Proceedings of the 35th International Congress of the ISAE

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Contents

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Talks, plenaries, and workshops at a glance

Saturday, August 4th

ISAE Council Meeting (09:00-17:00)

Registration and Poster set-up - Freeborn Hall (12:00-17:30)

Joint ISAE/ISAZ reception - Cantina del Cabo (19:00-21:00)

Sunday, August 5th

Congress opening - Freeborn Hall (09:00)

Plenary: Companion Animal Behavior - Freeborn Hall (chair: J. Serpell)

Coffee at posters (authors of even-numbered posters stay at their posters) - Freeborn Hall (10:00-10:40)

Companion Animal Behavior - 1100 Social Sciences (chair: K. Houpt)

Lunch (12:40-13:50)

Free papers: Weaning - 198 Young Hall (chair: E. Pajor)

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Plenary: Companion Animal Behavior - Freeborn Hall (chair: J. Garner)

Companion Animal Behavior - 1100 Social Sciences (chair: D. Feddersen-Petersen)

Coffee at posters (authors of odd-numbered posters stay at their posters) - Freeborn Hall (16:30-17:20)

Workshop A - 1100 Social Sciences

Workshop B - 198 Young Hall

Workshop C - Freeborn Hall

Free papers: Animal Management - 198 Young Hall (chair: J. Morrow)

Monday, August 6th

Plenary: Animal Experience and Human-Animal Interactions - Freeborn Hall (chair: J. Day)

Free papers: Animal Experience and Ethics - 1100 Social Sciences (chair: S. Christiansen)

Special Council Workshop Discussion: Ethics Guidelines for the ISAE - Freeborn Hall (10:50-11:50) (chair: C. Sherwin)

Technical Excursions (12:00-24:00)

Drinks at posters - Freeborn Hall (19:00-21:00)

Akeoke Competition - Memorial Union, MU II (20:00-21:30)

Tuesday, August 7th

Wood-Gush Memorial Lecture - Freeborn Hall (chair: I. Duncan)

Coffee at posters (authors of odd-numbered posters stay at their posters) - Freeborn Hall (09:30-10:10)

Free papers: Human-Animal Interactions - 198 Young Hall (chair: C. Phillips)

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Free papers: Handling and Transport - 1100 Social Sciences (chair: S. Millman)

Lunch (11:50-13:00)

