather pecking in laying hens.

12:05 ***K.S. Vestergaard, P.F. Johnsen.*** The development of feather pecking in fowl: the dustbathing hypothesis and the effects of distractability.

12:30 ***Lunch***

SESSION B: SOCIAL BEHAVIOUR (chair: L. Keeling) *Lecture hall WALTZ*

10:50 ***P. van Loo, V. Baumans, B. Van Zutphen.*** Modulation of aggression through different cage cleaning procedures in mice.

11:15 ***J.L. Gimpel, G.J. Mason.*** The mink mother (Mustela vison) and her behavioural role at post-weaning ages.

11:40 ***Y. Tessier, P. Pageat, E. Gaultier.*** The use of a pig appeasing pheromone analogue to reduce aggression on removal and return of individuals.

12:05 ***L.J. Pedersen, L. Rydhmer, M. Neil, A.M. Dalin.*** Oestrus behaviour of group housed sows in relation to individual competitive success.

PLENARY SESSION: FREE PAPER (chair: F. Ödberg) *Lecture hall PASCAL*

14:00 ***M. Cabanac.*** The phylogeny of emotion.

SESSION A: ABNORMAL BEHAVIOUR (chair: J. Mench) *Lecture hall PASCAL*

14:40 **H. *Würbel, R. Freire, C.J. Nicol.*** No rebound following selective prevention of stereotypic wire-gnawing in laboratory mice: implications for stereotypy as a coping response.

15:05 ***C.M. Nevison, C.J. Barnard, J.L. Hurst.*** An investigation into the motivational basis behind the development of bar related stereotypy in male ICR (CD-1) mice.

15:30 ***J.P. Garner, G.J. Mason, H. Broadbent.*** Cage stereotypy in Blue tits (Parus caeruleus) and Marsh tits (Parus palustris) is associated with a deficit in the inhibition of non-functional behaviour.

15:50 – 16:20 ***Coffee break***

SESSION A: ANIMAL MANAGEMENT (chair: F. Ödberg) *Lecture hall PASCAL*

16:20 ***S. Gunnarsson, L. Keeling, J. Svedberg.*** Effects of rearing conditions on behavioural problems in laying hens; an epidemiological approach.

16:45 ***M. Harris, H.W. Gonyou.*** Infanticidal behaviour in sows: some results of a large-scale survey of producers' records.

17:10 ***C.C. Ketelaar-de Lauwere, A.H. Ipema, J.H.M. Metz.*** Free access to forage and grazing as conditions for the application of fully automatic milking.

17:30 – 19:00 **ROUND-TABLES** *Manège (Top floor)*

1. Animal – technics interactions

organiser: J. Stefanowska

room: P. Neruda

2. Animal models of human psychiatric disorders: do cognitive disorders reflect impaired animal welfare?

organisers: H. Würbel & J. Garner

room: G. Simmel

19:00 ***Dinner***

20:00 – 22:00 **Cheese and wine party around POSTERS**

SESSION B: TEMPERAMENT (chair: H. Gonyou) *Lecture hall WALTZ*

14:40 ***P. Plusquellec, M.F. Bouissou.*** Comparative study of social behaviour and emotional reactivity between a fighting breed (Herens) and a dairy breed (Brune des Alpes) of cattle.

15:05 ***R.J. Kilgour, L.R. Fell, S. Wilson, J. House.*** Nervous feedlot cattle eat less frequently, differ in resting behaviour and use of the feedlot pen, grow slower and are more prone to illness compared to calm cattle.

15:30 ***T. Rekila, M. Harri, L. Jalkanen, T. Pyykonen.*** Attempts to reduce hyponeophagia in farmed foxes using anxiolytic drugs.

16:20 ***F. Wemelsfelder, E.A. Hunter, A.B. Lawrence, M.T. Mendl.*** The inter- and intra-observer reliability of spontaneous qualitative assessments of pig behaviour.

16:45 ***M.A.W. Ruis, J.H.A. Te Brake, J.A. van de Burgwal, H.J. Blokhuis, J.M. Koolhaas.*** The backtest performed at a very young age predicts the individual behavioural and physiological strategies of growing pigs.

17:10 ***M.T. Mendl, H.W. Erhard, S.B. Christiansen.*** No evidence for strong links between personality traits in pigs.

17:30 – 19:00 **ROUND-TABLES** *Manège (Top floor)*

3. Do coping styles exist in farm animals? Behaviour, physiology, welfare implications

organisers: M. Ruis & J. Malmkvist

room: W. Shakespeare

Thursday 23rd July

PLENARY SESSION: APPLIED ETHOLOGY AND THE DEVELOPING COUNTRIES (chair: J. Swanson) *Lecture hall PASCAL*

08:30 ***F. Galindo, A. Orihuela, D. Brousset.*** The development of applied ethology in Mexico.

SESSION A: SOCIAL BEHAVIOUR (chair: J.M. Faure) *Lecture hall PASCAL*

09:10 ***B. Forkman, M.J. Haskell.*** Rank and aggression in stable flocks of hens, a test of two hypotheses.

09:35 ***S. Cloutier, J.P. Beaugrand, R.C. Newberry.*** Previous social experience and comb size predict the outcome of encounters between unfamiliar hens.

10:00 ***R.B. D'Eath, L. Keeling.*** Social discrimination by hens in large and small flocks: implications for social organisation.

10:25 ***H.A.M. Spoolder, A.B. Lawrence, S.A. Edwards, P. Howard Simmins, T.W.Armsby.*** The effects of food level on the spatial organisation of dynamic groups of sows.

10:45 – 11:35 POSTERS SESSION *Manège (rooms Bunuel & Cervantes)*

Authors of even numbered posters stay at their posters.

11:30 ***Lunch***

13:00 22:00 ***Excursions*** (ending with a country buffet in Saint-Saturnin castle)

SESSION B: APPLIED ETHOLOGY AND THE DEVELOPING COUNTRIES (chair: J. Swanson) *Lecture hall WALTZ*

09:10 ***M. Picard, M. Vilarino, T. Yo, J.M. Faure.*** Tropical poultry production; How ethological tools may help researchers?

09:35 ***T. Sonoda, M. Uchikawa, T. Umezaki, T. Furuno.*** Mechanism of the organic rice-cultivation system with ducks.

10:00 ***S.J.G. Hall.*** Applied ethology and the ruminant livestock of semi-arid Africa.

10:25 ***H. Hernandez, P. Poindron, J.A. Delgadillo, A.D. Rodriguez, N. Serafin, P.G. Marnet.*** Using the flexibility of suckling behaviour in goat kids to increase milk collection in double management goats.

Friday 24th July

PLENARY SESSION: MOTHER-YOUNG BEHAVIOUR (chair: P. Poindron) *Lecture hall PASCAL*

08:30 ***A. Lawrence, C. Dwyer, S. Jarvis.*** An interactive model of behavioural change in parturient and lactating farm animals.

SESSION A: FREE PAPERS (chair: M. Mendl) *Lecture hall PASCAL*

09:10 ***P. Koene.*** Applied ethology and experiments with single or few subjects.

09:35 ***E.M.C. Terlouw, P. Rybarczyk, X. Fernandez.*** Differences in stress reactivity between Large White and Duroc pigs: consequences for meat quality aspects.

10:00 ***M. Gemus, P.C. Bartlett, R.F. Nachreiner, A.J. Zanella.*** Human characteristics and handling strategies: their effects on the physiological and behavioural responses of juvenile pigs.

10:20 – 11:10 **POSTERS SESSION & Coffee break** *Manège (rooms Bunuel & Cervantes)*

Authors of odd numbered posters stay at their posters.

SESSION A: ANIMAL WELFARE (chair: H. Simonsen) *Lecture hall PASCAL*

11:10 ***B.L. Nielsen.*** Inter-specific comparison of lactational stress: Is the welfare of dairy cows compromised?

11:35 ***B. Hoerning.*** Scoring system for an on-farm assessment of housing conditions.

12:00 ***J.E. Bolhuis, W.G.P. Schouten, V.M. Wiegant, I.C. de Jong.*** Individual differences in pigs: behavioural response to apomorphine.

12:30 ***Lunch***

SESSION B: MOTHER-YOUNG BEHAVIOUR (chair: P. Poindron) *Lecture hall WALTZ*

09:10 ***B. Schaal, G. Coureaud, P. Orgeur, R. Hudson, F. Lebas, P. Coudert.*** The transition from prenatal to postnatal environment in the rabbit: evidence for a transnatal continuity in olfactory cues and function.

09:35 ***C. Dwyer, A.B. Lawrence.*** Influence of lamb behaviour on the expression of maternal behaviour in sheep.

10:00 ***A.P. Goursaud, X. Boivin, R. Nowak.*** Specificity of colostrum in the development of a preference for the mother by the new-born lamb.

SESSION B: MOTHER-YOUNG BEHAVIOUR (chair: A. Lawrence) *Lecture hall WALTZ*

11:10 ***G. Ferreira, A. Terrazas, P. Orgeur, R. Nowak, P. Poindron, F. Lévy.*** Olfactory cues are not necessary for recognition of the lamb by the ewe.

11:35 ***G. Illman, M. Spinka, Z. Stetkova.*** Predictability of nursing without milk ejection in domestic pigs.

12:00 ***P. Poindron, H. Hernandez, F. Gonzalez, M.L. Navarro, J.A. Delgadillo.*** Mother-young relationships in goats: characteristics and possible implications or production in double purpose management.

PLENARY SESSION: ETHICS OF ANIMAL USE BY HUMANS (chair: M. Appleby)
Lecture hall PASCAL

14:00 ***P. Sandoe, L. G. Christensen.*** Staying good while playing God: the ethics of breeding farm animals.

SESSION A: ANIMAL WELFARE (chair: H. Simonsen)
Lecture hall PASCAL

14:40 ***L.R. Mathews, J.A. Walker, T. M. Foster, W. Temple.*** Influence of reward magnitude on elasticity of demand for dustbathing in hens.

15:05 ***S.M. Abeyesinghe, J.M. Randall, C.J. Nicol, C.M. Wathes.*** Aversion of broiler chickens to vibration and thermal stressors.

15:30 ***J.B. Kjaer, P.K. Isaksen.*** Individual use of the free range area by laying hens and effect of genetic strain.

15:55 ***A.J. Zanella, L. Brundige.*** Short and long term effect of loading techniques on behavioral and physiological responses of weight pigs.

16:20 ***K.C. Murray, J.C. Eddison, S.L. Cullinane, J.A. Kirk, S.M. Rutter, R.A. Champion.*** The effect of journey structure on the welfare of lambs.

16:40 – 17:10 ***Coffee break***

17:10 – 19:00 AGM of ISAE
Lecture hall PASCAL

From 19:00 ***Banquet & Dancing*** *(Restaurant Arverne, Place Delille)*

SESSSION B: ETHICS OF ANIMAL USE BY HUMANS (chair: M. Appleby)
Lecture Hall WALTZ

14:40 **A. *Steiger.*** Problems with animal welfare, disease and behavioural abnormalities of extreme breed types in pet animals.

15:05 ***W.R. Stricklin.*** Animal behavior versus animal welfare: distinguishing between "What is" and "What ought to be".

15:30 ***J.K. Kirkwood.*** Ethics of use of animals in conservation.

15:55 ***C. O'Connor, L. Milne, A. Rhodes, N. Gregory, C. Eason.*** Ethical approaches to vertebrate pest control in New Zealand.

16:20 ***L. Letourneau.*** Animal protection law and ethics: a close look at the existing orthodoxy.

Saturday 25th July

WOOD-GUSH MEMORIAL LECTURE: BIOETHICS (chair: J. Ladewig)
Lecture hall PASCAL

08:30 ***B. Rollin.*** Scientific ideology, anthropomorphism, anecdote, and ethics.

09:30 – 10:20 **POSTERS SESSION & Coffee break**
Manège (rooms Bunuel & Cervantes)

Authors of even numbered posters stay at their posters.

SESSION A: PHYSIOLOGY (chair: J. Ladewig)
Lecture hall PASCAL

10:20 ***K. Olsson, E. Hydbring, K. Cvek.*** Measurements of blood pressure and heart rate by radio-telemetry as a tool to evaluate wellbeing of goats.

10:45 ***S. Hansen, E. von Borell.*** Impact of pig grouping on sympatho-vagal balance as measured by heart rate variability.

11:10 ***E. von Borell, M.W. douglas, J.E. Cunnick, J.C. Pekas, D.R. Zimmerman.*** Behavioural and physiological indicators of hunger and satiety in restricted fed sows: Influence of feeding regimen.

11:35 ***D. Guémené, M. Garreau-Mills, S. Crisctomo, C. Morvan, D. Zadworny.*** Prevention of broody behaviour expression in domestic birds by means of immunological treatments.

12:00 ***N.B. Prescott, C.M. Wathes.*** Spectral sensitivity of the domestic broiler chicken.

12:30 ***Lunch***

SESSION B: HUMAN-ANIMAL RELATIONSHIPS (chair: W. Schouten)
Lecture Hall WALTZ

10:20 ***J. Lensink, I.Veissier.*** Effects of farmer's behaviour on reactivity and productivity of veal calves.

10:45 ***S. Waiblinger, Ch. Menke.*** Can reactions of cows be used for on-farm assessment of human-animal relationship in dairy farms ?

11:10 ***J. Jago, C.C. Krohn. L.R. Matthews.*** The effects of early handling with and without hand feeding on the development of the relationship between calves and humans.

11:35 ***G. Coleman, K. Breuer, P.H. Hemsworth.*** The effect of handling on the stress physiology and behaviour of nonlactating heifers.

12:00 ***A.L. Hovland, B.O. Braastad, M. Bakken.*** Effects of handling prior to mating and during pregnancy on growth and behaviour of farmed blue-fox cubs (Alopex lagopus).

PLENARY SESSION: ANIMAL WELFARE (chair: L. Matthews) ***Lecture hall PASCAL***

13:45 ***D.M. Broom.*** The evolution of feelings and their relation to welfare.

SESSION A: FREE PAPERS (chair: P. Le Neindre) ***Lecture hall PASCAL***

14:25 ***B.M. Spruijt.*** Reward centres in the brain: the animal's own welfare centre.

14:50 ***D. Bean, G. Mason, M. Bateson.*** Why do animals work for food when food is free? Using starlings to test the information hypothesis for contrafreeloading.

15:15 ***N. Lewis.*** Effects of frustration of feeding behaviour on swine.

15:40 **Closing of the Congress** ***Lecture hall PASCAL***

16:00 – 19:00 ***Visits of the city***

Sunday 26th July

Post-congress tour *(The timetable will be given during the congress)*

SESSION B: HUMAN-ANIMAL RELATIONSHIPS (chair: L. Matthews) ***Lecture hall WALTZ***

14:25 ***J.N. Marchant.*** Sow aggression towards the stockperson; relationships with approach test parameters and piglet survival.

14:50 ***H.W. Erhard, M.T. Mendl, L.V. Schotthorst.*** Qualitative and quantitative effects of handling on tonic immobility in pigs.

15:15 ***X. Boivin, H. Tournadre, C. Durier.*** Petting and bottle-feeding lambs make the caretaker a social substitute for the young animals put in short isolation test.

List of Posters

arranged by exhibition room and theme

EXHIBITION ROOM: BUNUEL

N° poster

THEME: HUMAN-ANIMAL RELATIONSHIPS

1 - Interspecific differences in fear of humans ("domestic behaviour") in farm animals *by* ***M.F. Bouissou, V.S. Lankin***

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Plenaries

arranged by programme order

Early social experience and lifelong responses to challenge: can we rear young animals to cope better with captivity?

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On farms and in laboratories, mother-infant interactions are routinely both impoverished and prematurely curtailed. Three areas of fundamental research suggest that this must have profound effects on lifelong responsiveness to stressors, and that modifying the quality and quantity of maternal care may be a simple and effective means of improving the welfare of captive animals.

1) Studies of rodent development: If pregnant rodents are stressed, their offspring show diminished activity in Open Field Tests, and increased corticosteroid output in response to acute stress (reviewed by e.g. Weinstock 1997: Neurosci. Biobehav. Rev. 21: 1.). However, rat pups exposed to pre-natal stress (PNS) do not develop these responses if cross-fostered at birth to non-stressed mothers, suggesting that altered maternal care is involved. One aspect of maternal care altered by PNS is pup grooming: this decreases in PNS mothers. Handling neonatal rats for as little as three minutes a day similarly has longterm effects on behaviour and physiology, but in the opposite direction: as adults, early-handled (EH) rodents show reduced corticosteroid responses to stressors and fewer behavioural signs of stress in Open Field Tests. EH animals are also less susceptible to conflict-induced gastric ulceration, resume drinking more quickly after being interupted by electric shock, reach greater weights in adulthood, and show fewer cognitive deficits in old age (see review by e.g. Meaney et al. (1988). Science 238: 766). Like PNS, EH effects may be mediated by maternal behaviour, as young rodents emit distress cries when handled which elicit grooming and nursing on return to the nest. Direct tests of this hypothesis have included exposing experimental litters to the sounds of other disturbed pups, so that their mothers are stimulated into performing maternal behaviour. Liu et al. (1997: Science 277: 1659) also recently published further evidence that maternal behaviour influences the development of the HPA. They observed mother-infant interactions, and found that some mothers spent more time licking and grooming their pups than others. As adults, the offspring of these 'more maternal' females showed reduced HPA responses to restraint stress.

2) Attachment theory: In primates, an important aspect of maternal care is the encouragement of exploration, through acting as a 'Secure Base' to which juveniles retreat when scared or tired. This occurs at a later stage of juvenile development than the grooming effects studied in rodents, when the young are mobile, semi-independent and exploratory. The role of this reassuring, comforting stable adult presence - the so-called 'attachment figure' - in the psychological development of infant human and non-human primates has long been recognised. Long-term deprivation can sensitise a human child to subsequent adverse events and later in life render it more vulnerable to psychological problems such as depression (e.g. reviewed Bowlby (1988). A Secure Base: Clinical Applications of Attachment Theory. Routledge). In several primate species, the offspring of mothers that restrict exploration are very cautious when exposed to novelty. Reduced exploration is also seen in the offspring of captive long-tailed macaques whose mothers are physically restricted.

3) Experimental psychology: Isolation post-weaning has been used by experimental psychologists to modify the development of frontal and striatal dopamine pathways. Behaviourally, this increases animals' sensitivity to the stereotypy-inducing effects of amphetamine, and impairs their abilities to suppress inappropriate behaviour (e.g. Jones et al. (1992). Pharmacol. Biochem. Behav. 43: 17). As the latter has recently been implicated in the stereotypies of voles, such developmental effects are highly likely to predispose animals to cage stereotypies.

Overall, improving the early social environment of animals in our care, particularly the maternal care they receive when young, may have enormous welfare implications and also reduce the prevalence of abnormal behaviour. Evidence for this from applied studies is presented.

The phylogeny of emotion

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Fever was selected early in Evolution as a defence against viruses and bacteria. Round worms, Arthropods, and Vertebrates respond to pyrogens with fever. Mammals and Birds use behavioral and autonomic responses to rise their body temperatures when infected. Ectothermic animals (bradymetabolic species) use behavior only. Thus, fever being a very ancient response to aggression by infectious agents must have been a useful way to cope and have been retained by natural selection through Evolution.

Fever, in addition, is also aroused by emotion in Mammals. Mere handling is sufficient to trigger shivering and skin vaso-constriction which result in elevation of core temperature. Since the elevation of core temperature is the result of co-ordinated thermoregulatory responses and is prevented by previous injection of salicylate, this is a fever. Ectotherms are not able to elevate their core temperature with autonomic responses, they depend only on environmental heat to regulate their core temperature. When they were gently handled and manipulated, lizards sought infra-red heat and elevated their cloacal temperature in a way similar to that of Mammals.

Such a behavioral fever was prevented by previous injection of salicylate. Thus, reptiles responded to emotional stress with a fever. On the other hand Amphibians and Fish, placed in environments that allowed behavioral temperature regulation, responded to various pyrogens with fever but mere handling did not produce fever in them. Therefore, it may be hypothesized that emotion emerged in Evolution between Amphibians and Reptiles. This was tested using another criterion of emotion, the tachycardia occurring during handling (see attached proposal for a short oral communication). In rat and lizard, but not in frogs, gentle handling of the animal triggered emotional tachycardia. Thus, there seems to exist a qualitative borderline between Amphibians and Reptiles. This conclusion is relevant for a good understanding of animal wellfare. In addition, the emergence of emotion allows further speculation about the emergence of consciousness. Since emotion is a mental phenomenon, it is permitted to hypothesize that consciousness emerged with Reptiles, and to speculate on the structure of consciousness inherited from its biological origin (Griffin, 1992, Animal Minds, Univ. Chicago Press; Dawkins, 1993, Through our eyes only? Freeman & Co.). Consciousness possesses four dimensions, quality, intensity, affectivity, and duration (Cabanac, 1996, Neurosci. biobehav. Rev. ,20, 33-40). In a final experiment, lizards were placed in a situation of motivational conflict between ambient temperature and a palatable bait.

The results very likely showed that the animals used their sensory affectivity to optimize their behavior. This would confirm that early Reptiles, Birds and Mammals, possess one of the dimensions of the conscious experience and, therefore, consciousness.

Applied ethology in Mexico

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Although animal behaviour studies have been carried out in developing countries for long, they have focused mainly on fundamental areas such as neurobiology or behavioural ecology. It is only very recently that the first groups of applied ethology have been built up. In Mexico, in 1995 the veterinary school at UNAM, with one of the largest population of veterinary students in the world, implemented compulsory courses for undergraduate and graduate students. Academically, that training program has had a big influence but, so far it had no real impact in the public opinion. As in other developing countries, that work has been partly developed as a tool to improve productivity. Animal welfare is not a major public's concern as opposed to what is happening in most developed countries. This difference is probably due to the fact that students and training staff are just beginning to discover the subject and that there is a low interest of that type of ethical issues in the public opinion.

Studies on applied ethology have been driven by funding organisms mainly on two major issues: 1) conservation of biodiversity and 2) animal production.

The biodiversity issue in large regions as Latin-america (Mexico, Colombia, Ecuador, Peru and Brazil), Africa (Zaire and Madagascar) and Asia (India, China, and Indonesia) is a major concern as they are territories rich in natural resources with an economical potential through sustainable use programmes. Endangered species are often kept in confinement for conservation purpose as it is seen as an alternative for the reintroduction of animals to their original habitat. In that context, applied ethology is a useful tool to improve the health, the reproductive state and the ontogeny of typical behaviour of those species. Academic institutions, zoos, government or non governmental organisations expanded those programs more than in any other area.

Most animal production research programs are addressed via traditional systems (i.e. genetics, nutrition, reproduction, etc.). Ethology is seen among farmers and technicians just as one among other areas of research for improving profits and it can concern any aspect of the behaviour (sexual, maternal, social, grazing...). Due to the economical situation of many developing countries, one of the priorities that must be considered for the development of applied ethology is a cost-benefit analysis for the farmers and the industry. At this stage, if it is possible to conciliate this with an improved welfare for the animal, the farmer will be interested in voluntarily carrying out changes in management procedures, but the argument will not be exclusively on the animal welfare basis. A big gap between applied ethology and the concept of animal welfare will probably remain for a while in these countries.

It is concluded that applied ethology in developing countries is having a very fast development and that promising results are to come. However more efforts have to be made by research groups and by societies such as ISAE, ABS or regional societies such as SOMEV (Sociedad Mexicana de Etologia Veterinaria) in order to make more accessible results on animal behaviour. This will allow the developing countries not to invest their limited resources for the generation of basic knowledge (physiology, endocrinology, etc.) but to allow their scientists to answer questions related to conservation of biodiversity and animal production. The future of applied ethology depends on the feasibility of its implementation,

which often requires changes in activities, priorities and management practices at all levels. This process involves more people than animals and as a consequence it is currently our major challenge.

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An interactive model of behavioural change in parturient and lactating farm animals

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There has been a long-standing interest in the maternal behaviour of farm animals, particularly in the context of its potential role in neonatal mortality. However, the focus in applied ethology on the immediate peri natal period has tended to obscure the fact that parturition is generally related to a wide-spread suite of behavioural and physiological changes which can affect not only the immediate survival of offspring but also long-term overall behavioural and physiological development of the neonate. There is sufficient generality across species to suggest that parturition triggers not only increased sensitivity and attraction to neonatal stimuli, but simultaneously also reductions in sensitivity to 'fear/anxiety' inducing stimuli and in the requirement for close social contact. Recent physiological results suggest potential neuroendocrine correlates of these changes, such as a significant down-regulation at parturition of stress-sensitive pathways such as the hypothalamic-pituitary-adrenal axis, and the involvement of the GABA system (which is strongly linked to anxiety) in maternal responses. Non-adaptive maternal behaviour (e.g. increased rejection of offspring) is presumably linked to an imbalance in these neuroendocrine inputs resulting in reduced stimulation of maternal behaviour and/or insufficient down-regulation of fear or gregariousness. Given this interactive model a wide range of genetic and environmental influences could impact to affect the quality of maternal care. This model provides a framework for understanding the diverse responses of parturient and lactating females, such as reports of a negative relationship between mothering/rearing ability and measures of fear in sheep. There are a number of predictions which follow from this model, but perhaps most importantly it indicates that in our attempts to reduce neonate mortality, either through genetic selection or environmental manipulation, we need to have a much broader view of the potential factors which can influence the quality of maternal behaviour.

Staying good while playing God: the ethics of breeding farm animals

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Farm animals are not what they used to be. Moreover, recent changes have occurred rapidly, because new reproductive and breeding techniques have accelerated the process of genetic selection immensely over the last few decades. The main goal of farm animal breeders is to increase productivity. Thus every generation of farm animals matures faster, yields more milk, or produces more meat or eggs, than the previous one. Equally, farm animals utilise foodstuffs in an ever more efficient way. In this process of change the quality of the product is also often altered: pork, for example, contains much less fat than it used to do.

Despite these apparent benefits, modern breeding gives rise to various ethical worries. There is worry about animal welfare. High-yielding dairy cows, for example, suffer more frequently from mastitis and other production related diseases than their ancestors, and some fast growing broilers suffer from leg problems. Another worry relates to the loss of biodiversity, and the consequent reduction of the gene pool - with the obvious implications that has regarding loss of potentially valuable genetic resources. For example in Northern Europe, many local cattle breeds have been lost in competition with the modern, high-yielding breeds. Finally, anxieties are aroused by the perception that newly bred animals are less "authentic", or less "natural", than their forebears. Thus many people find it problematic that animals are bred so that they can reproduce only by means of artificial insemination - as is the case, for example, with turkeys - even if the animals do not in any tangible way suffer as a consequence of this.

This presentation describes how modern breeding has succeeded in transforming various farm animal species. In addition the above mentioned ethical worries will be set out and discussed. It will be suggested that there are in fact two very different ethical outlooks underlying these worries, outlooks that we shall label "welfare ethics" and an "ethic of respect for nature". These two outlooks will be discussed and arguments will be presented in favour of welfare ethics. Finally , it will be discussed how it is possible to modify the breeding goals to give appropriate weight to animal welfare. In this connection it will be made clear what it takes to "operationalize", a welfare parameter within the context of a breeding programme.

The discussion will specifically revolve around the expected consequences of using alternative breeding goals in future dairy cattle breeding schemes. In several countries increased attention has been drawn to the attempt, recently made in the Nordic countries, to develop a more welfare friendly breeding profile for dairy cows. This profile besides milk production traits also gives consideration to traits relevant to animal welfare such as health, ease of calving, still birth, longevity and quality of udder, teats, feet and legs.

The evolution of feelings and their relation to welfare

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Feelings are brain constructs, sometimes with peripheral links, which may change behaviour and which often act as reinforcers during learning. Pain and thirst are examples of feelings which are potential negative reinforcers whilst sexual pleasure and eating pleasure are feelings which are potential positive reinforcers.

In origin, many feelings may have been epiphenomena of functional systems within the body, perhaps accidentally activated brain areas or now redundant brain pathways, and some may be no more than that now. However, most feelings can have effects on the individual such that it is more likely to carry out some adaptive action. Pain or fear may promote avoidance whilst good feelings, as part of the animal's state, may promote attempts to continue or return to that state so the consequence of the existence of the feelings is increased fitness. A gene would spread in the population if its action promoted the occurrence of a feeling which increased the chances that its bearer would survive and breed successfully. Hence it is proposed that most feelings in man and other animals have evolved.

Individuals which are not able to feel pain are at a considerable risk of injury. Responses to nociceptive stimulation may be reflexive but are usually associated with the feeling of pain. Once this feeling has occurred in a recognisable situation, future behaviour is normally modified so as to prevent the recurrence of the feeling. Similarly, the feeling of thirst is likely to result in more beneficial effects than would occur if only body-fluid monitoring systems without the associated feeling existed. These feelings can clearly vary in intensity, and perhaps in quality, and can usefully affect a range of bodily systems. The selective advantages of eating pleasure and sexual pleasure are to promote actions which increase the chances of, respectively, obtaining appropriate nutrients and copulating. Feelings of anxiety and grief are likely to amplify the attention paid to important life events and the efficacy of action taken, whilst achievement pleasure might help in the consolidation of accurate memory concerning what has been done well. However, individuals may have feelings of anxiety, grief or the other feelings mentioned above whose effect is too extreme to promote the fitness of the individual and, on the other hand, feelings may be too weak to have beneficial effects. Selection processes which may have resulted in the evolution of twenty-five different feelings are discussed in this paper and by Broom [1998, Adv. Study Behav., 27, in press].

Most aspects of feelings have evolved and help individuals significantly to cope with and respond to their environment. Hence since welfare concerns the individual's ease of, or difficulty in, coping with its environment and the extent of any failure to cope, feelings are an important part of welfare. The extent of other coping procedures and of effects of the environment despite attempts to cope are also important aspects of welfare. Important evidence concerning welfare comes from measures of abnormal behaviour, extreme physiological coping responses, immunosuppression, disease effects, neuromas, inability to grow and reproduce and life expectancy. These can indicate difficulties in coping or failure to cope, and hence poor welfare, whether or not there are bad feelings. We have to be able to consider the overall welfare of an individual which is unconscious or asleep, and hence having no feelings, or briefly euphoric because of administration of drugs but with serious

injuries or other problems. Where efforts are made to assess welfare, feelings and all other aspects of attempts to cope and of effects of the environment on individuals should be measured wherever possible.

Oral Communications

arranged by programme order

Stereotyped pecking after feeding by restricted-fed fowls is influenced by meal size

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Growing broiler breeder chickens, fed routinely according to a programme of chronic food restriction, typically show increased pacing before feeding time and increased drinking and pecking at non-food objects afterwards. Expression of this behaviour is often stereotyped in form. In two experiments at 8 and 14 weeks of age, they were caged individually, provided with two meals per day at 0900 and 1600 h, and tested with 0900 h meals that differed in either size (10, 25, 40 g) but not food form (pellets), or food form (pellets, mash) but not size (15 g). Measurements of behaviour were made from video recordings between 0915 (when all feeding had ceased) and 1600 h. As meal size increased, so did the proportion of time spent in stereotyped object pecking after feeding, while time spent standing (only) decreased; there were no other significant effects of either meal size or food form on post-feeding behaviour. It is concluded that the observed effect of meal size on object pecking was a consequence of the weight of food eaten per se, rather than the time taken to eat it. Paradoxically, whereas expression of abnormal behaviour is known to be correlated negatively with total daily food intake (Savory and Maros, 1993, Behavioural Processes 29, 179-190), it appears to be correlated positively with meal size within a given level of food restriction. It is suggested that this effect may be due at least partly to variation in patterns of dopamine activity in the brain.

The effects of environmental enrichment and lighting on injurious pecking by male, domestic turkeys

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Injurious pecking amongst turkeys is often prevalent and sometimes fatal. This problem might be reduced by using appropriate environmental enrichment and/or, lighting conditions. The study examined responses to 4 treatments using 8 light-proof rooms (2 rooms/treatment) containing 100 non-beak trimmed turkeys from 1-34 days of age. The treatments were: Enriched (12L:12D incandescent, supplemental UV light, straw and visual barriers), Control (12L:12D incandescent), Fluorescent (12L:12D fluorescent) and Intermittent (4(2L:3D):12D incandescent). Environmental enrichment reduced injuries due to wing or tail-pecking, and eliminated injuries due to head-pecking. On Day 34, the number of birds which had injuries due to wing or tail-pecking differed significantly from the distribution expected if injuries were present equally amongst all treatments (wing injuries; $G=13.9$, 3 df, $P<0.005$: tail injuries; $G=17.85$, 3 df, $P<0.001$). The distribution of the total number of birds culled or with injuries due to head-pecking throughout the study was also significantly different from that expected if injuries were equally prevalent amongst treatments ($G=9.847$, 3 df, $P<0.05$). Despite considerable environmental differences between treatments, there was consistency in the ages at which injuries due to wing-pecking (5-10 d), tail-pecking (20-25 d) and head-pecking (23-33 d) were first recorded. It is suggested the causal factors of feather-pecking amongst turkeys might be different from those of layer hens. The possible roles of moulting, feather emergence and aggression amongst wild turkey poults are used as speculative explanations of these consistencies in the onset of injurious pecking. It is concluded that in combination or independently, supplemental UV light, straw, pecking substrates and visual barriers can be used to reduce the injurious pecking amongst groups of male turkey poults.

Motivational and physiological aspects of feather pecking in laying hens

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Feather pecking resulting in feather damage, injuries and mortality causes severe welfare problems in laying hens. In a series of experiments with white 'Lohman Selected Leghorn' hybrids we could show that the rate of feather pecking is inversely related to foraging activity and that both feather pecking rate and foraging activity are significantly affected by the form and the availability of foraging materials (Huber-Eicher and Wechsler, Anim. Behav. 54: 757-768, Anim. Behav. 55: 861-873).

In an additional experiment, we tested whether birds showing high rates of feather pecking are also characterised by increased levels of stress. From week 19 to week 30 after hatching, 16 groups of 11 hens were kept in pens with or without long-cut straw as foraging material and provided with food in the form of pellets or mash. Stress level was assessed by body weight gain (weeks 19-25), egg production (weeks 19-25), heterophil/lymphocyte ratio (week 26), tonic immobility (week 27) and antibody titers (after immunisation in week 29) to sheep red blood cells, tetanus toxoid and human serum albumin.

Both provision of foraging material and food form had significant effects on feather pecking (interaction $P<0.0001$). Rates of feather pecking and feather damage were highest in groups without straw and with pellets. Egg production was significantly reduced in pens without straw ($P<0.02$), but not affected by food form. Both the duration of tonic immobility and heterophil/lymphocyte ratio were significantly influenced by provision of foraging material (Tonic immobility: $P<0.0001$; heterophil/lymphocyte: $P<0.0001$) and food form (Tonic immobility: $P<0.02$; heterophil/lymphocyte: $P<0.001$). Tonic immobility was longer and heterophil/lymphocyte ratio was increased in hens housed without straw and fed with pellets. Antibody titers to sheep red blood cells and tetanus toxoid were significantly lower in pens without than with straw (sheep red blood cells: $P<0.005$; tetanus toxoid: $P<0.001$), but not significantly influenced by food form. The results suggest that feather pecking in laying hens is associated with stress.

The development of feather pecking in fowl: the dustbathing hypothesis and the effect of distractability

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The dustbathing hypothesis of feather pecking development is the latest hypothesis explaining the cause(s?) of feather pecking. It was developed by the first author and presented first in 1989 and then in more detail in 1994 (Dissertation). Feather pecking is indeed a major problem in fowl, and it has received much attention by numerous workers in many countries. However, when the dustbathing hypothesis was first applied it was found that chicks could be reliably reared without damage appearing later in life.

It is striking that alternative systems result in much feather pecking and damage although the environment is usually rich and suited for foraging and exploration as well as for dustbathing (litter, access to outdoor areas with grass, soil, space etc.). Furthermore, it is always uncertain whether feather pecking will appear or not in such systems (it usuly does). The problem however is that feather pecking develops during early development (during rearing) so that what happens in the laying house is largely irrelevant for the prevention of feather pecking development.

We believe the reason (cause) for feather pecking development is that the chicks misimprint on feathers rather than imprint on sand at an early age so that for the rest of their life feathers are perceived as a stimulus for dustbathing, especially at the start of dustbathing (appetitive phase).

Many other factors than the ones mentioned above seem to influence feather pecking and the resulting damage in fowl and pheasants. For example a low stocking density decreases feather damage, and access to an outdoor run has a reducing effect. We suggest that these effects are due to DISTRACTABILITY, i.e. the birds pay more attention to (are «distacted» by), the environment and consequently pay less attention to feathers when they are further apart (the density effect) and when there is more to explore or to forage on (the effect of outdoor run, as well as of grain and hay on the floor) . These effects may bee seen both during rearing and laying. However, they are not related to developmental and causal aspects of feather pecking, but are more «immediate» effects, that have only minor consequence as far as feather damage is concerned.

Modulation of aggression through different cage cleaning procedures in mice

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In group housed male mice, increase of aggression after cage cleaning is a well known and unwelcome phenomenon. Transfer of some soiled sawdust from the previous cage to the clean cage is widely used to inhibit the increase of aggression. Controversy exists however, whether the transfer of olfactory cues increases rather than decreases aggression. In this study we investigated the effect of three cage cleaning procedures on aggression in group housed male mice.

Thirty six male BALB/c mice were conventionally housed in groups of three with nesting material (tissues) as enrichment and food and water ad lib. At the start of the experiment, the mice were four weeks of age. Six groups were full brothers and six groups were mixed at weaning to see whether kinship was an additional factor influencing aggression. Each week for a period of nine weeks, all cages were cleaned according to a randomised block design in either of the following three cage cleaning procedures:

1. Clean cage with clean sawdust and nesting material.
2. As in 1, additionally a handful of sawdust containing urine and faeces from the soiled cage.
3. Clean cage with clean sawdust, but nesting material transferred from the soiled cage.

Latency until first agonistic encounter, frequency and duration of agonistic encounters and number of fights were scored for 1 hour after cage cleaning.

When nesting material was transferred (3), aggression was significantly lower than in a cage with clean nesting material (1 and 2). Transfer of soiled sawdust (2) increased the number of fights. Kinship did not affect the level of aggression.

Results indicate that different olfactory cues have differential modulating effects on aggression. Nest scent may aid a reduction of social tension as a result of cage cleaning.

The mink mother (Mustela vison) and her behavioural role at post-weaning ages

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The role of the mink mother as a secure base from which to explore and to buffer stressful situations for their young on post-weaning age was studied based on the methodology developed for investigating attachment theory in human and non-human primates. A pair of kits, a male and a female, were taken from each of six litters to observe their exploratory behaviour and possible signs of stress when exposed to a strange environment. This was done in the presence of either the mother or of a peer companion and was repeated at four different ages. To control for the effect of repeated experiments, a naïve kit was used as companion during the last test of each litter. In that way, a comparison of experimental with naïve kits would reveal whether possible changes were due to the effect of age or of repetition.

Overall the presence or absence of the mother affected variables that were indicative of stress or fear (such as vocalisations or scratching the barrier between experimental and home compartment). It was concluded that the mother plays an important role in buffering stressful situations for their young at ages when they are no longer dependent on milk. Indicators of exploratory behaviour (e.g. latency to start exploration, latency to interact with novel object) were not affected by the absence of the mother. Therefore, according to our study, the mother does not play an important role as a secure base from which to explore at post-weaning ages in mink. There were no significant differences between sexes. Hence, the idea that the sex of the young mink has an influence in the kind of attachment that they develop with their mother is not supported by this experience. The changes found in consecutive experiments indicate that exploration in weaned mink is influenced by experience rather than age, as demonstrated by comparison with naive kits.

The use of a pig appeasing pheromone analogue to reduce aggression on removal and return of individuals

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We sought to assess the efficiency of a pheromone analogue called PAP (pig appeasing pheromone) in the reduction of agonistic behaviour on return of post-weanlings previously separated from their groups for 6 days.

100 piglets from a commercial piggery were divided into four groups : two comparable groups of smaller pigs each received either the test treatment or the placebo whilst two groups of bigger pigs were treated in the same way. One piglet of each group was randomly picked up and ear-tagged every 2 days, then put into another group, up to a total of 16 subjects. 6 days after separation, each piglet was re-introduced into its group. Treatment, either with test pheromone or placebo, was applied in the pens and on the individual subjects before they returned. We defined two types of aggressions, the first one being moderate and the second one violent. We analysed the first 15 minutes of video recordings which were made immediately following the reintroduction of the subjects and statistical analyses were performed through an ANOVA with repeated measurements.

The cumulative duration of fights involving the subject (3.4 min vs. 5.9 min, p=0.007) was significantly lower in the experimental group than in the control group. Some interesting trends were also recorded for the number of both types of aggressions involving the subject (37 vs. 51, p=0.053) or of violent aggressions in the whole group (5.4 vs 9.7, p=0.058) , the cumulative duration of aggressions in the group (11.85 vs. 18.48 min, p=0.06) and number of times the subject was bullied away from food (1.5 vs. 3, p=0.09).

Treatment had no effect on peaceful explorations, on the number of food intakes or on the time spent feeding, and on the mean duration of recumbency.

These results are carefully interpreted because of the slight alteration of the groups' sizes during the trial.

Oestrus behaviour of group housed sows in relation to individual competitive success

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Four groups of nine sows were housed in pens measuring 8,0 x 8,7 sqrm immediately after weaning. Video recordings of initiator, recipient and outcome of all aggressive interactions and sexual interactions (levering and mounting) were made for 10 days, using continuous observations for 15 minutes each hour round the clock. The social dominance relation between each individual was calculated as well as the competitive success of each sow.

The preliminary results showed large individual variation amongst sows in the amount of aggressive interactions initiated. Four sows were catagorized as neutral (involved in less than 20 interactions), 15 sows as high success sows(winning>50% of its interactions) and 17 sows as low success sows (loosing>50% of its interactions). In general, the amount of aggressive interactions were decreased significantly already after the day of grouping. The amount of levering and mounting were rising 2 days before the first observation of standing oestrus. However, in these measures large individual variations amongst the sows existed. Significantly more high success sows and neutral sows were mounting other sows more than 10 times (12 sows) compared to low success sows (5 sows) (p=0.05). Fifteen sows were never observed mounting any other sow. In contrast, the sow that was mounting most frequently was mounting up to 157 times. The sows had partner preferences, and the choice was strongly related to the dominance relation between the sows. Of the 16 sows that were mounting other sows more than 10 times only 2 of them preferred to mount a sow of higher social status than them selves ($p<0.01$).

In conclusion, large individual variations in both initiation of aggression and levering/mounting during oestrus was observed in group housed sows after weaning. The competitive success of the sows significantly influenced the sexual activity during oestrus and there was a clear tendency that sows preferred to mount sows of lower social status than themselves.

No rebound following selective prevention of stereotypic wire-gnawing in laboratory mice: implications for stereotypy as a coping response

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Three groups of six pairs of adult male laboratory mice of the ICR-strain kept in standard laboratory cages were selectively prevented from stereotypic wire-gnawing for 1, 5, or 10 days, respectively. Behaviour was observed throughout the 12 h dark period one day prior to prevention, on day 1, 4, or 9 (depending on the group) during the period of prevention and on post-inhibitory day 1 and 3. Prior to prevention wire-gnawing was positively correlated ($P<0.05$) with total activity and climbing. During prevention all three groups showed significantly reduced locomotor activity ($P<0.05$) and climbing ($P<0.01$) and significantly enhanced resting ($P<0.05$). However, the decrease of total activity was positively correlated with base-levels of wire-gnawing on day 1 only ($P<0.01$) but not at later stages of prevention. Similarly, climbing during prevention was positively correlated ($P<0.05$) with base-levels of wire-gnawing on day 1 and 4 but not on day 9 of prevention. These results indicate that the mice did adjust their activities to the new situation, although this was a gradual process over several days. However, on post-inhibitory day 1 all three groups immediately resumed wire-gnawing at pre-treatment base levels with performance following the same time course throughout the dark period but with significantly reduced peak performance ($P<0.05$). In the light of motivational theory these results shed doubt on the general validity of the coping hypothesis. Together with data on early development (Würbel et al. 1996, Ethology 102, 371-385) they rather suggest that stereotypic wire-gnawing in laboratory mice represents a stimulus-response habit.

An investigation into the motivational basis behind the development of bar related stereotypy in male ICR(CD-1) mice

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Laboratory rodents are often housed in polypropylene cages with a removable metal bar lid. Mice regularly perform behaviour patterns involving the lid (e.g. investigation, gnawing and jumping), and longer bouts may be classed as stereotypic (Wurbel et. al (1996), Ethology 102, 371-385). Suggested source motivations include active exploration of the cage, investigation of the external environment, thwarted attempts to leave the cage, or feeding motivation given the proximity of between the lid and food (Wiedenmayer (1997), Animal Welfare 6: 273-277).

Using modified cages, we examined the causal motivation for bar behaviour in ICR(CD-1) mice. Subjects were born and lived in cages of the same type, and were videoed pre- and post-weaning, at puberty following re-grouping, and as adults. Cages had a hole in one side overlaid with metal bars. Half of the cages had fixed side bars and moveable lid bars, the rest had moveable side bars and fixed lid bars. Husbandry procedures were carried out through the moveable bars, during which mice could briefly investigate the external environment. Food was placed inside the cage, removing any association between food and bars. Additionally, half of each set of bars was covered by Perspex so that mice could interact with bars without cues from the external environment.

These modifications allowed predictions to be made about where bar related behaviour should be performed depending on the source motivation. Adults spent 41.02 ± 2.14 % of their time budget in bar related behaviour. More time was spent at bars not covered by Perspex ($t_{1,31} = 11.91$ $P < 0.001$, 2-tailed), and at the moveable bars compared to the fixed bars ($t_{1,31} = 3.32$ $P < 0.005$). These results indicate the prime motivation behind bar behaviour is to investigate the external environment, with frustrated intention to leave the cage. The welfare implications of the results shall be discussed.

Cage stereotypy in Blue tits *(Parus caeruleus)* and Marsh tits *(Parus palustris)* is associated with a deficit in the inhibition of non-functional behaviour

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Individual differences in the stereotypies of schizophrenic and autistic patients correlate with deficits in the inhibition of inappropriate responses on a variety of learning tasks, indicating that stereotypy in these populations is symptomatic of deeper dysfunction (e.g. Frith and Done, Psychol. Med. 13, 779-786). We have recently reported similar correlations in Bank Voles (Garner and Mason, Proc. ISAE97) suggesting that cage stereotypy represents one symptom within a wider syndrome of behavioural changes in captive animals.

In order to characterise the taxonomic breadth of this "Captivity Syndrome", we tested for the association of stereotypy and cognitive deficits in a population of wild caught Marsh tits and Blue tits that had been kept in captivity for three years. Our Captivity Syndrome hypothesis predicts a positive correlation of stereotypy and trials to extinguish a response, and no positive correlation with trials to learn the same response. Four Marsh Tits and six Blue Tits were taught a spatial discrimination task to a criterion of 90% correct over 20 trials, and extinguished to a criterion of 25% of the omission rate during the spatial learning task.

Individual birds spent 6.7% to 90% of home-cage activity performing route-tracing stereotypies. All analyses employed the general linear method, and were blocked by species. As flight was hindered in several birds due to feather wear, the analysis included the interaction of feather wear and stereotypy. General learning effects were partialled out. For both species trials to extinction correlated positively with stereotypy ($F_{1,4}$=185.09; $p<0.001$) and feather wear ($F_{1,4}$=171.13; $p<0.001$). A significant interaction between stereotypy and feather wear ($F_{1,4}$=190.85; $p<0.001$) indicated that the effect of stereotypy flattened out with heavy feather damage. Blue tits took longer to extinguish ($F_{1,4}$=132.91; $p<0.001$).Trials to learn the initial discrimination failed to correlate with stereotypy ($F_{1,4}$=0.14; $p=0.731$), and did not differ between species.

These results indicate that the Captivity Syndrome, characterised by the association of stereotypy and an inability to suppress non-functional behaviour, is taxonomically widespread, and implies that the same behavioural control systems underlie these abnormal behaviours in both mammals and birds.

Effects of rearing conditions on behavioural problems in laying hens; An epidemiological approach

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There are often problems with mislaid eggs, cloacal cannibalism and feather pecking in large flocks of loose housed layers in litter floor housing systems. For this reason they have been the focus of several experimental studies. There have, however, been few epidemiological studies of these problems, even though statistical methods for assessing the risk of behavioural problems would be similar to those for assessing the risk of disease, which are well developed in epidemiological research.

Effects of rearing conditions on behavioural problems were investigated in commercial flocks of laying hens housed in two different loose housing systems. The sample population was 120 385 laying hens, from 59 flocks on 21 different farms. Detailed data on egg production, feather damage and mortality from these farms was available, as well as information on how the birds had been reared. Two hypotheses were proposed. These were, firstly, that access to perches before four weeks after hatching would decrease the prevalence of mislaid eggs and cloacal cannibalism and, secondly, that access to litter before two weeks after hatching would decrease the prevalence of feather pecking. Logistic regression modelling was used to test these hypotheses. In addition to the factors on access to perches or litter, models included hybrid, stocking density, group size, type of system, age at delivery and nest area per hen. Odds ratios were calculated from the results of the model to allow risk assessment.

No significant correlations were found between the prevalences of mislaid eggs, cloacal cannibalism and feather damage. The risk of laying mislaid eggs in flocks reared with access to perches was less than one third of that in flocks reared without perches (Odds ratio 0.30; $p<0.001$, $n=45$). Furthermore, the results showed that groups of birds exposed to perches before four weeks were less than half as likely to have problems with cannibalism compared to other groups of birds (Odds ratio 0.46; $p=0.03$, $n=32$). No other factor had a significant effect in theses models. Contrary to expectation, early access to litter did not have any significant effect on the prevalence of feather damage.

Infanticidal behaviour in sows: some results of a large-scale survey of producers' records

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Much has been speculated, but little empirically proven, about infanticidal behaviour in sows. Few studies have been made of this phenomenon (often called 'savaging'), and most inferences have been drawn from casual observation. Even the most basic of information - the incidence of the behaviour - has not been firmly established. Until now, there has been no reported large-scale study specifically designed to determine the frequency of savaging.

A survey was initiated to determine the incidence of fatal piglet savaging reported by producers on two large farrow-to-finish pig operations in Saskatchewan, both of which used gestation stalls and farrowing crates to house sows. Unit A was a new 1200 sow operation consisting entirely of first-parity animals. Unit B was a 600 sow operation, in the process of becoming established, containing sows from parities 1-5. The incidence of savaging was much greater on the new unit: over a seven week period on Unit A, of 269 litters, 18 gilts (6.69%) savaged one or more piglets to death, resulting in the death of 58 (2.19%) live-born piglets. This compares to mortality due to overlying (crushing) of 3.24% piglets, and total preweaning mortality of 8.12%. On Unit B, over a seven month period, of 786 litters, 2 gilts (3.17%) and 11 sows (1.52%) savaged one or more piglets to death, resulting in the death of 10 (1.51%) and 23 (0.3%) piglets, respectively. The average number of piglet victims per savaging episode was between 2.4 and 3.2.

On Unit A, both total and live litter size were on average larger in litters which were later savaged versus non-savaged litters (by 1.0 and 0.79 pigs, respectively), and there was a trend towards a significant positive correlation between savaging and total litter size ($r = 0.10$, $P = 0.101$). Records for Unit B included data from consecutive farrowings for some sows. Two sows savaged while giving birth to both their fourth and fifth litters, but in general, savaging on one occasion was not invariably followed by similar behaviour at the next parity. Similarly, one infanticide-free farrowing did not always preclude savaging at the next birth.

Free access to forage and grazing as conditions for the application of fully automatic milking

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Fully automatic milking systems (AMS) enable cows to be milked without human interference. Such systems are acceptable from the animal welfare point of view (1) when cows are not forced to pass through the system because it is their only way to the forage, and (2) when the system can be combined with grazing in the summer season. Both conditions were investigated.

In the first case, a situation in which cows could move freely between the lying and the forage areas, but had to pass through the AMS to reach the concentrate feeder was studied with two groups of 20 crossbred Holstein Friesian cows. More visits to the AMS and less waiting and less aggression in front of the concentrate feeder were seen in this situation, compared with one in which the concentrate feeder was freely accessible ($p<0.01$). Providing new concentrate every four hours instead of every two hours reduced waiting in front of the concentrate feeder and increased lying in the cubicles ($p<0.01$).

In the second case, grazing in combination with the application of an AMS was studied in a group of 24 crossbred Holstein Friesian cows. No grazing (cows indoors round the clock) was compared with unrestricted grazing (possibility for 24 hours outdoors daily) and restricted grazing (possibility for 12 hours outdoors daily). The AMS and water were continuously available in the cowshed. There were fewer milking visits in unrestricted grazing than in the other treatments ($p<0.01$). In the grazing treatments, cows spent more time foraging ($p<0.01$). The lying times did not differ between the treatments, but in unrestricted and restricted grazing, cows given the opportunity to graze spent respectively 93.5 % and 80.3 % of their lying time in the pasture. In unrestricted grazing and restricted grazing cows at pasture went to the cowshed in the company of at least one other cow in respectively 78.2 % and 82.4 % of cases. The weather affected cow behaviour. In unrestricted grazing, cows spent less time in the pasture between 10:00 a.m. and 5:00 p.m. if the outdoor temperature was higher ($p<0.01$).

Infanticidal behaviour in sows: some results of a large-scale survey of producers' records

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Much has been speculated, but little empirically proven, about infanticidal behaviour in sows. Few studies have been made of this phenomenon (often called 'savaging'), and most inferences have been drawn from casual observation. Even the most basic of information - the incidence of the behaviour - has not been firmly established. Until now, there has been no reported large-scale study specifically designed to determine the frequency of savaging.

A survey was initiated to determine the incidence of fatal piglet savaging reported by producers on two large farrow-to-finish pig operations in Saskatchewan, both of which used gestation stalls and farrowing crates to house sows. Unit A was a new 1200 sow operation consisting entirely of first-parity animals. Unit B was a 600 sow operation, in the process of becoming established, containing sows from parities 1-5. The incidence of savaging was much greater on the new unit: over a seven week period on Unit A, of 269 litters, 18 gilts (6.69%) savaged one or more piglets to death, resulting in the death of 58 (2.19%) live-born piglets. This compares to mortality due to overlying (crushing) of 3.24% piglets, and total preweaning mortality of 8.12%. On Unit B, over a seven month period, of 786 litters, 2 gilts (3.17%) and 11 sows (1.52%) savaged one or more piglets to death, resulting in the death of 10 (1.51%) and 23 (0.3%) piglets, respectively. The average number of piglet victims per savaging episode was between 2.4 and 3.2.

On Unit A, both total and live litter size were on average larger in litters which were later savaged versus non-savaged litters (by 1.0 and 0.79 pigs, respectively), and there was a trend towards a significant positive correlation between savaging and total litter size ($r = 0.10$, $P = 0.101$). Records for Unit B included data from consecutive farrowings for some sows. Two sows savaged while giving birth to both their fourth and fifth litters, but in general, savaging on one occasion was not invariably followed by similar behaviour at the next parity. Similarly, one infanticide-free farrowing did not always preclude savaging at the next birth.

Free access to forage and grazing as conditions for the application of fully automatic milking

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Comparative study of social behaviour and emotional reactivity between a fighting breed (Herens) and a dairy breed (Brune des Alpes) of cattle

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The current concern for animal welfare has resulted in an increased interest in the selection of behavioural traits in domestic animals. Although behavioural selection among farm animals has only recently emerged, breeders of species used in traditional events such as bull fighting or fights between cows have been interested in this topic for a long time. In this context, however, the specific behavioural traits that have actually been selected are not always evident. The aim of our study was to compare social behaviour (agonistic, tolerance) and fear reactions in two breeds of cattle, one selected for intraspecific fighting ability (Hérens), the other selected for milk production (Brune des Alpes) submitted to the same management techniques

It was hypothesized that these breeds would differ in several behavioural traits including: aggressive behaviour (Hérens>Brune) in undisturbed groups or in reaction to intruders; social tolerance (Hérens<Brune) in a food-competition situation; fear reactions (Hérens<Brune) and persistance (Hérens>Brune) in fear-eliciting tests (exposure to novel objects, surprise effects). To elucidate the effects of selection and fighting experience, both female calves (38 Hérens in 5 groups; 24 Brune in 3 groups) and adult females (4 groups of 8 Hérens; 4 groups of 8 Brune) were studied.

The results indicate that Hérens calves were more aggressive within undisturbed rearing groups than Brune (respectively 38 and 20% aggressive interactions/total) , less tolerant and more fearful (latency to sniff a novel object: respectively 258.2 vs. 191.5 sec, p=0.01); increase in cortisol level after a surprise effect: 12.2 vs. 5.7 ng/ml, p=0.003). On the contrary, adult Hérens cows were less aggressive than Brune both within groups (respectively 20 vs. 38% of aggressive acts/total) and towards intruders. Like Hérens calves, they were less tolerant. Preliminary results indicate that Hérens cows are less fearful (latency to eat after a surprise effect: respectively 51.3 vs. 94.3 sec, p=0.04).

Thus, the breeders' selection in Hérens breed appears to have led to hightened aggressiveness and emotional reactivity, at least in calves, and lower social tolerance. Results for the adult cows appear to reflect an interaction between selection and experience gained during fights.

Nervous feedlot cattle eat less frequently, differ in resting behaviour and use of the feedlot pen, grow slower and are more prone to illness compared to calm cattle

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The behaviour of 24 focal animals, 12 of which were classed as calm, 12 as nervous, in a group of 380 in a feed lot pen was determined by instantaneous scans. Every 15 minutes, the animals were located in a predetermined order and their behaviour noted as well as their position in the pen which had been marked out in a 6x6 grid of 36 squares. The behaviours to be noted, determined before the start of the observations, were five mutually exclusive primary behaviours, namely, feeding, standing but not feeding, lying sternally, lying laterally, and moving. Each morning, all animals were checked by two stockhandlers on horseback and any ill animals were removed for treatment. Animals from the Calm group were observed feeding on almost twice as many occasions as were animals from the Nervous group (25% compared with 14% of the scans respectively, P<0.001) and had a higher average daily gain (1.46 *vs.* 0.95 kg/head/day, P<0.01). There were also major differences between the two groups (P<0.001) in their use of the pen. When lying, the Calm animals used every rectangle in the grid and used them in a relatively random fashion; animals were observed in more than 5% of the scans in only eight of the 36 rectangles. In contrast, there were six rectangles in which the Temperamental animals were never seen lying, two where they were seen lying in more than 10% of the scans and one where they were seen lying in more than 15% of the scans. Five of the Temperamental animals showed signs of ill-health whereas none of the Calm animals did so.

Attempts to reduce hyponeophagia in farmed foxes using anxiolytic drugs

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Hesitation to eat in the presence of human (Feeding test) and an elevated secretion of cortisol have been assumed to be linked to fear in farmed foxes. The aim of this study was to test whether anxiolytic drugs can reduce these reactions in foxes. The experimental animals were three groups of 8 blue and three groups of 8 silver foxes, not eating in any of the four subsequent Feeding tests. In both species, one group served as the control, the second group received buspirone and the third group amitriptyline in their food twice a day, 20 + 20 mg for blue foxes and 20 + 10 mg for silver foxes. After two weeks of drug administration the following tests and analyses were carried out: four Feeding tests with one hour interval between two subsequent tests, rectal temperature, blood cortisol (nmol/l, RIA) immediately after capture (base level), 20 min after the first sample (stress response) and 2 h after ACTH administration (ACTH response) as well as 24-h urinary cortisol:creatinine (nmol/mmol) ratio. Although the experimental animals were initially those not eating in the Feeding test, the percentage of eaters had rosen when tested again after two weeks in the experiment being 88, 75, 50 and 63, 88, 50 % in buspirone, amitriptyline and control groups of blue and silver foxes, respectively (Chi-square, $P>0.05$ between groups). The following parameters in the same order were: rectal temperature: 39.2, 39.2, 39.1 (ANOVA, $P>0.05$) and 39.7, 39.2, 39.6 °C ($P=0.06$), baseline cortisol: 110, 110, 90 ($P>0.05$) and 110, 80, 100 ($P>0.05$), stress level of cortisol: 160, 130, 140 ($P>0.05$) and 230, 180, 270 ($P>0.05$), ACTH-response level; 320, 360, 370 ($P>0.05$) and 510, 460, 500 ($P>0.05$), urinary cortisol:creatinine ratio: 4.9, 4.2, 4.6 ($P>0.05$) and 2.9, 2.2, 2.2 ($P>0.05$). The results show that during the experiment foxes habituated to humans to such an extent that their fear level, as judged from the Feeding test, reduced also in the control group not treated with anxiolytics. Thus any possible effect of the anxiolytics in reducing fear remained undetected.

The inter-and intra-observer reliability of spontaneous qualitative assessments of pig behaviour

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Qualitative assessment is based upon the integration by the observer of many pieces of information which in conventional quantitative approaches are recorded separately. Behaviour is for example summed up as 'tense', 'anxious' or 'distressed'. Such interpretations form the core of the lay public's concern for animal suffering, and therefore are frequently dismissed as 'anthropomorphic' and unscientific. However, in theory it is possible that such assessments reflect observable aspects of behavioural organization, and may be liable to scientific analysis. A first step in considering this hypothesis is to investigate the inter- and intra-observer reliability of spontaneous qualitative assessments. Ten 15-week-old female pigs were housed in a 4 x 4 m. straw-bedded pen. Pigs were let singly into an identical, directly adjacent test pen for a period of 7 minutes, where they had the opportunity to interact with a human squatting in the centre of the test pen. Nine untrained observers were instructed to provide qualitative assessment of the pigs' interaction according to a 'Free-Choice-Profiling' (FCP) procedure, a food-science based methodology which allows observers complete freedom in their choice of terminology. Observers then repeated their assessment from two video-recordings of the live session, one showing pigs in the same order as the live session and one in different order. All data were analyzed with Generalized Procrustes Analysis, a statistical technique associated with FCP which finds a consensus between observer assessment patterns (the 'pig consensus profile'), and provides a measure of observer agreement. Results show 1. a very high consistency between the pig consensus profiles of all three repeat assessments ($p<0.001$), and 2. a high and significant level of observer agreement for these consensus profiles ($p<0.001$). Spontaneous qualitative assessment of animal behaviour thus appears to be based on commonly perceived and systematically applied criteria. The nature of these criteria remains to be investigated; however this study supports the potential of qualitative assessment as a scientific methodology in the field of animal behaviour and welfare.

The backtest performed at a very young age predicts the individual behavioural and physiological strategies of growing pigs

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In the backtest, described before by Hessing et al. (1993, Appl. Anim. Beh. Sci. 37, 285-295), individual female piglets (n=128) were restrained in a supine position and numbers of escape attempts and vocalisations were scored during 1 minute. The piglets were exposed to the backtest at the age of 2-4 days and this was repeated at 4 weeks. Relatively high correlations were found between escape behaviour in the first backtest, but not in the second one, and responses to challenges performed at a later age. Therefore, we selected the extremes in the first backtest for further analysis (no indications for bimodality) and classified them as being low resistant (LR; < three escape attempts; n=31) or high resistant (HR; >four escape attempts; n=45). The number of vocalisations for LR piglets in the first backtest was significantly lower than for HR ones (12 ± 3 vs 32 ± 2: mean ± sem; $P<0.001$). Physiologically, LR animals were shown to have higher (salivary) cortisol values than HR ones in response to some challenges at 24 weeks of age, such as routine weighing (1.07 ± 0.11 vs 0.51 ± 0.14 ng/ml; $P<0.05$) and i.m. administration of ACTH (200 IU; peak: 7.13 ± 0.50 vs 5.55 ± 0.33 ng/ml: $P<0.01$). Moreover, when compared to HR pigs, weights of LR pigs were lower at weaning (4 weeks of age; 7.21 ± 0.29 vs 8.27 ± 0.23 kg, $P<0.01$). Behaviourally, LR animals were less aggressive than HR animals, as tested in a foodcompetion-test at 24 weeks of age (index 1-8: higher index with more aggression; 3.7 ± 0.42 vs 5.7 ± 0.37; $P<0.01$). Our results imply that the behaviour of very young and naive piglets in a backtest, may predict individual behavioural and physiological reaction patterns at a much later stage. We suggest that novelty and/or the age of the animal may affect the predictive quality of the test, as shown by the results of the repeated backtest. Our results may fit well with the coping theory, since LR animals may reflect a more passive coping style, whereas the HR pigs may have a more active strategy.

No evidence for strong links between personality traits in pigs

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In pigs, we have found individual differences in certain aspects of behaviour (active/passive responses, aggressiveness, measures of persistence) to be relatively stable within individuals across time and situation. In mice, there is evidence that these 'personality traits' cluster to form two distinct 'personality types' ("active" and "passive": high aggressive animals being active responders and persistent). We investigated whether similar personality types also exist in pigs. 74 female and male pigs were tested for tonic immobility (TI: indicating active/passive responses) at 2.5 weeks of age, for response to a distraction in a familiar environment (measuring persistence in performing ongoing behaviour, distractibility, and responsiveness) and reversal in a maze task (measuring persistence in performing a behaviour which is no longer rewarded, learning speed) at week 10, and for attack latency (measuring aggressiveness) at week 11. The data had both categorical and continuous components. TI behaviour, for example, could be expressed as immobile or not immobile, and in terms of duration of immobility. Consequently, factor and principal component analysis were not considered appropriate for these data. We therefore analysed the data, without making assumptions about their distribution, by carrying out 132 non-parametric tests. Instead of the 6.6 significant results expected by chance, we found only one significant link, namely slow-learning males being more aggressive than fast learning males ($p<0.05$), and 4 statistical tendencies ($p<0.1$). Low aggressive pigs and slow learning males tended to be more active (shorter TI) than high aggressive pigs and fast learning males. Active animals (not immobile in TI) tended to be less distracted, and high responsive males and slow learning males more aggressive. Based on these results we suggest that in the pigs studied here there were no strong links between the 3 personality traits investigated, and no evidence for the two basic personality types observed in mice.

Rank and aggression in stable flocks of hens, a test of two hypotheses

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When a group of birds that did not previously know each other are mixed they will often start fighting, even when there is no obvious resource present to fight about. Two different hypotheses have been suggested for this, the confidence hypothesis of Barnard & Burke (1979, J. Theoret. Biol. 81, 65-73) and the "contract" of Dawkins & Pagel (1997, Behav. Proc. 40, 13-25). According to the confidence hypothesis the only beneficiary is the dominant individual in each pair who conditions the subdominant to expect defeat, thereby reducing the risk of challenges. This hypothesis thus suggests that there should be continuous pecking by the dominants on the subdominants. The contract hypothesis however predicts that both the subdominant and the dominant individual will gain from a reduction of the level of overall aggression. Thus a "contract" is formed in which a bird has a particular position which if maintained, results in a minimal amount of aggression. Since the contract benefits both individuals equally the incentive for maintaining it, or breaking it, is identical for both the dominant and the subdominant and we should therefore expect as many pecks from subdominants as from dominants. We studied 6 groups of domestic hens kept with food and water ad lib. Five of the 6 groups had linear hierarchies, only these 5 have been included in the following analysis. Of all the aggressive pecks observed 95% were directed at a subdominant bird. Most of the pecks were directed at the bird immediately below in the rank order (P=0.031 N=20 Wilcoxon Matched Pairs). These results support the confidence hypothesis according to which the dominant individuals are expected to attack continuously. It is also suggestive that the dominant animals are directing their attacks against the birds that are most likely to pose a threat to themselves.

Previous social experience and comb size predict the outcome of encounters between unfamiliar hens

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To obtain harmonious social groups and minimize social strife, we must be able to predict the outcome of grouping specific individuals. We hypothesized that previous social experience, body weight and comb size would be good predictors of a hen's aggressiveness and subsequent social status in a newly-formed group. Using structural equation modeling, we tested the efficacy of different models to predict the outcome of combining individuals varying in these characteristics. Data from triads of 150 Red Rock X Light Sussex hens were used in model development. Two hens that had previously won a fight were introduced to a third hen that had previously lost a fight. One of the previous winners was heavier, and had a larger comb, than the other two hens. After introducing these three hens, we recorded the frequency of sequences in which one hen attacked first one, and then the other, remaining hen (double attack). We also determined the social status achieved by the three hens in their new group. The model with the best fit to the data showed that hens with a large comb and previous experience of winning were most likely to perform double attacks and to achieve the alpha position in the new group (adjusted goodness of fit = 0.99). Including body weight in the model did not increase its predictive value (adjusted goodness of fit = 0.94). The robustness of our model was confirmed in a second trial involving 32 unfamiliar White Leghorn hens combined randomly in tetrads (adjusted goodness of fit = 0.98). The results show that a hen's previous social experience and comb size are good predictors of her aggressiveness and subsequent social status when introduced to strangers. This knowledge should be useful in developing strategies to minimize harmful aggression when forming new groups.

Social discrimination by hens in large and small flocks: implications for social organisation

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The ability of laying hens to discriminate between flockmates and unfamiliar birds was examined using hens kept in groups of 10 and 120. Two small test boxes with vertical bars were attached to the outside wall of each home pen. Sixteen subject birds from each pen size were introduced individually to a test box adjacent to their home pen and to an unfamiliar pen on four test days. To control for the effect of location, all of the birds were swapped between pens on half of the test days. As expected, hens in groups of 10 often approached and responded with threats and aggressive pecks towards subject birds, and when the subject was unfamiliar, attempted fights occurred more often (two-tailed Binomial, n=11, $p<0.001$; Note: On attempted fights, subjects were removed). Hens in groups of 120 almost never tried to fight with the subject hen (3/128 trials), and there was no evidence of a difference in aggression in response to flockmates or strangers (two-tailed Binomial, n=13, NS). However, in the groups of 120, the pen birds that approached and engaged the subject in aggressive interactions (pecks and threats) were significantly more likely to be heavier than her (Wilcoxon signed-ranks tests, n=16, $p<0.005$) and to have larger combs (n=16, $p<0.001$). These findings are in line with other recent work suggesting that social organisation of hens is different in larger flocks (Hughes et al. 1997, Appl. Anim. Behav. Sci. 54, 215-234). In addition, we provide the first provisional evidence in support of the idea that when kept in large groups, hens switch from their normal social system of individual recognition and remembered assessment of dominance (the pecking order), to a social system based on direct assessment of body size and conventional signalling of dominance through comb size, as first suggested by Wood-Gush (1971) in 'The Behaviour of the Domestic Fowl' and modelled by Pagel & Dawkins (1997; Behav. Proc. 40, 13-35).

The effects of food level on the spatial organisation of dynamic groups of sows

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The spatial organisation of domestic pigs is regulated partly through (the avoidance of) agonistic behaviour. Aggressive behaviour in group housed pigs is affected by the introduction of new animals, but has also been suggested to be influenced by food level. The present study investigated the effects of these two factors on the long term spatial organisation of groups of 30 sows. Sixteen subgroups of 5 gilts were introduced over 8 months to 1 of 2 dynamic groups fed sequentially from an electronic sow feeding system. One group (H) received 3.0 kg, the other (L) 1.8 kg of food per sow per day. Animals were reintroduced to the same treatment groups in the same subgroups for a second gestation, after farrowing and rebreeding. The sows' spatial organisation was recorded on a floor plan of the building at fortnightly intervals. From these a range of spatial parameters were calculated. During both parities, and on both food treatments, the average location during the hours of observation showed a significant ($P<0.001$) migration towards the areas of the building were least activity occurs. Food level only influenced proximity to the drinker and feeder in parity 1 (e.g. proportion of observations spent near feeder: 0.33 vs. 0.38, H vs. L respectively, $t= -2.16$, $P<0.05$). Food level did not significantly affect measures of inter-individual distances. However, time since introduction of a new subgroup did, with the average inter-individual distance between resident and new animals decreasing, and that within subgroups increasing. Differences between the two distances were no longer significant by day 28 after introduction. In contrast, throughout the entire gestation period, sows belonging to the same subgroup were observed more often within two meters of each other than sows from different subgroups. This suggests that complete social integration, which involves a random sharing of the immediate area around an individual, was not achieved before pigs were taken out of the group for farrowing.

Tropical Poultry Production: How ethological tools may help researchers ?

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Chicken production has proved to be adaptable to a variety of climatic, economic and social conditions world-wide. The efficiency of poultry production is based on the precise control of many technical features. However, techniques commonly used in northern hemisphere such as accurate laboratory analyses or standardised housing and management control require adaptation to the climatic and economic situations in southern countries. Poultry production in the tropics uses the same genetic stocks and similar techniques of production as temperate countries. Housing is different and is the essential factor of adaptation of chickens (i.e. open door with low bird density in humid, or confinement with water cooling in dry zones).

Interest in an ethological approach in poultry farming are:

- To reinstate careful contact between the technician and the animal .
- To partly compensate for inadequate availability of reagents and equipment.
- To re-evaluate the environmental factors of housing management, equipment, and modes of feed distribution taking into account the daily climatic fluctuations.
- To develop or adapt 'new ' techniques of production which might be more economical under tropical than under temperate climates.

Two examples of applications of behavioural observations to intensive poultry production in tropical countries are presented:

- Regulation of bouts of activity in broilers on two time scales (age and day),
- Self-selection of dietary protein and energy by broilers using whole cereal seeds.

The use of ethological methodology in poultry nutrition and management in tropical countries is a valuable tool which can complement the existing methods of evaluation and which requires no expensive equipment. It requires efforts in the selection, validation and standardisation of the procedures just like the jungle fowl did, some 50 million years ago, to become a broiler!

Mechanism of the organic rice-cultivation system with ducks

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The rice cultivation system in South-East Asia was changed to the system using the chemicals and medicines. Though, one of the traditional organic system has been revived as a modern and reasonable system by Furuno in Japan. In this system, cross-bred ducklings (AIGAMO, 20birds/10a) are introduced into the paddy fields, enclosed with net, and fed with some feed. Why do the rice plants grow well ?

The mechanism should depend on the relationships between the ducks and the rice plants. The behavior of ducklings and the growth of rice plants were measured in some trials, i.e., the interval of rice plants or the others were varied.

The ducklings swam around the paddy field but avoided the juvenile rice plants which were taller than them. They surveyed with their beaks on or in the surface of water, and sometimes did pecking behavior to the bottom of the plants, a similar way to wild ducks and the only behavior that ducks directed toward the plants.

Wider intervals of the rice plants increased the rice plant pecking behavior. Significant correlations were confirmed between the frequency of the behavior and the number of rice plant branching ($y=-2.11+0.01x$, $n=9$, $R=0.876$, $p=0.005$). The amount of branching was directly connected to the yield of rice. On the other hand, the level of extending was negatively correlated with frequency of the behavior ($y=-9.93+0.005x$, $n=9$, $R=0.633$, $P=0.067$), which supports the tolerance of the rice plants to the typhoon and also to diseases and insects.

In order to confirm these relationships, artificial beating to the bottom of rice plants was conducted with a wooden swing. Swinging accelerated branching (7-8 vs. 1-2 branches in a week) and suppressed extending (8 vs. 10cm a week).

It is clear that the natural performance sustains this system in the paddy field.

Applied Ethology and the ruminant livestock of semi-arid Africa

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Traditional livestock offer much for applied ethologists, who can contribute to sustainable intensification of production. The empathy of certain ethnic groups for livestock ensures survival and reproduction, quantified in recent studies in Benin, Zimbabwe and Ghana (non-ethological results: Hall et al., Rev. Elev. Méd. vét. Pays trop., 1995, 48, 77-83; Hall, Trop. anim. Health Prod. in press, and Rev. Elev. Méd. vét. Pays trop., submitted; Hall and Blench, AGREN Paper 82b, 1998). Livestock systems will increasingly be intensified. For example, in certain areas goats depend on cut-and-carry browse, probably not a traditional system. Breeds that have evolved in extensive systems will be replaced or required to adapt, and may be lost. New systems are needed that are productive yet also maintain the traditional breeds. A notable example of the application of ethology by local herders is the selection of animals for castration. In 1997, in both Ghana and Zimbabwe, all herders (n = 51 and 31 respectively) reported that the more active male calves, goats and sheep were kept for breeding; clearly an ethological criterion is applied. Fertile fields for future study include: (1). Neonatal mortality constrains productivity, and is the most obvious welfare issue in all livestock species, and investigations of neonatal and juvenile vigour are needed; (2). Survival of adult cattle in drought conditions in Zimbabwe appeared to be better for larger-bodied animals. While trekking, the cattle browse and foraging behaviour under these conditions needs to be studied; (3). Studies of behavioural ecology may help to resolve conflicts with wild herbivores; (4). The supply of child labour for tending livestock will decrease with implications for stockmanship.

Using the flexibility of suckling behaviour in goat kids to increase milk collection in double purpose management goats

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In temperate western countries, goats are used mainly as a dairy species and kids are separated from their mother at birth. By contrast, in developing countries, goats are used as a double purpose species in which milking follows a period of mother-young contact of 30 to 45 days, reducing therefore the early availability of milk for human consumption. In the present study, we investigated the normal rhythms of nursing during the early postpartum period and whether these could be manipulated to allow milk collection as early as one week postpartum. Four groups of goats (n= 10 to 13) were studied (controls: permanent mother-young contact, no milking; Exp10: 10 hours of contact, one milking/day; Exp5: 5 hours contact, one milking/day; Exp0: no contact, one milking/day). Suckling frequency was intense on day 1 postpartum (36/6 hr. in mothers of singles and 75/6 hr. in mothers of twins) and decreased dramatically by day 4 (12 and 22/6 hr. respectively). Limiting suckling to 10 or 5 hours per day resulted in virtually as much milk being collected in the Exp10 and Exp5 treatments as in Exp0 (75.5 kg ± 5.1, 75.5 kg. ± 11.0 and 89.2 kg. ± 15.4, $p>0.05$). On the other hand, the weight of the kids of these 3 groups was slightly lower than that of the controls ($p<0.05$), but no significant difference was found between the 3 experimental groups (15.3 kg ± 0.6, 11.8 kg ± 0.7, 12.1 kg. ± 0.7, 13.2 kg. ± 0.8 for C, Exp10, Exp5 and Exp0 respectively). Overall, kids showed a considerable capacity to adapt their suckling rhythm, and can be used as a method to raise milk production to a level similar to that currently obtained with 2 milkings a day and where the kid is early weaned.

Applied ethology and experiment with single or few subjects

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Environmental enrichment is a very important issue for zoos and is becoming more important for farm animals. Evaluation of the effect of enrichment in mostly done by behavioural measurement, but it is often difficult to apply statistics, due to low numbers. However, statistical techniques are available, for instance log linear analysis, single case analysis and meta-analysis, that - alone or in combination - could replace analysis of variance and can be applied to a single animal. Single case analysis is a method of statistical analysis of behavioural change in one individual. Meta-analysis is the combination of three or more analysis outcomes of different experiments concerning the same hypothesis. It may be used to combine p-values of three or more single case analyses. Characteristic of the mentioned techniques is a very careful preplanning of the experiment, i.e., the number and the order of treatments given to the subject(s). We used these statistical techniques in our farm and zoo animal research. A number of examples will be presented: single case analysis and meta-analysis of the effect of food deprivation on crowing in the rooster (1), in which crowing was reduced by deprivation ($P<0.001$); single case analysis and meta-analysis of the presence of a rooster or a hen on crowing in the rooster (2), in which both the presence of a rooster or a hen increased the number of crows ($P<0.001$), single case analysis and meta-analysis of feeding enrichment in a group of three orang-utans (3), in which in 2 out of 3 individuals enrichment changed their time-budget ($P<0.05$), and single case analysis of environmental enrichment in an Amur tiger (4), in which the amount of stereotypies was drastically reduced ($P<0.001$). Application of single case and met-analysis in evaluation of pilot-experiments and individual-oriented research in farm, pet and laboratory animals is recommended.

Differences in stress reactivity between Large White and Duroc pigs: consequences for meat quality aspects

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We studied individual and breed differences in behavioural and cardiac reactivity to stress and interactive effects of stress reactivity, breed and slaughter method on meat quality in pigs. Twenty-one Duroc and 21 Large White pigs were reared in groups of seven pigs of the same breed. Between the age of 3 and 5 months, pigs were subjected individually to two 20-min tests; exposure to a novel object and exposure to a human. Tests were carried out in an unfamiliar environment, introduction of the novel object or the human took place after 10 min. Durocs had a higher frequency of contacting the human than Large Whites, and this could not be explained by their generally higher activity. Heart rate and frequency of contact with the human were positively correlated for each breed. No breed differences in frequency of contact with the novel object have been observed. The animals were slaughtered at 6 months; half of each breed in a commercial abattoir (5 h of mixing, 2 h of transport, 13 h of lairage, presence of usual abattoir sounds including vocalisation of other pigs, 34 h of food deprivation), the other half in an experimental abattoir, avoiding stress as much as possible (individually slaughtered: 10 min of transport, no mixing or lairage, gentle handling, no other pigs present, no loud sounds; 14 h of food deprivation). Industrial slaughter led to higher muscle temperatures. Large Whites had higher scores for muscle redness and lower glycolytic potential than Durocs. Breed x slaughter method interactions for ultimate muscle pH suggest that Large Whites were more sensitive to slaughter method. For Large Whites, frequency of contact with the human during the test was negatively correlated with temperature and lactate content of the Longissimus dorsi muscle and positively correlated with its pH at 40 min. Thus, Durocs have a greater motivation to approach humans and Large Whites are more sensitive to slaughter conditions. There is a relationship between reactivity to certain stress factors measured prior to slaughter and meat quality aspects, at least for Large Whites.

Human characteristics and handling strategies: their effects on the physiological and behavioural responses of juvenile pigs

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There is a paucity of qualitative information regarding the impact of on-farm handling strategies on physiological and behavioural responses of pigs. The purpose of this study was to evaluate the interaction between human characteristics (self-esteem and gender) and human behaviour that effects pig handling.

University students completed a survey containing an instrument assessing interpersonal skills (self-esteem) and demographics. Students (n=32), matched based on esteem score and gender, moved 3 pigs though a circuit with obstacles designed to imitate pig handling facilities. Salivary cortisol, monitored in the pigs and handlers, before and after time in the circuit, was measured by radioimmunoassay. Video recordings and human observers provided information on time in the circuit, human-pig interaction and pig behaviour. Statistical analyses were performed using Pearson's correlation and general linear and regression models for dependent variables time in circuit and cortisol. Eight behavioural categories were identified in the human handlers. The combined use of these elements was called problem solving. Pigs responded using twelve behaviours including the avoidance behaviours, escape and turning.

Escape behaviour occurs when the pig moves past the handler. While human self-esteem and gender had no effect on time in the circuit, problem solving behaviour of humans significantly reduced the time in the circuit ($p=0.03$) and increased human cortisol ($p=0.0001$). Concerning pig, escape and turning behaviours were associated with increased time in the circuit ($p=0.01$) and pig vocalisations, high grunt ($p=0.001$, $r=0.4$) and squeal ($p=0.05$, $r=0.25$). In addition, pig cortisol levels were positively correlated with high grunts ($p=0.001$, $r=0.5$). In conclusion, time in the circuit and pig behaviour were affected by the diversity, or problem solving behaviour, of the human handler.

The transition from prenatal to postnatal environment in the rabbit: evidence for transnatal continuity in olfactory cues and function

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Newborn rabbits are nursed once per 24 h for 3-4 min. Their survival depends on the success of the first 2-3 suckling episodes. Efficient sucking depends entirely on the pups' ability to orient beneath the doe so as to locate and seize a nipple. These responses are guided exclusively by tactile and chemosensory cues. In the present study, we examined whether the orientation responses of newborn rabbits may be influenced by olfactory information acquired prenatally.

Consistent with this aim, we manipulated the pups' prenatal environment by controlling their pregnant mothers' diet (either control pellets or cumin-added pellets). Prior to any postnatal ingestion, pups were submitted to olfactory choice tests in a 2-sided arena. Pups were simultaneously presented with either 2 prenatal substrates (placenta), 2 postnatal substrates (colostrum), or one prenatal and one postnatal substrate (placenta vs. colostrum). The substrates matched or not the pup's prenatal olfactory environment.

Pups oriented longer to the side of the arena odorised with placenta (or colostrum) corresponding to the aroma their mother ate during pregnancy: ie cumin pups preferred the placenta (or colostrum) of cumin-fed does to the placenta (or colostrum) of control does, and conversely for control pups. In addition, pure cumin odor was attractive to pups born to cumin-fed does, while it was repulsive to pups born to control does. Finally, rabbit pups behaved as if the odors of placenta and colostrum were equivalent, suggesting that the two are undifferenciated at the chemosensory and/or motivational level. In conclusion, rabbit fetuses are monitoring and encoding the dominant odor of their amniotic ecology, and use it in their orientation responses in the neonatal niche.

Influence of lamb behaviour on the expression of maternal behaviour in sheep

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Poor attachment between ewe and lamb is a major contributor to perinatal lamb mortality. There is increasing evidence that the behaviour of the lamb may play a role in strengthening the ewe-lamb bond. Previously, we have demonstrated that significant breed differences exist between a lowland breed of sheep (Suffolk) and a hill breed (Scottish Blackface) in both maternal behaviour and lamb vigour (Dwyer et al., 1996, Reprod. Fertil. Dev. 8, 1123-9; Dwyer & Lawrence, 1997, Appl. Anim. Behav. Sci., in press). The superior maternal behaviour shown by the Blackface ewe may, however, be partly due to the greater activity of the Blackface lamb. To investigate the role of the lamb in determining maternal behaviour an embryo-transfer study was carried out between multiparous ewes of the two breeds such that the four combinations of ewe and lamb were obtained: Blackface ewe with Blackface lamb (BB, n=41); Blackface ewe with Suffolk lamb (BS, n=41), Suffolk ewe with Blackface lamb (SB, n=37), Suffolk ewe with Suffolk lamb (SS, n=36). There was little effect of ewe breed on lamb vigour with Blackface lambs standing (B=12.02 min, S=18.16 min, Kruskal Wallis H=14.2, d.f.=1, P<0.001) and attempting to suck (B=15.22 min, S=25.64 min, H=20.94, d.f.=1, P<0.001) more rapidly than Suffolk lambs. Suffolk ewes were more aggressive towards their lamb but this was not influenced by lamb breed (percent ewes butting lamb: BB=2.4%, BS=0%, SB=16.2%, SS=19.4%, χ^2=13.2, d.f.=3, P<0.01). Blackface ewes spent significantly more time grooming their lambs than Suffolk ewes regardless of lamb breed (proportion of time grooming lamb: BB=0.786, BS=0.787, SB=0.564, SS=0.611, s.e.m.=0.046, P<0.001). The proportion of lambs sucking successfully within 2 hours was affected solely by lamb breed, there was no influence of ewe breed (percent lambs sucking: BB=95.1, BS=70.0, SB=91.8, SS=68.6, χ^2=14.6, d.f.=3, P<0.005). These data suggest that lamb behaviour does not have a strong influence on those maternal behaviours concerned with lamb recognition (e.g. grooming). Lamb vigour promotes early sucking, largely independent of ewe behaviour, and may therefore play a role in recognition of the ewe by the lamb.

Specificity of colostrum in the development of a preference for the mother by the new-born lamb

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In the lamb, the first sucking bouts are necessary for the rapid development of a preference for the mother. The association of maternal cues with the presence of colostrum in the gut within 6 h after birth provides a basis of this early relationship. In this experiment we compared the reinforcing properties of ovine colostrum with those of other liquid diets : bovine colostrum or ovine milk obtained at one month of lactation.

In all groups lambs were left with their mothers and sucking was prevented by covering the udder between parturition and 6 h later. Lambs were assigned to one of four treatments : no sucking between 0-6 h (DEP, n=14) or fed 100 ml of the following diets via an intra-nasal catheter : ovine colostrum (OCOL, n=11), bovine colostrum (BCOL, n=11) or ovine milk (OMILK, n=12). All diets were a pool from several females. Thereafter, lambs had free access to the udder. At 24 and 48 h of age, lambs were tested in a two-choice test between their mother and an alien maternal ewe. Of all the variables measured during tests, only those relating to the expression of a preference were affected by the treatments. OCOL and BCOL lambs spent significantly more time near their mother than near the alien ewe (mean ± sem (s), OCOL: 198.0 ± 23.3 vs 17.9 ± 7.9, p=0.003 and BCOL: 171.4 ± 28.6 vs 21.0 ± 8.4, p=0.004). They strongly preferred their mother while in OMILK lambs there was only a tendency (171.3 ±30.5 vs 68.5 ±23.9, p=0.06). On the other hand DEP lambs did not show any preference (140.3 ± 25.2 vs 83.3 ± 27.3, NS). When tested a second time at 48 h, DEP lambs displayed a preference for their mother (132.2 ± 24.4 vs 48.8 ± 17.2, p=0.033).

We concluded that colostrum triggers the development of the preference for the mother by the new-born lamb, even if it comes from another species of ruminant, but that ovine milk is not as efficient. The reinforcing properties of these various diets would be optimally obtained with biochemical compounds common to ovine and bovine colostrum but only partly contained or active in milk.

Inter-specific comparison of lactational stress: Is the welfare of dairy cows compromised?

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The milk yield of the dairy cow has increased almost linearly since the 1940's, and the increased metabolic load which modern dairy cows face has led to concern for their welfare. This paper will review the metabolic load associated with lactation, and examine the extent to which the lactational output of dairy cows has been amplified by genetic selection relative to other mammals in terms of peak, mean and total energy output. It is argued that genetic selection for higher yield combined with improved management practices have led to cows which have a lactation that differs significantly, in terms of lactational duration rather than intensity, from that of other mammals. In relation to these findings, physiological and behavioural signs of metabolic stress, such as reduced health and fertility, are discussed as well as the possible cumulative effects of successive lactations. The use of various hormonal treatments to solve the acute fertility problem may have indirect consequences for the welfare of dairy cows, if reduced fertility is a coping strategy to deal with the high metabolic load associated with lactation. In addition, culling of cows due to recurring health problems may be delayed in order to cull infertile animals. It is concluded that the welfare of high yielding dairy cows, in terms of metabolic pressure, is not necessarily compromised, but that the modern dairy cow is functioning closer to its coping threshold thereby reducing the adaptive scope available to the cow. The higher genetic potential for milk yield therefore necessitates much higher standards of management and feeding in order to meet the greater nutrient demands of the dairy cow.

Scoring systems for an on-farm assessment of housing conditions

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A simplified method to assess the housing conditions of farm animals could be used for label programs (control), competitions (classification) and the analysis of weaknesses in the husbandry system (consulting). Scoring systems for animal welfare assess a number of criteria in several influencing areas (i.e. social contact, flooring) with points. They predominantly include features which make up the housing environment (technical indicators), but also characteristics of the animal and of the management (index system). Both, quantitative (i.e. floor space) and semiquantitative parameters (i.e. outside run) are used. In Austria, the „Tiergerechtheitsindex" (animal welfare index) TGI35L has been developed, on which the German version, the TGI 200, is based. The TGI35L has been integrated into animal welfare justice regulations. So far more than 20.000 farms have been evaluated in Austria. In Germany, more than 2.000 farms have been evaluated by agricultural universities. The potential and limitations of such scoring indexes are demonstrated by own investigations on 65 dairy farms with littered loose housing systems and on 40 ecological farms with laying hens. Partly an own modified scoring system was used in addition, which took into account some of the criticism of the TGIs.

The different scoring systems came up with similar results (correlation coefficients of 0,8 and higher for dairy systems). Differences between the systems relate mainly to differences in the parameters used or in the amount of points for the same indicator. Ecological farms with dairy cows gain within the own scheme more points than conventional ones (56 vs. 43 % of maximum). There have been no differences between the housing systems for dairy cows. Most points were reached in the feeding area, followed by the laying and the walking area. In laying hens, systems with a higher degree of freedom gain more points on average. Most points score free range systems with an additional covered outside run. Overall, the method was able to point out deficiencies of the housing systems and therefore provides the opportunity for improvements. Although the fixation of the points and the relations of the influencing areas could not be scientifically justified in detail, the scoring systems offer a reliable method to assess housing conditions for the mentioned pragmatic purposes.

Individual differences in pigs: behavioural response to apomorphine

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In rodents, individuals adopting different behavioural and physiological response patterns (or 'coping styles') when challenged, differ in susceptibility to the dopamine-agonist apomorphine (APO). The current study investigated if pigs exerting a behaviourally active or passive coping strategy when stressed by a physical restraint differ in their response to APO.

At 10 and 17 days of age pigs were classified by the backtest (Hessing et al., 1993, Appl. Anim. Behav. Sci. 37:285-295) as high-resistant (HR, n=10) or low-resistant (LR, n=10). At 17 weeks of age pigs received a saline and an apomorphine injection (0.2. mg/kg BW, s.c.) on two consecutive days in a balanced design. Post-injection behaviour (8 behavioural elements) in a 3x4 m test pen was scored continuously for 120 min.

Individual pigs differed greatly in their response to APO. In general, APO induced hyperactivity (increase in locomotion, $p<0.001$; decrease in standing, $p<0.001$). In addition, APO increased the occurrence of some peculiar, in saline conditions rare, activities, which seemed to represent a transition or a conflict between postures, such as standing or walking with bent wrists or walking with the hind limbs while the fore limb was resting on the floor. These activities were more pronounced in APO-treated LR pigs ($p<0.05$). Snout contact with the floor, an oral stereotypy also labelled 'snout contact fixation', however, was significantly increased in HR pigs under APO-conditions ($p<0.01$), but not in LR animals. The higher stereotypic response to APO of the HR animals ('active copers') corresponds with the results of studies on rodents.

In conclusion, pigs classified early in life by a physical restraint, the backtest, differ in their behavioural response to apomorphine, suggesting a difference in the dopaminergic system.

Olfactory cues are not necessary for recognition of the lamb by the ewe

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Ewes identify their young at short and long distance through the use of different sensory modalities. Proximal recognition, based on olfactory cues, is established within the first 4-hr post-partum (pp) and allows selective udder acceptance. Distal recognition involves visual and auditory cues and takes place at 12-hr pp. Whereas it is well established that anosmic ewes cannot recognise their lamb at close quarter, no study has investigated the possibility of these ewes to identify them at distance. We compared therefore the ability of anosmic and intact ewes to recognise their lamb at a close contact at 4-hr pp by presenting successively an alien and the familiar lamb, and from a distance in a 2-choice test between their own and an alien lamb at 12-hr and 24-hr pp. Proximal recognition tests at 72-hr and 1 month pp were also undertaken to assess whether this recognition could be restored in anosmic ewes.

At 4-hr pp, whereas all intact ewes rejected alien lambs at suckling (42/42), only one anosmic ewe did so (1/36). Nevertheless, in the distal recognition test both anosmic and intact ewes spent significantly more time near their lambs at 12-hr pp (anosmic: 65 ± 8 s vs 29 ± 5 s, $p<0.02$; intact: 69 ± 10 s vs 33 ± 6 s, $p<0.02$). This recognition was still observed 24-hr pp (anosmic: 57 ± 10 s vs 16 ± 3 s, $p<0.02$; intact: 62 ± 6 s vs 30 ± 5 s, $p<0.02$). Although at 72-hr pp only 5/36 anosmic ewes refused the alien lamb at suckling, this proportion significantly increased 1 month pp (18/36; $p=0.002$) .

Distal recognition can be established independently from proximal recognition. Moreover the fact that anosmic ewes develop proximal recognition after one month suggests that vision and audition can compensate for the loss of smell. Learning of olfactory cues is therefore not necessary for recognition of the lamb.

Predictability of nursing without milk ejection in domestic pigs

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The motivation to nurse often seems to be similar in nursing without milk ejection or non-nutritive (NON-N) and nutritive nursing (NN). The question arises, whether the behaviour of the piglets and sow is indeed the same. We investigated quantitatively whether the latency to start teat massage, the proportion of piglets participating in the nursing, the intensity of teat massage (in terms of snout movement frequency) by the piglets and the grunting rate by the dam differ between NN and NON-N. These behavioural characteristics were compared between videotaped NN and NON-N in 7 sows and their litters at the age of 7-8 days after farrowing. Teat massaging movements and sows' grunts were counted during periods of 40 seconds one minute before (Period 1) and one and a half minute after the milk ejection (Period 2) in NN, and during the same periods, calculated from the start of the nursing, in NON-N. Grunting frequency was also assessed during 30 seconds before and 30 seconds after the start of the udder massage. The latency to start teat massage by the piglets and their participation in the massage were the same in NN and NON-N. During Period 1 teat massage intensity did not differ between NN and NON-N (13.3 vs. 18.7 snout movements, paired t-test, p=0.094), but it did differ during Period 2 (20.9 vs. 12.5, paired t-test, p=0.005). The grunting frequency was similar in the two types of nursings both before (0.27 grunts per second in N, 0.22 in NON-N, paired t-test, p=0.216) and after the start of udder massage (0.47 vs. 0.35 grunts/sec., p=0.148). In NN, the grunting increased further to 0.68 grunts/sec. in Period 1, whereas in NON-N, it remained at 0.34 grunts/sec. (p=0.005). We conclude that both the sow and her litter enter non-nutritive nursing with full motivation to accomplish a complete nursing, and it is not until the initial massage is in full progress that it is revealed in the sow's grunting that the milk ejection will fail. The adaptive value of non-nutritive nursing is discussed and it is hypothesised that their function is to down-regulate an excessive milk investment in the current litter.

Mother-young relationships in goats: mechanisms of control and possible implications for production

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Early works suggested that the maternal behaviour of goats was quite similar to that of sheep. However, the fact that lambs are followers and kids are hiders may be associated with other differences in mother-young relationships, a hypothesis reinforced by the apparent difference in the mechanisms of selectivity in goats (labeling) and sheep (individual odour memorization). Recent studies allow to propose a more complete picture of mother-young relationships, and how they may be important for production, especially when goats are used as a double purpose species.

At parturition, dams show reduced gregariousness and defend their young, thus reducing the risks of kid exchanges at the time of parturition. As in sheep, vaginocervical stimulation appears to facilitate maternal behaviour. Nursing frequencies are high despite the hiding behaviour of the kid (up to 75 bouts/6 hours on the day of birth in mothers of twins). Nevertheless, the suckling activity of kids is highly flexible and can be used to promote milk production in association with milking. As for selective bonding, goats learn the individual odor of their kid, as do sheep and this selective behaviour is controlled by vaginocervical stimulation. In addition, mothers are able to recognize their young on the basis of visual and/or acoustic cues on day 1 postpartum. Kids also develop an early capacity (24 hours) to discriminate between their dam and an alien one, although the sensory cues involved remain to be identified. Overall, these results lead to a reconsideration of the hypothesis that some differences exist with respect to mutual mother-young bonding between sheep and goats due to the difference in their early spatial strategies. It also opens new possibilities for the management of adoption in goats and underlines the interest of controlling mother-young relationships during lactation to optimize milk production in double purpose management.

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Influence of reward magnitude on elasticity of demand for dustbathing in hens

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Measures of demand elasticity provide a useful means for objectively quantifying the value of environmental resources to animals. A common procedure used to generate demand functions involves manipulating the cost of access to a fixed amount of a resource per reward (e.g. 5 minutes access to litter) and measuring the changes in resource use as the price increases (elasticity). The size of each reward is often chosen arbitrarily on the assumption that elasticity is independent of reward magnitude. This assumption is true for commodities such as food and water (e.g. Hirsh and Collier 1974, Physiol. Behav. 12: 647 - 655) but has not been adequately tested with other activities/resources (e.g. dustbathing) which may be devalued when presented in short bouts. The aim of the current study was to determine the influence of reward magnitude (duration of access to litter) on elasticity of demand for dustbathing.

Individual hens (n = 6) gained access to a dustbath containing peat by pecking a key on Fixed Ratio schedules of reinforcement (increasing from FR1 to 640). In three separate conditions, the duration of access was varied (150, 300 or 450 seconds). Demand elasticities were calculated from the slopes of the best fit straight line functions relating numbers of rewards obtained to price of access on logarithmic coordinates. The mean elasticities were -0.42, -0.43 and -0.43 for 150, 300 and 450 sec access, respectively, and not significantly different ($p>0.05$). Elasticities were also calculated using only the data for rewards when dustbathing occurred; these were -0.20, -0.19 and -0.24 for 150, 300 and 450 sec access, respectively ($p>0.05$). The "dustbathing only" elasticities were significantly smaller than those calculated using all rewards ($p<0.05$), which is in agreement with previous studies in our laboratory demonstrating that litter has more value (shallower demand curve) as a substrate for dustbathing than for other activities.

This study has demonstrated very clearly that the bout length arranged per reward (for access to litter) does not influence measures of demand elasticity. Thus, as with other resources, the value of items such as litter can be reliably quantified in demand studies by providing opportunities for short periods of access per reward only.

Aversion of broiler chickens to vibration and thermal stressors

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Systematic characterisation of broiler response to single and multiple stimuli of different natures is required to improve broiler welfare during transport. A raceway technique (Rushen, 1996. J. Anim. Sci. 74: 1990-1995) was developed to investigate responses of 16 female broiler (Cobb) chickens, aged 42 ± 3 days, to concurrent vibration and thermal stress (VT - Frequency: 2 Hz, Acceleration: 1 ms-2, Air temperature: 40°C, 18% RH) or to no applied stressors (C - Control) at one of two levels of pre-trial feeding (F: fed 30 g two hours before the session or N: not fed before the session). Birds were trained daily to traverse consecutively 3.5 m raceways into 0.25 m^2 treatment boxes for food. Infra-red light beams at 1.0 m intervals were used to measure run times and initiate door closure, confining birds within the treatment boxes for 10 s. On completion of training, a single 60 min treatment exposure to VT or C was imposed after 5 reinforced runs. Birds continued to run as in training immediately post-treatment. Times taken to return to feed on the first run immediately post-treatment ranged from 6 to 86 s for C birds and 10 to 5669 s for VT birds. Analysis of variance was used to compare mean run times over five runs pre- and post-treatment in a factorial, split plot design. Mean run time for VT birds was greater during post-treatment than pre-treatment (11.2 vs. 7.5 s respectively, $p<0.05$) suggesting this treatment was aversive. No significant effect of treatment was evident for control birds. There was no significant effect of pre-trial feeding. Further work will establish the sensitivity of the current technique in distinguishing bird responses to vibration or thermal stress alone.

Individual use of the free range area by laying hens and effect of genetic strain

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Lower population density (Appleby et al. (1988) and environmental enrichment (Nørgaard-Nielsen et al., 1993, Appl. Anim. Behav. Sci. 38:345-352) reduce feather pecking in laying hens. Free range egg production systems should provide both compared to more intensive systems, assuming the range area is used by the hens to a substantial degree. This is not the case (Grigor, 1993, Ph.D. thesis, University of Edinburg).

The hypothesis was put forward and experimentally tested, that a strain difference might be found for the use of the range area. Furthermore the individual range behaviour was examined. A total of 675 hens of four genetic strains (medium heavy ISA Brown (I), New Hampshire NH), White Leghorn (WL) and a cross of NH and WL (C)) were marked individually and placed in 24 houses at a density of 4 hens per m2 and flock sizes of 30 hens (25 for WL). At 19 weeks of age (w) the hens were given access to a range area of 7 m2 per hen. Scan samples were taken 3 times a day of the number and identification of hens on range. At 20 w the average percentage of hens on range was 13.8b, 2.0c, 26.1a and 18.4ab respectively for strains I, NH, WL and C ($P<0.05$, GLM-test, 23 df.). At 26 w these figures were 51.0a, 29.0b, 47.4a and 42.5ab % ($P<0.05$, GLM-test, 23 df.). The percentage of individuals in a given strain observed at least once using the range area during week 20 was 59.2a, 15.2b, 84.2a and 69.4a for strains I, NH, WL and C respectively ($P<0.05$, GLM-test, 23 df.). It was concluded that a substantial variation in range behaviour occurred between individuals as well as genetic strains. Individual range behaviour will be further discussed.

Selective breeding can affect the performance of abnormal behavior and neurophysiological indicators in mink

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Captive minks (Mustela vison) often develop stereotypies. Mink selectively bred to be inactive or to show stereotypies were observed for 8 weeks. Seventeen males were chosen for this study. Group A minks (n=6) were selected from the inactive line, and group B (n=6) minks from the stereotypic line. A group of 5 additional minks (group C) were removed from a randomly bred population, and showed similar levels of activity to group B but had no stereotypies. Animals were euthanized and blood and brain tissue were collected. Cortisol and ß-endorphin levels were measured in plasma using radioimmunoassay (RIA). White blood cells (WBC) were isolated, lysed, and intracellular dynorphin levels were measured by RIA. Brains were removed and norepinephrine (NE), epinephrine (EP) and dopamine (DA) levels were measured in extracts of frontal cortex (FC) using HPLC. Serotonin levels were measured in FC tissue using ELISA. Mu and kappa opioid binding was measured in brain hippocampal tissue. Stereotypies were not observed in group A. Group B and Group C performed stereotypies for 43.8 % and 1.8% of observation time, respectively. Cortisol levels (ng/ml ± SEM) were higher in inactive animals (A= 84.37 ±9.66, B= 31.66 ± 11.74 and C= 57.48 ±11.06) ($p=0.01$). High stereotypy animals had higher levels of intracellular dynorphin (pg/mg protein ± SEM) in WBC than inactive or control animals (208.9 ±36.5; 108.38 ±25.66 and 62.9 ±5.37, $p=0.01$). There was no difference in plasma ß-endorphin, FC NE, EP and serotonin levels among the studied groups. Inactive animals had higher levels of DA (pg/mg protein) in the FC than control animals (A=53.82pg ± 12.88; B= 25.98 tissue ± 12.6, and C=3.66 tissue ± 0.45, $p= 0.02$). The density of hippocampal kappa opioid receptors was higher than the mu opioid receptors , but no differences were observed among the studied groups. High intracellular dynorphin levels in WBC may reflect the concentration of this opioid peptide in the brain, and supports previous findings relating modulation of the opioid system in association with abnormal behavior in animals.

The effect of journey structure on the welfare of lambs

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An investigation was conducted to examine the effect of journey structure on the welfare of lambs. A total of 135 lambs (Charollais X, liveweight 41.26kg (SD ±3.05kg), 90 transported and 45 non-transported controls) were used on three different journey types, replicated three times within a randomised block design. The journeys were: direct transfer from farm to abattoir, one involving three additional pickups *en route* and one involving a period of holding at a livestock auction market.

IGER Behaviour Recorders were used to identify jaw movements and lying, standing and walking behaviours. Control animals spent more time ruminating than transported animals ($P<0.0001$, 1.03hrs ±0.39 and 0.26hrs ±0.22, respectively) and more time lying down ($P<0.0001$, 3.48hrs ±0.56 and 1.68hrs ±0.55, respectively). There were no significant differences in durations of either of these behaviours between transport treatments ($P>0.05$ in both cases)

Transported animals experienced greater liveweight loss than controls ($P<0.0001$, 0.86kg ±0.44kg and 0.53kg ±0.35kg, respectively) and those on the multiple pickup and market holding treatments experienced greater liveweight loss than those on direct transfer from farm to abattoir ($P<0.0001$, 0.99kg ±0.41, 1.01kg ±0.42, 0.58kg ±0.37kg, respectively). There was no significant difference between the first two treatments ($P>0.05$).

Transportation *per se* affected the behaviour and liveweight of the lambs. Whilst liveweight loss was greater in animals on the more complex journey types than on the direct transfer journey, ruminating and lying behaviours were unaffected. These preliminary analyses suggest that direct transfer from farm to abattoir may be less deleterious to the welfare of lambs than journeys involving multiple pickups *en route* and journeys involving holding at a livestock auction market. However, no differences between these two journey types have been identified. Further behavioural analysis, together with that of ultimate carcass pH will provide more information about the effect of journey structure on the welfare of lambs.

Problems with animal welfare, disease and behavioural abnormalities of extreme breed types in pet animals

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During the last 15 years there has been growing interest concerning extreme breed types in pet animals. A wide range of breed defects (morphology, physiology, behaviour, mortality, morbidity) has developed in pet animals affecting their welfare. Some countries have introduced rules in their animal welfare legislation to reduce such breed defects. The Council of Europe has included in the European Convention for the Protection of Pet Animals of 1987 and in recommendations of 1995 rules on the breeding of pet animals. In dogs, problems concern sceleton (chondrodystrophy, brachycephaly, teeth anomalies, persistent fontanella), eyes, ears, skin, coat and tail, semilethal factors and aggressive behaviour. In cats they concern sceleton (tail, chondrodysrophy), head (form, eyes, ears) and coat (colour, structure of hair), in rabbits sceleton (dwarf rabbits with abnormalities), head (short jaws, long ears) and fur (spotted fur, structure of hair), in poultry skin (skin folds, head, beak, tail), feathers (legs, tail, head, structure of feathers) and lethal factors, in pigeons skin (head, beak), feathers (legs, head, tail, neck, structure of feathers) and behavioural anomalies. Similar problems are known from mouse, hamster and guinea pig (long or short hair, lethal factors; Japanese dance mouse), from pet birds (canaries with abnormal feathers or bodily position; zebra finch with eye anomalies, lethal factors and abnormal copulation behaviour; budgerigars with high frequency of neoplasms), and pet fish (goldfish with long fins, restricted swimming behaviour, altered scales, eye problems; guppies with abnormalities of tail and vertebral column; Siamese fighting fish with long tail fins, reduced mobility, aggressive behaviour). Potential measures for improvements include legislation, information and education, breed standards, and finally attitudes of breed organisations, judges, individual breeders, veterinarians and pet owners.

Animal behavior versus animal welfare: distinguishing between «what is» and «what ought to be»

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The term Applied Ethology is sometimes used in reference to topics of both animal behavior and animal welfare. An argument is presented that within the academic world, animal behavior and animal welfare should be viewed as two very different endeavors because of their different goals, even though they share considerable common ground. The goal of animal behavior is to define «what is» while the goal of animal welfare is to decide «what ought to be.» These types of distinctions are commonly made in the groupings found within philosophy. The human attempt to develop a rational understanding of the universe, its components, and their interrelationships is defined as science, according to philosophers. Thus, science is said to be an attempt to define «what is.» The human attempt to determine «what ought to be» is said by philosophers to be an activity that falls into the realm of ethics. In academia, animal behavior is the attempt to develop a rational understanding of all the actions, postures, movements, smells, noises, and changes of color and shape that characterize the lives of animals. Animal behavior is thus a study of «what is.» Ultimately, animal welfare is a question of how animals «ought to be» treated by humans. While statements derived from science, including behavior, may (or even should) be used as premises for an ethical argument, animal welfare is ultimately a question of ethics, not science. For example in determining space requirements, animal behavior research can be used to measure «what is» required in terms of area for hens to turn around, spread their wings, dust bathe, fly, etc., but the question of whether a hen «ought to be» able to perform these behaviors is a question of ethics. Applied Ethology is very important in defining the «what is» of animal behavior, but Applied Ethology can only contribute partially to determining «what ought to be.» Recognizing this relationship should advance both applied animal behavior as a science and the welfare of animals.

Ethics of use of animals in conservation

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Habitat protection and/or restoration are usually the most important elements of species conservation. However, under some circumstances, more active interventions are required. These actions can range from supplementary feeding and disease prevention or treatment to translocations, establishment of captive-breeding populations, and reintroductions. In addition, it has been proposed that a variety of artificial reproductive techniques may play a role in species conservation in the future. In all these interventions, the interests of the individual animals involved may be compromised in pursuit of the goal of maintaining population viability or restoring communities. Protecting the welfare of individual wild animals during such interventions can present many challenges because of the diversity of potential risks and, in many cases, the scarcity of data on aspects of their biology relevant to their management. As the human population continues to grow, it is likely that pressures on many wild animal populations will continue to increase, and that active interventions will increasingly be used in conservation programmes. There is a danger that in endeavours to save a species, the interests of individuals can be somewhat overlooked. To deal with this, in all cases, the planning stage should include the weighing of conservation benefits against welfare costs. There is also a good case for employing a two-Is approach in the planning, that is, (i) to Intervene with no more animals than necessary to achieve the purpose, (ii) to refine and Improve the techniques used (eg for capture, transport, housing, quarantine, husbandry, release etc) as much as possible.

Ethical approaches to vertebrate pest control in New Zealand

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Some vertebrate species cause damage to agricultural or conservation lands and are consequently classified as pests, requiring management. There is a growing public concern over the ethics of such control operations. Wildlife managers therefore have to balance the benefits of pest control against the pain, fear or distress to the pest species. In New Zealand, possums (*Trichosurus vulpecula*) are a major vertebrate pest causing extensive damage to native fauna and flora and spreading bovine tuberculosis to farm animals. It is only recently that research has begun to investigate the humaneness of different possum control methods, to identify practices that meet community expectations. The development of a draft national trap standard (based on ISO standard) has provided an objective process for assessing traps using pathological (e.g. physical injuries) and physiological (e.g. brain stem reflexes) measures. Of the vertebrate pesticides in current use it has been generally perceived that 1080 (sodium monofluroacetate), cyanide and anticoagulants cause little pain, but scientific evidence has been lacking. To complement other studies on the physiological response of possums to traps and pesticides, we are assessing the behavioural responses of possums to these control methods. Detailed descriptions of the behaviour of captive animals have been recorded following lethal ingestion of cyanide and phosphorus. The spontaneous behaviours and physical response data have shown favourable signs for cyanide as a humane toxin but not phosphorus. Assessment of other vertebrate pesticides will continue until a comparative database of behavioural responses is developed. Pest managers need to make informed choices on the humaneness of control methods in the light of society's changing attitudes to acceptable ethical limits for possum control.

Animal protection law and ethics: A close look at the existing orthodoxy

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In North America and Europe, legal and quasi-legal norms regulate the use of nonhuman animals for human ends and purposes. From these norms emerge a philosophical conception of the relations between human beings and nonhuman animals. That is, animal protection law forms an ideological framework which sets forth a moral status for nonhuman animals.

What is this ideological framework? In discussing the notion of an ethic of animal use as well as the interrelated concept of ethical limits to the genetic engineering of nonhuman animals, the conception of human-animal relations which emerges from animal protection law cannot be ignored. For, not only does this conception establish the ideological structure within which public policymaking in the field of animal protection currently takes place, but it institutionalises a particular moral status for nonhuman animals. Briefly stated, the conception of human-animal relations which emerges from animal protection law in the Western world is a form of egoism. Indeed, human beings protect nonhuman animals only to the extent to which benefit in return is provided to them.

Now, since the advent of legal positivism, there exists a distinction between law and morals. The two are separate issues. Still, as an institution, the law is not exempt from moral scrutiny, and neither is animal protection law. That being so, and in light of the positions advanced by contemporary moral philosophers, what are the moral challenges faced by the conception of human-animal relations underlying animal protection law? Before supporting, or rejecting, this conception, one should at the very least fully understand the place it occupies within the realm of animal ethics. Generally speaking, the ideological framework defined by animal protection law in the Western world is criticised as being speciesist, that is, as resting on a prejudice in favour of the interests of members of one's species against those of members of other species.

Measurements of blood pressure and heart rate by radio-telemetry as a tool to evaluate wellbeing of goats

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Arterial blood pressure and heart rate signalise both physiological and psychological alterations and have been recommended as meaningful variables to evaluate stress and wellbeing. Earlier it has been difficult to measure blood pressure in animals without restraining them. Therefore, a newly developed chronically implantable device was tested, which allowed registrations round the clock in undisturbed goats. Initially, we have studied the effects of reproductive period, blood sampling, feeding and food deprivation in the same four animals on blood pressure, heart rate and cortisol concentration. At night (00.00 to 06.00 h) the blood pressure did not differ between periods (mean blood pressure: 70 mm Hg). The heart rate was 78 ± 1 beats/min during the nonpregnant, nonlactating (= dry) period, 123 ± 1 beats/min during the 5th month of pregnancy ($P<0.05$ vs. the dry period), and 93 ± 8 beats/min at peak lactation ($P<0.05$ vs. the dry period). Morning and afternoon feeding temporarily increased heart rate by about 20 beats/min during late pregnancy, and 30 beats/min during lactation and the dry period. Blood pressure increased a few mm Hg. After a meal the heart rate decreased, but more slowly during pregnancy and lactation compared to the dry period. Blood sampling between meals did not affect blood pressure, heart rate or the plasma cortisol concentration, but cortisol tended to rise during feeding (NS). Depriving lactating goats of four consecutive meals decreased heart rate from 97 ± 7 to 75 ± 7 beats/min ($P<0.05$), did not change blood pressure, but the plasma cortisol concentration increased from 15 ± 4 to 41 ± 14 nmol/L ($P<0.05$). In conclusion, the telemetric device functioned for at least 8 months without any signs that the animals noticed its presence. Reproductive period and feeding routines have to be considered when planning experiments and evaluating changes in heart rate, blood pressure and cortisol concentrations.

Impact of pig grouping on sympatho-vagal balance as measured by heart rate variability

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Heartbeat is characterised by a beat-to-beat variation, mainly triggered by the sympatho-vagal activity of the autonomous nervous system. This phenomenon is called heart rate variability (HRV). We examined the usefulness of HRV for documenting long-term effects of grouping on pigs.

A quantitative Lorenz plot analysis was used to calculate the HRV-parameters: standard deviation of instantaneous, beat-to-beat R-R-interval variability (SD1) and of continuous, long-term R-R-interval variability (SD2). In addition, the SD2/SD1-ratio was calculated. It was demonstrated that SD1 correlates to vagal tone and SD2 to overall activity of all components that control heartbeat. Therefore, SD2/SD1 ratio should partly reflect the sympathetic activity.

Sixteen single-housed pigs were grouped at the age of 21 weeks (G-pigs, group size of 4). In weekly intervals from week 19 to 25, data of G-pigs were compared to a control group of eight pigs that remained in single housing (S-pigs). HRV-parameters were calculated from non-invasive telemetric measurements of R-R-intervals. Individual medians of parameter values from on average 25 five-minute-periods per week in which pigs remained in recumbancy were taken into account.

None of the parameters were different between G-pigs and S-pigs when all 24 pigs were single housed (week 19, 20: $p>0.05$). After G-pigs were grouped, their SD1 was lower and SD2/SD1-ratio was higher compared to S-pigs from week 21 to 24 ($p<0.05$). In week 25, no differences were found between G-pigs and S-pigs in SD1 and SD2/SD1-ratio ($p>0.05$). G-pigs and S-pigs never differed in SD2 during the whole experiment ($p>0.05$).

The results indicate that grouping of pigs might induce a significant decrease in the vagal tone (SD1) and an increase in the sympathetic tone (SD2/SD1) for several weeks. In our experiment, the sympatho-vagal balance returned to normal (control) conditions after three weeks. Therefore, HRV could be a sensitive tool for detecting long-term alterations in internal states.

Behavioural and physiological indicators of hunger and satiety in restricted fed sows: Influence of feeding regimen

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Restriction of feed intake in gestating sows limits excessive weight gain during the gestation period. However, a small meal might not be sufficient to activate the feedback system in the brain for termination of feeding motivation. Effects of daily (1-d) or 3 day (3-d) interval feeding on body weight gain, blood glucose and plasma cholecystokinin (CCK), immune function and behaviour were determined during the gestation period of sows that were fed either 2 kg daily or 6 kg of a corn-soybean meal diet once every 3 days. Data were analysed by ANOVA and shown as LSQ means ± pooled SEM. Body weight gain during the 42 d trial was not influenced by treatment (1-d: 19.7 vs. 3-d: 20.9 ± 1.35 kg, P>0.05). Blood glucose was similar before feeding (1-d: 51.3 vs. 3-d: 51.0 ± 0.67 mg/dL, P>0.05) and increased 2 h post-feeding in 3-d fed sows (72.7 ± 1.21 mg/dL, P<0.05) but not in 1-d fed sows (54.3 mg/dL). Pre-meal CCK was greater for 1-d fed sows than for 3-d fed sows (1-d: 0.54 vs. 3-d: 0.34 ± 0.02 pM, P<0.05). CCK in sows of both regimens increased post-feeding above pre-meal level (P<0.05), with 3-d fed sows exhibiting higher levels than 1-d fed sows (3-d: 2.34 vs. 1-d: 1.87 ± 0.11 pM, P<0.05). Immune response as shown after mitogen induced proliferation of T-cells was greater in 1-d fed sows than in 3-d fed sows (P<0.05). Daily fed sows were in general more active during 24 h intervals than 3-d fed sows (1-d: 26.7 vs. 3-d: 15.8 ± 1.18 %, P<0.05) and showed a greater amount of mouth-based activities within 2 h following feed delivery (P<0.05). Water usage was generally higher in 1-d fed sows (11.6 L/d) than in 3-d fed sows (8.5 ± 0.87 L/d, P<0.05), but not different on days where both groups were fed (1-d: 11.6 vs. 3-d: 14.4 ± 1.05 L/d, P>0.05). Our data indicate that extended feeding intervals with a greater amount of feed per meal resulted in a prolonged satiety. However, we do not recommend a 3-d feeding regimen for sows but emphasise the need for evaluating the impact of feeding regimens on feeding motivation and ultimately on the welfare of gestating sows.

Prevention of broody behaviour expression in domestic birds by means of immunological treatments

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Although, its occurrence is highly variable depending upon the species, the strain, the environmental factors, etc, expression of broody behaviour is a common feature in different species of domestic birds (turkey hens, duck hens, geese, chicken hens, etc.). Its expression is negatively correlated with egg production. Consequently, in order to prevent severe economic loss, effective control of its expression is of importance to breeders and egg producers. In this context, pharmacological treatments are of potential interest and numerous trials were run in order to test various approaches. A number of the tested treatments successfully induced the disruption of broodiness expression but none of them resulted in a resumption of egg laying. It has long been reported that high levels of prolactin were associated with its expression however, a causal relationship was not clearly established until recently. It has also been recently shown that prolactin synthesis and secretion are under the control of VIP secretion in birds. Consequently, the objectives of the more recent approaches were the inhibition of prolactin secretion or the inhibition of its biological activities. They consisted in the use of active or passive immunisation procedures directed against the VIP (El Halawani et al. 1995, Biol. Reprod. 52: 179-183; Sharp et al. 1993, J.Reprod. Fert. 66: 11-38) or against the prolactin itself (Guémené et al. 1994, Brevet français n° 94/05550 19 Revendications, p 37; Crisóstomo et al. 1997, Reprod. Nut. Develop. 37: 253-266). In order for, peptide synthesis (VIP) and/or recombinant DNA technology (chicken and turkey prolactin) were used to produce large quantities of immunogenic protein. These approaches has been shown to be successful by partially or fully preventing the expression of broody behaviour both in bantam and turkey hens.

Spectral sensitivity of the domestic broiler chicken

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The spectral sensitivity of seven domestic broiler chickens (Cobb) was determined in a behavioural test. Initially the birds were trained to receive a food reward by pecking at a clear, perspex panel behind which was a light stimulus (circular, diameter =9mm) originating from a tungsten halogen lamp. Subsequently they were trained to choose between two panels only one of which was lit; the assignation of light and dark on each panel was randomly ascribed between trials. The colour of the lit panel was determined by the light transmitted through 13 closely defined narrow bandwidth filters between 326nm and 694nm (LOT Oriel Ltd.). The flux of photons and hence the intensity of the stimulus received by the bird could be controlled by changing the voltage across the lamp. The photon flux was gradually reduced until the birds failed to detect accurately the lit panel. Success was defined as a choice of the lit panel nine or more times in a sequence of 10 trials, providing that sequence contained at least four changes in the positions of the stimulus. Generally, the birds showed a peak sensitivity between 540nm and 577nm. The results agree with electro-physiological data between 507nm and 694nm (Wortel et al., 1987. J. Comp. Physiol. A. 160, 151-154), and psychophysical data between 500nm and 700nm (Honigmann,1921. Pflugers Archiv. Ges. Pysiol. 189, 1-72) but our data shower higher sensitivities between 380nm and 507nm compared with electro-physiological findings. Our findings confirm that domestic broilers can 'see' into the UVA range, and that their spectral sensitivity is different to the human. The implications of this is that the measurement of light intensity in poultry housing using the lux unit does not accurately describe the intensity perceived by the broiler. Also, experiments using colour, for example differently coloured lighting or food, need to account for this different sensitivity when interpreting their results.

Effects of farmer's behaviour on reactivity and productivity of veal calves

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Human-animal interactions can largely affect the behaviour and physiology of farm animals, and in turn affect the productivity. Effects of human behaviour on veal calves' behaviour and productivity were studied in a survey, including 50 farms, all with similar inputs and size.

Four criteria were observed during one morning meal of the calves : 1) the farmer's acts towards the calves expressed as the first axis of a principal component analysis, a positive value indicating a higher level of positive acts opposed to negative acts, 2) the frequency of withdrawal of the calves when the experimenter is passing by, 3) the duration of withdrawal after touching the head when drinking, and 4) the frequency of withdrawal from the farmer after the meal. All possible data concerning disease levels, cleanliness, buildings and external factors, of possible influence on calves' reactivity, were noted as well. According to growth rate, feed efficiency and mortality, farms were classified as having either very good or good production results.

When performing correlation analysis, we found that the more a farmer behaves positively towards its calves, the less the calves withdraw from the experimenter when it approaches ($r=-.49$) or touches them ($r=-.42$) and from the farmer when it approaches them approaches ($r=-.56$) ; also these three withdrawal measurements were correlated to each other ($r=.55$) ($P<0.01$ in all cases). This indicates that the farmers' behaviour is of strong influence on the calves' reactivity towards him, and that calves can generalise towards other persons.

Logistic regression analysis showed that the farmer's behaviour and also cleanliness, were the most important factors influencing the production results with both positive signs of effect ($P<0.05$), indicating that positive behaviour and a high level of cleanliness led to better production results. Production results were not related to the calves' behaviour, suggesting that the farmer's behaviour affects production by other means than the reactivity of the calves.

Can reactions of cows be used for on-farm assessment of human-animal relationship in dairy farms?

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The human-animal relationship has strong effects on farm animal behaviour, welfare and performance. Therefore it has to be taken into account when assessing animal welfare on farms. The aim of the study was to test, whether measurement of reactions of cows towards man is a suitable method for on-farm assessment of the human-animal relationship in dairy farms.

On 35 dairy farms with loose housing various avoidance and approach reactions of cows towards an unknown person were measured. Behaviour of stockmen towards cows was observed during milking and in other work situations and a questionnaire about management was used. Further possible factors influencing the behaviour of the cows, such as characteristics of the herd, single animal and stable, were taken into account and the social behaviour of the herd was observed directly. Statistical methods used were factor analysis, Spearman-correlation and multiple regression.

Avoidance and approach reactions correlated significantly with the behaviour of stockmen as well as with the intensity/quality of contact. E.g. avoidance distance of the herd was lower on farms where stockmen (1) talked to and touched the cows in milking parlour more often (r_S= -0.589, p≤0.001), (2) were better able to identify the individual cows (r_S= -0.374, p≤0.05) and (3) brushed their cows more often (r_S= -0.509, p≤0.01). Avoidance distances correlated closer to most of these factors than approach behaviour. Stepwise regression underlined the main influence of human-animal relationship on avoidance reactions towards man. Herdsize, breed and age showed much lower or no effects. Besides, social behaviour had significant influence on some reactions: e.g. higher frequency of social licking was related with smaller avoidance distance (stand.coeff. of regression = -0.406, p≤0.01).

Despite further influences approach and especially avoidance reactions reflect well human-animal relationship and can be used as a basis for on-farm assessment of this aspect.

The effects of early handling with and without hand feeding on the development of the relationship between calves and humans

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The effects of hand feeding and physical handling on the behavioural response of young cattle to humans was investigated in 40 Danish Holstein Friesian calves removed from their dams immediately after birth (day 0) and housed in single pens. From day 2 to 16 after birth calves were fed twice daily either by a person entering their pen and offering milk from a bucket, or while visually isolated from humans. In addition, half of the hand-fed calves were handled (stroked) during feeding, and half of the calves visually isolated during feeding were handled twice daily outside of the usual feeding time. The duration of each handling and/or feeding treatment session was 3 minutes. The approach behaviour of each calf to an unknown person was assessed at days 2, 16, 31 and 61 in both their home pen (test duration = 90 s) and in a novel arena (test duration = 180s). Handling (stroking) had no significant effect on latency to interact with the stationary person. Hand-fed calves had a shorter latency to interact with a person in their home pen at day 16 (2.8s vs 8.9s, se=2.01, P<0.05), 31 (4.1s vs 16.5s, se=4.43, P<0.001), and 61 (6.4s vs 21.6s, se=4.28, P<0.001), than those that were visually isolated from humans during feeding. No significant treatment effects were found at any age in latencies to approach and interact with the person in the arena. It is concluded that hand feeding has a greater influence on the relationship between young cattle and humans than physical handling alone. However, this seems limited to the location in which the feeding took place. This effect is relatively persistent as significant differences existed 6 weeks after treatment had ceased and 3 weeks after milk weaning. Interactions between humans and animals are likely to be modified more effectively by hand feeding or by associating handling with food.

The effect of handling on the stress physiology and behaviour of non-lactating heifers

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Recent research indicates that sequential relationships exist between stockperson attitudes and behaviour and animal behaviour, fear and productivity in the pig and poultry industries. High fear of humans, through stress responses, may have adverse effects on growth, reproduction and welfare. The major objective of the following study was to investigate the effects of handling on the stress physiology and behaviour of dairy cows.

Heifers were randomly allocated within weight strata into positive or negative handling treatments. Both acute and chronic stress responses were studied using indwelling catheters: samples were collected frequently before and after human exposure to measure the acute cortisol response to humans and samples were collected hourly from 0900 to 1600 hrs to measure mean basal cortisol concentration. At the end of five treatment weeks, behavioural responses to an experimenter were measured in a standard test.

Compared to positively handled heifers, those in the negative-handling treatment showed higher pm total cortisol levels (19.4nM/L vs 15.8nM/L, $p<.05$), showed higher pm free cortisol levels (2.0nM/L vs 1.1nM/L, $p<.05$), less time to approach within 1 m of experimenter, (165s. vs 121s., $p<0.05$); more time to first interact with the experimenter, (174 s. vs 133s., $p<0.05$); fewer interactions with the experimenter, (0.1 vs 2.4, $p<0.05$) and less time spent within 1m of experimenter, (1.7s. vs 22.9s., $p<0.05$). Furthermore, the negatively-handled heifers had a greater flight distance to the approaching experimenter (4.6m vs 2.2m, $p<0.05$).

These results provide clear evidence that human contact is an important determinant of fear of humans and acute and chronic stress in heifers.

Effects of handling prior to mating and during pregnancy on growth and behaviour of farmed blue-fox cubs (Alopex lagopus)

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In general handling by humans has been shown to be a stressful experience for farmed foxes. Stress experienced by the mother may additionally influence the development of her cubs. The aim of the present study was to illuminate the effects of handling both prior to mating (oestrus inspections) and during the last third of the pregnancy on reproduction, growth, and behaviour of the offspring.

Thirty multiparous blue-fox vixens were chosen for the experiment. For all vixens, number of oestrus inspections prior to mating was recorded (≤10=low, >10=high). Half of the vixens experienced 1 minute handling per day the last 15 days of the pregnancy while the other half remained as controls. All cubs (n=230) were tested until 49 days of age while 120 were chosen for further tests.

Neither number of oestrus inspections nor prenatal stress influenced the litter size, sex-ratio or weight at birth. However, both number of oestrus inspections and prenatal stress were related to reduced growth of the cubs until weaning at 49 days of age. There was an increase in activity in a handling test at 49 days related to both a high number of oestrus inspections and prenatal stress. In an open-field test, the cubs from mothers with high numbers of oestrus inspections were less active than other cubs. However, prenatal stress tended to reduce the activity of females and increase activity of males.

Prenatally stressed female offspring had more success in a food-competition test than control females, while males from control mothers had greater winning success than experimental males. A high number of oestrus inspections did not affect the food-competition capacity of the cubs.

The effects of handling may be caused by handling itself or may reflect qualities of the vixen that indirectly affect the development of her cubs. These questions will be the objectives for future investigations.

Reward centres in the brain: The animal's own welfare centre

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Changing environmental circumstances requires that organisms evaluate their success in coping with environmental demands resulting into altered responses (adaptation). A general form of adaptation is the continuous change in sensitivity to various classes of stimuli (sensitisation and habituation). Evaluation does not only take place after an action but in order to make an efficient choice from various possible actions at a given moment, the potential success of such actions has to be estimated before. The weighing of different options may be realised by comparing the expected rewarding properties of these options. The advantage of a reward centre as an "economy measure" for various motivational systems is, that required changes in sensitivity in case of deprivation can be easily achieved by altering the threshold for reward. A disadvantage is that interference between different motivational systems is possible. Deprivation of one need may lead to compensatory actions of other behavioural systems; for instance isolated animals will consume more and have a lower threshold for pain. The involvement of an integrated reward centre in estimating the potential efficacy of an activity has been addressed by studying the common characteristics of anticipatory responses to different incentives. It has been shown that endorphins are involved in anticipatory responses and that these responses have general characteristics independent of the nature of the incentive. It has also been shown that the animal alters its threshold for reward due to experience for instance stress. The anticipatory response increases when the animal has been isolated. Moreover, the isolated animal does not only anticipate for companionship, but also for other rewards of which they have not been deprived (palatable food), as if they seek compensation.

Thus, the anticipatory response indirectly reflects the animal's own sensitivity to an incentive in relation to previous experiences and appears appropriate for estimating the welfare condition from the point of view from the animal.

Why do animals work for food when food is free? Using starlings to test the information hypothesis for contrafreeloading

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Contrafreeloading (CFL), where food is worked for although free food is available, has been used as evidence that captive animals have a 'behavioural need' to forage. However, it has also been proposed that contrafreeloaders instead perform this behaviour to acquire information about sub-optimal food-sources, for use in future foraging (Inglis & Ferguson 1986, Anim. Behav. 34, 614 - 617). We tested this hypothesis with two experiments on starlings, Sturnus vulgaris, given dishes containing pure food or sand-food mixtures. In Experiment 1, starlings were given a choice between ad lib. food or a food-sand mixture covered either by a clear plastic membrane, which allowed visual inspection, or a black plastic membrane which did not. When visual assessment was prevented, the birds contrafreeloaded, taking a mean of 77.0% of their intake from the poor quality dish (Wilcoxon $T = 2.52$, $n = 8$, $p<0.05$), but when they could assess the poorer patch merely by looking, the birds significantly preferred ad. lib. food, and took a mean of only 17.1% of their intake from the poorer patch (Wilcoxon $T = 2.38$, $n = 8$, $p<0.05$), as predicted by the information hypothesis. In Experiment 2, we trained 12 birds with four colour-coded dishes, presented simultaneously, containing food, sand, and two different mixtures of food-sand covered with a sand layer that prevented visual inspection. All birds contrafreeloaded. When tested in extinction with the best dish removed, the starlings went straight to the second best dish more often than expected by chance (e.g. expected no. visits = 4, observed no. visits = 9, log-likelihood ratio test: $G = 12.87$, $df = 2$, $p<0.01$). Thus contrafreeloading involves the acquisition of useful information about sub-optimal food sources. Overall, both experiments support the idea that working for food represents a 'need to know' rather than simply a 'need to forage' (cf. Forkman 1996, Behaviour 133, 129 - 143).

Effects of frustration of feeding behaviour on swine

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Pigs acquire, through learning and evolution, expectations of their environment. Frustration of expectations results in motivation to change these conditions and is therefore adaptive. Initially, frustration should produce problem solving behaviour. If these responses are unsuccessful, other behaviours, reflecting general frustration are elicited. Our purpose was to study these responses.

Eighteen grower pigs (initial weight. 21.1 kg) were fasted for 1, 2 or 3 hours each morning by removing feeders. On training days full feeders were returned. On test days nonfunctional feeders (empty non-lid feeders (O) or feeders with the lids bolted down (L)) were returned. Pigs were videotaped for 2 hours following return of the feeders and behaviour on training and test days was compared by split-plot-in-time analysis ($p<.05$). A 6 x 6 Latin Square design incorporated 6 treatments (2 feeder types x 3 fast periods) over 6 weeks. Both single pigs and pairs were observed. Blood cortisol levels were determined prior to, and at the conclusion of the experiment, as a crude indication of stress during the 6 weeks of on-and-off frustration.

Frustration increased activity : resting decreased (Single: 67.6 to 64.3%, Pairs: 66.8 to 58.3%), sitting increased (Single: 1.7 to 4.7%, Pairs: 2.4 to 6.2%), playing increased (Pairs: 0.3% to 0.9%)]. Frustration increased activities related to problem solving: oral manipulation of the feeder by single pigs was more pronounced during the first hour than the second hour in L-feeders (7.1 vs. 5.2%) but not in O-feeders (6.1 vs. 6.5%). Frustration increased oral manipulation of other pigs (Pairs: 1.9 to 5.6%) and objects (Single: 8.8 to 28.4%, Pairs: 6.9 to 14.9%)]. Pigs exposed to L-feeders during the final week had higher cortisol levels (92.3 nmol/L) than those exposed to O-feeders (56.9 nmol/L). Frustration, as expressed in increased oral activity, did not substantially diminish over a six week period although general activity levels tended to return to normal.

Sow aggression towards the stockperson; relationships with approach test parameters and piglet survival

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Stockperson-directed aggression by the sow in open farrowing systems increases management difficulties, but may enhance piglet survival. The objectives of this study were to compare aggression exhibited in different farrowing systems and to determine any relationships with piglet survival and responses in a human approach test. Sixty-two gilts were tested at 6-8 weeks prior to parturition. Gilts were moved to a handling area, fitted with a heart rate monitor and moved to a 2.4m x 2.4m test arena. After 2 min acclimatisation, an unfamiliar experimenter entered the pen and stood for 3 min against one wall. Then, the experimenter approached the gilt and touched her snout. Behaviour and heart rate were recorded continuously. For farrowing, gilts were randomly assigned to either conventional crates or a group system comprising five individual pens with communal passageway and dunging area. At parturition, litter size and piglet weights were recorded. The aggression displayed by the gilt during piglet weighing was scored on a scale of 1 to 5 (non-aggressive to extremely aggressive) using sow behaviour and vocalisations as indicators. Aggression scoring was repeated at 7 days, 14 days and weaning. An average score was then calculated for each sow. Penned gilts had a higher aggression score than crated gilts (1.76 ± 0.13 vs. 1.26 ± 0.07, $z=-3.18$, $p = 0.0015$). There were no differences in approach test measures between gilts assigned to the two farrowing systems and the aggression score was not related to behavioural approach test measures. However, aggression of penned gilts was related to the heart rate rise elicited when touched during gestation, ($r=-0.54$, $p=0.002$), meaning that gilts which appeared less disturbed by human contact or more confident could be potentially more aggressive towards the stockperson. In both farrowing systems, aggression was not related to maternal success, measured in terms of litter mortality, which suggested that the aggression did not appear to be advantageous for piglet survival. With further research, the relationship between the heart rate response to human touch and subsequent aggression may enable the development of tests to predict which sows could be aggressive at farrowing.

Qualitative and quantitative effects of handling on tonic immobility in pigs

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Behavioural tests allow the study of the behaviour of individuals under controlled conditions. Many tests, however, differ between studies in the methods used. Here we show how apparently small alterations to the methods can result in qualitative changes in the behaviour of the test animals.

The test described measures tonic immobility (TI) and has been suggested to reflect the active/passive element in pigs' reaction to challenging situations.

Extensive handling before the test resulted in the pigs' vocalising during immobility (n=17; handling: 71% vocalise, no handling: 10% vocalise; $p<0.01$). 'Gentle' handling (pigs were marked with felt pen on days 7, 8, and 10 after birth) did not have this effect, but resulted in sex differences (no handling (n=219): no sex difference, 'gentle' handling (n=86): females more active, $p<0.05$).

The 86 pigs who had been subject to 'gentle' handling at one week of age were tested for TI on three consecutive days at 2 weeks of age. If pigs did not become immobile (non-TI), up to 4 inductions were carried out immediately afterwards. Once immobile, the pigs had ECG pads attached to their chests. These pads were removed 20 seconds after pigs had come out of immobility. When 10 weeks old, they were tested for their reaction to distraction in a runway and for learning speed in a Y-maze, and at 11 weeks for aggressiveness.

The susceptibility to TI increased across the 3 test days ($p<0.001$). Non-TI pigs on day 1 were more likely to respond to distractions than TI pigs ($p<0.02$). Non-TI pigs on day 2 were more aggressive. Non-TI pigs on day 3 were slower at learning the maze task than TI pigs ($p<0.02$).

The same behaviour shown on different test days therefore predicted different characteristics later on, suggesting that repeated testing may alter the meaning of the behaviour expressed.

Petting and bottle-feeding lambs make the caretaker a social substitute for the young animals put in short isolation test

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The present experiment investigates the reaction towards their shepherd of artificially reared lambs according to their previous contact with him. Female lambs (n=45) were artificially reared from multi-nippled buckets in groups of three for six weeks. Fifteen of them were petted and bottle fed in group for six min, twice a day, in their rearing pen during the first four weeks (T1). Fifteen others only received petting during the same time (T2). The remaining fifteen lambs received no extra human contact (T0). Weaning occurs at 6 weeks of age and animals were gathered and received the minimum human contact. Tests were divided in three successive parts: a)Isolation for 1 min; b)Presence of a shepherd who squatted at one end of the pen for 2 min, trying to touch the lamb if it approached; c)Isolation for 1 min. They were performed in an unfamiliar pen (10x2m) at 4, 6 (just before weaning), 9, 13 and 23 weeks of age. Statistical analyses for repeated data were performed with the group as a statistical unit (5 per treatment). T1 spent more time in contact with the shepherd than T2 and T0, T2 more time than T0 (T1: 77.2±6.2s; T2: 49.4±6.1s; T0: 16.9±6.1s, $P<0.01$). In presence of the shepherd, T1 vocalised less ($P<0.01$) than T0 (4.4±0.7s vs. 7.72±0.8s), T2 were in between (6.2±0.9s). When the human disappeared, T1 vocalised more ($P<0.01$) than T0 and more ($P<0.05$) than T2, T2 have a tendency to vocalise more ($P=0.08$) than T0 (T1: 16.9±1.1s, T2: 13.8±0.7; T3: 11.6±0.6). These criteria decreased significantly with the period of test ($P<0.01$) but differences between treatments remained over age. Durable impact of the quality of the human contact in early age, especially linked with the food reinforcement, on the animal perception of the shepherd are clearly shown by this experiment.

Posters
arranged by list order

Interspecific differences in fear of humans (« domestic behaviour ») in farm animals

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Domestication results in a strong reduction in fear reactions towards humans. However, in sheep and other domestic mammals, a high level of intraspecific variability has been observed for these reactions. The aim of this study was to compare fearful behaviour of Ile-de-France lambs (IF, n=41), Large White (LW, n=43) and Mei-Shan (MS, n=13) gilts, Charolaise (CH, n=27) and Fresian (F, n=15) heifers, Welsh females ponies (W, n=22), and Saanen goats (S, n=37). The test consisted of a conflict situation between food motivation and fear of a human. Behaviour of each subject was depicted by a score (from 1 to 6) based upon the number of staining dots that it received when it approached food (Lankin, 1997, Genet. Sel. Evol., 29, 73-92). Animals were tested twice, first in subgroups of 5 to 7, then individually.

Diversity of behaviour was found within all species/breeds, whether the animals were tested in group or individually. MS had the lowest score (1.0±0.00), with a prevalence of avoidance reactions, while LW had the highest (5.8±0.13) with a prevalence of feeding reactions. The mean scores for other species/breeds were IF (1.5±0.12), S (1.5±0.12)<F (2.7±0.42), CH (3.2±0.40)<W (4.1±0.29).

In contrast to group testing, social isolation significantly increased fear reactions in sheep (1.1 vs 1.5; P<0.01), LW gilts (5.1 vs 5.8; P<0.02) and ponies (2.2 vs 4.1 P<0.001), but decreased them in MS gilts (1.6 vs 1.0; P<0.01). There were no changes in goats (1.8 vs 1.5; ns) and cows (F: 3.8 vs 3.2, ns; CH: 3.1 vs 2.8, ns). Individual variability was increased by isolation in gilts of both breeds (e.g. Coefficient of Variation=0.0 in groups vs 77.7 in isolation for MS), goats, ponies and Fresian heifers, but lowered it in CH heifers and sheep (51.7 vs 43.3).

The results suggest that "domestic" behaviour is both breed and species- specific dependent, and its variability reflects an interaction between social, emotional and environmental (level of satiety, man-animal contacts) factors.

Cats free living in towns: distribution and relationships with people

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In many towns cats group together in colonies whose number and location may give raise to people complaints due to hygienic problems, noise or other inconvenients. On the other side the presence of these animals may have, on some persons, positive effects, as the cats become something to care for and to whom give affect and attention. Aim of this research is to know better the number and distribution of cats population in a large town, in order to improve their control and management.

156 colonies of cats free living in Milan have been analysed, through the following informations: 1) cats distribution, habits and health; 2) people's attitudes towards the cats; 3) cats' behaviour towards people. The data were recorded using questionnaires sent by people caring for the free cats to the local Veterinary Health Service.

The main results indicate that: 19 cats live mainly near the houses, where they find shelter and feed (given them usually by only one person); the number of cats in the colony is mostly from 6 to 10 cats; very seldom cats' number is more than 16 animals. The colony dimension is negatively related to health and mortality (rho= -0.26; P = 0.002) and to hygienic problems (rho = -0.23; P = 0.008), which are positively related to aggressive behaviours (rho = 0.27; P = 0.005). Moreover, the larger the colony, the higher the overlapping of territories. 2) 70% of people are concerned with cats' welfare, while the main complaints are referred to hygiene and noise. 3) Cats in smaller colonies allow persons to approach and have a positive relationship with them, as the cats may be handled and caught. People in this case care more for cats' health and welfare, also through sterilization, that both stabilizes cats' population and increases positive effects of their presence for people loving them.

The training of pig-truck drivers

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Sixty per cent of haematomas on pig carcasses are caused by the human handling between the farm to the slaughterhouse. It is also well-known that stressing pigs before slaughter leads to a decrease in meat quality (PSE and acid meat). Since 1990, the French Technical Institute for Swine (I.T.P.) has organised training sessions for pig-truck drivers. The purposes of this session are to improve meat quality and to reduce skin damage by increasing pig welfare, and also to improve the working conditions of drivers.

A one-day training session is organised in the transport company or in the slaughterhouse. There are 5 to 10 drivers per session. The physical and behavioural characteristics of pigs are described by the analysis of: 1) pig heart rate records during its loading and transport from the farm to the slaughterhouse, and 2) video tapes. By then, critical points for men and pigs during the different phases of transportation are underlined and discussions about loading systems and improvements are initiated. Slides on skin damages due to stick, bite or electric goad are shown and a lecture about welfare legislation is also made. These presentations help trainees to understand how good handling practices are important from an economical point of view as well as from the image consumers have on pig production.

Since 1990, 300 drivers have been trained by the I.T.P., representing 75% of the profession in France. After training sessions, many slaughterhouses have recorded a decrease in skin damages such as haematomas. Since 1995, an European directive 95/29 stipulates that pig-truck drivers should receive a specific training. Since then, a significative increase in the demand for training sessions is recorded (80 drivers trained by the I.T.P in 1997).

How to train cattle breeders to handling of bovine?

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Mastering the handling and the restraint of cattle is essential for modern husbandry. The intensification of production entails an increasing number of cattle per farm as well as a decrease in the number of farm hands. This results in a reduction in human/animal contact which contributes to making all intervention to the herd tiring and potentially dangerous for humans as well as for animals. Since 1980, the French Institute for Husbandry (I.E.) collaborating with professional bodies has offered to farmers training sessions adapted to the various types of production.

Each one-day session welcomes about 10 trainees. The morning is dedicated to theory which is put into practice in the afternoon. On one hand, the training is based on the description of cattle (sensory abilities, behavioural and physical characteristics) and on the other hand on the description of restraining equipment and its optimal use. Following this is a discussion of problems that participants may have come across on their own farms. Educational aid relies on theoretical talks and the analysis of situations recorded on films or slides. Practical work is done with cattle, consisting of direct physical contact between humans and animals, the various techniques used to handle animals on the farm, and the development and use of simple restraining equipment.

Since 1980 over France, more than 80,000 people have attended these training sessions with one of the 25 trainers. The vast majority of trainees agree that they changed their attitudes towards animals after the sessions. The figures provided by a farmers' insurance company (Mutuelle Sociale Agricole) reveal that the number of accidents with animals has not increased despite the increase in the number of animals per farmer since 1980.

Effects of early training of lambs at different ages on their behavioural and physiological responses during human-animal interactions and to a novel object

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A standardised veterinary examination procedure was combined with stroking and friendly speaking to lambs during 10 minutes. This training of the presumably aversive handling was applied 28 times per lamb in presence of the group members and, where applicable, mothers as follows: twice daily for two weeks either after birth (group B) or after weaning (group W), once daily over the 6 weeks from birth to weaning (group BW). A control group received no training (group C). At weeks 14, 24 and 34 of age isolation tests (t14, t24, t34) were carried out with 1) a novel object (a huge ball, only t14), 2) the familiar person being passive (P) or 3) applying the veterinary examination procedure (VE). The tests lasted 15 minutes each and were applied in changing order. Lambs were catheterised for blood collection 1 day before testing took place. Altogether 32 lambs were investigated, with deaths in groups C and W (after t14) reducing n to 7. All values below are medians.

In general, training effects were apparent in t14 but did not remain constant during t24 and t34. Any training reduced the percentage of time spent struggling (B: 17.5 %, W: 20.0 %, BW: 35.5 % vs. C: 59.0 %; $p<0.01$) and adrenaline responses (increase from pre- to post-test values) in the VE-test (B: 0.078 ng/ml, W: 0.092 ng/ml, BW: 0.059 ng/ml vs. C: 0.222 ng/ml; $p<0.01$). Additionally, short term but intensively handled lambs (B, W) in the P-test showed less behaviour indicative of excitement (B: 58.0 %, W: 40.5 % vs. C: 89.0 %; $p<0.01$) and lower adrenaline responses (only trend for W-lambs; B: 0.071 ng/ml, W: 0.088 ng/ml vs. C: 0.233 ng/ml; $p<0.01/0.07$). Only B-lambs consistently showed significantly less struggling or excitement behaviour than controls during all VE- and P-tests, supporting the idea of an early period in which learning is more efficient, as long as training is of sufficient intensity. The novel object-test did not reveal any behavioural or physiological differences which could substantiate the hypothesis that effects of early handling are due to influences on the general animal's reactivity.

Does the social environment influence cattle's reactions in the docility test ?

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The presence of pen-mates is known to influence the individual's response to stressful events in farm animals (Boissy and Le Neindre, 1990, Appl. Anim. Behav. Sci. 25, 149-165). Thus, animal's reactivity to handling could change according to the social context. However such hypothesis has not yet been explored. The present experiment investigates the effect of the social environment on the reactions of cattle to humans evaluated in the docility test (Boivin et al., 1992, Appl. Anim. Behav. Sci. 32, 313-323). In this handling procedure, the animal is drafted from its group and isolated in a pen contiguous to its social group. A handler then tries to keep the animal in a corner for 30 consecutive seconds with a maximum test time of 2.5 minutes. A docility score which synthesises the reactions of cattle in this test, is obtained (Le Neindre et al., 1995, J. Anim. Sci. 73, 2249-2253).

Thirty eight ten months old calves from two beef breeds (Salers and Limousine) were used. They were reared in four groups of single breed in free-stable during the first three months and then kept on pasture until the tests. The responses of each calf in the docility test, with or without the presence of pen-mates, were observed over two days, with half the animals tested with each social environment each day. The difference (DIFF) between the two docility scores obtained with and without pen-mates was computed. No significant effect of the presence or absence of pen-mates was observed ($DIFF = -0.18 \pm 0.42$, $t = -0.44$, $p = 0.66$). No significant difference was also observed between Limousine and Salers breeds ($DIFF = -0.59 \pm 0.62$ *vs.* 0.13 ± 0.29, $p = 0.37$). In addition, a highly significant correlation between the two test performed for each animal was found ($r = 0.65$, $p = 0.0001$). These results indicate that calves' response to the docility test is not depending on the absence or presence of the social group and is well reproducible.

Effects of handling on the behaviour of foals

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The aim of this study was to look at the effect of handling on the subsequent behaviour of foals towards humans. Twenty two foals of the same breed and born in the same breeding farm were followed from birth to 37 days. The procedure included handling (bringing the foal to the mother for suckling at birth, stroking the foal at a later stage) while mother and young were together in an individual box and observations in paddocks where groups of several dams and foals were present. Two main groups were made :

- group 1 handled at birth : group 1a : handled at an age of 25 to 35 days
  group 1b : not handled after birth
- group 2 not handled at birth : group 2a : handled at an age of 25 to 35 days
  group 2b : not handled (control)

At the age of 37 days, a test was made where the latency of approach of the foal by an human, and the time during which the foal accepted stroking were measured.

Early and late handling did not lead to the same effects during the test. The early handled foals (group 1) accepted more rapidly to be approached and stroked, but the time of stroking was variable. The late handled foals (groups 1a and 2a) did not show shorter latencies of approach but allowed longer times of stroking. The most effective procedure was a combination of both early and late handling which cumulated these effects.

Observations of foals with their dam showed very few differences between the experimental and control foals in their general behaviour. However the early handled foals tended to stay closer to their dam and played less with other foals.

Behavioural features of flocks have to be used to manage hillsides overgrown with shrubs

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In South of France, much is expected from sheep grazing for maintaining overgrown hillsides. Few farmers want to use these environments as they require a shepherding technique based on in-depth knowledge of the animals' behaviour. We studied the items used by an experienced shepherd to incite his flock to cover a whole territory of this type. We observed the behaviour of a flock of 600 ewes and the shepherd's practices on 16 daily circuits during winter. We monitored the percentage of animals engaged in grazing, moving and standing, the localisation of the flock, the shepherd's actions and his explanations. The pastoral territory (100ha) is made of copses of *Quercus ilex*, partially opening onto calcareous grasslands (15ha). The analyses are based on topographical and vegetation maps.

Initially confined to the open areas (60% of the grazing time), the shepherd prospects with his flock for neighbouring shrubby areas and progressively gains access to new sectors. At the end of the season, the flock spends 60% of its time in an overgrown environment. To increase the grazing areas, the shepherd says he relies on:

- the topography followed by the animals, to gain access to new areas,
- the less dense zones of vegetation searched by the animals, that he tries to join together.

In addition, the shepherd allows the animals to move away whilst still keeping them under control:

- he determines in advance the place where he will be able to recover them,
- he manages the flock as a whole around several animals wearing bells. This enables him to control the unity and direction of the flock at all times.

This study (at the circuit level) led us to describe the rules which enable a shepherd and his flock to progressively gain access to hilly and overgrown territories. It would be interesting (on a real-time scale) to define the behavioural indicators used by the shepherds to maintain control of the movements and activities of the flock.

How to train cattle-truck drivers ?

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The European directive 95/29/CE on the welfare of animals during transport mentions that cattle-truck drivers who have to handle and carry animals should benefit either from specific training obtained within the company or through a training organisation, or from the equivalent practical experience. To meet this directive and the demand of meat companies to improve meat quality, « l'Institut de l'Elevage » (Husbandry Institute) has set up training sessions for cattle drivers.

The three-day training period takes place at the company. On the first day, the trainer goes with 1 or 2 drivers during their round to shoot a film on their practices. The film will be further used as educational material. On the second day, by means of talks, the trainer expounds the behavioural and physical characteristics of cattle to be taken into account during the various phases of transport to ensure the safety of the driver and the welfare of the animals. Practical work on handling and loading cattle is carried out. On the third day, after a conference about legislation on animal transport, the trainees take part in the analysis and criticism of the films shot on the first day. From then on, they make suggestions to solve the problems they have identified either as regards to the driver's behaviour or to potential improvements of the truck. At the end of the session, the company receives a report. A one day « booster » is planned 6 or 10 months later.

In nearly 10 years, 50 private companies have resorted to « l'Institut de l'Elevage » and more than 300 drivers have been trained. Since 1991, the demand grows exponentialy. In 1991, about 12 people have been trained and 83 in 1997.

The effect of dogs on physiological responses of human facing a challenging task

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Pet ownership has been associated with an improvement in human health in several studies. The role of pets in decreasing stress responses in human is poorly understood. In this study, physiological indicators of stress were monitored in pet owners and non pet owners facing a challenging task.

Twenty student volunteers (10 pet-owners, 10 non-pet-owners) were instructed about the protocol for 30 minutes. They were left alone (non-pet-owners) or with their dogs (pet-owners) (t0). Fifteen minutes later, they started an arithmetic task (t15) which lasted for 30 minutes (t45). After t45 the subjects took a 15 minute-break (end at t60). Heart rate was monitored continuously from t0 to t60 using a transmitter belted to the student's body (Polar Sport Tester). Saliva samples were collected using cotton buds at the t15, t45 and t60, and cortisol concentrations were measured by RIA. Mean heart rate was calculated for the following intervals: t0-t15, t15-t45 and t45-t60. Comparisons between pet-owners and non-pet-owners were carried out using Mann-Whitney U test. The effects of the task on heart rate and cortisol in both pet-owners and non-pet-owners were analyzed using Friedman test. Changes in salivary cortisol concentration during the test were measured using Wilcoxon signed-rank test.

There was no significant difference in heart rate between pet-owners and non-pet-owners throughout the experiment. Both pet-owners and non-pet-owners showed an increase in heart rate during the task, but only non-pet-owners increase reached significance ($p=0.02$). Pet-owners' salivary cortisol concentration was higher than that of non-pet-owners at t15 (8.5 ± 2.5 vs. 5.0 ± 1.7 nmol/l, $p=0.003$), but no difference was observed in both post challenge (t45) and post break (t60). While no changes were observed among non-pet-owners' samples, pet-owners' cortisol concentrations showed a significant decrease at t45 ($p=0.015$) and at t60 ($p=0.008$).

Heart rate for non-pet-owners increased significantly at the time of challenge. On the other hand, salivary cortisol decreased at post challenge only in pet-owners, but their baseline level was higher than non-pet-owners. These data showed some association between physiological markers of stress and pet companionship, and it merits further investigation.

Social deprivation after weaning maintains maternal preference in lambs

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In domestic ungulates, social relationships with conspecifics develop with age and experience. Soon after birth, a strong preferential bond establishes with the dam. Subsequently, to a lesser extent, the young associates with other members of the flock, especially other young. The attractiveness of the group may increase due to husbandry practices: For example, the abrupt separation from the dam at weaning strengthens bonds between peers. The present study was designed to investigate the influence of the social experience after weaning on the development of social attraction in lambs.

Twenty four female Ile-de-France lambs were used. They were reared together and single suckled until weaning occurred at three months of age. After maternal separation, each lamb was randomly assigned to one of two social conditions, either physically and visually isolated from conspecifics (n=8) or housed with three other weaned lambs (n=16). After four weeks in such conditions, lambs were individually exposed to three choice tests to assess their social preference: 1) between a familiar lamb (known before weaning) and an alien one, 2) between its dam and a familiar ewe (known before weaning), and 3) between its dam and a familiar lamb. In test 1, the total time spent in the areas facing the two target lambs was less for isolated lambs than for grouped lambs (123 ± 21 vs. 168 ± 26 sec, respectively; $p<0.05$), regardless of the level of familiarity of the target lambs. In tests 2 and 3, the time spent near the dam out of the time spent near the two target animals was more important for isolated lambs than for grouped lambs (test 2: 78 vs. 52 %, respectively, $p<0.03$; test 3: 70 vs. 45 %, respectively, $p<0.05$). It is concluded that social deprivation after weaning maintains a preference for the dam and decreases the development of the attraction for peers.

Behaviour of sows in two different types of farrowing pens

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Behaviour before farrowing was studied with 4 sows in free straw farrowing pens and with 4 sows in strawless farrowing pens with fixing crate. After farrowing, were tested 2 sows on 3rd, 10th and 21st days in each type of farrowing pens. The method with individual interval pictures during 24 hours were used. Besides, frequency of getting up and maternal manifests of behaviour were recorded permanently.

Free type of pens: The longest period of total lying and of lying on side was noticed at 3rd day after farrowing (81 % and 68.4 %, $P<0.05$). The longest time of eating was at 10th day after farrowing (11.5 %). The longest time of activities, like movement, standing and sitting together was at 21st day after farrowing (4.9 %). The highest frequency of getting up was at 21st day after farrowing (29 times, $P<0.05$). The frequencies of maternal behaviour and nursing were the highest at 3rd day after farrowing (37.5 and 44 times per sow).

Crate type of pens: The sows were sitting and standing the longest time before farrowing (3.9 % and 4.3 %). The highest proportion of total lying was noticed at 3rd day after farrowing (92.4 %) and of lying on side at 3rd day as well as at 21st day after farrowing (65 %). The longest time of eating was at 21st day after farrowing (3.8 %). They stand up most frequently at 21st day after farrowing (53 times). The frequency of nursing was balanced (23 to 36 times). The most manifestations of maternal behaviour were at 10th day after farrowing (9.5 times).

The straw farrowing pens were more suitable from the point of the welfare of sows.

Comparison of sow lying behaviour, piglet aggregation behaviour and production performance in crates and oval pens

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A comparison was made of sow lying behaviour, piglet aggregation behaviour and production performance in crates (n = 10) and oval pens (n = 8) (balanced for parity and time of year). 24h time-lapse video tapes were made and a farrowing day defined for each sow by noting the 24 h period during which the sow gave birth (0900 to 0900). Each sow and litter was analysed from 1200 to 2000 during the 24h immediately following this day. The following analyses were conducted: (1) The number and type of each lying behaviour was noted; (2) Each litter was scanned every 10-min and the number of piglets within 0.3 m of the sow noted, expressed as a proportion of litter size and an index was calculated for each sow based on the mean for all scans; (3) At each lying behaviour the number of piglets within 0.3 m of the sow was noted, expressed as a proportion of litter size and an index was calculated for each sow based on the mean for all lying behaviours. Parameters were compared between systems using a Mann Whitney U-test. Although crushing mortality was higher in the oval pen (crate: 0.40 ± 0.16; oval: 1.75 ± 0.31; $p < 0.01$), the total number of lying behaviours did not differ (crate: 7.20 ± 1.47; oval: 8.00 ± 1.39; $p > 0.05$). Only 'flips' (movement from lateral on one side to the other within 10 sec) showed a significant difference (crate: 0.70 ± 0.42; oval: 2.25 ± 0.75; $p < 0.05$). There was no difference in the proportion of aggregating piglets at 10-min scans or lying behaviours. Increased crushing mortality in the pen appears due to the increased number of sow 'flip' behaviours and not piglet aggregation behaviour.

Female-nest relationship in the domestic rabbit: the impact of free versus limited nest access on offspring survival and development

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Wild rabbit does leave their pups in an isolated nursery burrow which is carefully closed and concealed. They then reopen the burrow every 24 h to nurse their litter for 3-4 min. Female-nest relationships enforced by rabbit breeders are very contrasted with those observed *in natura*: domestic does give birth in a nest-box and have potentially continuous access to the nest and offspring.

This study was aimed at assessing the consequences of limited (15 min per day) versus free access to the nest on pups (n=890 from 89 litters). Offspring survival, pathology and growth rate (between d 0 and 28) in primiparous and multiparous females were evaluated among 3 treatments: A: free nest access; B: limited nest access on d 0-3; C: limited nest access on d 0-5. Pup mortality between d 0-28 was significantly higher in primiparous does receiving treatment A (18%) than in primiparous does exposed to treatments B and C (7.3 and 8.9 %; $p<.001$). But pup death rate was already significantly higher in free nest-access conditions at postpartum d 4 (treatment A: 9.3%; pooled treatments B-C: 2.7%, $p<.001$). While pups B-C primarily died from starvation (56%), mortality of pups A was explained by more varied causes (starvation: 21.5%; digestive, circulatory, respiratory dysfunction and wounds). Neonatal death rate was strongly influenced by the does' parity. Regardless of treatment, primiparous does had more dead pups than multiparous does (11 vs 3%) within the 0-28-d period. In addition, the effect of the treatment was significant in primiparous females and not in multiparous females.

These data suggest that, in breeding conditions, the regulation of nest access in a way that matches the natural pattern of doe-nest relationships reduces pup mortality in maternally inexperienced females. Additional analyses will be presented about the consequences of doe-nest interactions on pups' growth rate, and on the does' responses to nest-box closing.

Pre-and post-farrowing behaviour of Japanese wild boars, Sus scrofa leucomystax, in farrowing pens

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In recent years, the number of wild boar farms has increased gradually in Japan. However the knowledge on Japanese wild boars' behaviour is still very limited. A project was carried out on Japanese wild boars under captive conditions in order to describe Part 1: the pre-farrowing behaviour, Part 2: the farrowing behaviour, and Part 3: the response to human in pre- and post-farrowing periods.

Part 1: Five females were observed from 3 weeks to 1 day before parturition. Each farrowing pen consisted of an eating room and a farrowing room which included a nursing box. General activity increased significantly on the day just before farrowing compare to the activity on the previous days : lying reduced (36% to 8%), and walking (17% to 42%) increased. That increase of walking during the pre-farrowing period is similar to the ones described in previous studies on wild boars and pigs. However, the ratio of some other behaviours and the postures of resting had also changed before that increase of walking.

Part 2: The five females were observed from 1 hr before farrowing to 1 hr after it by using a continuous sampling method. During the pre-farrowing period, the time spent nest-building was higher than during the farrowing period. This behaviour was not observed during the post-farrowing period. One female ate some food during the farrowing period. One of the females had killed all her boarlets by the next morning. She bit and kicked boarlets when they tried to nurse. The behavioural pattern of that female was not similar to that of others, especially during the farrowing and post-farrowing period.

Part 3: Responses to the human in pre- and post-farrowing periods were recorded when the man stood by the door of the farrowing pen. In pre-farrowing period, the females ignored the human or rather avoided his close contact. After farrowing, they were significantly more aggressive (performed pawing, rush, head butting and vocalization of threat) than before ($P<0.01$). Two weeks after farrowing, they began to have the same behaviour than before farrowing.

The effect of parity on the behavioural and physiological responses of parturient pigs to the farrowing environment

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There is increasing evidence that restriction of pre-parturient behaviour in pigs is stress-inducing, characterised by an elevation in hypothalamic-pituitary-adrenal (HPA) activity in gilts. To determine whether sows adapt to behavioural restriction at parturition, through modification of nest-building behaviour, we studied the behaviour of pre-parturient sows in either conventional farrowing crates (without bedding, n=7) or straw-bedded pens (n=7) in both their first and second parity, with physiological measurements being taken in the second parity only. Observations and blood sampling (every 30 minutes) were carried out during the 24 hours before the onset of parturition. Crated pigs showed a reduction in the number of times they changed posture across parities which suggests that the attempted nest-building behaviour of sows with prior experience of farrowing crates is less fragmented. The crated pigs spent a greater proportion of time sitting than penned pigs across both parities ($F_{1,12}=9.4$, $p<0.01$), and also spent less time orally manipulating available substrates ($F_{1,12}=10.67$, $p<0.05$). Penned pigs spent a greater proportion of time standing during the immediate pre-farrowing period of their second parity than their first ($F_{1,6}=6.24$, $p<0.05$), and also used a more extensive range of substrates. Plasma cortisol profiles indicated elevated HPA activity in crated sows during the pre-parturient period ($F_{1,11}=5.53$, $p<0.05$) suggesting increased physiological stress, however this was at a lower significance level than that seen previously in gilts. The modifications seen in the nest-building behaviour of penned pigs suggest that experience increases the range of pre-parturient behaviour which may constitute an 'improvement' in their nest-building behaviour. The crated gilts appeared to show adaptation to a crate environment at parturition by performing less fragmented nest-building behaviour. In conclusion the nest-building behaviour of pigs is modified over parities with adaptation to behavioural restriction occurring. However this adaptation, through prior experience, does not completely reduce the elevation in HPA activity as previously reported in pre-parturient crated gilts.

Long-term effect of colostrum feeding methods on behaviour and production in female dairy calves

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In dairy herds the calves are generally separated from their dams immediately after birth and fed colostrum from buckets. The lack of contact with their dam during the first days after birth may have an effect on the welfare, health and production of the calves. An experiment was carried out with 60 female Friesian calves divided into 3 groups: 1) single box and no contact with the dam (SO), 2) maternity pen with its dam and no suckling (C0), and 3) maternity pen with its dam and suckling (C4). In the post treatment period, from day 5 and until the end of their 24th week of lactation all three groups received the same rearing.

Calves of the groups C0 and C4 grew more than calves in group SO (respectively, 533±111g/d and 549±113g/d vs. 266±104g/d; $p<0.10$). The latter ones had the highest frequency of non-nutritive sucking on fixtures during 24 hours at day 3 (respectively, 15±0.2 vs. 0.2±0.3 and 0.1±0.2; $p<0.001$). In the post treatment period, non-nutritive sucking on fixtures was lower in group C4 than in group SO when observed on days 21, 42 and 70. The duration of physical contact to a human in a voluntary human approach test in weeks 2, 10 and 25 was lower for group C4 than for the two other groups. In a social test in weeks 3 and 11, C4 calves spent more time near an unknown animal than S0 calves (respectively, weeks 3: 581±80s vs. 193±86s; $p<0.01$; weeks 11: 450±70s vs. 196±69s; $p<0.05$). In a forced human approach test on pasture at 15 to 18 months of age, C4 heifers were more difficult to approach than SO and C0 heifers (respectively, 2.9±0.1m vs. 2.2±0.1m and 2.5±0.1m; $p<0.05$).

Keeping the dam and calf together for the first 4 days after birth increased the daily gain and the calves' fear of humans and decreased non-nutritive sucking on fixtures. Rearing the calf with the cow appears to affect socialization on humans much less if calves were fed by humans.

Temperament of Merino ewes influences maternal behaviour and survival of lambs.

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The temperament of breeding females can exacerbate their reactions to stress, including the stresses caused by birth difficulties, or the novelty of the neonate. A strong correlation between the temperament of a ewe and her maternal behaviour at lambing would suggest that temperament may be used in selection to ascertain the maternal ability of ewes prior to their inclusion in the breeding flock. Temperament was defined as the fearfulness and reactivity of an animal in response to humans and novel environments. It was tested in 508 ewes from 1992 to 1996 by the arena and box tests described by Murphy *et al* (1994, Proc. Aust. Soc. Anim. Prod. 20, 247-250) and the ewes were selected divergently for calm or nervous temperament.

At lambing, the calmer ewes retreated a lesser distance when a human approached them (2.3*v*6.2 m)and returned to their lambs more quickly (28 *vs.* 62 sec) than nervous ewes. They also spent longer grooming their lambs after birth (38 *vs.* 24 min) and bleated to their lambs more frequently (473*v*320) than nervous ewes. Fewer calm ewes separated from their lambs (14 *vs.* 77) and for a shorter time (1.6 *vs.* 12.4 min). In addition, the calmer ewes spent much longer on their birthsites (3.6 *vs.* 1.3 hr) than the nervous ewes.

This maternal behaviour was reflected in the survival of lambs to 12 weeks.

Lamb mortality	**Calm**	**Nervous**	
% of all deaths	34 (54/157)	66 (103/157)	P<0.001
% deaths per flock	11(54/497)	20 (103/519)	P<0.001
% of all deaths attributable to the ewe*	26 (32/123)	74 (91/123)	P<0.001
% of deaths per flock attributable to the ewe	6 (32/497)	18 (91/519)	P<0.001

*excluded stilbirths, infections and injuries at birth.

Under extensive conditions, the temperament of ewes influences both their maternal behaviour after parturition and their rearing ability. Calm ewes exhibit better maternal behaviour after parturition and consequently rear more lambs to weaning than ewes with nervous temperaments.

Development of a preference for the mother by the new-born lamb : involvement of peripheral cholecystokinin receptors

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Postnatal learning of maternal cues by the new-born lamb is believed to be related to the rise of plasma cholecystokinin (CCK) occurring after the first sucking bouts. Only lambs in which access to the maternal udder is not prevented during the neonatal period have an increase of CCK plasma levels and develop a preference for their mother at 24 h of age. It is known that plasma CCK does not cross the blood-brain-barrier and would facilitate learning by acting on peripheral CCK-A receptors.

We tested the involvement of peripheral CCK-A receptors by comparing the effect of devazepide, an antagonist which crosses the blood-brain-barrier and prevents the development of a preferential relationship with the dam (Nowak et al., 1997), to that of 2-NAP which does not cross the blood-brain-barrier. At birth lambs received either an i.p. injection of saline (N=14), devazepide (0.1 mg/kg, N=12), or 2-NAP (0.01, 0.1, or 1 mg/kg; N=13, 16, and 15 respectively). No side effects were observed on their locomotor, sucking and vocal activity after the injection. The expression of a preference for the mother was tested in a two-choice situation at 24 and 48 h. The lambs motivation to reach the ewes and to stay with them was not affected by the treatments unlike their discriminative behaviour. The time spent near the mother or the alien ewe did not differ significantly in devazepide lambs and those receiving 0.1 mg of 2-NAP. By contrast, lambs from other groups spent more time near their mother than near the alien ewe. The effect of devazepide, but not that of 2-NAP, persisted at 48 h of age. Growth rates and rectal temperatures of drug-treated animals did not differ from SAL.

We concluded (i) that the use of 2-NAP at 0.1 mg/kg was sufficient to prevent the development of a preference for the mother within 24 h after birth, and (ii) that devazepide had longer lasting consequences reflecting, in all likelihood, an effect at the brain level. Nevertheless, this suggests that peripheral CCK-A receptors are involved in early learning of maternal cues which leads to the establishment of this preferential relationship.

Psychobiological consequences of a very early weaning (on the 6th day) in the Large-White piglet

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Hyperprolific Large-White sows produce 15 piglets or more per litter, and neither the number of teats nor the milk production of these sows allow all piglets to survive. Excess piglets are usually weaned around the first week of age, and this study was undertaken to assess the consequences of such an early separation from the mother. Locomotor, social and feeding behaviour, urinary cortisol, intestine lymphocytes population and animal growth rate of piglets weaned at 6 (W6) or 28 (W28) days of age were compared. We followed nine W6 and nine W28 litters of 5 to 8 piglets. We observed their behaviour (4h / d) and assayed their urinary cortisol from the 5th to the 20th day. Intestine lymphocytes population was measured in 3 piglets / treatment (W6 and W28) at d36. The W6 piglets displayed more oral (belly-nosing) and aggressive activities towards their littermates than the W28 piglets did (oral activity: d7, d 20: $P<0.05$; d8, d12, d14: $P<0.01$; aggressive activity: d8: $P<0.01$; d12: $P<0.05$, respectively). They also vocalised and explored the pen more often (vocalisations: d6, d7, d8: $P<0.01$; exploration: d8, d14: $P<0.05$; d12: $P<0.01$, respectively). Resting activity of W6 piglets was lower than that of W28 piglets (d6, d20: $P<0.05$; d8, d14: $P<0.01$; d12: $P<0.001$). However, most of these differences were no longer observed two weeks after weaning. Urinary cortisol level was not higher in W6 than in W28, except for the day after weaning ($P<0.05$). A greater number of T and B lymphocytes was found in W6 intestine as compared with W28, at 36 days of age (lymphocytes T: $P<0.05$; lymphocytes B: $P<0.001$). Lastly, W6 rapidly adapted to dry feeding, and at 28 days of age, their growth rate which was reduced after weaning did not differ from that of W28. In conclusion, this study shows that a very early weaning induces psychobiological disturbances but that piglets rapidly readapt their social and feeding behaviour.

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Differences in suckling behaviour of three Brazilian beef cattle breeds

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The knowledge of suckling behaviour contributes to optimise management and selection of beef cattle. However, there is little information about it in Brazilian beef cattle. Forty one cows, 14 Gyr, 17 Nelore (both *Bos taurus indicus*) and 10 Caracu (a creole cattle, *Bos taurus taurus*) were bred according to a diallelic crossing design. The animals were kept in pasture from birth to weaning and were observed once weekly during daylight. Three traits were recorded: Suckling frequency (SF), time spent in each suckling (TS) and total suckling time per day (ST). Breed of the cow affected the suckling frequency and the time spent in each suckling ($p<0.05$), Nelore and Gyr presented the highest suckling frequency means (2.52±0.03 and 2.57±0.04 times/day, respectively), followed by Caracu cows (2.02±0.07). The highest time spent in each suckling was that of Caracu (12.71±0.73 min.), followed by those of Nelore (8.47±0.31) and Gyr (8.29±0.41). No significant difference was observed among dam breeds with respect to the total time suckling spent per day (Caracu=26.47±2.72, Nelore=21.86±1.31 and Gyr=21.51±1.68 min.). Genetic group of calf affected all behavioural traits when the dam was Nelore ($p<0.01$) and the suckling frequency when it was Gyr ($p<0.05$); the averages of these groups were:

Dam/sire breeds	Gyr/Gyr	Gyr/Caracu	Gyr/Nelore	Nelore/Gyr	Nelore/Caracu	Nelore/Nelore
SF (times/day)	2.78 ± 0.05a	2.26 ± 0.07b	2.67 ± 0.08a	2.36 ± 0.04b	2.29 ± 0.06b	2.96 ± 0.03a
TS (min.)	-	-	-	9.23 ± 0.45a	7.20 ± 0.62b	8.99 ± 0.32a
ST (min.)	-	-	-	21.65±1.83 b	16.60±2.62 c	27.32±1.40 a

There are genetic differences in suckling behaviour and these shoud be considered in planning crossbreeding in order to choose dam's breed. The effect of calf group may not be related with individual heterosis.

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Repeated adoptions during lactation impair the welfare of sows and piglets

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Extensive cross-fostering is widely used in early-weaning units in order to uniformize body weight. This practice is also believed to increase piglets weight gain. However, young suckling piglets develop teat fidelity and repeated adoptions go against this behaviour. This experiment was therefore conducted to compare the behaviour of 12 control and 12 fostered litters. Once every three days (from days 1 to 16 of lactation), all piglets were weighed and three piglets were switched between two fostered litters. Their non-fostered littermates were called residents. Behaviour was noted for 2 h after weighing and adoption and during one nursing period 24 h later. Fights were more frequent in fostered than in control litters at all ages of adoption ($P=0.0001$), during (20.7±1.2 vs 5.2±0.6) and between nursings (at the udder:17.4±1.5 vs 4.6±0.7; elsewhere: 9.6±1.0 vs 3.9±0.6). This effect was still significant 24 h after adoption ($P<0.02$), except at days 1 and 16. Within fostered litters, most fights occurred between one resident and one fostered piglet ($P<0.001$). Failed nursings increased ($P<0.05$) in fostered litters (mean=2.1±0.5), as well as face and body lacerations ($P<0.01$). Within fostered litters, scratches were more frequent in fostered than in resident piglets (29 vs 10%). At all ages except day 1, fostering sows were more aggressive towards the piglets ($P<0.05$), most snaps being directed at fostered piglets ($P<0.001$). Also, fostering sows spent 15 to 30% less time lying on the side than control sows at days 4, 7, 13 and 16 ($P<0.05$). Finally, no weight gain improvement was observed, fostered piglets being even lighter than control piglets at weaning (4.7±0.1 vs 5.4±0.08; $P<0.001$). These data demonstrate that cross-fostering done repeatedly during lactation is stressful for piglets and sows.

Network for swine breeding and ethology - the influence of maternal traits on piglet production

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A network for swine breeding and ethology has been established in the Nordic countries. The project "Maternal behaviour of sows, with a focus on genetics, physiology and social environment" is performed within the network. This 4-year project started in January 1998, and the aim of the poster is to call for advises, suggestions and ideas.

Before maternal behaviour can be included in the breeding evaluation, we need to learn more about its genetic variation, correlations with other important traits and interactions with the environment. Further, we need new methods for recording maternal behaviour on a large scale and for analysing behavioural traits. Preliminary results from 125 sows in one nucleus herd indicate genetic variation in sows' reactions to a screaming piglet and in sows' defence of piglets.

Test traits describing maternal behaviour will be developed and validated. Methods for genetic analyses of categorical traits will also be developed. Finally the test traits will be recorded on a large scale in nucleus herds and the heritabilities will be estimated. Extreme boars will be selected, based on breeding values for maternal traits, and their daughters will be blood sampled regularly, using catheters. The sows will be compared with regard to hormones, metabolites, milk production and maternal behaviour. Physiological and behavioural variables will also be studied in nucleus herds. Relations between social ability and maternal behaviour and the influence of stress (during pregnancy, prenatal and postnatal) on maternal behaviour will be investigated. Piglets stressed by mixing during lactation will be compared with unmixed piglets. Physiological and behavioural stress reactivity, ways of coping with social and non-social stress, and later, maternal behaviour will be recorded on these animals.

How is the chick's vocalisation connected with the behaviour of the mother hen ?

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The vocalisations of young chicks contain information about the internal state of the animals. To use this information for the scientific evaluation of the chick's needs it is essential to study the behavioural context of the calls. Because the mother hen is the natural and most competent receiver of the calls of young chicks, it is necessary to analyse the interaction between the hen's behaviour and the chick's vocalisations in order to decode these calls. The main question asked in the present study was how the chick's vocalisations correspond with the behaviour of the mother hen. Four groups of 10 chicks were reared by a mother hen and observed continuously for 2 weeks. Behaviour and vocalisations were recorded on videotape. The behaviour of the hen and the young chicks was noted during 1304 randomly selected intervals of 80 sec. The call type incidences of the chicks were evaluated with the help of three-dimensional sonagrams. The influence of hen behaviour on vocalisations was dependent on the current behavioural situation of the chicks. A comparatively high percentage of pleasure notes (52 % of all calls given) and only a few distress calls (1,8 %) were given during feeding by the chicks while the hen was resting. When the hen began to feed, there was a significant increase in distress calls (5,6 %) and short peeps (65 %) and a decrease to 26 % in the number of pleasure notes (ANOVA, $p<0,05$). When the hen was the initiator of the start of activity after resting the chicks uttered more distress calls and short peeps than in the cases when the chicks initiated the period of activity after resting. Earlier studies of chicken calls did not note the described effects of the hen's behaviour on the vocalisations of the chicks. But these effects could be useful to elucidate the psycho-physiological state of the animals during the uttering of the different call types.

Social and maintenance behaviours of Japanese Black cows having various numbers of associates in a communal pasture

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In a previous study, we observed that cows from the same farm of origin formed affiliative groups in communal pasture. Affiliative behaviours tended to increase, escape behaviour tended to decrease, and the mean durations of grazing and recumbency behaviours tended to increase with the numbers of associates from 0 to 3-5. In this experiment, we investigated the effects of 5 or more associates on social and maintenance behaviours in order to investigate optimal group size in cattle.

One hundred and eighteen cows derived from each farm were turned out into communal pasture at 12 May. Twelve cows, aged 3-8 years, having 1, 2-4 or 16 associates were selected as focal animals at random. Each focal animal was followed and observed for 8 hours from sunrise from 12 to 15 July after completely adapted to a grazing site. Three persons observed 3 focal cows simultaneously in each day. The communal pasture consisted of 10.3 ha artificial pasture and 0.9 ha woodland. The nearest neighbour and distance to nearest neighbour were recorded at 10-minute intervals and maintenance behaviours at 1-minute intervals. Social behaviours and participants were recorded continuously.

Cows from the same farm were more frequently nearest neighbours to focal animals and allogroomed with focal animals longer than cows from other farms (chi-square test: $P<0.001$, $P<0.001$). Time spent allogrooming of cows having 2-4 associates was the longest in the herd. Aggressive behaviours of cows having 16 associates were less than of the other focal animals (Least significant difference method: $P=0.07$). Cows having 2-4 associates escaped less, and grazed more than the other focal animals (Least significant difference method: $P<0.05$). Cows having one associate grazed less continuously than other cows. From present study (better life in 2-4 associates) and previous study (better life in 3-5 associates), it was considered that cows having 2-5 associates were the most psychologically stable.

Development of lamb recognition from a distance by their mother in the peripartum period

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Ewes recognize their lamb at close quarters on the basis of olfactory cues within 2 to 4 hours after parturition but recognition from a distance using other cues needs several days to develop. However the possibility that non olfactory recognition could establish more rapidly has never been investigated. Here, we studied the ability of Rambouillet and Préalpes-du-Sud/Lacaune ewes to develop non olfactory recognition during the first day postpartum in a two-choice test between their own and an alien lamb in which close contact was prevented by penning the lambs behind two fences one metre apart, thus preventing perception of olfactory cues (Alexander and Shillito, 1977)

In both breeds, all ewes recognized their young at suckling at 4 h in the olfactory recognition test. At 8 hr, Préalpes-du-Sud/Lacaune mothers did not spend more time near their own than near the alien lamb (25.6 ± 3.7 sec. vs. 23.6 ± 4.5 sec., $p>0.05$, $N=19$) in the non olfactory recognition test, whereas they did so at 12 and 24 h (12h : 34.8 ± 4.1 sec vs. 12.4 ± 3.0 sec, $N=20$; 24h : 48.3 ± 5.9 sec vs. 27.2 ± 4.9 sec, $N=29$; $p<0.05$). This was also the case for the Rambouillet ewes (12h : 64.5 ± 8.6 sec vs. 18.0 ± 6.7 sec, $N=10$; 24h : 55.2 ± 9.9 sec vs. 15.3 ± 6.3 sec, $N=9$; $p<0.02$)

We conclude that recognition of the lamb from a distance is strongly established in both breeds as soon as 12 h after parturition but does not develop as quickly as proximal recognition. Therefore, although ewes can identify their young by olfaction they can also use other sensory information to recognize them from a distance on the day of parturition, thus reinforcing their capacity to maintain contact with their litter.

Development of a test for maternal behaviour in sows - «the screaming piglet test»

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The screaming piglet test has been used early postpartum to test sows' reactivity towards piglets being crushed, by playing a recorded piglet scream and registering the posture changes of the sow. Two experiments were performed to validate the test.

Experiment 1: The effect of piglet identity, (own (O) vs. alien (A)) and sow posture, (lying (L) vs. in the process of lying down (l)) was investigated in a 2x2 factorial design with 48 crated sows in 6 replicates, each tested with the 4 combinations in balanced order. No significant effect on sows reactions was found. In the first test, however, the first reaction (at least lifting the head) towards AL was faster than to Al (2 vs. 18 sec; χ^2 =3.76, P=0.05) and faster than to Ol (2 vs. 22 sec, χ^2=4.77, P<0.05). In the fourth test the effective reaction (at least sitting up) was faster towards own piglets, compared to alien piglets (12 vs. >120 sec, χ^2=3.74, P=0.05).

Experiment 2: Forty gilts farrowed in crates or enriched pens. In second parity the crated sows were equally split up in to crates and pens, as were the penned sows. The reaction of sows toward an alien piglet scream was tested while in the process of lying down. Gilts reacted faster in pens compared to crates (0 vs. 29 sec, χ^2 = 11, P<0.0001). Second parity sows showed a faster effective reaction in pens compared to crates (37 vs. 120 sec, χ^2 = 6.78, P<0.01). No effect of previous farrowing environment was found. Maximum reaction in the two parities was correlated (r_s =0.43, P=0.01, n=32). Latency to first reaction was shorter in parity one (33 vs. 57 sec, P=0.01, n=32), but not latency to an effective reaction.

Although the sows' attention towards piglets shifts early postpartum from alien piglets to own, suggesting a habituation/sensitisation process, neither piglet identity nor sow posture are crucial factors for the test. Enriched environment makes the sows respond faster, but some consistency in response over pregnancies persisted.

Behaviour of nursing cows during different ages of calves

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The work evaluated maintenance and adoptive behaviour of nursing cows. Four Holstein dairy cows, matched according to same milk production were used in the trial to nurse 12 calves. Nursing cows with the calves were kept in one group with loose straw housing and concrete exercise yard, but motion of the cows was limited by a long tying chain. Four 24 h long ethological observations were conducted when the calves were 2,3,5 and 8 weeks of age. Nursing cows behaviour were no statistically different. The shortest lying time (only lying without rumination) by cows occurred during the first 24 hour observation (223 ± 6 min) and was due to the highest frequency of suckling by calves. The longest standing while ruminating (170 ± 17 min) was also associated with this shortest lying time. The longest eating time (440 ± 26 min), total rumination and total standing time were also recorded during the first observation. The shortest total lying time (lying and lying while ruminating) likewise occurred during the first observation (553 ± 15 min). Frequency of the nursing was highest between 6-9 h A.M. and 4-7 h P.M. at the age of 2 and 3 weeks. Frequency of the nursing at the age of 5 and 8 weeks had seven main periods, which were almost regularly divided during the 24 h periods. Calves indicated a preference for specific cows while ignoring others. Total nursing time was highest during the first observation when the calves aged 2 weeks (from 309 to 560 min). The average time of one suckling according to individual cows during a 24 h period ranged from 260 to 321 sec.

The effects of mixing and re-grouping on the social organisation of group-housed sows

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78 Large-White x Landrace mixed parity sows were weaned from farrowing crates into groups of 6 and mixed into straw-bedded service pens with individual feeding stalls. Groups were transferred to similar gestation pens after 4 weeks where they remained until farrowing. In experiment 1 (n=24) lesion scores on days 1 (prior to mixing) 3, 7, 28, 56 and 84 were 0; 9.5; 6.5; 4.0; 5.0 and 6.0 respectively. Scores on day 3 were significantly higher than all other days ($p<0.05$). On days 28, 56 and 84, groups were transferred to a large straw bedded pen and given their daily feed ration on the floor in standardised tests (floor feeding tests). Aggressive interactions during the tests were significantly higher on day 28 (5.5) than on day 56 (2.5) and day 84 (2.0) ($p<0.05$). In experiment 2 (n=54) 9 groups were divided into 3 pairs after the 4 week service period, housed separately for either 2, 4 or 6 weeks and then re-grouped into original groups. At mixing there were on average 3 fights per group lasting 70 s. There were no fights when sows were re-grouped. Lesion scores and aggression during floor feeding tests did not increase after re-grouping and were unaffected by the duration of separation. Separation had no affect on feed displacement times which were significantly less at 4 weeks after weaning (41 s) than they were at 1 week after mixing (60 s) or 1 week after re-grouping (54 s) ($p<0.05$). Social rank positively correlated with sow weight and parity ($r_s=0.63$). Social rank had no affect on any production parameters measured. Out of 13 groups from both experiments, 6 formed non-linear hierarchies and in 6 groups, positions within the hierarchy changed over the gestation period. It was concluded that the formation of social hierarchy in sows is a complex process. Aggression declined rapidly after mixing and became stable after 7 days but remained high for over 28 days when sows had to compete for food. It was shown that sows may be removed and returned into groups of 6 after a 6 week period without any major disruption to social organisation.

Effects of space allowance on the behaviour and growth of red deer hinds and sheepreared in monospecific or mixed groups at pasture

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Our objective was to measure the effects of space allowance on social interactions, activity patterns and growths of yearling hinds and ewes reared at pasture in monospecific (MS)or mixed (HS) groups. Thirty individuals of each species were assigned to 2 MS groups of 10 animals (hinds : H1 and H2, ewes : E1 and E2) and to 2 HS groups of 5 hinds and 5 ewes (M1 and M2). During 28 days, H1, E1 and M1 were kept at high space allowance (HSA : 267 m²/animal) and H2, E2 and M2 at low space allowance (LSA : 67 m²/animal). During the following 28 days the groups tested the other space allowance. To avoid any effect of herbage allowance on performance, each group was moved to a new pen every 4 days. Interindividual distances in MS groups were lower at LSA than at HSA (hinds: 10.0 ± 0.3 v 15.4 ± 4.8, $p<0.05$; ewes: 7.9 ± 0.5 v 11.0 ± 2.5, $p=0.13$). In HS groups, distances between homospecific individuals were shorter than between heterospecific individuals (hinds : 8.8 ± 1.6 v 11.0 ± 1.0, NS ; ewes : 5.3 ± 1.1 v 7.5 ± 2.3, NS ; hinds- ewes : 14.6 ± 0.9 v 20.6 ± 1.0, $p<0.05$). When reared in MS groups, LSA hinds were more aggressive (frequencies of agonistic interactions / hour: 10.0 (9.6-12.8) v 5.0 (1.9-11.6), $p<0.05$), were less synchronised during grazing, had shorter and more frequent meals (duration of a meal: 41 ± 9 v 44 ± 10 min, $p<0.05$; number of meals per day: 11.9 ± 2.1 v 10.4 ± 1.6, $p<0.05$), and grew slower than HSA hinds (184 ± 63 v 225 ± 42 g/d, $p<0.01$). Such effects were not observed for ewes. In HS groups for both hinds and ewes, the restriction of space disturbed grazing patterns and reduced growths (hinds: 141 ± 42 v 211 ± 56 g/d; ewes: 170 ± 47 v 202 ± 32 g/d, $p<0.05$). Reducing the space allowance induced behavioural disturbances and lower performances that were intensified by mixed stocking. Ewes were less sensitive to space allowance and mixity than hinds, certainly because of their higher level of domestication.

Effects of social stress on heart rate and heart rate variability in growing pigs

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Social stress is a common phenomenon in pig husbandry. In this experiment, social stress was produced by a food competition test with a penmate and a resident-intruder test with an unacquainted pig. We studied the effects of social stress on heart rate and heart rate variability in growing pigs, and determined the relations between the outcome of the food competition test and the heart rate responses to the food competition test and resident-intruder test. Twelve crossbred barrows (10 weeks of age) were used in the experiment. Heart rate was measured by biotelemetry. By measuring heart rate variability we estimated the autonomic control of the heart, with either a sympathetic or a parasympathetic prevalence (e.g. Sgoifo et al., Am. J. Physiol. 273, H1754-H1760; Hull et al., J. Am. Coll. Cardiol. 16: 678-685). Pigs that were defeated in the food competition test had a higher heart rate ($p<0.10$), but no significant differences in heart rate variability were observed between defeated pigs and winners. All pigs were defeated in the resident-intruder test with an unacquainted heavier pig, however, large individual differences in heart rate responses were observed. Pigs that were defeated in the food competition test were more sympathetically activated in the resident-intruder test than pigs that won the food competition test (i.e. the heart rate variability was significantly lower for defeated pigs ($p<0.05$)) , and had a higher heart rate in the resident-intruder test than winners ($p<0.10$). As it has been shown that the outcome of a food competition test is correlated with the social status of pigs (Hessing et al., Vet. Imm. Immunopathol. 43: 373-383), the social status may determine in the heart rate responses to the food competition test and resident-intruder test. When heart rate is used as an assessment of stress, the results suggest that pigs that were defeated in the food competition test may experience more stress during the food competition and resident-intruder test.

The effects of ad libitum vs. restricted feeding on 24 hour patterns of behaviour in dynamic groups of pregnant sows

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Competition for access to food and the re-establishment of the social organisation after introduction of new animals are the main causes of agonistic behaviour in dynamic groups of pregnant sows. In stable groups, food related aggression can potentially be reduced through the provision of a high fibre diet ad libitum (Brouns 1993, PhD thesis, Univ. Aberdeen, UK). The present study aimed to investigate the effects ad libitum feeding has on levels of aggression in dynamic groups of sows. Two groups of 30 gestating sows were housed in two adjacent deep straw pens. One group (R) was fed a restricted amount of conventional diet from an electronic sow feeder station, with a feeding cycle commencing at 18:00 h. The other group (A) had ad libitum access to a high fibre diet containing 600 g unmolassed sugar beet pulp per kg of food. Over a six week period, eight focal sows were selected from each treatment each week, consisting of two newly introduced animals and six resident sows. Behaviour of focal sows was recorded for two 24 hour periods after introduction of the new sows into each pen (at 09:00 h). Aggression and general activity were highly correlated (r_s =0.47, $P<0.001$). A sows were more active between 17.00 and 21.00 compared to R sows (%standing: 11.0 v 3.9% for A v R respectively; $P<0.001$), but the reverse was true between 01.00 and 09.00 hours (e.g. %standing between 01.00 and 05.00 hours: 1.1 vs 6.4% for A v R respectively; $P<0.01$). However, the main peak of activity for both groups was between 09.00 and 17.00 hours. Newly introduced A sows were involved in a higher number of aggressive encounters compared to newly introduced R sows (3.6 v 1.3 interactions per 4 hour time period, for newly introduced A v R sows respectively; Tukey, $P<0.05$). The data suggest that sequentially fed sows spent more time feeding over night than ad libitum fed sows. This decreases the probability of interactions with new animals introduced at the beginning of the day, compared to ad libitum systems.

Environmental enrichment: Physiological consequences originated from fighting

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The goal of an environmental enrichment is to enhance the welfare of animals and reduce stress. These can be reached for example by reducing the aggressive behaviour between cage mates or by giving animals more natural living environment (like burrows). The aim of this experiment was to study the effects of different environments on the physiology and aggressive behaviour of outbred NIH/S mice. Fifty-six male mice were housed 8 weeks from the age of 5 weeks in groups of 4 animals per cage in four different cage environments: Control animals (n=16), Aspen wood-wool as nesting material (n=12), Aspen wood-wool with Plastic Box (n=16) and Aspen wood-wool with Plastic Bottle (n=12). The aggressiveness of groups was determined by the occurrence of wounds; in non-aggressive cages none of the animals had wounds; in aggressive cages there were one or more animals with wounds. The aggressive behaviour was clearly increased in cages with Aspen wood-wool only as enrichment. Over 70 % of the injured animals were in this group. Moreover, animals with wounds had smaller weight gains and weights of brown and epididymal adipose tissue and their weights of adrenal gland and spleen were increased. The physiology of animals in aggressive groups without wounds was similar to that of animals in non-aggressive cages. The other two enrichment groups did not differ from the control group. This indicates that the nesting material may intensify agonistic behaviour which may lead to alterations in physiology and thus may not be alone a suitable enrichment for male NIH/S mice. Plastic boxes and bottles with nesting material were clearly used by NIH/S mice and the boxes and bottles seemed to antagonise the aggressive-inducing effect of Aspen wood-wool. The reason why nesting material enhanced aggressive behaviour is yet unclear. The enlarged spleens might indicate activated immune defensive system caused by wounds. The other alterations in physiological parameters suggest increased stress caused by real injury rather than aggressive behaviour of other cage mates.

Complexity and aggression in Label Rouge chickens

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Wild animals use the complexity of their environment to lower their exposure to predators and to escape from encounters with aggressive conspecifics. Complexity can be enhanced through different types of concealing cover including vegetative cover used by birds. Domestic fowl are often reared in large groups in indoor pens providing minimal cover apart from the walls and ceiling. We predicted that the presence of artificial cover would reduce the frequency of agonistic interactions among domestic fowl kept in indoor pens. We also predicted that the frequency of agonistic interactions would be higher in larger than in smaller groups, especially when birds were distant from cover. We reared 8 groups of 110 Label Rouge chickens (55 males, 55 females) in eight 14m2 floor pens. Throughout rearing, each group was given access to a 65m2 "activity pen" adjacent to the home pen for 1 h daily. The activity pen was divided into 9 equal quadrats. The four corner quadrats contained panels of vertical cover. The central quadrat was furthest from the walls and was considered to have no cover. At 9 wk of age, we made observations of the number of chickens present, and the frequency of aggression (fights, pecks, threats, chases, leaps and stand-off's), in each corner quadrat (with cover) and in the central quadrat (without cover). On different observation days, we observed either 110 birds or 20 birds (10 males, 10 females) from each group in the activity pen. Agonistic interactions were more frequent in groups of 110 birds than in groups of 20 birds (pecks, $P<0.05$; threats $P<0.001$; total aggression $P<0.01$). In the large groups, the presence of cover reduced the frequency of agonistic interactions (pecks, $P<0.05$; threats $P<0.05$; total aggression $P<0.001$). This effect of cover was not detected in the small groups, possibly because birds in smaller groups engage in fewer agonistic interactions when distant from cover due to a higher theoretical predation risk. This explanation does not exclude the possibility that cover would reduce aggression in small groups stocked at higher densities. Our results support the prediction that environmental complexity reduces the frequency of aggressive interactions in large groups of domestic fowl.

Effects of number of rabbits per cage on their production and reactivity

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Nowadays, one of the main problems in fattening rabbits is to evaluate the welfare of these animals in cage considering the social behaviour of this species. The aim of this work was to study the reaction and the productive traits of rabbits bred in cage at the same density but with different number of animals. Ninety male rabbits were bred in cages from weaning (30 days) to slaughter (82 days). Fifteen rabbits were housed one per cage (20.5 x 41 x 29 cm), 30 rabbits were house two x cage (41 x 41 x 29 cm), and 45 animals were housed three x cage (61.5 x 41 x 29 cm). Every 15 days the individual liveweight, the cage feed consumption and the presence of lesions due to aggressive behaviour were recorded. At 57 and 77 days of age two repetitions of an open-field test (6 min lasting) were performed on 33 animals, in order to measure their emotionality . The number of animals per cage does not seem to affect weight gain, feed consumption and carcass weight. During the whole breeding period the animals did not present lesions due to aggression.. The results of open-field test did not show differences among repetitions. The factor analysis shows the presence of three main factors explaining 61% of variance: 1st factor (28% of cum. var. expl.) includes alarm reactions and moving in the environment opposed to latency time; 2nd factor (19% of cum. var. expl.) includes standing still and freezing (very low for all the subjects) opposed to exploration; 3rd factor (15% of cum. var. expl.) includes weigh opposed to grooming. The distribution of rabbits along the three factors does not seem to be influenced by the number of rabbits per cage. The majority of rabbits reacts to the new environment exploring; however the low number of lines crossed and the high latency to enter(mean = 42.42 sec) seem to indicate a rather high level of emotionality. The number of rabbit per cage at the same density seems do not affect the welfare of rabbit in the fattening period probably due to the short time they spent in cage.

Instability of dominance relationships in farmed red deer

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Low social status depresses reproductive success of wild red deer (*Cervus elaphus*) hinds, but does not in a captive population. We speculate that dominance status may not be enforced in the long term when animals are re-grouped for management purposes. Dominance relationships of wild hinds are very stable over time, and strongly correlated with age (Thouless and Guinness 1986, Anim. Behav. 34: 1166-1171). We show that this is not the case in a farm environment.

We observed agonistic interactions of hinds subjected to re-grouping every few months. Hinds were observed on seven occasions over three years (samples 1-7, N = 26, 30, 66, 55, 40, 66 and 40). The following numbers of hinds were carried forward from sample 1 to sample 2, sample 2 to sample 3 etc.: 8, 30, 55, 21, 23 and 15 respectively. Dominance hierarchies were constructed in accordance with previous red deer studies (Clutton-Brock et al. 1979, Anim. Behav. 27: 211-225). Yearlings were invariably subordinate, but hinds aged between two and eight years were distributed randomly throughout the hierarchies ($p > 0.1$). Social status was not correlated with weight, body condition score, or factors associated with investment in a calf (birth weight, weaning weight minus birth weight, and calf sex).

Changes in social status (from high- to low-ranking or vice versa) of the hinds carried forward between samples were tested: five out of the six comparisons showed significant proportions of animals changing status (minimum 12.5%; maximum 52.4%).

Instability of dominance relationships has mixed implications for the production and welfare of farmed deer. Re-organization of groups may be stressful in the short term as status has to be re-asserted after every mix. But animals at this site do not remain at extremes of the hierarchy for long, so hinds are unlikely to suffer long-term consequences of low social status.

Influence of testing time and food type of neighbours on behavioural reactivity of tethered heifers toward a novel food

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Influence of time of testing and food type of neighbours on behavioural reactivity of tethered heifers towards novel food in a 30 minutes test was investigated using a 3 x 2 factorial design with four replicates of six tethered Friesian heifers. Regularly, the heifers were fed once daily (10:30 hours) with a mixed ration and straw as roughage (ad lib.). The novel food was 4.5 kg of carrots. Two times of testing were applied: either at regular feeding time (REG) or after 30 minutes with access to familiar food (30MIN). Neighbouring heifers had access either to novel food (NF), familiar food (FF) or no food (0F). Duration and frequency of eating and sniffing as well as the number of comfort behaviour were registered using video analysis. Furthermore, frequency and duration of disturbance from neighbours was registered.

Time of testing affected the behavioural reactivity of the heifers towards novel food; REG-heifers spent 156±18 seconds sniffing at the novel food, whereas 30MIN-heifers only sniffed in 76±24 seconds ($F_{1,14}$=6.71, p<0.05). Furthermore, the REG-heifers tended to have a higher frequency of sniffing (12.2±1.1 vs. 9.0±1.4; $F_{1,13}$=3.21, p<0.1) and to perform a higher number of comfort behaviour (15.2±1.7 vs. 10.5 ± 1.8; $F_{1,16}$=3.53, p<0.1) than the 30MIN-heifers. Only the frequency of eating was affected by the food type of the neighbours; both 0F-heifers (7.9±1.0) and NF (10.3±1.5) ate more times than FF (4.2±1.0) ($F_{2,13}$=6.52, p<0.05). FF-neighbours spent less time disturbing than 0F-neighbours did (99±19 sec vs. 275±30 sec) (p<0.01).

The results suggest that testing at regular feeding time led to higher behavioural reactivity towards novel food than testing after 30 minutes with access to the familiar food. Although feeding neighbouring heifers with their regular food led to less disturbance, the food type of the neighbours did not seem to be of major importance for the behavioural reactivity of tethered heifers.

How group heterogeneity affects cattle feeding behaviour

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In a loose housing system, cows having high nutritional requirements might be penalised when mixed having cows with low requirements. This was checked by comparing 2 groups made of cows at different physiological states (3 barren and 3 lactating) to groups made of either 3 barren (2 groups) or 3 lactating cows (2 groups). It was assumed that group size has no effect (Hinhede *et al.*, 1995 Anim. Sci. 46: 46-53). Animals were given hay *ad libitum* during 8 weeks. The feeding behaviour was recorded for 5 days.

Lactating cows ate more than barren cows (2.21 *vs.* 1.88 kg dry matter/day/100 kg body weight, P<0.05), spent more time eating (5h42 *vs.* 4h49, P<0.001) and ate slower (45 *vs.* 52 g dry matter/min, P<0.01). No differences between groups made of cows of similar *vs.* different physiological states were observed in food intake, time spent eating and eating rate. Short meals (<60 min) were more frequent in mixed groups (+35% for lactating cows, +12% for barren cows). The time lactating cows spent eating from midnight to 10:00 was significantly greater when they were with barren cows (2h *vs.* 1h30). The synchronisation of eating activity (number of cows eating at the same time) differed according to physiological states but not according to the composition of groups: 1.63 vs. 1.82 (P<0.001) and. 1.70 vs. 1.81 (P<0.01), respectively for barren vs. lactating cows in homogeneous and mixed groups (average for the 3 cows of each physiological state). Whatever the situation, about half the cows of the group ate at the same time.

It is concluded that mixing lactating and barren cows does not influence the intake level but alters the timing of feeding : short meals are more frequent in mixed batches and lactating cows, with higher nutritional requirements, eat more at night. However, these results are to be taken with caution since the size of groups varied with their composition.

Enriched living environment or wounds did not affect the anxiety of NIH/S mice

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Environmental enrichment has been thought to be an important factor for welfare of laboratory animals. In this study, the possible effects of different enriched environments and fighting in a group on the anxiety of male laboratory mice were studied. Male NIH/S mice were housed from the age of 5 weeks in groups of 4 animals in four different cage environments: control groups with bedding only (n=16), the others with bedding and aspen wood wool as nesting material (n=12), aspen wood wool + plastic box (n=16), aspen wood wool + plastic bottle (n=12). The aggressiveness was determined by the occurrence of wounds in animals; if one or more animals in cage were wounded, the group was said to be aggressive. At the age of 12 weeks, animals were tested for anxiety in 5 min elevated plus maze test. The latencies, entries and total time were recorded separately for open and closed arms as well as for central area. Moreover, risk assessment behaviour, rearing and grooming were monitored. The living environment did affect aggressiveness: wounded animals were found in all cages with aspen wood wool only as enrichment. In the other environments, wounded mice were found only occasionally. Although living environment or aggressiveness in a group caused minor differences in some separate behaviours, they did not affect the general behaviour of animals in the elevated plus maze. The behaviour of wounded animals did neither differ from that of non-wounded ones. In conclusion, the enriched environments tested or agonistic behaviour in group did not affect the anxiety of NIH/S male mice.

Social and resting behaviour of heifers after single or group introduction to the dairy herd

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Introducing heifers to an established herd may subject them to considerable social strain. The question was posed whether it is advantageous to introduce heifers in groups which may provide mutual social support. Twenty three heifers were moved consecutively either as single animals (n=8) or as groups of 3 (n=5) into a herd of 32 dairy cows and removed again after one week. All animals were dehorned. Continuous focal animal sampling on introduced heifers was carried out from video tapes for 12 h after introduction (d1) and three days later (d4) to measure social interactions, lying and rest. In groups, data from 2 observed animals each were pooled.

Social interactions with herd members generally decreased from day 1 to 4 (Wilcoxon Matched Sample, n=13, $p<0.002$). Interactions included olfactory control, few licking, butts and displacements by butts or approach. The number of social interactions/hour varied between 6.2 - 25.3 (d1) and 1.6 - 9.7 (d4). Single heifers had more interactions than group heifers (Mann-Whitney, medians; d1: 16.6 vs. 11.6, $p<0.008$; d4: 6.2 vs. 3.2, $p<0.02$). With regard to interactions involving displacements, singles and groups only tended to differ on day 1 (6.8 vs. 4.4, $p=0.11$) but not on day 4 (1.2 vs. 1.4). There was no significant difference between singles and groups in lying times. During the first 12 h of day 1, heifers were lying for only 114 minutes (median, range: 205-21), indicating a considerable disturbance. On day 4 lying time significantly increased (n=13, $p<0.002$) to 325 minutes (median, range 399-66).

In view of the high individual variation, more animals should be investigated and more parameters included before definite conclusions can be drawn. However, from these data it appears that already on day 4, heifers were not under serious social strain anymore. The lower number of interactions with unfamiliar herd members of group-heifers leads to suggest that they formed subgroups within the herd. This did, however, not significantly alleviate introduction in terms of agonistic interactions and resting behaviour.

Behavioural and physiological reactions of male pigs to an intruder

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The present study investigated the effect on behaviour, heart rate and release of neuropeptide Y, noradrenaline, adrenaline, cortisol and renin in male pigs after the confrontation with one, two or four alien male pigs in the home pen. A total of 24 pigs of Yorkshire x Swedish Landrace or Danish Landrace selected as the most dominant in their litter were housed individually. Either one, two or four alien pigs were released in the dominant pigs home pen during 2-7 minutes. Blood was collected through the Port-A-Cath catheter at 5, 30 and 60 min. and at 24h. (base level) after the confrontations. Heart rate and blood pressure (MAP) was constantly recorded by an internal sender (Data Sciences international, USA).

In 65% of the confrontations the resident pig took the initiative to start a fight. In 8% of the confrontations the resident pig won the fight, whereas 42% of the fights ended without any clear dominance-subordinate relationship. The mean length of the fight was 54.4 s (± 9 SEM, MIN 3 s, MAX 144 s). In 3 of the confrontations no severe fight occured, but pigs sniffed and pushed on each other. There were significant increases from the base level to 5 min. after the fight in the blood plasma level of neuropeptide Y ($p<0.01$), noradrenaline ($p<0.01$) and cortisol ($p<0.01$), and also after 30 min. in neuropeptide Y ($p<0.01$). There were significant positive correlations between length of the fight and noradrenaline 5 min. after ($p<0.05$) and neuropeptide Y 30 min. after ($p<0.05$) the fight. There was a tendency of a correlation between length of the fight and renin and cortisol 30 min. after ($p<0.01$) the fight. Heart rate and blood pressure increased at the start of the fight whereafter it gradually decreased to the value previous to the fight. It is concluded that there is both an agonistic respons and a physiological reaction due to fighting in male pigs when being confronted with intruders in their home pen.

Home-ranges and social structure in a group of brown bears in a large bear enclosure

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In nature all bear species are mainly solitary, but sometimes bears will tolerate each other in places where food sources are abundant. In such situations, a social structure is formed quickly to avoid repetitive aggressive encounters and to use the food resources efficiently. In captivity, solitary animals are forced to live with conspecifics. In a 2 ha « Bear forest », thirteen European brown bears of different ages and sex live together. Three bears are blind due to mistreatment earlier in life. Three age classes are distinguished: young (0-4 years, n=4), adult (5-10 years, n=4) and old (>10 years of age, n=5). To determine the home-ranges of the bears, their locations were scored frequently between August'96 and June'97. A 100% home-range was the area where the animal spent all of its time; a 50% home-range was the area where it spent most of its time. The young bears used all available space of the enclosure, while the adult and old bears did not. The 100% as well as the 50% home-ranges of the young bears were significantly larger ($p<0.001$) than those of the adult and old bears. During May 1997, encounters between bears were provoked by feeding at one particular place in the forest, instead of scattered around. 419 encounters were observed, a dominance-subordinate matrix was made and a hierarchy was formed by calculating the Dominance Value of each animal (DOM encounters/ total (DOM+SUB) encounters). A hierarchy was found with the old males in the highest ranks. The blind bears occupied a special position within this social structure, ending up with a lower rank than expected on their age and sex. The brown bears in the bear forest have developed a social hierarchy, based upon age and sex, which is highly comparable to that in the wild under favourable food conditions.

The importance of pecking and food consumed in an experiment studying social facilitation of feeding in laying hens

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Different hypotheses of the function of social facilitation include local resource competition, learning about new food and increasing group synchronisation. To distinguish among these hypotheses detailed information about the proximate causal factors involved is required. In this first of a series of experiments we focussed on local resource competition and whether the food consumed by the stimulus bird affected the behaviour of the test bird. If social facilitation of feeding is caused by competition for food, a correlation would be expected between the food consumed by the stimulus hen and the test hen. Six stimulus hens and 12 test hens were used. The test hen was placed in an experimental cage and given food to ensure that it was not unduly hungry. After 15 minutes the stimulus hen was placed into the other section of the cage for a 15 minutes test period. The feeding behaviour of the stimulus hen was altered by changing the food deprivation time. A standing hen (the stimulus hen when not deprived) and an empty cage were used as controls. The amount of food eaten was recorded by weighing the food troughs before and after each test. As expected, stimulus hens ate more when deprived for longer time; 7.1+1.3 g, 17.5+3.0 g, 20.1+1.8 g and 24.4+3.9 g when deprived for 1,6,12 and 24 hours respectively ($F=35.0$, $R2=0.56$, $df=29$, $p<0.001$). The food intake of the stimulus hen did not influence the food intake of the test hens ($F= 0.86$, $R2=0.015$, $df=59$, $p=0.36$). The test hens ate on average 3.9+0.3 g of food in the 15 minutes test. Because there is no correlation between the food consumed by the test hen and the stimulus hen there is no evidence to support the hypothesis that social facilitation of feeding is caused by competition for food.

Do hens in large flocks form subgroups ?

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There are some indications of subgroup formation when domestic fowl are forced to live together in large flocks. However, according to other studies (Appleby et al, 1989, Brit. Poult. Sci. 30, 545-553) the birds move around more freely. In this study experiments were carried out to test the hypothesis that hens form subgroups and that this formation is influenced by males. In a tiered aviary system (density averaged 16 hens / m^2) eight groups of 500 brown laying hybrids were kept in pens. Half of the groups contained 1 male per 25 females. At peak production four birds roosting closely together and four birds roosting far apart from each other were taken out (repeated with new birds) and put together in groups. Their agonistic behaviour was studied during two days before they were put back. At 70 weeks three groups of 10 females per pen roosting closely together were dyed with different colours and their locations observed for two days and nights.

Independent of sex composition, the incidence of aggressive behaviour in small groups that had been roosting closely together was lower ($P<0.001$) than in groups that had roosted far apart from each other. Groups from the ends of the pens had a stronger tendency to stay within these areas during daytime and to come back to the same roosting sites at night, than groups from the middle of the pen ($P<0.05$). These results indicate that laying hens in large groups actually form subgroups. However a necessary prerequisite might be an environment that allows correct localization.

Usefulness of a porcine pheromone analogue in the reduction of aggression between weanlings on penning; study of ear bites

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We have recently patented a porcine pheromone analogue designed to reduce stress in pigs. Post weaning is a critical period in terms of social stress and unacquainted piglets are mixed together during this period resulting in dramatic fights which are detrimental to farm profitability.

The aim of this study was to assess the efficacy of the pheromone analogue in this context of acute stress. In order to quantify the consequences of this stress the number of skin lesions on the ears of weaners was recorded. 69 piglets weaned at 21-24 days in a commercial piggery were included in the study. To abide by the breeder's husbandry practice, piglets were divided into three groups : one pen of 23 middle-weight piglets which received the test treatment and two pens of 23 heavy and light weight piglets respectively which received the placebo. The combined mean initial weight of the two control groups did not differ from the weight of the treatment group. Skin lesions were counted on both surfaces of each ear before mixing, 5 hours later and 72 hours later. The selected parameter was the number of skin lesions at the time of assessment minus the number of wounds before mixing. Thus we could counter the effect of initial variability. Treatment was applied in the pens just before regroupment, and so on until day 4.

Five hours after mixing, we recorded a mean of 30.9+/-25.1 new scratches in the control group vs. 5.0+/-6.9 in the treated group ($p<0.0001$, U test). Seventy-two hours after mixing, there were 35.8+/-23.6 and 12.4+/-18.0 skin lesions respectively ($p<0.0001$, U test).

In conclusion, the pheromone analogue appears to reduce the number of ear wounds occurring in groups of post-weaning piglets when compared to controls in the first 3 days after mixing.

Influence of breed on cattle reactions during social isolation

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In the extensive systems of animal husbandry, individually handling animals is one of the most important stress factors. The social reactivity that is known to be partly influenced by genetic background, could partly explain why, in beef cattle kept in the Pyrenees, Pirenaica animals are more difficult to handle than Parda Alpina animals. The present experiment aims at elucidating the existence of genetic differences in response to isolation from the herd in these cattle breeds. An isolation test was performed in both breeds at three different ages: 2-3 months (n=2x10), 10-12 months (n=2x10) and 2-9 years (n=2x10). The isolation test consists first of introducing one animal in a restraint box without loosing contact with conspecifics and of keeping it in these conditions during 5 min. Then, the herd is removed while the subject is still restrained during 10 min more. Before and after the test, blood samples were taken by venipuncture for assaying cortisol. During the 15 minutes of the test, heart rate is recorded (II derivation of the electrocardiogram). Behavioural observations (vocalisations and body movements) are recorded continuously with a computer using an event-recording software program for observational research. Animals were trained to test conditions except the isolation during the four previous days and initial measurements were taken in the fourth day.

Social isolation induces a significant increase in cortisol and heart rate in the all animals. Significant breed differences are reported in heifers: Pirenaica heifers are characterised by the highest values (Cortisol: 17.3±9.4 *vs.* 7.9±2.1 ng/ml, $p<0.01$; Heart rate: 130±39 *vs.* 95±15 bpm, $p<0.05$). In response to social isolation, all animals vocalise more than they did in presence of the group, but Pirenaica animals vocalise more than Parda Alpina (29±22 *vs.* 11±16, $p<0.05$). It is concluded that social isolation, as main stress factor in cattle, has different consequences according to breed.

Social learning in hens is influenced by the demonstrator-observer relationship

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Social learning can affect the spread of information and new behaviour within groups of animals. If some animals are more influential or salient demonstrators than others then transmission of information or behaviour will be unevenly distributed. In a previous experiment we suggested that dominant hens were more influential demonstrators than subordinate hens (Nicol & Pope 1994, Anim. Behav. 47, 1289- 1296). In this study we extended the social categories of birds used as demonstrators. Demonstrators were selected from 20 separate flocks as the most dominant hen, the most subordinate hen, a mid-ranking hen, or a cockerel. Demonstrators were pre-trained to perform the keypeck response to obtain a food reward. Six observers from each flock individually watched the demonstrator perform the task for four 5-minute sessions held on consecutive days. On the fifth day observers were tested individually in the operant chamber. There were no quantitative differences in demonstrator performance but demonstrator category had a significant effect on subsequent observer behaviour. Hens that had observed cockerels performed very few general pecks or operant pecks. Hens that had observed dominant demonstrators performed more operant pecks but hens that had observed subordinate demonstrators performed more general pecks in the chamber. One explanation is that more precise learning is required to exploit the same food resource as a socially dominant conspecific. However, inconsistencies between replicates suggested that the effects may be due some other factor imperfectly associated with social dominance. We therefore examined the possibility that the differences in foraging ability might affect demonstrator salience. In a second experiment using the same protocol we manipulated the foraging success of dominant hens from 4 additional flocks, but this had no significant effect on their subsequent influence as demonstrators.

Great Pyrenean dogs to protect sheep herds from predators such as stray dogs or wild animals

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In France, each year, stray dogs and wild animals kill or injure about 100 000 sheep. To face this, breeders could resort to an ancestral practice of entrusting dogs with guarding and protecting the sheep herds. To study this practice, we first observed the breeders' know-how. This know-how has subsequently been validated during 4 years on 100 puppies placed in herds which had yet been attacked. The dog's behaviour was regularly observed during 16 months.

The dog's efficiency was established when it fulfilled 3 conditions :

- to be bonded with the herd and friendly towards it (The dog stays constantly with the herd and does not disturb the animals),
- not to be aggressive towards humans (Few reactions in front of unknown people),
- to protect the herd from predators (Strong reactions when other dogs or wild animals approach the herd, Fewer attacks after the arrival of the dog compared to before).

Above all, to be effective, a dog must be born of efficient protecting dogs. In France, most of the dogs used are Great Pyrenean. The results of the study show that an early imprinting of the puppy (at 2 months of age) to the sheep makes that it gives all its affection to the herd. This treatment causes the adult dog to stay permanently in the herd and to protect it from predators. To achieve this, the breeder must educate its dog to be obedient and prevent it from disturbing the sheep or leaving the herd. In the herds in which the puppy has been introduced according to the recommendations, the predation due to stray dogs has been stopped or considerably limited. In 1998, 250 protecting dogs work.

Free-ranging Corsican pigs: use of space, feeding and social behaviour, and meat quality aspects

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On Corsica, pigs are bred and reared in groups in semi-natural mountainous environments. They receive minimal food supplementation, thus depending mainly on natural food sources. Between November and January pigs are finished with chestnuts and glands and slaughtered, carcasses are transformed into meat products in a traditional way by the farmers. A group of about 50 individually identifiable pigs (boars, sows and piglets), has been studied over a one-year-period. Pigs were kept on a mainly uncultivated 12 ha area comprising open and half-open grassland, maquis (dense Corsican bushes) and a small river. Around feeding (total of 30 kg concentrate daily at 9:00 h), stable dominance relationships were observed. During feeding and resting pigs showed persistent preferences to be physically close to specific group members. After feeding, similar-aged animals left the feeding spot in small, stable groups. Independently of season, pigs spent 20% of daytime in open land and 10% in maquis. In spring and summer, pigs spent 70 and 55% of their daytime in half-open grassland, respectively. Both piglets and adults were active during 65% of their daytime, they spent 30 and 20% of their daytime rooting and ingesting grass, 10 and 5% exploring, and 8 and 4% in locomotion, respectively. During summer, animals became active earlier, and remained active until after sunset, but rested more during the afternoon. Stapling reduced significantly the amount of time spent surface, half-deep and deep rooting. Pigs used specific sites for resting (maquis), exploring and feeding (grassland). Faeces contained 40% of plant fibres, 10% of plant seeds, 8% of pebblestones and 6 % of sand as well as remains of animal hair, earth worms and snail shells. Analysis of faecal cuticular fragments found 45% monocotyledons and 20% dicotyledons. At slaughter, cortisol levels obtained at bleeding after percussion stunning were positively correlated with carcass weight and meat colour.

Reaction to separation in mares and foals

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This study assessed the reaction to separation in 20 pairs of mares and foals from 19 farms. All mares and foals were tested in their home environment by two persons. One person entered the box and led the foal outside, then stood by the foal with one hand on its chest and one hand on its withers. Behaviour of both the mare and foal was registered for 110 sec by scan sampling every 10 sec. The behaviour patterns sampled for the mares were: standing, orientation towards foal, eating, biting/licking fixtures, pawing, walking. All occurrences of kicking, urination, defecation, whinnying, nicking and snorting were recorded. For the foal the behaviours sampled were: standing still, staying in one place but moving the legs, trying to get away and all occurrences of whinnying. Additionally, each mare and foal was given a score for degree of reaction (1=quiet, 2=tense, 3=very tense). The behaviour patterns were tested by a Kruskal-Wallis Test for the explanatory variables age of foal in days(<79, 80-89, >90) age of mare in years (<5, 6-12, >13) and parity of mare (1, 2-4, >5). There were no effect of age of mare on any of the behaviours measured. Foals <79 days moved less than older foals (X^2=6.66, DF=2, P<0.05). More of the youngest foals were scored as quiet (X^2=6.11, DF=2, P<0.05). First parity mares stood still less (X^2=6.36, DF=2, P<0.05) and walked more (X^2=6.21, DF=2, P<0.05) and they tended to have higher temperament scores than mares of later parities (X^2=5.62, DF=2, P=0.06). There were no significant correlations between the behaviour scores of the mares and their foals but there was a significant negative correlation between nicking and foal standing still (Pearson correlation, r=-0.65, P<0.05) and between orientating towards foal and foal standing still (r=-0.48, P<0.05). This indicates that the presence of the mare and her behaviour affected the behaviour of the foal. The results show that age influences behaviour of foals and that parity influences behaviour of mares.

Social and maintenance behaviours of Japanese Black cows having various numbers of associates in a communal pasture

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In a previous study, we observed that cows from the same farm of origin formed affiliative groups in communal pasture. Affiliative behaviours tended to increase, escape behaviour tended to decrease, and the mean durations of grazing and recumbency behaviours tended to increase with the numbers of associates from 0 to 3-5. In this experiment, we investigated the effects of 5 or more associates on social and maintenance behaviours in order to investigate optimal group size in cattle.

One hundred and eighteen cows derived from each farm were turned out into communal pasture at 12 May. Twelve cows, aged 3-8 years, having 1, 2-4 or 16 associates were selected as focal animals at random. Each focal animal was followed and observed for 8 hours from sunrise from 12 to 15 July after completely adapted to a grazing site. Three persons observed 3 focal cows simultaneously in each day. The communal pasture consisted of 10.3 ha artificial pasture and 0.9 ha woodland. The nearest neighbour and distance to nearest neighbour were recorded at 10-minute intervals and maintenance behaviours at 1-minute intervals. Social behaviours and participants were recorded continuously.

Cows from the same farm were more frequently nearest neighbours to focal animals and allogroomed with focal animals longer than cows from other farms (chi-square test: $P<0.001$, $P<0.001$). Time spent allogrooming of cows having 2-4 associates was the longest in the herd. Aggressive behaviours of cows having 16 associates were less than of the other focal animals (Least significant difference method: $P=0.07$). Cows having 2-4 associates escaped less, and grazed more than the other focal animals (Least significant difference method: $P<0.05$). Cows having one associate grazed less continuously than other cows. From present study (better life in 2-4 associates) and previous study (better life in 3-5 associates), it was considered that cows having 2-5 associates were the most psychologically stable.

Individual aggressiveness and group mate's responses of cattle towards human in docility tests

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Farm herbivores are gregarious animals and social group's members often influence each others (Boissy and Le Neindre, 1990, Appl. Anim. Behav. Sci. 25:149-165). The presence of a fearful animal in a group can affect the reaction of the others when put together but also maybe during individual tests. Thus an individual's score of docility (Le Neindre et al,1995, J. Anim. Sci. 73, 2249-2253) may not only reflect individual characteristics, but also the influence of the composition of social group which will vary according to the individual reactivity of its members. If this hypothesis is validated, individual data obtained with the docility test procedure can not be considered independent and individual selection based on a docility test would not be valuable. However, such a hypothesis has not yet been explored.

Ten-month old calves (n=1024) from the Limousine beef breed were gathered in 228 groups of 8 in free-stables for 1.5 months after weaning. Individual docility tests were then performed once on each calf and docility scores were computed. In addition, aggressiveness of the animals towards humans (threat and attack) were noticed. Mean docility scores per group (excluding the aggressive animals) were very similar ($t_{226} = 0.28$, $P>0.5$) in groups with one aggressive animal (n = 24 groups) or two (n = 2 groups) towards humans (docility score = 13.24 ± 0.19) and in groups where no aggressiveness was recorded (n = 202, docility score = 13.29 ± 0.07). Under the conditions of this experiment, the hypothesis of an influence of aggressive animals on the other's docility was not validated.

Behavioural and cortisol responses of red deer (*Cervus elaphus*) after open-field tests

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The aim of this study is to evaluate the influence of a five-minute open-field test on the welfare of a group of red deer hinds (*Cervus elaphus*) using subsequent behaviour and cortisol increase as stress indicators. This test was chosen because it includes some potential stressor agents (visual isolation, restraint and unfamiliar surrounding).

Six hinds, 3 to 6 years old, were submitted individually for six consecutive days to an open-field test in a new pen of 3.5 x 4.5 m divided into 9 equal parts. After the tests the behaviour of the group was recorded for two hours using video cameras. Blood samples were taken before and 10 minutes after the end of the open-field test. Plasma cortisol values were determined using a ImmuChemTMCORTISOL-CT125 RIA Kit, ICN Pharmaceuticals.

The animals spent more time "standing" ($F(1, 28) = 9.51$; $P<0.01$) and "nose-licked" ($F(1, 28) = 9.19$; $P<0.01$) and "self-licked" ($F(1, 28) = 15.21$; $P<0.001$) after the test than on a normal day. There were no significant differences for the other activity patterns (frequency or time spent lying, ruminating, eating or displaying aggressive patterns). However the mean of these patterns show that when the animals underwent the test they spent less time in normal activity and more time in patterns that could be interpreted as symptoms of nervousness or agitation. A t-Student test showed statistically significant differences ($T(10) = -3.367$, $P<0.01$) between the mean cortisol value at time zero (36.12 nM/l) and 10 minutes after open-field (93.80 nM/l).

These results seem to indicate that the capture, restrain, visual isolation and unfamiliar surroundings that this test involves disturb the normal activity of intensively housed red deer hinds and produce a stress reaction that could lower their welfare.

A method for assessing the temperament in dairy sheep

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The aim of this study was to investigate the individual behaviour in dairy ewes during machine milking in a milking parlour and to check the distribution of behavioural types (temperament).

The temperament of individual dairy ewes being milked in a milking parlour « Alfa Laval Ltd ». 2X24 was evaluated by a method reflecting factors influencing the individual behaviour. Temperament assessment was carried out over several years by means of observer's evaluation. Four adjectives had been selected as summarising six adjectives used to describe sheep temperament in a milking parlour during a pilot study, taking position into the milking parlour, feed reaction, activity toward neighbours, feed reaction toward forage offered by hand, reaction toward positioning the teatcups, persistency of taking place into the milking parlour.

Each of the four adjectives described four degrees of a behavioural trait: 1) Activity toward neighbours: superactivity toward neighbours, activity with looking round, changeable passiveness, passiveness 2) Feed reaction toward forage offered by hand (of a stranger): feeding with relish, cautiously feeding, rarely feeding, no feeding 3) Reaction toward positioning of teatcups: placid, anxious only toward positioning of teatcups, anxious during whole milking or kicking without getting down teatcups, violently kicking and getting down teatcups. 4) Taking position into the milking parlour : voluntarity and persistency, voluntarity and no persistency, no voluntarity and persistency, no voluntarity and no persistency. Scores from 4 to 1 were given to the animals with 4 for the most favourable reaction to 1 the most unfavourable. On the base of the scores of each reaction an individual complex score (CS) was formed. Six consecutive observations during morning machine milking were carried out. One month later the same procedure, using another observer was repeated. In this way the temperament of 731 dairy ewes within two years period was studied. A factor analysis for the behavioural trait adjectives produced four factors.

Three behavioural types – strong, intermediate and weak, distinguishing significantly ($P<0.001$) in the behavioural trait adjectives were established. High coefficients of repeatability of the trait adjectives and CS in two consecutive years and by different observers in ewes of different ages were determined (r from 0.5 to 0.97, $P< 0.001$).

Anticipatory behavior as a positive indicator for well-being in rats

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In most studies concerning animal well-being the type of indicators used for assessing well-being are so called negative indicators. Examples of these negative indicators are stress-levels, pathology, immuno-suppression, etc. These indicators all measure the lack of well-being in an animal. It is, however, also possible to use measures that indicate the presence of well-being in animals. In the present study we tried to assess whether anticipatory (or preparatory) behavior (hyperactivity) could be used as a positive indicator for well-being in rats and if rats showed any of this behavior in relation to environmental enrichment. For this purpose we used a classic conditioning model in which rats (5 groups of 12 Wistar males) received a conditioned stimulus (a bell) before a 10 minute observation period in which behavior was observed. After the observation period the animals received one of five possible unconditioned stimuli (30 minutes): 1) transfer to an enriched cage; 2) contact with receptive females; 3) transfer to a new empty cage; 4) transfer to a meshwire cage in bright light (mild stressor) or 5) animals remained in home-cage as a blank control. All animals were trained each day for five weeks and behavior was observed every fifth day. Results indicate that rats did show anticipatory behavior prior to enrichment and sexual contact but in lesser extent to the bare cage, the wire cage or the blank control. The behavior is inhibited by administration an opioid antagonist 30 minutes before the unconditioned stimulus. We conclude that both sexual contact and enrichment are positive experiences for rats as they show in both cases large amounts of anticipatory behavior typical for rewards. Furthermore, the administered antagonist counteracts the effect of the unconditioned stimulus, which indicates the involvement of the opioid system. Overall conclusion is that so called anticipatory behavior can be used as a positive indicator for well-being in rats.

Reactions of Llamas Towards Novel Objects

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There is an increasing interest in keeping domesticated South American camelids as pet animals in Europe. The present study was designed to evaluate reactions towards novel objects in llamas bred in Europe to avoid fear-eliciting stimuli, thus improving the human-animal relationship.

During 10 weeks five novel objects were introduced in 4 repetitions in a random order in a family group of 7 adult and 3 juvenile llamas. Only one object was presented per day for one hour on the same place of the pasture (1.3 ha). Direct observations were made by time sampling method (every 10 min) one hour before (control) and one hour during object presentation. The following static objects differing in novelty were used: (1) tape-recorder playing music, (2) tape-recorder playing human voices, (3) sheep model with natural skin, (4) human model (window-dummy), (5) triangular trestle (1 m height, 0.6 m length) covered with textile. Basic activity (standing, walking, running, lying), defecation and distance from the novel object were recorded. For the estimation of distances the pasture was divided into squares.

When the objects were introduced no flight occurred, but more defecation (28.6% of all occurrences) was recorded in the first 10 min after object presentation. There were no consistent changes in frequencies of basic activity due to the object presentation (sign-test, control vs. presentation). However, distribution of animals across the pasture was influenced. Overall percentage of animals observed within closest squares decreased after the introduction of the object for the objects 1, 3, 4 and 5 (control vs. presentation, respectively: 17.1 vs. 3.3%, 14.8 vs. 7.1%, 22.5 vs. 14.2% and 13.3 vs. 1.7%) while it increased with the object 2 (control vs. presentation: 7.1 vs. 15.0%). When based on individual movement within closest squares, however, differences were only significant for the presentation of music and the trestle (respectively, $p < 0.016$; $p < 0.032$; McNemar test).

Among the stimuli presented, the most unusual ones (music and trestle) caused more pronounced avoidance. It is of interest that the human voice was the only stimulus to induce some approaching behaviour, while the optic cue of a silent human model was not similarly attractive, probably because the animals had learnt to combine human voices with food reward.

Individual differences in the behaviour of horses : the effects of genetic and environmental factors

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Our study, based upon experimental tests, shows how different factors are imbricated in the determinism of temperamental traits of horses (emotivity, learning abilities). A total of 698 horses of various ages and sexes and from 16 different breeds was tested. Multivariate statistical analyses (PCA) show that some breeds are close in their behavioural reactions like Camargue, Fjord and Merens or Spanish horses and Appaloosas. In general show horses exhibited higher levels of emotivity than horses that are used for out riding, western riding or harness. An analysis of variance (with SAS) shows that 7 factors have a significant effect on the horses' reactions to the tests , whereas 2 (age and sex) did not appear as such. Three factors have the most influence : the sire ($p = 0.0004$), the place (as an overall way of life : $p = 0.0001$) and the breed ($p = 0.028$). However the different factors seem to influence differentially the horses characteristics. Genetic factors (breed and sire) were involved in all tests but played a major role on the reactions to new objects The type of work and the place influenced the reactions to social separation and the learning abilities. To a lesser degree, other environmental factors like housing, type of food and number of riders are all involved in the observed individual differences in behaviour.

The coefficients of heritability indicate that the horses behavioural individual characteristics have a genetic basis, especially in the fear reactions. In overall, this study shows how environmental factors modulate intrinsic individual characteristics.

Regulatory influences of domestic behaviour on productivity in sheep

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The associations between activation of the hypothalamic-pituitary-adrenal system (HPAS) and domestication-related (domestic) behaviour and productivity of sheep were examined in an experiment involving 95, 43 and 255 sheep of the meat-and-wool, the Altaian merino and milk Avassi breeds, respectively.

Using a test situation with free access of animals to food in a new environment, differences in the latency of the 10 different phenotypes (22 groups) to approach food varying from 71.3 to 3.9 s, were detected. Differences in the food ingestion speed, varying from 1.6 to 2.3 g/(min x kg of live weight), were also found. The corticosteroid concentrations in blood under the stress of zootechnical examination, and the latency to approach food, respectively, were inversely associated with live weight ($r=-0.58$, $n=22$ and -0.45, $n=22$) and wool yield ($r=-0.63$, $n=22$ and -0.30, $n=22$), whereas food ingestion speed was positively associated with live weight at birth ($r=0.48$, $n=22$), wool yield ($r=0.24$, $n=22$) and wool yield:live weight ratio ($r=0.60$, $n=22$). An age-dependent change in the domestic behaviour, which brings about a transition from the "wild" phenotype, with pronounced defensive reactions, into contrasting adaptive "domesticated" phenotype, leads to an enhancement of the regulatory role of feeding reactions and a decrease of negative influences of defence reactions on productivity. Thus, the behavioural changes in the "wild" sheep coincides with a decrease of HPAS reactivity to the stress of isolation from herd and with an increase in the live weight and wool yield. Moreover, the age-dependent new formation of a class of "domesticated" phenotypes in Avassi sheep, which was absent at the age of 18 months, brings about a correlated variability of domestic behaviour and milk yield in the sheep at the second ($r=0.38$, $P<0.01$) and the third ($r=0.26$, $P<0.05$) lactations which was absent at the first lactation.

It is concluded that domestic behaviour affected the growth and development through associated physiological responses and behavioural polymorphism contribute to the variation in production parameters in sheep of different breeds.

Behaviour and reproductive traits in cocks

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Reproductive success is generally related both to physical and to behavioural traits: the evaluation of the relationships between these factors can help in understanding the adaptive capabilities of intensively reared animals.

To this aim the present research has been carried out on 20 cocks (*Gallus gallus*), caged and used for semen collection. The following variables were recorded in two replications (40 and 41 weeks of age): a) reproductive traits: semen quality (motility; linear forward progression; number of spermatozoa per ejaculate; b) testosterone levels; c) reaction to behavioural tests (tonic immobility; open field). Principal Component Analysis of the open field test (expl. cumul. var.=52%) showed three main components: 1) activity vs. inactivity (26% expl. var.); 2) displacement activities and flying attempts (15% expl. var.) and 3) vocalizations vs. latency to move (11% expl. var.). Freezing behaviour levels were very low for all the subjects. Higher activity levels in the open field were negatively related to semen quality, mainly to motility (rho = -0.53, $P < 0.01$ and rho = -0.48, $P < 0.04$ in the two test repetitions) and linear forward progression (rho = -0.49; $P < 0.02$ and rho = -0.41, $P < 0.08$ in the two test repetitions). Tonic immobility times were negatively correlated with testosterone levels (rho = -0.54; $P < 0.03$). These results suggest that different motivations can underlie the activity-inactivity reactions in the two tests: in the open field, the need to avoid detection by possible predators may favour reduced movement. In tonic immobility test the fear level, due to physical restraint and human beings, is higher in animals which have also lower testosterone levels, and this could indicate higher stress levels. In the present study the reactions in the two tests, together with physiological traits, may indicate different adaptive capabilities in cocks with higher or lower reproductive characteristics, in two stimulus situations.

Are cannibalistic laying hens more attracted to blood in a test situation than other hens?

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Cannibalism is an important welfare problem for laying hens, but it is not known why only certain individuals develop this behaviour. Since blood per se might be one factor motivating cannibals to peck at other birds, the aim of this experiment was to investigate if attraction to blood differs between cannibalistic birds and other birds.

Hens of three categories were collected from flocks experiencing problems with cannibalism. The categories were cannibals, victims and healthy birds with normal behaviour as controls. Birds of four strains were collected from five farms. Ages varied between 25-65 weeks. A trio of birds, consisting of one bird of each category, was collected from the same flock on the same day. Comparisons were made between birds within each trio. The 'blood-on-feathers-test' was performed one week after catching, when the victims' injuries were usually completely healed. During the 15 minute test session, two bundles of feathers (same colour as the bird to be tested) were placed in front of the individually caged birds. The bundles were either clean or soaked in chicken blood. All pecks at the feather bundles and latencies until first peck were recorded.

Contrary to our hypothesis, there was no significant difference in pecking between cannibals and other birds. All birds preferred the blood soaked feathers compared to the clean. One explanation may be that in the barren test situation blood is a potent pecking stimuli for all birds, whereas in the more varying farm environment it is only attractive to cannibalistic birds.

	Median number of pecks at blood soaked feathers		clean feathers	**Median latency (sec) to peck at** blood soaked feathers		clean feathers
Controls n=21	49.0	**	2.0	16.4	***	276.0
Cannibals n=21	57.0	***	1.0	29.3	***	767.0
Victims n=20	7.0	**	1.0	18.5	**	576.0

Wilcoxon Signed Rank Test. **=P<0.01, ***=P<0.001

Are there taxonomic differences in abnormal behaviour that relate to species-typical foraging niche?

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Terlouw et al. (1991; Anim. Behav. 46, 939 - 950) proposed that the post-feeding oral stereotypies of pigs contrast with the pre-feeding locomotory stereotypies of carnivores because of differences in these animals' natural foraging techniques. However, these apparent species differences could be merely artefacts of husbandry, e.g. pigs are more physically restricted and food-deprived than carnivores (Mason & Mendl 1997; Appl. Anim. Behav. Sci. 53, 45 - 58). To see if there are genuine species differences that cannot be explained by husbandry, we surveyed all the papers referred to by Mason 1991 (Anim. Behav. 41, 1015 - 1037), all ISAE conference abstracts 1991 - 1997, all volumes of Zoo Biology (1982 -), and all volumes of the International Zoo Yearbook (1959 -). We recorded all cases of cage-induced abnormal behaviour, controlling for feeding level (e.g. excluding food-restricted subjects), restraint, and early experience. 113 mammal species were scored as showing abnormal behaviour in captivity (excluding 8 cases where the behaviour was clearly unrelated to foraging). The sole or most common abnormal behaviour significantly differed between Rodents, Primates, Ungulates and Carnivores ($\chi^2 = .50.31$, df = 6, $p < 0.001$); for example, 81% of the 63 carnivore species favoured locomotory movements, while 72% of the 25 ungulate species preferentially displayed oral activities. For the 29 species recorded as showing a peri-feeding peak, pre-feeding pacing predominated in 15 of the 21 carnivore species, and post-feeding oral movements in 5 of the 5 ungulate species. Post-feeding manipulative stereotypies were also recorded in two primate species. Within the Carnivora, oral stereotypies were most common in the least carnivorous bears and the walrus (a mollusc-grazer), while the felids (obligate predators) showed nothing but pacing. Thus these data reveal real taxonomic predispositions to different forms of abnormal behaviour. We hypothesise that these predispositions relflect foraging niche in the wild.

The effect of diet and exercise on the behaviour of stabled horses

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Reported here are the results of a preliminary trial to investigate the effects of diet and exercise on the behaviour of four stabled horses. Horses were kept for four weeks on each of the four combinations of diet (forage and mixed forage/grain) and exercise (light and strenuous) regimens in a 4x4 Latin Square design. Video observations were made on 3 consecutive days in the second and fourth weeks of each period, during a set handling trial, which consisted of routine grooming tasks and a surcingle mounted heart monitor being fitted. Observations were also carried out on 3 consecutive days in the second week during a four hour period (12 noon to 4pm) when the horses were housed in stalls. Five minute scan sampling of the behaviour of each individual in turn was concentrated on three 30 minutes observation periods constituting the beginning, middle and end of the four hour period. Behaviour was recorded from videotapes using the Observer 3 and analysed using multifactor ANOVA in SPSS for Windows.

During the handling trials the main effect on behaviour was associated with exercise. Horses which had been only lightly exercised exhibited significantly higher frequencies of a number of "unco-operative" behaviour patterns e.g. Head Evasion ($F=71.8$ (1,3) $P<0.01$). During the periods of stall housing, horses receiving the mixed diet exhibited higher frequencies of Head Down ($F=15.7$ (1,3) $P<0.05$) and Rest Leg ($F=10.8$ (1,3) $P<0.05$) during the third period of scan sampling, associated with repeated transfer of weight from one back leg to the other, suggesting a state of restlessness. There was an interaction between diet and exercise for a number of redirected oral behaviour patterns e.g. Lick Object ($F=20.4$ (1,3) $P<0.05$) with highest mean durations being recorded for horses receiving the mixed diet and light exercise. Only one horse Windsucked during the trial, when fed the mixed diet. Frequency and duration of Windsucking were highest when receiving a mixed diet and light exercise.

This small, preliminary trial indicated that both diet and exercise could effect the behaviour of the four horses studied.

Deprivation of dustbathing behaviour in feather pecking and non feather pecking birds: Effect on corticosterone and TI response

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12 Lohman Brown hens were from 48 weeks of age kept individually in wire cages and daily provided with a box of sand for 1 hour. Prior to the experiment, the 12 hens had been kept in groups of 36-40 birds on deep litter, 6 birds were identified as being feather peckers and 6 birds were identified as non feather peckers. During the experiment birds were divided into 2 groups of each 6 birds (3 feather peckers, FP, and 3 non feather peckers, NFP), and the experimental period was divided into 2 consecutive periods, each period lasting 21 days. During period 1, birds in group 1 had daily access to a box of sand for 1 hour whereas birds in group 2 were deprived of sand. During period 2, birds in group 2 had daily access to sand for 1 hour whereas birds in group 1 were deprived access to sand during this period. At the end of period 2, all birds were given access to sand 24 hrs in their home cages. Blood was sampled from all birds by means of heart puncture once before the experiment started, on day 3, 11 and 21 in period 1 and period 2, and on 3 occasions when the birds had 24hrs access to sand. The tonic immobility (TI) response were measured the following day after each blood sample.

The corticosterone level and the TI response did not differ between birds having 1 hour daily access to sand or no access to sand in either period 1 or 2, and the influence of having access to sand for 1 hour did not differ between FP and NFP birds. An analysis with repeated measurements showed that the level of corticosterone did not differ between FP and NFP individuals. In contrast the duration of TI was longer in NFP than in FP birds ($p<0.001$), and more induction periods were needed to induce the state of TI in FP birds ($p<0.05$). In conclusion FP and NFP birds did not react differently to a deprivation of access to dustbathing material, and NFP birds appeared to be more fearful than FP birds.

Ground pecking deprivation and frustration: a comparison of their effects on feather pecking

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Feather pecking is believed to be a redirection of ground pecking, however hens will feather peck even when provided with litter. One mechanism that might cause redirection in the presence of litter may be frustration; where the hen can perceive a suitable pecking substrate but her access is blocked. This study hypothesised that frustration, caused by a transparent Perspex cover preventing access to the litter, would result in a greater redirection of pecking to feathers than total deprivation of litter. Mature ISA Brown hens were housed individually in pens that minimised opportunities to ground peck except in designated litter areas. Thirty hens were randomly allocated to one of five treatments: deprived of litter for one day, deprived of litter for 10 days, frustrated from pecking litter for one day, frustrated from pecking litter for 10 days, or litter present and accessible (control). Behaviour was recorded using focal animal observations. Feather pecking was recorded on the last day of the treatment period when each hen was presented with four securely clamped wing feathers (c.f. Bessei et al. 1997, Proc. 5th Europ. Symp. Poul. Welf., 74-76) for a 10 minute assessment period.

The median percentage time spent pecking these feathers severely was significantly greater for frustrated hens than control hens (respectively 10.3% vs. 0.8 %; $p<0.05$), but there was no significant difference between deprived hens (2.9%) and control hens. Significantly more time was spent in severe feather pecking after 10 days of deprivation or frustration than after one day of deprivation or frustration (respectively 13.6% vs. 2.3%; $p<0.01$). Deprivation and frustration did not affect mild feather pecking. There were few differences in behavioural repertoire when access to litter was deprived or frustrated, and there was a tendency for 'Gakeln' frustration calls to be increased by one day of frustration compared with baseline calls (respectively 1.7% vs. 0.7%; $p=0.077$). This study suggests that if a litter substrate is provided, unhindered access will be essential to reduce the risk of severe feather pecking.

The relationship between stereotypic behaviour and plasma and salivary cortisol levels

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McGreevy and Nicol (1995, Proc. 29th Int. Cong. ISAE, 135-136) found that plasma cortisol levels were significantly higher in crib-biters (n=6) than in normal horses. Subsequent work has indicated that a correlation exists between plasma and salivary cortisol levels in horses (n=4) (Lebelt et al., 1996. Proc. 30th Int. Cong. ISAE. 28-29.).

This study examined mean plasma cortisol levels in horses with oral stereotypies (n=24) or locomotory stereotypies (n=19) to clarify the relationship between stereotypies and stress responses. Each stereotypic horse was matched for sex and age (to within one year) with a normal horse on the same yard, which then acted as a control. Blood and saliva samples were taken from rested horses between 800 and 1130 hours. Cortisol levels were determined by a radioimmunoassay. Mean salivary cortisol levels were determined for 20 oral stereotypers and 16 locomotory stereotypers plus their controls. When a two-tailed t-test was performed, no significant differences were found in plasma cortisol levels between oral stereotypers and their controls (13.49 ng/ml ± 1.39 vs. 13.42 ng/ml ± 1.06) nor between locomotory stereotypers and theirs (11.80 ng/ml ± 1.22 vs. 12.63 ng/ml ± 1.29). Pearson correlation coefficients revealed that a significant relationship exists between the plasma and salivary cortisol levels of oral stereotypers (saliva cortisol: 1.55 ng/ml ± 0.12, r=0.65; P<0.01) but not between the plasma and salivary cortisol levels of their controls (2.62 ng/ml ± 0.68, r=0.07), locomotory stereotypers (3.19 ng/ml ± 0.96, r=-0.11) and their controls (2.23 ng/ml ± 0.54, r=-0.07).

These data contradict earlier work and suggest that the current stress responses of the two groups are similar. No correlation was found between plasma and salivary cortisol levels in three of the four cohorts studied. This indicates that greater caution should be taken when saliva is sampled to determine stress responses in horses.

Rate-dependent effect of fluoxetine on captivity-induced stereotypies in bank voles

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We deem it premature to consider stereotypies and obsessive compulsive disorders as synonymous. There are differences at the behavioural and cognitive levels, and their respective neurobiochemical background should be better investigated. In humans, specific serotonine reuptake inhibitors are used against depression but also against obsessive compulsive disorders. Patients are reported either to improve after several weeks of treatment, or to show no reaction at all. Similar differences have been observed empirically in dogs (Luescher, pers.comm.).

Eight voles with established stereotypies were first injected s.c. once daily with solvent during 6 days, subsequently with 10mg/kg fluoxetine during 1 month. Strong individual differences were observed. Fluoxetine increased the sterotypies' level of the 2 individuals with the lowest stereotypies' pre-drug rates and decreased it in the other animals, which suggests a rate-dependent effect, i.e. that the effect of a drug depends from the frequency of that behaviour. One-way repeated measures ANOVA (6 individual with high stereotypies' level) showed that a significant decrease (F=5.1; p=0.01) occurred during the second and third 10-days periods (day 20 to 30). No significant effect was found on general activity. Rate-depency analysis was performed on all 8 subjects by linear regression and Pearson's correlation between stereotypies' rates during the control period and log percentage of effect of the drug. Both showed a significant negative relation in the 2nd and 3rd drug period (F=10.18, r= -0.79, p=0.02; F=8.02, r= -0.76, p=0.03), the low-stereotypies voles increasing their level, the high-stereotypies voles decreasing it.

Conclusions:

- This rate-dependent effect fits available clinical experience.
- 5-HT is in some way involved with the background of stereotypies in this species.
- Even if it is still too early to consider obsessive compulsive disorders and stereotypies as similar, both may share some common neurobiochemical mechanism.

Effects of three different feeding techniques on oral activities of group housed veal calves at two to eight weeks of age

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An important key to solving problems due to intersucking of pen mates in young group housed veal calves is the feeding system, namely its adaptation to the species-specific behaviour. Three different feeding techniques - electronic automated feeder (A), teat bucket (T) and bucket with floating teat (F) - were investigated, including 3 replicates of 48 male German Holstein veal calves (A: 1 group of 16, T: 2 groups of 8, F: 2 groups of 8), i.e. 144 calves in total. Calves were kept on slatted floor, fed commercial diets and 100 g hay per day each. Additional to ad libitum water supply, a water-filled teat bucket per 8 calves was provided. Oral behaviour in the third, fifth and eighth week of age was observed for 48 h from video recordings with instantaneous scan sampling every 5 minutes, including 1 of each bucket group and the automated feeder group per replication, i.e. 96 calves in total.

Altogether calves spent 21.0 % of observed time on oral activities with 11.8 % on non-nutritive activities, including 2.7 % at water teats. The more frequent meals of the automated feeder reduced non-nutritive activities in general (A: 9.8 %^{a}, T: 12.3 %^{b}, F: 13.0 %^{b}; $p<0.001$). However, frequencies of the most health-relevant activities at prepuce, navel or scrotum were lowest in „floating teat" calves (F: 0.2%^{a}, A: 0.4 %^{b}, T: 1.3 %^{c}; $p<0.05$), possibly caused by a preferred adoption of the learned sucking position with head down in the bucket. Weekly examination of the skin of the 144 calves revealed more frequent reddenings in automated feeder calves (A: 91.7 %^{a}, T: 72.9 %^{b}, F: 56.3 %^{b}, $p<0.05$). Thus, intersucking around the feeder (in 82.5 % of cases) was more harmful, although no skin lesions or navel inflammations were caused. Improvement of the feeder, e.g. better protection of feeding animals, is needed to realise its potential advantages.

Overall disease incidences and weight gains were similar to results from other studies on single housed young veal calves, suggesting that it can be feasible to keep veal calves older than two weeks in groups.

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Feeding motivation and stereotypies in pregnant sows fed increasing levels of fibre and/or food

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Twenty-one multiparous sows were used in a latin square design, from days 7 to 90 of gestation, to test the effect of fibre and food level on feeding motivation and feeding-related stetreotypies. Treatments were: VHF (very high-fibre, 29% ADF, 50% NDF, 4.5 kg/d); HF (high-fibre, 23% ADF, 43% NDF, 3.5 kg/d); C (low-fibre control, 8% ADF, 20% NDF, 2.5 kg/d); and CAL (low-fibre control fed ad libitum). All diets except CAL provided a similar amount of major nutrients on a daily basis and were served in two meals. Two-hour observation periods starting at the afternoon food delivery revealed that sows spent more time eating on VHF and CAL (mean=21.2 min) than on HF (13.2 min) and C (7.7 min) and more time on HF compared to C ($P<0.01$). When time spent eating was removed from total observation time, the percentage of remaining time spent in stereotypies was lower for VHF (median=17.9%) compared to C (median=48.9%), and lower for CAL (median=6.3%) compared to other diets ($P<0.01$). During operant conditioning tests (OCT) performed before afternoon meal and after morning meal, less rewards were obtained by CAL sows ($P<0.01$), but there was no difference between other treatments. Over 24 h, 5-min interval scans showed that VHF and HF sows spent less time sitting and standing than C sows, but more than CAL sows ($P<0.05$). Also, CAL sows spent more time resting than sows on other treatments ($P<0.01$). In conclusion, no reduction in feeding motivation of sows fed high-fibre diets could be measured by OCT but very high levels of fibre were effective at reducing stereotypies and activity during the 2 hours post-feeding. However, these effects were not as marked as those observed with ad libitum feeding.

Effect of suppressed suckling duration on time spent tongue-playing and some stress indicators in calves

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It was investigated whether suppression of suckling duration causes the tongue-playing and influences behavioural, physiological and psychological stress indicators in calves.

Eight Japanese Black (a beef breed) calves were separated from their mothers at 2 days of age, and they were fed on milk replacer from a feeding bottle with a nipple until weaning (42 days of age). Four calves suckled milk replacer during 518 sec per once (long suckling duration), others did during 93 sec (short suckling duration) on the average. The suckling duration was regulated by the size of a hole in the rubber nipple. Tongue-playing was observed until 60 days of age. Grooming and sucking object as displacement behaviour (indicators of behavioural stress; Seo et al., 1998, Appl. Anim. Behav. Sci. 56, 1-12) until 60 days of age, heart rate after suckling at 35 days of age and plasma cortisol concentration (indicators of physiological stress) at 40 days of age (5=before, 0=during, 5, 10, 15, 20 min after suckling) were measured to evaluate stressfulness of the treatments.

Tongue-playing and sucking object appeared more in short suckling calves than in long suckling calves until 60 days of age (Tongue-playing; 7.9 vs. 4.8% / 6-h observation $P<0.09$, Sucking object; 4.4 vs. 1.0% / 6-h observation $P<0.01$). Grooming behaviour was not significantly influenced by the treatment. Heart rate for 30 min after long suckling decreased gradually, while it decreased rapidly after short suckling. The rate of decrease in plasma cortisol concentration from '0' to '5' min was more rapidly after long suckling than after short suckling (-62.9 vs. 22.5% $P<0.04$). Therefore, it is thought that decrease in suckling duration causes behavioural, physiological frustration and the tongue-playing until immediately after weaning.

Coping style and stereotypies in sows

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In a non-social backtest as described by Hessing *et al* (1993, Appl. Anim. Behav. Sci. 37, 285-295), 143 female piglets were tested at 10 and 17 days of age to determine the coping style. In this test, each piglet is individually restrained in a supine position and the number of escape attempts is counted. Based on the backtests, pigs are classified as Low Resisting, High Resisting or Intermediate. The animals were mated and during pregnancy, sows were housed in individual stalls (not tethered). Technical results were recorded for the first litter. Thirty-three pregnant sows from this population were observed during different parities. The following parameters were recorded: sow posture (standing, sitting or lying), bar biting, sham chewing, rooting en tongue playing. We used 17 High Resisting and 16 Low Resisting sows to compare the behaviour of sows with contrasting coping styles. Nine sows were observed simultaneously for one hour, starting ten minutes after feeding in the afternoon.

Sows showed stereotypic behaviour 25-99% of the observed time. The average total stereotyping time (64.8±3.7%) was the same for each parity and backtest type. Only average rooting time was related to parity ($P=0.02$). Primiparous sows showed rooting behaviour 13% of the observed time, while sows in higher parities did so for 5-7% of the observed time. However, only three sows were primiparous, compared to six to ten sows in higher parity groups. Technical results for the first litter were not related to backtest type or stereotypic behaviour.

We conclude that the backtest has no predictive value for stereotypic behaviour in the sow, or for technical results in the first litter.

Differences in feather quality between commercial layer breeds

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In intensive poultry husbandry cannibalism is partly masked by beak trimming. However, within four years beak trimming will be forbidden in the Netherlands. In the extensive poultry husbandry it is already forbidden and cannibalism is a large problem. That genetics may influence feather pecking and cannibalism is already known for several decades. The feather quality of some commercial breeds, common in the Netherlands, is measured.

Feather damage due to feather pecking is investigated in five White Leghorn and seven brown breeds, at the age of 57 weeks. Beaks were trimmed but earlier research has shown that little differences in beak quality were present between these breeds. During the laying periods hens were kept in rows of battery cages, one breed per row, four hens per cage. These cages were placed in one room with four blocks, each breed being represented in each block. The feather quality at nine bodily places of all four hens from one cage per row was scored from zero (no damage) till eight (severily damaged) by one observer. The same was done by another observer for the four hens from another cage from each row (in total 32 hens per breed). Mean scores per bodily place of the eight hens of each row (four repetitions per breed) were tested by analysis of variance. The following model being used: $y = \mu$ + effect block + effect breed + error

Breeds differed significantly ($p < 5\%$) in the feather quality of breast, belly and wings (grand means respectively: 4.2 ± 0.3; 3.8 ± 0.3; 2.9 ± 0.3). One of the breeds used in extensive poultry husbandry turned out to be most vulnerable for feather pecking. Only brown breeds are used in extensive farming, however one of the White Leghorn breeds showed best feather quality. This breed seemed most promising for husbandry without, or with only a mild form of beak trimming.

Incidence of sucking milk compared to drinking on the behaviour and heart rate of calves

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Veal calves display lots of oral behaviours: sucking, licking and nibbling can take place for half of the active time (Veissier et al. 1997, JAS, 75, 356-365). It is known that milk stimulates sucking and that nibbling derives from the same drive as eating solid foods (dePassillé et al. 1992, Appl. Anim. Behav. Sci., 34, 23-36 ; Veissier et al., Appl. Anim. Behav. Sci., in press). The present study aimed to determine if sucking can be compensated by other oral activities. Also, sucking is known to have a calming effect in human and rats (Blass 1994, Acta Pædiatr Suppl, 397, 71-76). The second objective was to look for this calming effect measuring heart rate and general activity.

Twelve bucket-fed calves were compared to twelve calves fed from a teat. All were in individual crates with no possibility of cross-sucking. However, licking between calves was possible through the partitions.

Sucking the bars of the feeding grille was observed only after milk intake and in bucket-fed calves (14% time between 5 and 10 min after the meal, comparison with teat-fed calves: $P<.01$). Also, licking neighbour calves and parts of the crate were observed after the milk meals and with a greater incidence in bucket-fed calves ($P<.01$ and $P<.05$). On the whole, bucket-fed calves were more active after the milk meals and took longer time to adopt a resting posture (51 vs. 42mn after the meal, $P<.05$). There was no incidence of feeding type on other activities and at other time of the day. Heart rate during feeding was higher in bucket-fed than in teat-fed calves (177 vs. 157 beats/min, $P<.01$).

The results showed that bucket-fed calves compensate the lack of sucking their milk partly by sucking bars and licking other calves or objects but not by nibbling. Also, compared to the oral activities displayed by bucket-fed calves, sucking a teat seems to have some calming effect.

Manipulating cattle behaviour to protect stream environments

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Cattle have been implicated in polluting watercourses by the deposition of faeces and urine, increasing sedimentation level and in damaging the integrity of riparian ecosystems. The aim of this study was to assess the use of an alternative water source as a means of reducing impacts of cattle in the riparian zone. Thirty pregnant Angus cows of mixed age were allocated at random to two fields (15 cows in each) of similar size (about 3 ha), slope, height and pasture cover, with a stream at the bottom of each field. A water trough was placed at the top of the hill in one of the fields. The fields were grazed twice, once in late autumn and once in early winter. The fields were notionally divided into 3 zones: top, middle and bottom. The bottom zone included the riparian zone, defined as the area within one cow body length of the stream. Weather data were collected throughout the trials. The cattle were observed from 08:00 - 17:00 hours every second day, using scan sampling every 10 minutes to record the behaviour and location of each animal. In addition, in the riparian zone behaviours such as drinking, defecation, grazing and resting were recorded every minute. Sedimentation rate was measured by turbidity loggers: the levels were lower in the field with the trough. In autumn, daily minimum and maximum temperatures ranged from 5.2 to 19.8 °C, and in winter, from -1.1 to 15.4 °C. The distribution of animals in the fields differed between seasons. During the autumn cattle spent most of their time in the middle of the field (average 0.46); this was likely to be due to the greater pasture availability. In addition, as feed supply declined over the study fewer animals were observed in the bottom of the field where the trough was present. In the winter, cattle spent most of the day (average 0.65) at the top of the hill; most likely to obtain warmth from the sun. As the pasture declined in the field without a trough over the week of the trial, the proportion of time spent in the bottom zone increased from 0 to 25 %, whereas in the other field, time spent in this zone was unchanged. Thus, it should be possible to reduce damage in the riparian zone by placing alternative water sources distant from streams.

Investigations on behaviour in two lines of turkeys by enriching their environment

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In Germany rearing and fattening of turkeys are normally conducted in intensive housing systems without outdoor areas and with an absence of an internal structure. Captive environments can be improved by adding vertical partitions to divide the space into different functional areas and by adding biologically relevant features, such as perches.

The purpose of this study was to evaluate the effects on behaviour and productivity of two lines of turkeys (BUT Big6, Nicholas N700) by provision of straw bales, perches and access to range compared with commercial conditions (control).

In total, 624 day-old male turkeys (312 of each line) were placed in 12 compartments each with 52 individuals in environmentally controlled, light-proof rooms measuring 4.5 x 3.9m. Each of the 4 compartments were equipped either with perches or outdoor area and straw bales or only with litter. The behaviour was video-recorded once per week during the light-phase from 2 weeks of age up to 20 weeks. The experiment was analysed using time sampling in ten-minutes-intervals. Data were analysed by using General Linear Models Procedure (GLM) of the Statistical Analysis System (SAS Institute) and expressed as a percentage of total number of animals. Means were separated using Duncan's multiple-range test. Differences were considered significant when $p<0.05$.

Turkeys of N700 were recorded significant more frequently on the perches (15.7 % vs 11.7 %) and in the outside areas (42.3 % vs 35.5 %) than animals of Big6. The animals preferred perches with a height of 60 centimetres. Perching activity reached a peak around 5 to 7 weeks of age and decreased after this time. The percentage of animals with breast blisters increased by use of perches.

The results show that the motivation to use environmental enrichment still exits in turkeys of heavy hybrid lines and in particular they are motivated to use perches. However as the perches which were proposed had negative consequences , their modification according to the animal's requirements is necessary.

Housing of free range rabbit breeding groups with electro-net fencing

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As a pilot study a new housing system for domestic rabbits was studied for about 8 months. One breeding group of three does and one buck was kept on a pasture area of 36 m² fenced by a customary electrifical net (chicken wire, mesh: 7 cm x 7 cm), fixed into the ground by usual sticks with double-spikes. A moveable hut was put at the rabbits´ disposal for shelter, nesting and drinking. The hut includes 4 nesting-pipes and the possibility to use the place under and on the top of the hut which was covered. The fence and the hut were moved 2 - 7 times per week. By this kind of grazing in portions the breeding group rotated on an area of 400 m², so after a month the rabbits grazed on the same surface as a month before. Supplementary a coventional pellet food was offered ad libitum.

The results of 6 months concerning to the number and size of litters (92 born, 81 weaned) and the weights of weaned young rabbits (28 days of age = 405 g, 40 days of age = 895 g) have been satisfactory, by an average consumption of pellet food between 45 - 60 % compared to the amount in cage housing. Between the third living-day and weaning no losses occured. Additional stripes of different materials (stuff, plastic-foil or -net) avoided escapes of the young rabbits through the meshes of the fence. Daily moving of the fence avoided successfully digging of the adults below the fence. The requirement of working hours per doe was between 3 - 5 minutes per day. The weaned young rabbits were sold for the double of conventional price. Therefore this system of housing breeding groups of domestic rabbits on range could be also an economic alternative to battery housing.

Comparison of behavioral patterns of commercial hens and Gifujidori under cage and free range conditions

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Gifujidori is one of the oldest and most famous native breeds of chicken in Japan. There have been reports on genetical studies of this breed, however, the behavioral characteristics of the fowl have not yet been studied. The objective of the present study was to compare the behaviour of Gifujidori with commercial hens under cage and free range conditions. Two 9.4 x 4.7 m areas in the open field environment were used. Ten Gifujidori and the same number of commercial hens (Dekalb XL) were moved from conventional cages (2 birds / cage) to each area. The behavior of both breeds was observed from 06:00 to 16:00 on the 1st, 2nd, 3rd, 8th, 15th, 22nd and 29th days using a scan sampling method. Number of birds performing each behavior (feeding, drinking, ground pecking, walking, standing, sitting, dust bathing, preening, etc.) stabilized after the 8th day in the commercial hens. On the other hand, it took a few more days for the behavior pattern to stabilize in Gifujidori. Mean distance to other individuals in commercial hens was longer than that in Gifujidori which formed a more cohesive flock. At the same time, another 10 commercial hens and Gifujidori were observed under individual cage conditions (948cm2 / bird). The behavior of both breeds was observed from 06:00 to 16:00 using a scan sampling method. Proportions of walking and preening in Gifujidori were higher than that in commercial hens. On the other hand, proportions of feeding and sitting in commercial hens were higher than that in Gifujidori. These points will be discussed in this paper.

The frequency of resting, and feeding behaviour of pigs reared in a kennel housing system during cold weather

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A kennel housing system referred to as the «Nuertingen» system was installed, at Ridgetown, in a naturally ventilated finishing barn. This system was originally developed in Germany and this study was designed to evaluate a similar pen arrangement under Canadian conditions. Each Pen extended 9.6 m across the width of the barn and was 4.6 m wide. At each end adjacent to the walls of the barn there was 1.2 m of slatted floors. A row of three adjoining kennels was located along each side of the solid floor area between the slatted floor areas. Each kennel was 2.4 m long and 1.5 m wide. A double layer of plastic strips covered the fronts of the kennels. This permitted easy access to the kennels by the pigs and allowed for a warmer micro climate to be maintained within. For this study 86 pigs were reared in two pens containing 42 and 44 pigs. The pens were fitted with wet-dry feeders, located centrally. When the pigs weighed an average of 80 kg they were recorded by time-lapse video for 24 hrs over two consecutive days. External daytime temperatures ranged from -5 ^{O}C to +3 ^{O}C respectively. Feeding frequency varied depending on the time of day 10-13 % of the pigs in the day time to 0% at night. Feeding activity occurred during most hours of the day. Peak numbers of pigs were observed feeding during the day time hours with minimal feeding activity occurring between 4am and 8am. The pigs were observed resting in 86.6% of the observations. They rested in the kennels for 82% of the observations and outside on the floor in 4.6% of the observations.

Behaviour of wild red deer (Cervus elaphus) under captivity conditions

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The aim of this study is to determine the behavioural adaptative response of wild red deer hinds (Cervus elaphus) to intense captivity conditions. For this reason we evaluated certain behaviour patterns which vary under stress conditions such as abrupt environmental changes.

A group of eight hinds coming from the wild, aged from 3 to 6 years old, were maintained under enclosure in a 3.5 by 4 m pen. The group activity was recorded with a stable video camera fixed at 2.25 m above ground level and 2.9 m to the pen area. The study was carried out over a period of 25 days and the behaviour was only recorded on 10 of these 25 days, randomly chosen (1, 3, 4, 7, 8, 9, 12, 17, 22, 25), from 9:00 to 15:00. The behaviour patterns collected in this way were subsequently evaluated in terms of frequency and time, by using a computer program designed for this purpose.

Several patterns were statistically different between days. The difference was mainly between the first week and the other days: frequency of "feeding" ($F(9, 70)=15,556$; $P<0.001$), "lying" ($F(9, 70)= 6,641$; $P<0.001$), "self-licking" ($F(9, 70)= 4,129$; $P<0.001$) or "movement" ($F(9, 70)= 18,828$; $P<0.001$) and in the time spent "lying" ($F(9, 70)= 2,517$; $P<0.05$) and "feeding" ($F(9, 70) = 6.560$; $P<0.001$). For other patterns such as the time spent "standing" as well as "scratching" and "stretching" frequencies there were no significant differences.

The general evolution observed in the considered patterns seems to indicate that the animals become familiar with their new environment within the first week of study.

Effect of type of milk on sucking response of artificially reared lambs

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Practices that stimulate sucking response of artificially reared lambs may be effective in promoting a rapid acceptance of the artificial teat, so improving performance of lambs. Thirty twin-born Gentile di Puglia male lambs, separated from their dams 24 to 36 hours after birth, were divided into 3 groups of 10 each and fed one of 3 different types of milk during the first 3 post-separation days: I group = sheep mass milk; II group = milk substitute; III group = sheep mass milk and milk substitute in a 0.5 to 0.5 ratio. Milk was offered ad libitum in 4 meals a day at 6 hour intervals. Milk was dispensed by graduate bottles provided with 50mm long latex teats. Before each meal, teats were soaked in milk and presented to the lambs, that were allowed to smell them; then, the lambs' muzzle was sprinkled with a little of milk. The following parameters were recorded: latency time to first sucking (the time between teat presentation and the first successful sucking attempt), adaptation time to the artificial teat (the time between lambs' separation from their dams and the acceptance of the artificial teat, each lamb was considered to have accepted the artificial teat when it was able to suck milk four times in succession without assistants' help), and individual milk intakes. Animals in the second group exhibited a longer latency time than those in the first ($P<0.01$) and in the third group ($P<0.05$) and a less rapid adaptation to the artificial teat when compared to lambs in the first group ($P<0.05$). Lambs fed the milk substitute had reduced milk intakes compared to those given the ewe's milk ($P<0.01$) and the mixed milk ($P<0.05$). These results indicate that offering lambs normal sheep milk may be effective in promoting a rapid and lasting adaptation to the artificial teat.

Behavioural implications for dairy cows exposed to different types of access to a milking robot

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Dairy cows had the opportunity to enter an automatic milking system (AMS) voluntarily three different ways:

A. Selection stall. The selection stall was placed in either the feeding area, between the lying area and the feeding area, or between the feeding area and the lying area. Passage through it was either obligatory by one-way cow traffic or optional by free cow traffic. During the selection process, the cow was enclosed in the selection stall. The number of visits to the stall met the planned milking frequency only if the concentrate reward was given there. The cows that were refused access to the milking stall delayed leaving the selection stall. In one experiment with a pusher, the cows left the selection stall on average in 24 s during milking visits and in 115 s during non-milking visits ($P<0.05$).

B. Milking-stall selection. This made an extra selection stall unnecessary. Every cow entered a milking stall, where the decision was made to milk or not. More than 40% of visits were non-milking visits. The cows returned to the AMS on average 2 hours after non-milking visits and 5 hours after milking visits ($P<0.05$).

C. Walk-through selection. This made it possible to select cows while they were moving between the lying and the feeding areas. The motivation of cows was estimated by their rate of movement. They moved several times faster (0.32 m/s) when they were selected for milking than when they were not selected (0.06 m/s) ($P<0.05$). Because walk-through selection allowed free movement, the cows could engage in such behaviour as backing up or colliding with the selection gate. Sometimes a cow moved faster than the selection gate. Sometimes two cows entered the AMS together.

Although these types of access to the AMS have their advantages and disadvantages, they produce one common effect: denial of milking (when this also means denial of a concentrate reward) seems to be unpleasant for the cows. The cows that enter the AMS voluntarily, but are not milked, should get some positive reward after they pass through the selection.

Bottlenecks in the transport of exotic animals for pet industry

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In the Netherlands about 15,8 million animals are owned as a pet. Similar figures can be found in other European countries. Most people own cats or dogs but also ornamental fishes, reptiles, amphibians and birds are popular. About 20 million exotic animals are imported in the Netherlands for pet industry. It is estimated that about 20-30 % of the imported animals are caught from the wild. Before the animals are sold in regular pet shops most of the animals have a former experience of transport and storage. Standards of transport boxes and care taking for air-transports are laid down in the Life Animal Regulation (LAR) of the International Air Transport Association (IATA).

This research project is a pilot study on the subject of transport of exotic animals for pet industry. During this research project 38 animal transports (of an estimated total of 2500 a year) at the main airport of the Netherlands are checked for mortality, injury, health and behaviour. Besides that the quality of transport boxes and care-taking are described.

In 38 transports mean mortality is 1 %, but varies between 0,05 % till 20 % or more. About 63 % of the animal transports are not according the standards of the IATA. Following causes were registered: some transports were longer than 48 hours, way of care taking during staying at the airport (for instance rough handling, no water supply), constructions of transport boxes are not in accordance with IATA standards, high densities, some transported animals were too young or had a bad condition. Apart from acute transport stress, also long term effects may occur as is suggested by high mortality the first year after transport.

In conclusion transports of exotic animals for pet industry can cause serious welfare problems for the animals. The amount of transported animals is high. Based on the list of bottlenecks and the inventory of welfare problems, some measures are proposed which should improve the condition of the animals in the short term and long term.

Behavioural and physiological effects of hunting red deer (*Cervus elaphus*) with hounds

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Undisturbed red deer live in small home ranges of approximately 150 ha. When deer were hunted by humans with hounds, the average distance travelled was at least 19 km. Hunted deer tended to circle back to the place where they were first found. Hunts were shorter when the deer were subjected to higher levels of potential stress by people. Our study of 64 hunted red deer provided the first empirical evidence on their state at the time of death (1997, Proc. R. Soc. Lond. B. 264, 1707-1714). Blood and muscle samples obtained from hunted deer after death were compared with samples from 50 non-hunted red deer that had been cleanly shot with rifles. Concentrations of cortisol in the hunted deer (197 nmol/l), typically associated with extreme physiological and psychological stress, were much higher than in the non-hunted deer (2.7 nmol/l, $p<0.001$). Damage of red blood cells occurred early in the hunts with hunted deer having ten times the concentrations of haem found in non-hunted ($p<0.001$) and nearly five times the concentration of bilirubin ($p<0.001$). The effects on deer of long hunts were: depletion of carbohydrate resources for powering muscles ($p<0.001$) and disruption of muscle tissue ($p<0.001$). Beta-endorphin levels were positively correlated with muscle disruption ($p<0.01$). Deer that ended up in rivers or lakes at the end of hunts had significantly higher level of creatine kinase ($p<0.01$), suggesting that they went to water to deal with the physiological effects of the chase rather than as part of an anti-predator tactic. Taken together, the evidence suggests that red deer are not well adapted by their evolutionary or individual history to cope with the level of activity imposed on them when hunted with hounds.

The use of passive avoidance to determine aversion to slaughter gases in farmed mink (*Mustela vison*)

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Passive avoidance is a powerful technique for assessing an animal's aversion to environmental conditions, because the technique can titrate reward consumption against exposure to the noxious stimuli to assess its aversiveness. This experiment illustrates a straightforward protocol that employs passive avoidance.

Carbon dioxide is commonly used on fur farms to kill mink prior to pelting. We trained eight mink to obtain a reward (a novel object) by entering a chamber, which could be filled with carbon dioxide to commercial concentrations of 80% by volume. In the absence of carbon dioxide, mink showed a short latency to enter the chamber (16 ± 2.1s) and spent much of the next ten minutes interacting with the novel object (45% ± 12%). Mink also opened doors that were heavier than their body weight in order to enter the chamber. When carbon dioxide was presented in the test chamber, mink would not enter and instead coughed and recoiled from the its entrance. We conclude that mink detect high concentrations of carbon dioxide and will not endure these concentrations to perform a highly valued behaviour. This technique could be used to test aversion to lower concentrations of carbon dioxide and to other slaughter gases such as carbon monoxide so that humane methods of euthanasing mink can be found.

Behavioural and physiological responses to ACTH injections, Force-feeding procedure and various potential source of stress in male mule ducks

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Male mule duck is now the type of bird the most commonly used for the production of "Foie gras" in France. Force feeding, which is an obligatory practice to permit its production, is questioned in terms of welfare and stress. Among the different criticisms, the facts that the birds are forced to ingest large amounts of food and often placed in battery cages are two other important ones. Acute activation of the adreno-corticotrope axis, following a stress or an injection of ACTH, is reflected by a rise in plasma corticosterone levels whereas chronic stress can lead to desensibilisation. On the other hand, disturbance can lead to behavioural stereotypies and/or variation in the motivation to express natural and/or conditioned behaviours. Taking these criticisms and the scientific background into consideration, a number of trials has been run with the following questions being addressed : what are the short (minutes) and long term (days) physiological responses to placement in cages, physical stress and/or repetitive force feeding, what are the behavioural responses to force feeding procedure, is there any evolution of the daily time budget during the cramming process and what can be the duck's spontaneous ingestion capacity of food ? There is no overall functional difference of the adreno-corticotrope axis between male mule ducks and other species of birds. Otherwise, results from four independent trials indicated that force-feeding per se did not induce any consistent short term increase in corticosterone levels whereas, the adrenal gland was fully responsive to ACTH challenge and external stimuli such as the capture or physical constraints. Interestingly, ducks get quickly accustomed to these external stimuli. On a behavioural point of view, we found that force feeding procedure is far from being fully aversive, since ducks will spontaneously walk and enter in a room in order to be fed by force-feeding procedure. Moreover, there is not consistent evolution of the time budget and feed consumption could spontaneously reach up to the maximum amount that is force fed per day. In conclusion, we have no scientific evidence that force-feeding is perceived as stressful by the male mule ducks.

Effect of a feline appeasing pheromone analogue on manifestations of stress in cats during transport

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This study sought to assess the efficacy of a feline facial pheromone analogue (F3 fraction) in the reduction of stress responses related to transport by car. Fifty eight adult cats were included in the study. Their ages ranged from 1 to 7 years (mean 3.3) and both sexes were represented. The cats were put into a cat carrier and transported by car on a return journey for the purposes of a holiday. The journeys ranged between 100 and 500 km. The animals were randomly assigned to one of two treatment groups : either test group or control group. The test group received treatment with a 5 per cent alcoholic solution of the F3 fraction and the control group received treatment with a placebo which consisted of solvent alone. Both of the treatment solutions were contained in blinded bottles, and participating owners were not aware of the nature of the solution they had to apply. Treatment consisted of delivering eight spray-applications of the relevant solution in the cat carrier half an hour before departure.

The total number of quantitative undesirable behaviours (somatic responses) , e.g. vomiting, urination or defecation was recorded. Non-quantitative undesirable behaviours (mewing, agitation, salivation) were also scored by the owners using a 'stress scale' which graduated from 0 ('quiet trip') to 6 ('the driver must stop the car'). These two scores were then combined to give a global score.

Comparison of these scores through a Mann-Whitney's U test showed a significant discrepancy in favour of the test group (0.72+/-0.84 vs. 10.31+/-2.30, $p<0.0001$).

The conclusion from the study is that during car travel, F3 shows a high efficacy in reducing somatic stress responses and anxiety-related behaviours in cats.

Preference for different floor types in farmed foxes

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Farmed silver (*Vulpes vulpes*) and blue foxes (*Alopex lagopus*) were let to choose between different standard farm cages each having a different floor material: plastic covered wire-mesh (WM), dry and/or wet wood (DW, WW), dry and/or wet sand (DS, WS). In winter and spring, any wet floor was frozen (IW or IS). The orders of floors in the quartets and location of the quartets in the barn were different for each of the 12 individuals in each of four experiments. The use of floors was analysed from videotapes for active behaviour and rest from 6 or 5 subsequent days. Rest comprised 50-60% of the total 24-h day in both species. In winter, the order of active time on different floors was DW(34) = DS(33) > IS(17) = WM(15) and resting time DW(59) > WM(26) = DS(15) > IS(1) in the silver foxes, and DS(29) = DW(26) = IS(25) = WM(20) and WM(41) = DW(30) = DS(24) > IS(5) in the blue foxes, respectively (% of daily time in parentheses; '=' is $p>0.05$, '>' is $p<0.05$ for chi-square test ???). In spring, the order of active time was DS(36) > DW(25) = IW(24) > WM(15) and resting time DW(51) > WM(19) = IW(16) = DS(15) in the silver foxes. In summer, the order of the active time was DW(34) = DS(34) = WM(20) > WS(13) and resting time DW(48) = WM(31) = DS(22) > WS(0) in the blue foxes. Rest consisted of 14-20 and 10-12 bouts in the silver and blue foxes, respectively. Most often the foxes rested on the same place they had used earlier, independently of floor material. Thus, within-individual consistency and between-individual variation in preferences resulted in large variation in group means, especially concerning the resting place, and suggesting a low level of priority. Although solid floors were highly preferred floor materials when dry, they turned to least preferred ones when wet.

Adaptation of calves of dairy cow to a cold and variable micro-climate

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Indoor housing of dairy cows is based more on tradition than on a sound knowledge of climatic requirements of the animal. Adaptation of young calves to a cold and variable micro-climate was studied to identify housing conditions that do not overtax their physiological and behavioral capacity to cope. A total of 44 Ayrshire bull calves were subdivided in three groups living in different climatic conditions in winter 1996-1997 and 1997-1998. They were evenly divided into three test groups and they entered the 63 days test at the age of 7-12 days. One group was housed in a warm room (+10-+16 °C), the second group was in a cool room (0-+5 °C) and the third group was in a room where the temperature was changing (+6- -22 °C) according to the climate outside. Blood samples were collected weekly and the calves were weighed four times during the test . There were no significant differences in mean daily growth rate between the test groups ($p>0.05$, ANOVA), although those calves housed in cool and cold test rooms had higher serum cortisol values ($p<0.001$, ANOVA) during the first two test weeks than those in warm room. There were no differences either serum thyroxine (T_4) or triiodothyronine (T_3) values between the groups ($p>0.05$, ANOVA). The infrared photographs showed that skin surface temperatures were lower in those calves housed in the cold ambient temperatures. The results of this study indicate that calves could be housed in simple, low cost shelters although the temperature is even sub-zero. In this study the calves were kept in groups enabling them to reduce the impact of cold through huddling behaviour. A dry, 40 cm deep litter bed and a lower air velocity than outdoors (0.25 m/sec) further reduced the severity of cold. The lower skin surface temperatures in calves housed in the cold indicate that they have undergone adaptive chances in response to the low temperature history, either through circulatory adjustments or through changes in hair coat insulation.

Enrichment value of toys for farm foxes

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A monotonous housing environment can cause frustration or abnormal behaviour in domestic animals and may thus reduce welfare. Environmental enrichment is a logical solution to this dilemma. Enrichment can be achieved, for example, by providing animals with inanimate objects that can be used for chewing or playing. Housing cages of farm foxes are rather small and barren. The aim of the present study was to clarify to what extent toys can be used as an enrichment in traditional fox cages. Specific aims were to find out (1) how much foxes use toys, and (2) if toys have any beneficial effects on welfare and reproduction.

The toys used were made of wood and measured 30 cm in length and 8 cm in diameter. Three separate experiments were carried out. In Exp.1, the behaviour of 8 male blue foxes housed with toys was video recorded from January to May. In Exp. 2, 16 male blue foxes with and 16 without toys were housed singly from January to June; thereafter, an open field test was conducted on the animals of each group. In Exp. 3, 50 female blue foxes with and 50 without toys were housed singly from January onwards; both groups were bred normally. Whelping result was recorded. Results of Exp. 1 showed that use of toys was frequent. On average, there were 77 contacts with a toy per fox daily. Contacts with toys slightly decreased with time. Most often toys were used for carrying around, chewing, poking and sniffing the toy. In Exp. 2, no significant differences were found between groups in open field activity. In Exp. 3, number of born kits per breeding female was 10.3 ± 0.8 and 8.4 ± 0.9 in groups with and without toys, respectively ($p>0.05$). On the basis of the present results, it appears that foxes might derive some welfare benefits from toys. Thus, the use of such toys for foxes housed on commercial farms is recommended.

Thoroughbred bedding preferences and associated behaviours differences

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Stabled horses are most commonly bedded on straw, wood shavings and shredded paper. In this study, we asked eight Thoroughbred horses which bedding they preferred and we recorded their behaviour on each. Each horse was individually housed in a test arena, which consisted of two standard Lodden box stables connected by a concrete passage. Each bedding combination (straw vs shavings; straw vs paper; paper vs shavings) was offered four times to each horse, controlling for left-right bias in each of two observation periods (Day; 12:00 to 18:00 hours: and Night; 21:00 to 08:00 hours). The horses position and behaviour were recorded by instantaneous scan sampling once per minute.

Horses preferred straw over paper and shavings over paper (Binomial test: $P < 0.05$ in each case). Horses also showed a preference for straw over shavings after accounting for positional bias (Chi-squared test: $X^2 = 10.49$, $P < 0.05$). On all beddings, they spent most of their time standing but horses on straw spent significantly more time in bedding related activities such as nosing (Anova; $P < 0.01$). This suggests that the preference for the straw-bedded stable is associated with the increased opportunity for exploratory or manipulative behaviour provided by the straw. These results are particularly interesting in the light of McGreevy et al's survey (Equine vet J.1995, 27: 86), which found that Thoroughbred horses bedded on straw were less likely to perform abnormal activities including a range of stereotypies. Provision of straw may, therefore, be a useful environmental enrichment for reducing the risk of stereotypic behaviour.

The behaviour of laying hens in relation to European recommendations on cages

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The E.U. law for laying hens' cages (450 cm²/hen x 40 cm high) is meant to change. Proposals are for an increase of area (600 or 800 cm²), height (60 cm) and addition of perches. The aim of this study was to compare, in terms of welfare, the behaviour of hens raised in cages of different size.

Two flocks of laying hens were studied in seven cages' designs differing in floor area (450, 600 or 800 cm²/hen) and height (40 or 60 cm); half of the largest cages (800 cm²/hen x 60 cm high) was equipped with perches (20 cm/hen). To measure behaviour improvements we asked the following questions and our results gave the following answers:

1) Did hens use perches and extra space?

- YES, hens spent 50% of their time on perches, and were seen significantly less often occupying the front of the cage as floor area increased (450 vs. 600 vs. 800 cm²/hen, 49 vs. 43 vs. 37%, p=0.001).

2) Did cage modifications result in variations in frequency and duration of behaviour?

- NO, out of 11 different behaviours observed, chosen among comfort, abnormal and maintenance categories, only percentages of walking changed significantly (450 vs. 600 vs. 800 cm²/hen, 1.6 vs. 4.4 vs. 5.4% walks/hen/mn, p<0.001) as well as frequency of wing stretching plus flapping (40 vs. 60cm, 0.08±0.01 vs. 0.28± 0.02 stretches/hour/hen, p<0.001).

3) Was the ethogram more varied as space increases?

- NO, space per se did not increase behavioural repertoire. Birds however did perch when perches where provided.

4) Were abnormal behaviours reduced in larger cage?

- NO, stereotyped pacing and cage pecking were equally expressed with values ranging between 1 and 2% of daylight hours.

These cage designs resulted in little change in hens' behaviour. Therefore it is not possible to conclude that the increase of cage's size, according to European recommendations, implies a real improvement of the hen's welfare.

Ethical consumers? Social representations of stock farming in France

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People have different concerns about the ways in which animals are reared for human consumption, so there are also varied attitudes to stock farming. They vary from spontaneous confidence placed in so-called traditional methods of stock farming to complete rejection, justified or otherwise, of alternative, artificial environments in which many animals are now reared. Similar rejection can be associated with the supposed or actual presence of constituents judged to be artificial in the food given to the animals. It can also be bound up with actual or imagined cruelty or suffering that producers, carriers, slaughterers or scientists inflict daily on animals. Reactions like these are most frequently found in relation to so-called industrial methods of stock farming.

This paper reports results of a questionnaire survey carried out in 1998 with a sample of 1000 French people. It followed a series of interviews with scientists, producers and consumers which was intended to place opinions concerning animal welfare and attitudes to products of animal origin in a wide context of scientific investigations and household food habits. The intention was to profile French ethical consumers, very concerned with farm animal welfare.

The questionnaire first provided the opportunity of obtaining an auto-social definition of animal welfare (concerning methods of stock farming acceptable to everyone) and measured willingness to pay for increases in welfare necessary to meet such a definition. Secondly, the questionnaire collected customers' opinions out their preferences for buying and consuming products derived from 'non-industrial farms' or 'industrial farms', the history of their consumption of different categories of meat, their habits in relation to supplies of meat and other foods of animal origin, and the general meaning of such choices.

The effect of group composition on stress in the African catfish (Clarias gariepinus)

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African catfish (Clarias gariepinus) were purchased from a commercial hatchery. New groups were established in 3 sex ratios, A=all male, B=all female and C=male/female 1:1. On day 0, twelve 140 L tanks were stocked with 20 fish (4 replicates of A,B.C). On day 1, 7, 14 and 21 after grouping fish of one tank per group were sacrificed by a lethal dose of MS222 (tricaine methane sulfonate). All fish were weighed and the number and area of skin injuries (inflicted by bites) were measured at grouping (day 0) and when the fish were sacrificed (day 1, 7, 14, 21). Blood samples were taken from the caudal vasculate to determine cortisol concentration.

The percentage of fish with skin injuries was higher in females than in males (A males 66%, B females 86%, group C males 54%, C females 78%). The difference between males and females in the mixed sex group (C) was significant ($p<0.05$).The mean number of skin injuries per fish was higher in females than in males (group A males 1.9 vs. group B females 3.2, $p<0.01$; group C males 1.4 vs. group C females 2.6. $p<0.05$).The mean area of skin injure per fish was greater in the mono-sex groups (A males 41.4 mm, B females 55.2) than in the mixed sex group (C male/female 36.4). Fish in the A group showed smaller injuries than fish in the B group. No sex differences were found in the mixed sex group (C). Cortisol levels were lower in the mixed sex group (C) than in the mono-sex groups. Females showed significant higher cortisol levels than males.

In conclusion male catfish are less aggressive (measured as number of bites and area of injury) than female catfish. In mixed sex groups aggression is lower than in mono-sex groups. Higher cortisol levels in female Clarias compared to males might indicate that grouping of females is more stressful or that females are more active.

Behaviour and productivity of sows and piglets in the Farrownest and traditional rectangular crates

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The Farrownest crate has been designed to allow for more behaviourial needs of sows while maintaining the advantages of traditional crates. Thirty five sows were housed in traditional rectangular crates and 37 sows were placed into Farrownest crates. Ten litters per treatment were videotaped. Behaviour was recorded every 5 minutes during the last 24-hours pre-partum and every 10 minutes for four days post-partum. No significant differences ($P > .05$) were found between production parameters in the two systems, although a lower level of crushing was seen in the Farrownest (.35 piglet/litter) compared to rectangular crates (.57 piglet/litter). Average daily gain of piglets tended to be higher in the Farrownest than in rectangular crates (190 vs. 176 g/day, $P > .05$). Pre-partum bar-biting was higher in rectangular crates than in the Farrownest (2.2% vs. 0% of observations, $P < .05$). Dog-sitting before parturition occurred slightly less in rectangular crates than in the Farrownest (8.2 vs 10.4%, $P > .05$). Sows in the Farrownest turned frequently during the last 24 hours before parturition. Turning was highest from 16 to 8 hours pre-partum and decreased towards parturition. Frequency of turning after parturition (4 days) was 4.4 times lower than frequency of turning before parturition (24 hours). Piglets in the Farrownest were lying slightly more in contact with the mammary (38% vs. 24%, $P < .05$) and less under the lamp (10% vs 33%, $P < .01$) than those in rectangular crates during the first day after parturition. Lying at the mammary decreased and lying under the lamp increased after the first day. Results indicate that the Farrownest tended to reduce stillbirths and crushings and resulted in slightly more piglets weaned. The main advantage of Farrownest type crates from a welfare point of view is that the sow has more freedom of movement and can turn around. Sows can investigate and assist newborn piglets and maintain physically unrestricted visual contact with the piglets.

Frustration and the gakel-call in different contexts in the laying hen, *Gallus gallus domesticus*

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Under certain conditions vocalisations are signals of the sender's condition towards conspecifics. Therefore vocalisations might be used as indicators of welfare. There are strong indications that in laying hens the gakel-call is an expression of frustration, i.e. the thwarting of biologically relevant behaviour. If welfare is defined as the state of an animal in which it can fulfil its physical and mental needs, it is clear that the blocking of biologically significant behaviour impairs the animal's welfare. In earlier experiments we found a significant increase in the number of gakel-calls during frustration of feeding behaviour with increasing durations of food deprivation. However, it is unclear whether different contexts of frustration result in differences in gakel-calls (in number or structure).

In this experiment we used two commercial strains of laying hens, 10 ISA Brown Warrens and 10 White Leghorns. They were deprived in random order in their feeding, drinking, dustbathing and pre-laying behaviour. During the training period they were taught to receive 15 min access to food, water, dust or a nest at a specific time. During testing they were denied this reward. Behaviour and vocalisations were recorded in three 15-min periods; before nonreward, during nonreward and after nonreward.

During deprivation of nest site a significant ($P<0.001$) larger number of gakel-calls (mean: 31) was given compared to the food (6.9), water (3.4) and dust (2.8). Blocking of nesting behaviour led to a significant ($P<0.05$) larger number of notes (mean: 5.2) per gakel-call than deprivation of food (2.8), water (3.1) or dust (2.0). These findings suggest that welfare is most impaired during frustration of pre-laying behaviour.

Maternal behaviour of the Mexican hairless pig (Pelon mexicano) under agro-forestry conditions

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The aim of this study was to gather behavioural information and production performance data on the Mexican Pelón (which means hairless) swine, a descendant of the Iberian pig, which is threatened with extinction. This data would allow us to test the hypothesis that peasants raising these animals in the forest can strengthen their economy by producing a high quality pork with less capital investment, contributing to soil enhancement through nutrient cycling and improving animal welfare.

A herd of 100 Mexican hairless pigs were raised during summer in a 230 ha. Agro-forest enclosure at Chapa de Mota, State of Mexico. Animals were commingled with a herd of sheep and goats. Sixteen focal sows and their litters were observed using direct and indirect observation to gather data on suckling behaviour. Sows were housed in individual farrowing pens during 14 days post-partum; piglets were allowed to cross-suckle. After this period all the animals were taken to the forest and allow to forage on a different area every day. The animals were observed during 3 continuous sucklings (around 3 h sampling sessions) every week, until sows showed signs of weaning.

Average lactation period under natural conditions was 11 weeks. The sows had an average reproductive cycle of 174 days which is superior to sows of this species kept in backyard conditions. Of the 229 sucklings recorded, milk ejection failed in 106 (46%); the suckling intervals averaged 5.8 ± 0.829 min in the pens and 3.5 ± 0.241 min in the forest ($p<0.025$); 50% of the sows nursed on their feet with 51% of the suckling being successful. It was interesting that the sows were observed performing another activity like rooting, while nursing their piglets.

We concluded that the Mexican hairless pig can be raised under agro-forestry conditions without a significant negative effect on their reproductive performance. Ongoing research will help to determine if their maintenance, social and sexual behaviour when commingled with the herds (sheep and goats) are advantageous or not.

Effects of reduced time on pasture caused by prolonged walk to pasture on behaviour and daily growth of Mpwapwa Zebu cattle

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In Tanzania and other African countries, cattle are often allowed to graze only during daytime. The daily walk to pasture limits time for foraging even more. To investigate this situation, we reduced access to pasture from 9 to 5h by increasing the daily walk from 0.5 to 4.5h. Twelve cows in each of two treatment groups were observed for two weeks and, after a break of two weeks, observed again when the groups were subjected to the opposite treatment. The two groups stayed on different pastures. The pastures were switched every day to control for differences in pasture quality.

The cattle had no access to food during the walk or at night. We observed the cattle in each treatment group for 8 of 14 days at 5-minute intervals during the entire time at pasture. Behaviour and weight gain was analysed with GLM. When only 5 hours at pasture, the cattle grazed for a larger proportion of the available time (61 vs. 57 %, $p=0.045$) at the cost of ruminating (12 vs. 17%, $p=0.006$). There were no differences regarding locomotion behaviour between the treatments groups. The total proportion were 31 % for standing, 52 % for walking slowly, 7 % for walking, and 10 % for lying. The cattle spent 37 % of their time in the shade of trees. Both weather and pasture quality affected behaviour but these factors were balanced between treatments.

After the 14 days of treatments both groups were kept together again. Compared to the former 5-hour animals, the former 9-hour animals had a higher weight gain of 3.6 kg ($p=0.024$) 4 days after the treatments and 4.5 kg ($p=0.058$) after 16 days. This is a higher daily weight gain of about 300 g. These changes could be due to reduced access to pasture or to energy requirements for the walk to pasture.

Extensive beef cattle production in Argentina: experimental projects to improve economic efficiency

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In Argentina, the economy is traditionally based on extensive agriculture and cattle production. Eighty percent of the beef cattle are reared on the pampas, which cover 42 millions hectares. Classically used breeds are Hereford, Angus and Brahman, and their crossbreeds. Large beef farms create employment by recruiting farmers who don't possess land. Due to recent changes in economic models, about 60% of the Argentine beef farms have an insufficient income, leading to desertion of the rural areas. Increasing competition for land use between beef production and agriculture (much less labour-intensive) leads to further unemployment. It is necessary to increase cattle production efficiency in order to develop sustainable beef production. On the one hand, experimental trials will aim to improve production on pasture from 200 to 500 kg of meat/ha/year by increasing numbers of animals per hectare and by strategic food supplementation. Differences in performance between breeds will be assessed. On the other hand, meat quality from different breeds and crossbreeds needs to be characterised and standardised for further improvement. Meat quality is influenced by genetic background and rearing conditions and negatively affected by stress at slaughter. Individual stress reactivity depends on genetic background and rearing conditions. Therefore, experimental trials will aim to determine the interactive effects of genetic background, rearing conditions and individual differences in stress reactivity on meat quality. A number of simple stress tests that can be carried out under field conditions, have been developed to assess stress reactivity on different rearing sites using the different breeds and crossbreeds. Tests include successively: i) introduction into a nonfamiliar environment allowing visual auditory and olfactory contact with group members, ii) exposure to a novel object, iii) exposure to a nonfamiliar human, iv) social isolation. Measurements include behavioural and cardiac responses. The results will further give important information on genetic and rearing effects on ease of handling of the animal (human safety).

Cattle "temperament": What are we measuring?

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The reactions of the animals in relation to the human beings probably were an important aspect in the definition of those that would be domesticated. Recently, researchers and farmers have turned their attention to these cattle reactions during handling, and using them to describe "temperament". To characterise and to quantify this trait is the current challenge, but it is necessary to develop valid and simple methodology to make possible the utilisation of temperament on the farm. We study 3 types of tests to measure the "temperament" in beef cattle: (1) "flight distance", classifying the animals at 5 levels as a function of its reaction to the approach of human beings; (2) "movement scores during weighing", classifying the animals at 3 and 5 levels (WS3 and WS5) and (3) "flight speed", measuring the time taken by cattle to travel 2 meters after the weighing and exiting the scale. In one of our studies (n = 511 cows of Nelore, Gir, Guzera and Caracu breeds) there was significant association between the movement score during weighing (WS5) and the flight distance ($r = -0.36$; $p < 0.01$), this value suggests that the measures do not represent the same characteristic. In other study (n = 169 Nelore yearlings calves) the two movement scores during weighing (WS3 and WS5) were highly correlated to each other ($r = 0.88$, $p < 0.01$), but there were not significant correlation of the flight distance with these two movement scores ($r = -0.17$ and -0.14, respectively; $p>0.05$). We concluded that all the measures considered did not characterise the temperament in its wider sense (the pool of individual's psychophysiological traits that determine the emotional reactions), but they represent just some aspects of the temperament, which should be considered independently, such as tameness, docility and fearfulness.

Subgrouping and homerange of cattle in agroforest without fencing in Northern Japan

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Agroforestry gradually becomes a subject of world attention as one of many sustainable animal production systems. It is important to know animal behaviour, because productivity plays an important role in this system. Thirty Japanese Shorthorn cows, their 24 calves, 5 heifers and 1 bull were turned out in the national forest with no fencing in northern Japan from spring to autumn. This national forest consisted of new planted areas of Japanese cedars (40%), former planted areas of older cedars (20%), natural forest areas of latifoliate trees (30%), rivers and roads. Subgroups and their location were recorded twice a day (morning and afternoon) for 7-8 days each in the beginning of the turn (May), spring (June), summer (August) and the end of the grazing period (October). Location of subgroups was plotted on the map of 1/20,000 and homeranges were calculated using the minimum convex polygon method. Homeranges of individuals were analysed using 2-ways ANOVA (age and seasons). Frequency of affiliation in each pair in terms of subgroup formation was analysed using least-square ANOVA (familiarity, kinship, age difference) and cluster analysis. Results indicate:1) Stockperson took 5h11min. on average for the dairy routine. He took part in not only inspection, but also controlling herd behaviour such as restriction of homeranges, guiding to rich grazing areas, guiding smaller subgroups to larger subgroups, and so on. 2) The 35 female cattle divided into some subgroups by familiarity ($P<0.001$), kinship ($P<0.01$) and familiarity*kinship ($P<0.001$). Average sizes of subgroups were 5.8 in May, 10.4 in June, 7.2 in August, and 6.2 in October. The bull did not have affiliation with special cows. 3) Homeranges of individuals in each observation periods were 73.1-105.4ha in average, being larger in spring and summer ($P<0.01$) and smaller in older cows($P<0.05$). Homeranges of all members were 378.4, 259.5, 371.6, and 690.7ha in May, June, August and October, respectively. Homeranges of individuals and all members were 499.8 and 822.0ha in the year-round, respectively. We discussed these results from the views of environmental aspects. Free-ranging cattle in an Asian monsoon zone make a good living in narrower area than in an arid nomadic zone.

Costs of locomotive and ingestive behaviour by sheep grazing grass or clover monocultures or mixtures of the two species

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We need to know the energetic costs of diet selection to develop efficient grazing systems. We measured locomotive and ingestive behaviour of ewes rearing twin lambs grazing 0.3ha plots of either *Lolium perenne* (G); *Trifolium repens* (C); conterminal monocultures of 50 % grass and 50% clover by area (G:C) or a mixture of grass and clover (M). Measurements of ingestive behaviour and locomotion were made when the sward was 6.5 cm high. For treatments M and G:C, clover content of the diet was estimated using the n-alkane technique. Ewes on treatments M and G:C selected higher proportions of clover (0.35 and 0.61) than offered in the plots (0.18 and 0.51). Intake rates were highest for ewes grazing pure clover compared with those grazing pure grass or mixtures (G, 5.4; C, 6.5 and M, 4.2 g dry matter/min; $P=0.008$). Eating time tended to be shorter on pure clover than on other plots (579, 495, 664 and 592 min/day for G,C,M,G:C; $P=0.072$), distances walked were similar (1.14, 1.12, 1.19 and 1.40 km/day). The numbers of lying bouts/day were 32, 26, 18 and 24 ($P=0.001$), where a lying bout was a period starting with the animal lying down and ending with it standing up. The energy cost associated with rising, standing and walking - estimated to be 1.07 MJ/day - was similar between treatments. However, the estimated metabolic energy concentrations for clover and grass were 12.6 and 11.6 MJ/kg dry matter. Thus the energy cost per energy ingested was less for ewes on pure clover than on pure grass. Ewes grazing mixture M had the lowest intake rate and tended to spend longer eating than other ewes, maybe due to more time spent searching for clover. These results suggest that ewes on treatment G:C had greater daily intakes than other ewes (G 3127, C 3217, M 2789 and G:C 3594 g dry matter/day). This marked increase in intake when grass and clover are offered together as monocultures compared with other treatments, warrants further research.

Exploitation of spatially heterogeneous pastures by sheep

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In a small (80 x 80m) and in a large (160 x 160m) cocksfoot plot, 136 bowls containing pellets (main ingredients: maize and beet pulp) were grouped together to create preferred feeding sites (four of 9 and four of 25 bowls) of fixed location over series of 12 days. The bowls were buried to the rim, but animals could use distal landmarks to orient. Groups of three ewes were tested once a day for 30 min. During the first days of series, the ewes visited more bowls with increased experience of a particular site distribution ($P < 0.05$). Then, the number of bowls visited levelled off, but the ewes became more efficient in finding them ($P < 0.05$) and spent more time grazing. The plateau was higher in the small plot (126 vs. 82 bowls; $P < 0.01$). Performance was poor when the site distribution was changed after 12 days, which proves that the ewes did not locate bowls from a distance by smell. In a second experiment, we compared the choice, and subsequent impact, of groups of four ewes in cocksfoot plots (80 x 80m) where 136 patches (30 x 30cm) of ryegrass were either randomly distributed (plot *Rand*) or grouped together (plots *Ag.1* and *Ag.2*) to create preferred feeding sites (four of 9 and four of 25 patches). We assumed that sheep could use their memory to return to preferred sites in plots *Ag.1* and *Ag.2* whereas they would not remember the precise location of many isolated patches in plot *Rand*. After 2 h, patches in plots *Ag.1* and *Ag.2* tended to be more exploited: their height was reduced by 20.5 and 19.5% (vs. 10.7% in plot *Rand;* $P < 0.10$) and ewes had spent 12.8 and 13.1% of time on them (vs. 10.6% in plot *Rand; NS*). These results indicate that sheep quickly learn the distribution of preferred feeding sites at pastures.

Movement patterns of sheep and cattle within and between continuous short-term grazing bouts

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Movement patterns of grazing animals are crucial to understanding the development of sward heterogeneity. The aim of the study was to investigate the differences between cattle and sheep in their pattern of movement during grazing. Six pairs of heifers (312 ± 8.3 kg) and six pairs of ewes (97 ± 3.9 kg) each grazed identical 20 x 40 m plots of perennial ryegrass for approximately 45 minutes. Heifers and ewes grazed separately. Numbers of bites and steps (movement of 1 foreleg) and time spent grazing were recorded for one animal per pair from video. Position and activity of this animal were recorded on a scaled map of the plot and used to calculate distance travelled within and between grazing bouts. A grazing bout began when an animal took a bite and ended when it took 2 steps without biting. Heifers and ewes had similar bite rates (80 vs 79 /min, p=0.71), step rates while grazing (6.8 vs 8.6 /min, P=0.19) and number of bites per step (11.9 vs 9.9, p=0.10). Although heifers took longer steps while grazing than ewes (0.37 vs 0.26 m, p<0.001), speed of forward movement (2.5 vs 2.2 m/min, P=0.29) and bites per metre of forward movement (32.2 vs 37.4, p=0.18) were similar. Heifers had longer bouts than ewes (180 vs 51 s, p=0.013) with more steps per bout (19.8 vs 6.7, p=0.008), and bites per bout (244 vs 67, p=0.017) and greater distance moved per bout (7.3 vs 1.8 m, p=0.003). The shorter bouts for sheep may result from greater vigilance, from searching for better quality material or from the need to process material already harvested. Heifers moved faster than ewes between grazing bouts (28.7 vs 11.4 m/min, p=0.07), with similar step rate (51.9 vs 46.2 steps/min, p=0.60) but greater step length (0.51 vs 0.24, p<0.001). Distance moved between grazing bouts was similar (1.72 vs 1.31 m, p=0.42). This may be because there was no need to search for the next bite in these dense homogeneous swards.

The skills to cope with early-weaning in pigs: a comparison of indoor and outdoor

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The sudden weaning imposed at 3-5 weeks of age, in the commercial pig industry (compared to the 10-20 weeks occurring in natural conditions) requires pigs to shift immediately from a total milk to an all-solid-food diet, as well as to mix with many unknown pigs in a strange environment. The weaned pig requires a number of skills not needed in the suckling phase, including the abilities to root, graze, chew and eat solid food, as well as a readiness to mix socially with piglets from other litters. The project was designed to determine whether piglets reared outdoors develop the skills necessary to cope with early-weaning more rapidly than those reared in conventional farrowing pens.

The behaviour of piglets indoors in crated farrowing pens and outdoors in groups of 4 sows and litters was observed over the last week of the suckling phase, and over the first week after weaning, when the indoor and outdoor pigs were mixed together in straw-bedded kennels. Before weaning, outdoor pigs engaged in more activity in general (outdoor piglets were lying for 25.3 % of the time observed, versus 68.8 % in indoor piglets; $p < .001$), especially rooting (outdoors: 21.5 % of time versus indoors: 5.3 %; $p < .001$), grazing and chewing of various substrates, and they gnawed for sustained periods at nuts delivered to the sows. There was a small trend for them to be suckling less frequently. After weaning, outdoor pigs spent more time with snout in pellet feed, presumably feeding (2.51 versus 0.55 incidences/pig/hour at the 2 min scans ($p < .005$) on the afternoon of weaning; 3.14 versus 2.36 ($p < .05$) 4 days later) and were more active. Outdoor-reared pigs displayed less ear- and tail-chewing (42 observations at scans versus 78 in indoor pigs; $p < .05$) and less belly-nosing (3 versus 27; $p < .001$). Outdoor-reared pigs appeared to be much better equipped to cope with early-weaning in this environment.

How degree of selectivity modifies foraging behaviour of sheep on reproductive compared to vegetative swards

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We investigated the effect of sward phenological stage in interaction with the animal's degree of selectivity on foraging behaviour of sheep. We tested the hypothesis that intake per bite, intake rate (IR) and intake were determined by the amount of preferred items (green leaf mass per ha, GLM), and that the relationships did not vary with the phenological stage of the sward nor the animal's degree of selectivity. Vegetative (V) *vs.* reproductive (R) sward structures were compared under rotational grazing by 11 dry ewes, with 6 ewes of variable degree of selectivity studied in detail. Faecal nitrogen concentration (FNC) at the time of greatest consumption of stems (ranging from 1.36 to 2.51 g/kg organic matter) was used as an indicator of animal's degree of selectivity.

The green leaf mass was the variable most strongly correlated with intake per bite in both sward structures, but inclusion of the variable 'stem mass per ha' in the model resulted in slight but significant improvement in the prediction of intake per bite. The coefficient of the variable 'stem mass per ha' varied among animals and was related to animal's degree of selectivity. Time per bite increased linearly with intake per bite, the slope being greater on reproductive than vegetative sward (0.00757 *vs.* 0.00275 sec/mg dry matter). Consequently, parameters of the 'intake rate / green leaf mass' model varied with sward phenological stage, equations being $IR_V = GLM/(24.9+(15.3*10^{-2}\ GLM))$ and $IR_R = GLM/(46.8+(20.2*10^{-2}\ GLM))$. On reproductive swards, slope of the regression of 'time per bite' on 'intake per bite' (b) increased linearly with animal's degree of selectivity (b=-0.0078+0.0078 FNC) and asymptote of the 'intake rate / green leaf mass' model (b') decreased linearly with animal's degree of selectivity (b'= 10.93-3.129 FNC). These results emphasize the importance of inter-individual variation in the trade-off between quality of the diet selected and intake rate. For a given green leaf mass, grazing time was higher on reproductive than on vegetative swards. Grazing time, daily dry matter intake and daily digestible dry matter intake were not related to the degree of selectivity of the animals.

Effect of cold or hot exposure and body weight on the feeding behaviour of group-housed growing pigs

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The individual feeding behaviour of 4 groups of Piétrain x Large White barrows (3 to 4 per group) was studied over two consecutive stages of growth. The initial body weight was 30 kg at stage 1 and 60 kg at stage 2. In experiment 1 (2 groups), ambient temperature varied in a cyclic way from 22 to 12°C and 12 to 22°C with 3 or 4 consecutive days at each of the following temperatures: 22, 19, 16, 14 or 12°C. Similarly, in experiment 2 (2 groups), temperature varied from 19 to 29°C and 29 to 19°C with 3 or 4 consecutive days at 19, 22, 25, 27 or 29°C. Photoperiod was fixed to 12 h of light. Within each experiment, the voluntary feed intake decreased significantly with increased temperature; it averaged 2496 and 1791 g/d at 12 and 29°C, respectively. Neither the daily number of meals (11 and 10 per pig on average in experiments 1 and 2, respectively) nor the rate of feed intake (37 g/min) were affected by temperature. Meal size and ingestion time per meal decreased with increased temperature with a marked effect in experiment 2 (265 vs. 195 g/meal (P=0.0898) and 7.7 vs. 5.0 min/meal (P=0.0230) at 19 and 29°C, respectively). The feeding pattern was mainly diurnal (62%). From stage 1 to stage 2, the increment in voluntary feed intake was associated with a decreased daily number of meals (12 and 9 per day at stages 1 and 2, respectively) and an increased meal size (180 and 305 g at stages 1 and 2, respectively). From data of this study (n=240) and other results (n=56) obtained in similar conditions, an equation to predict voluntary feed intake from temperature (T, °C) and body weight (BW, kg) is proposed: voluntary feed intake (g/d)= -1486+113T-2.57T²+84.4BW-0.38BW²-0.82T×BW (RSD=305, n=296). The present relationship indicates that voluntary feed intake depends on temperature and body weight with a marked negative effect of high temperature in heavier pigs. Finally, our results demonstrate that the rapid change in feeding behaviour with temperature occurs through changes in meal characteristics (size and duration) rather than in daily number of meals.

Comparison of feeding behaviour and performances of weaned piglets fed with two types of dry feeders with integrated drinkers

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Feeders with integrated drinkers could improve pig productivity and welfare. "Tubetype" ones (**T**) allow the animals to mix flour and drinking water. Feeding behaviour and performances of piglets were compared during 5 weeks after weaning, when using this feeder or another type (**V**), where drinking and eating places are separated. Eighty (tests 1 and 2) or sixty (tests 3 and 4) piglets were equally divided between two rooms, only different by the feeder. No differences in productivity were significant, except for the mean daily water consumption (l/pig.day) which was higher with **T** than with **V**, in trials 1 and 3 (1.8 vs. 1.4, and 2.1 vs. 1.3, P<0.001). Each week of tests 2 and 4, the occupation time of the feeders and the average number of animals using the feeders were recorded during 24 hours (day: 06h-22h; night: 22h-06h). Multifactor analysis of variance revealed effects of feeder, group size and period of the day on both measurements (P<0.01). When grouping 40 piglets, values measured for **V** were higher than for **T** (97.6% vs. 89.7% and 4.5 vs. 3.7, P<0.05); when grouping 30, only the occupation time was significantly different (83.5% vs. 75.8%, P<0.01). In each test, both feeders were used for a longer time and by more piglets during the day than during the night (P<0.01). However when grouping 40 animals, **V** was visited by more piglets than **T** during the day or during the night (5.3 vs. 4.5 and 3.0 vs. 2.1, P<0.05), and for a longer time only during the night (93.1% vs. 72.7%, P<0.05). In this case, animals used both feeders during almost all the day period (**V**: 99.9% and **T**: 99.1%). When grouping 30 piglets, only the occupation time during the day was higher with **V** than with **T** (94.1% vs. 86.5%, P<0.01). In conclusion, even if productivity is not affected, feeding behaviour and thus eventually welfare are influenced by the type of feeder, especially with high number of animals.

The approach test acclimatisation period: how long is long enough for sows ?

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Although approach latency has been used to quantify a pig's fearfulness of humans it may be confounded by the degree of acclimatisation to the test arena. During acclimatisation, a pig's behaviour and internal physiological state alters. Sows are typically permitted only 2 minutes to acclimatise prior to approach testing. The objective of this experiment was to determine an appropriate acclimatisation period in three different environments: home pen (HP); novel pen in the home barn (NPH); novel pen in a novel barn (NPN). Twenty-four Large White X Landrace sows were assigned to one of the three treatments according to parity and stage of gestation. All test arenas were rectangular, solid-sided, with straw-bedded floor areas between 8.8-9.8m2 and were subdivided into 16 equal sections: 4 central; 12 peripheral. Sows were fitted with a heart-rate monitor and transferred individually to the test arena. Behaviour and heart rate were recorded continuously for 30 minutes. Locomotory behaviour was the highest in the NPN treatment (mean±s.e. no. of sections crossed: NPN, 182.3±26.0; HP, 70.3±7.9; NPH, 87.3±9.5; $F_{2,21}=13.2$, $p<0.001$). Heart rate was strongly correlated with locomotory behaviour within all treatments (HP, $r=0.86$, $p<0.001$; NPH, $r=0.98$, $p<0.001$; NPN, $r=0.93$, $p<0.001$) and was lowest ($p<0.001$) in the HP treatment. Long-term and short-term heart rate variability were lowest in the NPH treatment ($p<0.05$), indicating increased sympathetic nervous stimulation in this environment. Heart rate (HR) and locomotory behaviour (LB) decreased over time until they no longer differed significantly between treatments (LB at 19 min onwards; HR at 25 min onwards). Sows in the novel treatments spent more time ($p<0.01$) in the pen periphery and less time rooting ($p<0.05$), despite performing more rooting bouts, than sows in the HP treatment. The results indicate that sows in the novel treatments engaged in more exploration and thus, the approach test is likely to be more effective when carried out in the home pen. Behavioural and physiological acclimatisation is not achieved within 2 min, irrespective of the test environment and even in the home pen, a minimum of 10 min is recommended.

Relevance of urinary and catecholamines assessment in swine urine

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Physiological stress responses are usually assessed through the measurement of plasma corticosteroids [CS] and catecholamines [CA] (adrenaline and noradrenaline). However, these plasma measures present physiological (pulsatility, circadian rhythm...) and practical limitations (stress induced by collection procedure). Urinary measurements might provide an alternative to assess the activity of the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system in basal and stress states. Indeed, urine is the main elimination route for these hormones and can be collected non-invasively. Moreover, urinary CS and CA sum up over several hours i.e. since the last micturition or collection time, thus rendering their assessment more reliable than in plasma.

We carried out two experiments to assess further the reliability of these urinary measurements. Analytical methods have been described previously elsewhere [Hay and Mormède, J. Chrom. B, 1997, 702, 33-39 & 703, 15-23]. First, we investigated whether the concentrations of CS and CA in urine collected early in the morning (a procedure routinely used in commercial breedings) were representative of their total 24h-excretion. Urines from pregnant sows were collected continuously using vesical catheters in containers that were emptied at 8h00, 13h30 and 17h00. CS and CA concentrations in the 8h00 samples were highly correlated to the amount excreted during 24h ($r > 0.93$, $p<0.0001$, $n=21$).

In a second experiment, we compared basal concentrations of CS and CA in urines obtained from Meishan (MS) and Large White (LW) sows. Earlier plasma studies revealed that MS pigs show higher cortisol (x 2-3) than LW; cortisol concentrations in MS urines were fivefold greater than that of LW (28.1 vs 6.2 pg/µg creatinine, $p<0.0001$). CA concentrations were also greater in MS than in LW sows (noradrenaline: 25.4 vs 5.9 pg/µg creatinine, adrenaline: 8.7 vs 2.8 pg/µg creatinine, $p<0.0001$).

These experiments emphasize the validity of urine collection as an alternative to plasma collection for CS and CA assessment. The relevance of these measurements to animal welfare and in chronic stress studies is currently under evaluation in our laboratory.

Evaluation of a plus-maze test adapted to mink

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The elevated plus-maze test is widely used in ethopharmacological research of fear/anxiety. In contrast to the system used in rodents, elevation was not an important part of the plus-maze adapted to mink. The test apparatus consists of two un-covered ('open') and two covered cage arms of equal size (l: 148cm), extending perpendicular from a common central platform. Twenty adult male mink belonging to groups selected over 8 generations for fearful (n = 10) or confident (n = 10) reaction towards humans were tested for 5 minutes July and December 1997. Behaviour and vocalisation were recorded on video. The animals were prior to the experiment tested by additional tests involving humans ('stick test' and 'Trapezov' hand test') and object test. These tests had earlier been shown to reflect differences between the two groups. Mink from the fearful group did not differ in amount of time spend in open or covered areas compared to mink from the non-fearful group, and only in trial 2 did both groups spend more time in the covered (42-44%) than in the open area (35-38%). The average latency time to entry into the covered arms was reduced from the first to the second trial (47 vs. 9 s) for the confident group, whereas no reduction was observed for the fearful individuals. Neither time used, frequencies of visits, speed nor the ratio between time used in open/covered arms could reveal any difference between the two groupings of mink. However, in both trials only fearful mink showed approach-withdrawal behaviour (in all parts) and freezing postures (in open parts of maze). The plus-maze test adapted to mink showed limited ability to separate the two groups, either due to failure of test principle or because no difference exists between these mink when tested without an observer present, indicating a non-generalised fear response.

Understanding the spatial and physical properties of objects: an investigation into object permanence in the domestic hen

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Understanding the ability of domestic animals to comprehend spatial and temporal properties of social and physical objects in their environments is fundamental to knowing if they understand their own relationships to these objects. This involves both learning and cognition and has consequences for welfare. One important cognitive concept is object permanence, which is the individual's ability to recognise that objects still exist when out of sight. Piaget (The Child's Construction of Reality, 1955) described its development in infants as a series of six distinct stages. The object concept of the domestic hen was examined in an intermediate level test (Piagetian Stage 4), in which the subject searches for an object hidden by a single cover. In experiment 1, the relevance for hens of two variations of this test was examined (n=6). A target object (food dish) was hidden either under paper or behind a single box on alternate test days. To prevent any response shown being the result of learning rather than cognition, the hens were firstly trained to search for the object by rewarding them for finding it, but no rewards were given for correct search in subsequent test trials. The hens proved capable of finding the hidden object but individual success rates were variable (11 - 89%) compared to a standard criterion of attainment (89%), presumably due to the absence of rewards during testing. Response rate was lower when the object was hidden under paper than when hidden behind the box. In experiment 2, the effect of rewarded and non-rewarded trials and of spacing trials over days was examined using this box test. Rewarded trials gave higher success rates than non-rewarded trials ($p<0.05$). The results indicated that tests of object permanence can be adapted for domestic hens and provide information about cognitive abilities. Additionally, non-rewarded trials may provide a method of examining object permanence that reduces the influence of learning.

Effects of confinement on the motivation to perform locomotor behaviour and spatial preferences of calves

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An open-field test and a preference test were used to investigate the importance of having the opportunity to perform locomotor behaviour. Thirty-six two months old female Holstein-Friesian calves were confined during either four weeks (4 wk), two weeks (2 wk), one week (1 wk) immediately prior to testing, or kept loose for the whole period (control). Locomotor behaviour (walking, trotting, galloping, bucking and buck-kicking) of all calves was recorded during a 10 minutes open-field test. Two days later the spatial preferences of twenty-eight of the calves were measured in a maze consisting of a central choice area, a large (21 m^2) and a small (2.4 m^2) goal room. The choice area could be entered from two sides. Each calf was given 6 successive tests, entering from each side of the choice area three times in a randomised order. Calves were given a maximum of 120 seconds to enter either of the two rooms. After entry they were left for 120 seconds in the chosen goal room. During the open-field test confined calves performed more bucking and buck-kicking than control calves (14, 13, 9 and 4 seconds for 4wk, 2wk, 1wk and control; $p<0.01$), but did not differ in other measurements. Calves showed a preference for the large room to the small, but there was no effect of treatment on this preference. The median latency to enter increased over tests (17, 30, 41, 44, 84 and 64 sec for tests 1, 2, 3, 4, 5 and 6; Friedmans $F=24.4$; $p<0.001$). The higher level of bucking in confined calves may either reflect a response to the novelty of the opportunity to buck or a build up of internal motivation to move during confinement. The lack of effect of length of confinement suggests that it is either a response to novelty or that the motivation builds up within days. Although calves preferred the large room, the increase in latency to choose suggests that their motivation to move may be fulfilled during the first tests.

Thwarting of normal roosting behaviour in laying hens

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It has been suggested that roosting above ground is important to laying hens and that they should be provided with perches to improve welfare. However, no study has addressed the question of motivation for roosting. We studied the undisturbed roosting behaviour and the reaction when roosting was thwarted. Fifty-two adult LSL laying hens were kept in groups of 26 on deep-litter with perches (perch space 0.9 m/hen). Scan behavioural observations of the number of hens on each perch level were performed for 60 minutes after lights-off. Eight groups of three hens were thereafter kept in experimental pens equipped with perches and each group observed in four different situations: pen unchanged (BASE), perch covered with plexiglass (PC), perch removed (PM) and again in the unchanged pen (POST), using focal behavioural sampling for 60 minutes after lights-off. In the home pen, hens started to climb the perch immediately after lights-off. After 10 minutes, more than 90 % of the hens were roosting. All hens roosted tightly together on the top perch. In the experimental pen, treatment effects (Wilcoxon Signed Rank Test, $p<0.05$) were found for the variables sitting, standing, walking and escape attempts (jumping up at the pen side and attempts to fly), with birds sitting less, standing more and showing more escape attempts when the perch was unavailable:

	BASE	PC	PM	POST
sitting[1]	$65.4^{a} \pm 7.5$	$22.4^{b} \pm 6.6$	$8.0^{c} \pm 2.2$	$74.2^{a} \pm 5.7$
standing[1]	$26.0^{ac} \pm 7.4$	$44.9^{b} \pm 4.5$	$43.3^{ab} \pm 5.2$	$20.8^{c} \pm 6.0$
walking[2]	$19.3^{a} \pm 8.2$	$18.7^{a} \pm 3.7$	$34.1^{b} \pm 4.0$	$10.1^{a} \pm 6.9$
escape attempts[3]	$0.024^{a} \pm 0.021$	$0.101^{b} \pm 0.029$	$0.242^{c} \pm 0.069$	$0^{d} \pm 0$

[1] % of time observed
[2] % of time spent on floor
[3] frequency per 100 sec observed

Both the extensive use of perches in the home pen and the behavioural changes when perching was thwarted support the hypothesis that roosting on perches is important to the hen.

The use of CRH challenge to assess chronic stress in veal calves

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The hypothalamo-pituitary-adrenocortical (HPA) axis is a major component of neuroendocrine responses to stressful events. After a chronic activation, the pituitary becomes less sensitive to CRH and the adrenals become more sensitive to ACTH. Two experiments were run to test the methodology of the CRH challenge in veal calves in order to detect modifications of the HPA functioning during chronic stress.

In experiment 1, 4 doses of CRH were used (0 µg/kg; 0.1 µg/kg; 0.5 µg/kg; 1 µg/kg). Each dose was injected to 5 calves equipped with jugular catheters. Blood was regularly collected during five hours after the CRH injection. Levels of ACTH and cortisol were determined respectively by an immunoradiometric technic and a radioimmunoassay. The integrated responses of ACTH and cortisol increased with the dose injected. That of ACTH could be accurately extrapolated from one blood sample taken during the 3 hours after CRH injection, whereas two samples taken before the peak (15 min) and after (2 hours) seem necessary to assess the integrated response of cortisol. Thus a simplified protocol for blood sampling was proposed and used in the second experiment.

In experiment 2, 32 veal calves were fed either milk replacer only or supplemented with solid food, and were either isolated or housed in groups of four. They were injected with 1µg/kg CRH when they were 2 months old. Calves housed in groups had higher basal cortisol levels but lower cortisol increases after the injection of CRH.

It seems that the CRH challenge can be used to evaluate responses of veal calves to their environment. However, to be used as a measure chronic stress, this test has to be further validated using conditions of more intense stress.

Hormonal changes in heifers during calving are related to phases and severity of labour

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The aim of this study was to determine whether plasma concentrations of cortisol, adrenaline, noradrenaline, β-endorphin, met-enkephalin, vasopressin and oxytocin vary depending on the phase and severity of labour in ten heifers (six of the Swedish Red and White and four of the Swedish Friesian breed). Blood samples were taken once daily for three days before labour and three days afterwards, and at pre-determined phases during labour. All heifers delivered one calf. Five of them needed obstetrical assistance (OA) and five did not (NOA). Data are means ± SEM, $p \leq 0.05$.

The cortisol concentration was elevated during the labour pains, compared to three days before parturition, and peaked when the calf was born (OA: 126 ± 28 nmol/l, NOA: 110 ± 23 nmol/l). Plasma adrenaline peaked after delivery in both groups (OA: 2.3±1.7 nmol/l, NOA: 1.5±0.9 nmol/l). The noradrenaline concentration did not change in heifers which needed assistance, but increased during expulsion in heifers calving without help, and peaked one hour after labour (3.6±2.6 nmol/l). The β-endorphin concentration was elevated one hour after labour only in heifers that needed assistance (21 ± 2 pmol/l). The met-enkephalin concentration rose during expulsion (OA: 39 ± 8 pmol/l, NOA: 43 ± 8 pmol/l). Vasopressin increased during expulsion, and peaked when the calf was born (OA: 21.6 ± 9.7 pmol/l, NOA: 4.5 ± 2.1 pmol/l). Plasma oxytocin peaked when the head of the calf was visible in heifers that needed assistance (485 ± 99 pmol/l), and when the calf was born in heifers that did not receive assistance (427 ± 134 pmol/l). Heifers that needed assistance had longer parturitions (6.9±1.7 h vs. 3.0±0.7 h) and higher circulating (i.e. area under curve) levels of plasma noradrenaline, β-endorphin, vasopressin and oxytocin, indicating that these hormones are released in order to deal with the pain-related stress associated with labour.

Effects of intracerebroventricular infusion of Corticotropin-Releasing Factor on feeding behaviour in sheep

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Corticotropin-releasing factor (CRF) is known to inhibit feeding behaviour in rats. On the other hand, in ruminants which has different digestion system, there is no obvious evidence whether CRF has some effect on their feeding behaviour or not. As CRF is thought to have an important role in mediating stress responses, CRF might be related to an inhibition of feeding behaviour in ruminants during stressful situations. Therefore we examined acute changes in feeding behaviour in sheep following intracerebroventricular infusion of ovine-CRF (oCRF). Three sheep were subjected to restricted feeding for 2 hrs., 9.00-11.00 am, a day. Feed intake had become stable (about 50g/10min) in intact condition from 60 min after the onset of feeding. On the experiment day, they were infused with either oCRF (0.5 , 5 and 50 lg dissolved in 0.5 ml artificial cerebrospinal fluid [aCSF]) or 0.5 ml of aCSF (Control group) into third ventricle over 60- to 90-min period after the onset of feeding. Feed intake during each 10 min was recorded. Feeding behaviour was also recorded by a time-lapse videocamera. Serial blood samples for cortisol measurement were collected via indwelling jugular catheters. Heart rate (HR) and rectal temperature (RT) were recorded by a telemetry system. In all the Treatment group, feed intake decreased between 90- and 120-min period after the onset of feeding compared with Control group. 0.5-50 lg oCRF elicited a dose-related increase in plasma cortisol values over 80- to 120-min period. There were no difference in HR and RT among all the group. These results indicate that oCRF would inhibit feeding behaviour in sheep. In contrast with the cortisol response to CRF, feeding behaviour was inhibited by a minimum dose infusion (0.5 lg of oCRF). Further study is needed to assess the role of oCRF in an inhibition of feeding behaviour in stress situations.

The influence of long wave radiation on the behaviour of piglets in warm conditions

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In warm regions, houses for farm animals are usually uninsulated and open for good ventilation. A shelter protects animals against solar radiation, but emits long wave radiant heat from the inside surface.

The behaviour of twenty-one piglets (Belgian Landrace, 20 kg, groups of 3-6) was tested in relation to long wave radiation at two levels (466.2 W/m^2 and 714.1 W/m^2) during 4 hours at an air temperature of 27 ± 1°C. Radiation was produced by heaters mounted on the ceiling of the climatic chamber. Piglets spent more time lying on the slatted floor (dunging area) when long wave radiant heat load was highest (78.3 ± 49.1 vs. 24.8 ± 30.0 minutes, $P<0.05$). Lying-huddling time decreased significantly (84 ± 40 vs. 121 ± 29 minutes, $P<0.05$) when thermal radiation intensity increased. Eating time and eating frequencies varied greatly within the different groups, but radiant heat load was a highly significant factor for drinking time (3.01 ± 1.59 vs. 1.36 ± 0.56, $P<0.05$). Water intake by mammals is usually correlated with food intake (Anand, 1961, Physiol. Rev. 41, 677-708), but was not observed in this study. It was concluded that long wave radiation of 714.1 W/m² at 27 ± 1°C is an important environmental parameter for the lying and drinking behaviour of piglets, which should be considered when designing pig' buildings in warm regions.

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The D.G.M. Wood-Gush Memorial Lecture

Scientific ideology, anthropomorphism, anecdocte, and ethics

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It is virtually impossible to emerge from a training program in the biological or biomedical sciences without developing skepticism about and distaste for anthropomorphic attribution of mental states to animals. Equally suspect is any attempt to demonstrate such states by appeal to anecdotal information of the sort routinely accepted by ordinary common sense.

The incorporation of this skepticism into developing scientists is a major part of what I have elsewhere termed the common sense of science[1], the set of basic or philosophical assumptions taught as fact along with the factual material that constitutes the scientific discipline in question. In the case of animal mental states, this philosophical position may be stated as follows: Science can only deal with what can be directly observed or what is subject to experimental verification. It is argued that failure to hold this position historically led to a science impaired by speculation, metaphysics, and even theology—witness the élan vital of Bergson, the entelechies of Driesch, and various theological teleologies which have attempted to explain biology, from Paley to Creationism. Now it is evident, the argument continues, that thoughts, feelings, concepts, desires, intentions in animals are not the sorts of things which can be either perceived or explored experimentally. Thus such material is not a legitimate object of study. This position, implicit in some versions of positivism, found clear expression in Watson's formulation of behaviorism, and exerted major influence even on thinkers opposed to behaviorism, such as Lorenz and Tinbergen. Thus the 1957 volume, Instinctive Behavior, which described the first encounter between behaviorists and ethologists, stressed the absolute concord between both groups regarding the methodological need for avoiding talk of animal mentation (that is, animal mental activity, or thought). The two factions in fact agreed on little else.[2]

If talk about mentation is ruled out by fiat, it is a fortiori the case that such talk cannot rely on anecdotal evidence, which often tends to be anthropomorphic in substance. Indeed, even if we allow for the possibility of scientific talk about mental states in animals, the common sense of science asserts that such anecdotal evidence ought to be suspect on other grounds. Anecdotes depict events which are unique, non-repeatable, described by naive observers, and which are often reported by observers biased in favor of what they report. Furthermore, they tend to employ anthropomorphic categories of description, and such categories may famously a) be inappropriate to the species in question (as in the layperson's tendency to attribute intentional theft to a pack rat) or b) be so wildly speculative as to be absurd (as when ordinary people say that their dog knows his birthday is coming).

With such a formidable arsenal of arguments against talking anthropomorphically of mental states in animals and supporting such claims anecdotally, one can understand scientists' reluctance to permit such talk, and indeed such talk virtually disappeared from scientific literature during most of the twentieth century. Nonetheless, the issue has once again been thrust forward into the scientific arena.

Why has this occurred? There are many historical factors which have tended to soften the positivistic/behavioristic skepticism about animal consciousness, which I have detailed elsewhere.[3] But one in particular is worth recounting here: Ordinary common sense, as

distinct from the common sense of science, has of course never had any doubts about attribution of mental states to animals—indeed, as Hume point out, few things are more repugnant to ordinary common sense than skepticism about animal mind.[4] But, until recently, ordinary common sense cared little about the implausibility of scientific common sense; if scientists wanted to believe that animals have no minds—fine; scientists believed many strange things!

A major clash between these two competing common senses has only arisen in the last two decades. For it is only in that period that ordinary common sense has begun to draw any significant moral implications from the presence of thought and feeling in animals. Although ordinary common sense certainly never doubted that animals could feel pain, fear, etc. it drew no moral conclusions from this, largely because animal exploitation was invisible to daily life because of the nature of animal use. Science, on the other hand, insulated itself from the moral implications of its own activity with animals not only by the denial of animal mentation but by another principle of scientific ideology—the claim that science is value-free, and thus can make no moral claims and take no moral positions, since moral judgments, too, are impossible to verify.

Of late, however, ordinary common sense has grown increasingly conscious of our moral obligations to animals, and increasingly unwilling to let science go its own way. The reasons for this change in public attention to animal treatment—and to science's agnostic attitude to this—are largely moral ones, growing out of profound changes in animal use that have arisen in the past fifty years. Prior to World War II, and indeed for virtually all of human history, the overwhelming use of animals in society was agricultural—animals were reared for food, fibre, locomotion and power. The key to successful animal production was husbandry, an ancient term derived from the old Norse words «hus/bond»—bonded to the household. Husbandry meant putting one's animals into the optimal environment in which they were biologically suited to thrive by virtue of natural and artificial selection, and further increasing their natural ability to survive and flourish by providing protection from predation, medical attention, protection from extremes of climate, providing food and water during times of famine and drought, etc. Indeed, so powerful is the part played by husbandry in human history that when the Psalmist needed a metaphor for God's relationship to humans, he drew on the archetypical husbandry role, that of the shepherd: «The Lord is my shepherd, I shall not want. He leadeth me to green pastures, He maketh me to lie down beside still waters, He restoreth my soul.»

Husbandry was an almost perfect mixture of prudence and ethics. It was self-evident that the wise man took care of his animals—to fail to do so was to harm himself as well as his animals. Husbandry was assured by self-interest, and there was thus no need to place heavy ethical emphasis on proper care of animals. The one exception was the ancient prohibition against overt cruelty and outrageous neglect, designed to cover those rare sadists and psychopaths unmoved by self-interest.

Proper treatment of animals, then, for most of human history, was not heavily stressed in social ethics, since it was supported by the strongest of motivations—self-interest. Husbandry agriculture—the overwhelming use of animals in society—was about putting square pegs in square holes, round pegs in round holes, and generating as little friction as possible while doing so. Animal agriculture—historically virtually all of animal use—was thus a fair contract between humans and animals, with both sides benefitting from the ancient contract represented by domestication.

This ancient and fair compact changed dramatically in the mid-twentieth century with the rise of high technology agriculture. With the advent of «technological sandpaper»—

antibiotics, vaccines, hormones, etc.—agriculture was no longer constrained by the animals' biological natures. It was now possible to force square pegs into round holes, round pegs into square holes, with the resulting animal suffering irrelevant to profit. The connection between animal welfare and animal productivity was severed. Similarly, with the rise of massive amounts of research and toxicity testing on animals beginning at approximately the same time, animal use could benefit us while harming them in unprecedented ways—inflicting disease, wounds, burns, fear, pain, etc. on animals so we could study them, with no compensatory benefits to the animal subjects. For the first time in history, the welfare of animals used by humans became a moral issue. By the late 1970s, European and North American society were demanding that animal use be modified in research and agriculture so that animal suffering be mitigated and animal well-being be assured.

In this way scientific ideology, agnostic about animal consciousness, clashed with ever-increasing social concern about animal treatment. The new social tendency to concern itself about animal welfare forces upon science what I have called «the reappropriation of ordinary common sense» about animal thought and feeling. Thus, for example, in the face of U.S. federal law which requires control of pain and suffering in laboratory animals, it is obviously inappropriate for scientists to express total skepticism about our ability to know what animals think and feel.[5] Thus scientific ideology is threatened, and must adapt to accommodate ordinary common sense. And this is precisely what has occurred. Take, for example, the symposium on animal pain and suffering convened by the American Veterinary Medical Association in 1987, and its attendant Panel Report on Animal Pain.[6] Traditional scientific common sense had explained pain research as research into pain mechanisms and behavior, and ignored any talk of the subjective experiential dimension.[7] But this report acknowledges that animals do feel pain, pointing out that pain research which is extrapolated to humans is after all done on animals! Indeed, the report continues quite reasonably, all animal research which is used to model human beings is based in a tacit assumption of anthropomorphism; and if one can in principle extrapolate from animals to humans, why not the reverse as well?

But a hard-line proponent of the common sense of science would very likely remain unmoved by our discussion, and might respond as follows: I grant that political pressure forces upon us the need to behave as if animal consciousness is scientifically knowable and affirmable. But, in fact, it is not, for the reasons detailed above. A bitterly amusing example of such scientific conservatism was related by Dr. Robert Rissler, the United States Department of Agriculture official charged with interpreting the 1985 U. S. federal laws aimed at furthering of welfare laboratory animals. In addition to requiring the control of pain and suffering through proper anesthesia, analgesia, sedation and euthanasia, the laws required that non-human primates used in research be provided with environments that «enhanced their psychological well-being.» Rissler, a veterinarian, knew little about primates, and even less about their psychological well-being, having himself been trained under skepticism about animal mentation. Nonetheless, he was charged with writing regulations giving operational meaning to the psychological well-being of primates. Somewhat naively, he approached the American Psychological Association's Primatology Division, seeking their counsel on defining this obscure notion. «Don't worry,» they assured him. «There is no such thing.» «Oh, but there will be after January 1, 1987, [the date the law took effect] whether you help me or not!» replied Rissler tellingly.

Science is, of course, our vehicle for knowing about the world. If science denies our ability to access animal mentation through anecdotal data and anthropomorphic language, it removes itself from answering or helping to answer the key ethical questions about animal well-being that have emerged in society. To address questions of animal treatment, welfare,

acceptable environments, pain and suffering, etc. we must be able to make meaningful claims about what the animals experience and feel. To do this, we must in turn be allowed to use anthropomorphic locutions (that is, verbal expressions), based in our ordinary empathetic experience of animal lives. Indeed, the psychologist Hebb showed that when zoo-keepers were not allowed to use anthropomorphic, anecdotally based locutions about their animal charges, they reported themselves unable to do their jobs.[9] My animal agriculture students, when taught animal behavior by a mechanist who refused to use mentalistic locutions about animals, similarly reported ignoring the professor's teachings when they went home to their ranches. «If I can't say that the bull is pissed off today,» said one such student, «I won't live real long.» Our ability to work with animals, anticipate their behaviors and meet their needs rests foursquare on such locutions. Scientific common sense's agnosticism about such locutions therefore in essence removes questions of animal welfare from the realm of legitimate empirical investigation. Thus it becomes necessary to examine briefly the logic of the common sense of science if we wish to guarantee that the admission of some animal mentation into science represents more than sullen and minimal acquiescence to the vagaries of public opinion.

It is first of all necessary to point out that the skepticism discussed above, if systematically adhered to in science, would render doing science impossible. For in actual fact, scientific activity involves certain assumptions which flagrantly violate the claim that everything in science must be observable or subject to direct experimental confirmation. Consider the following: Science assumes that there is a real, public world out there, existing independent of my perceptions, and accessible to other humans and to other scientists in particular. It also assumes that other scientists perceive the public world and think more or less as we do, and that it is possible to distinguish between true and false scientific reports about experiences of that world. It also assumes that there really is a past, even though we cannot experience it directly, and that it is not the case that the universe was created three seconds ago, fossils and all, and us with all our memories.

The key point is that none of those beliefs can—even in principle— be confirmed by observation or directly tested by experiment. Yet few scientists are disposed to reject them, even though they conflict with what is implied by the assumptions of scientific common sense. If they did reject them, they could not do science! (What would solipsistic science be like? Why publish?) Thus the hard–line skepticism discussed above must be modified, or it destroys science altogether.

The obvious response is that it is wildly implausible to embrace solipsism (the belief that only I exist), to deny other minds or an external world, or to treat the history of the world as three seconds old. And to this I fully agree. Yet, in my view, it is equally implausible to deny mentation to animals. Philosophically, as soon as one has given up the hard line which only admits directly observable facts into science, and one has admitted that certain non-verifiable beliefs are admissible on the grounds of plausibility (e.g., of an external world independent of observers and commonly accessible), one has replaced a rigid logical criterion for scientific admissibility with a pragmatic one in which one needs to argue for exclusion of certain notions from science, rather than simply apply a mechanical test. And, of course, this is what has in fact occurred in the history of science--science now talks of all sorts of entities and processes which are not directly verifiable or directly tied to experiment, from gravitation to black holes. Indeed, contemporary physics, traditionally cited as the hardest of hard science, has produced many notions which violate the common sense of science.[8] Such theoretical notions are accepted, of course, because they help us understand reality far better than we do without them.

Talk of mind in animals has a similar justification. We have already mentioned Hebb's point that we could not interpret animal behavior in ordinary life without imputing such notions as pain, fear, anger, affection to animals—all of which have a mentalistic component in addition to a behavioral one.[9] If saying that a dog is in pain means only that the dog is exhibiting a certain range of behaviors or responses, this does not explain its cringing or loss of appetite; to explain such responses we must also assume that it is feeling something—hurt—which is functionally equivalent to what we feel when we hurt. This assumption is in fact, as the American Veterinary Medical Association Pain Panel said, presuppositional to doing pain research and analgesia screening in animals and extrapolating the results to people—what we are interested in is a feeling common to both, not merely similarity in plumbing and groaning.

We have thus far attempted to establish that the traditional scientific skepticism about animal mind is wrong-headed. Furthermore, using the example of pain, we have argued that, in at least some cases, scientific attribution of mentation is inevitable and based in anthropomorphism as presuppositional to its intelligibility.

It is now relevant to introduce the notion of anecdote as a source of information about animal mentation, and assess its relevance to science. An excellent place to begin, for it retains the simple case of pain we have been using, is a famous article by Griffiths and Morton, which appeared in the Veterinary Record.[10] This article was one of the first recent papers addressing the recognition and alleviation of pain in animals. It is noteworthy that while the authors do provide criteria for assessing pain and its degree in animals, they stress that the best sources of information about animal pain are farmers, ranchers, animal caretakers, trainers—in short those whose lives are spent in the company of animals and who make their living through animals. Given the plausibility criterion discussed earlier, such a position is obvious. Whereas scientists could get on perfectly well in highly artificial laboratory situations saying that it is impossible to know about animal pain and other mental states, those who live with and depend on animals could not. If you fall into the latter class, and don't recognize pain, fear, anger, etc. in your animals, you will lose your livelihood, be highly vulnerable to injury, unable to control or train your charges, etc. Thus, given that science specifically denied the reality of animal thought, and made no attempt to study it, it is perfectly proper to look to those who have been compelled to understand animal thought for millennia. To be sure, such information will be "anecdotal"—i.e., not obtained in laboratory experiments and not analyzed, but that does not mean it is illegitimate.

Thus we have seen that, in the simple case of pain, the common sense of science is wrong, and that one can talk of what animals experience; that one must use a measure of anthropomorphism (even as we use our own individual experiences as a guide to understanding that of other humans); and that one must depend (at least currently) on anecdotal information. Indeed, an even more striking argument can be made regarding the concept of suffering, which does not even appear in the scientific literature with regard to humans; let alone animals. One can also support these arguments with others. Similar physiological mechanisms for pain in humans and animals, similar behavioral responses, similar neuro-chemistry, and the plausibility of phylogenetic continuity all argue in favor of attributing the feeling of pain to animals, as does the fact that humans who do not feel pain, for congenital or acquired reasons, do not fare well.[11]

One could respond to the argument we have developed thus far in this way: As long as you focus on simple, fundamental, primitive mental experiences like pain, your argument is unexceptionable. But as soon as one leaves sensation and begins to talk of higher mental processes in animals, one cannot accept anecdotal anthropomorphic evidence. Ordinary

common sense and its discourse is far too disposed to exaggerate animal intelligence, planning, reasoning, emotional complexity, and to jump to unwarranted conclusions by seeing animals as little humans. Indeed, it was precisely such romantic, unbounded anthropomorphism and exaggerated anecdotes which abounded in the 19th century that led in part to the behavioristic/positivistic reaction against animal thought!

How does one reply to such an objection? In the first place one might argue (as did Buytendijk) that the ability to feel (and respond appropriately) to pain indicates mental sophistication beyond mere sensation.[12] Thus, pain in and of itself would be of little value if it was not coupled with some ability to choose among alternative strategies of response, e.g., fight or flight, hide, evade, etc. Thus the evolutionary function of pain consists in the ability of the noxious stimulus to evoke not only motivation to alleviate it, but strategies to deal with it as well. It is in fact this insight which led pain physiologist Ralph Kitchell to conjecture that animals may well suffer pain more profoundly than humans do.[13] Since they lack the cognitive abilities possessed by humans to understand the sources of pain and to formulate strategies for its relief or for its mitigation, Kitchell has suggested that the motivational aspect of pain, i.e., the hurting, and related drive to escape it may well be more profound in animals than it is in humans, and thus their experience of pain may be, on balance, worse than ours. As I have pointed out elsewhere in this regard, it has often been argued that as animals lack the tools for transcending the here and now provided by linguistic capacity and concepts, they also lack the suffering which we experience from anticipation of pain and other noxious experiences. However, if this is the case, they also lack anticipation of the end of pain, and have no «hope.» In a terrible way, they are their pain; there is no light at the end of the tunnel.

Be that as it may, I should rather respond by affirming that the argument and strategy we have constructed for using anecdotal and anthropomorphic information to identify pain is in principle no different from using the same approach to understand "higher" (or other) mental processes. The relevant distinction is not pain (or sensation) versus thought (or higher mental processes)—it is rather good versus bad anthropomorphism, reasonable versus unreasonable anecdote.

Once again, the key notion for our analysis is plausibility, the same sort of measure we use when we attribute thoughts, plans, feelings, and motives to other humans, be it in daily life or when serving on a jury. Let us recall that we do not experience other people's mental states and that language can be used to conceal and deceive. How, then, do we judge other humans' mental states? What we do is use a combination of weighing of evidence and what we might call "me-thropomorphisms"—extrapolations from our own mental lives to others. For example, if a friend of mine who has shown a normal propensity for jealousy, suddenly finds his wife, whom he has loved deeply, running around flagrantly with another man, and tells me he bears her no ill will, I am skeptical. I can in principle be convinced that he feels no jealousy, but this would require very extensive observation and interaction with him to displace my plausible interpretation. On the other hand, if he tells me that he is jealous and angry, or behaves that way, it is certainly reasonable to assume that he is, for that fits what I know of myself and others.

Although we would be hard-pressed to articulate them, we all have rules–of–thumb for judging the plausibility of anecdotes about other people, and of explanations of their behavior. The female student who tells me that a professor obviously has a crush on her and cites as evidence the fact that he ran into her twice in one week at the grocery and said "hi," may reasonably not be taken seriously. In fact, the vast majority of our knowledge of human behavior does not come from scientific research, but from life experience and what would be dismissed by the common sense of science as "anecdote."

My claim, like that of George Romanes, is that anecdote is, in principle, just as plausible a source of knowledge about animal behavior as it is about human behavior, provided it is tested by common sense, background knowledge, and standard criteria of evidence. Thus, when a child says that there is someone on the street giving away money to everybody who wants it, we suspect either misunderstanding or swindle, since by and large, people don't do such things. By the same token, when someone interprets his dog's restlessness as evidence that the dog knows it is his birthday, we can dismiss that, since we have no reason to believe that the dog has—or even can have—a concept of birthday. On the other hand, if the person telling the anecdote explains the dog's excitement by saying that he has learned that when his masters cook and clean all day and frequently look out of the window, guests are coming, that is consistent with what we know of dogs' abilities.

More difficult cases occur when the anthropomorphic anecdote concerns a species of animal with which we do not enjoy the familiarity we do with dogs, though here the problem is in principle no different than when we deal with people who come from cultures significantly different from ours. When they belch loudly after a meal, we may label them as rude people out of ignorance of their culture, in which such an act is a polite compliment; we can make the same mistake looking at unfamiliar animals. Compare the child—or urban adult—who reports equine sex-play as "fighting."

Thus it would seem to me that once one has in principle allowed the possibility of anthropomorphic, anecdotal information about animal mentation, one must proceed to distinguish between plausible and implausible anecdotes (the latter of which may nonetheless turn out to be true, though we are right to be skeptical) and likewise between plausible and implausible anthropomorphic attributions. The fact that many people tell outrageous anecdotes, or interpret them in highly fanciful or unlikely ways, and even publish such nonsense, should not blind us to the many plausible anecdotes and reasonable interpretations coming from people with significant experience of the animals in question, any more than outlandish stories about humans should cause us to doubt all accounts of human behavior.

Anecdotes and their interpretation may obviously be judged by many of the sort of principles Romanes relates in his classic introduction to Animal Intelligence. Does the anecdote fit with other knowledge we have of animals of that sort? Have similar accounts been given by other disinterested observers at other times and in other places? Does the interpretation of the anecdote rely upon problematic theoretical notions? (Such as a grasp of the concept of "birthday" by a dog.) How well do the data justify the interpretation? Does the person relating the anecdote have a special interest in either the tale or its interpretation? Penny Patterson's stories of Koko in her fund–raising letters naturally excite some skepticism. What do we know of the teller of the anecdote—Konrad Lorenz or Baron Munchausen? One can—and we do—set up plausible rules for judging anecdotal data, be it about humans or about animals. The alternative is to create total skepticism about the common sense experience that has given us most of our social knowledge of the behavior of people and animals.

One fascinating point which has escaped notice is that anecdotes are logically no worse off than reports of scientific experiments and their interpretation—in some ways the latter may be more suspect. As we know from the rash of recent reports of data falsification, fraud, and dishonesty in scientific publications, scientists are as human as anyone else. Given a "publish or perish system" for science, scientists feel the pressure to produce or else they must effectively give up their careers. If this is so, then researchers have a strong interest in obtaining results, which in turn should excite our natural suspicion. It is true that scientific reports are replicable in principle, but there is little money for such replication, as long as a

result is consistent with data in the field. Anecdotes are, of course, also replicable in principle, either by experiment or observation. In the final analysis, any report of an experiment is by definition an anecdote, not a confirmed hypothesis. The following question should be considered by anyone interested in these issues: Is it more unreasonable to trust the account of a disinterested lay observer or a scientist who must get results to survive? Do the theoretical biases which scientists develop during their training have less or more or equal effects on their capacity to observe than the theoretical biases built into a non-scientifically trained, but intelligent observer?

For purposes of winding up this discussion, let us conclude, appropriately enough, with an anecdote which is very interesting to lay people and to students of animal behavior. The story was reported in detail on Denver television accompanied by videotaped pictures of the events described. In the story, an African elephant at the Denver Zoo had lain down and refused to get up, a condition known to be fatal if not corrected. All efforts to get the elephant to stand up—including bringing in a hired crane—had failed. By chance, the Asian elephants were herded past the afflicted elephant. The Asian elephants broke ranks, approached the fallen elephant, and nudged and poked him until he stood up. They then supported him until he stood on his own.

Thus far, we have an anecdotal narrative, with little or no theoretical bias and no interpretation offered. The story certainly provides data relevant to the study of elephant behavior. Although the TV station has an interest in presenting dramatic stories, it filmed the events and its account was supported by other observers.

The common sense interpretation of the data offered by the station, and by the average observer, was that the elephants were altruistically helping another elephant, even though it was of a different species. Such an interpretation is more problematic than the simple report of the events, since "help" is ambiguous and speculative. The events are certainly open to other interpretations. When, however, one adds that story to the many other stories of elephants showing helpful behavior to other elephants, together with the extensive data we have on problem solving ability and the social nature of elephants, the interpretation gains in plausibility.

To dismiss data on (and interpretations of) animal behavior simply because the data were not obtained in laboratories (which are in any case highly unnatural conditions for animals); or not observed by "accredited scientists" is against the spirit of what science should be. To be sure, common sense is "theory laden" with problematic categories and interpretations, but so too is science. It is at least as hard to see how intelligent, educated scientists accepted behaviorism so thoroughly for most of this century as it is to see how ordinary people can accept astrology today.

As Feyerabend suggests, science should be democratic in its acceptance of data sources, but stricter in the theories or explanations it produces. Attribution of mental states to animals provides a very plausible theoretical structure for explaining and predicting animal behavior. Anthropomorphism, if tested against reasonable criteria for evidence, is another plausible—and indeed inevitable—theoretical approach to assessing animal behavior. And finally, since there are and always have been far more ordinary people out observing animals than there are scientists engaged in the same activity, it would be a pity to rule out anecdote, critically assessed, as a potentially valuable source of information—and interpretation—of animal behavior. In fact, ever-increasing social–ethical concern about animal treatment essentially requires information about what matters to animals as the raw material for producing social policy. Since the common sense of science has morally castrated the language it uses to describe animal behavior, avoiding, for example, morally laden

descriptions of animals expressing pain in favor of «neutral» locutions like «vocalizing,» the gap must be filled by the language of ordinary common sense, replete as it is with morally relevant locutions about animal experience.

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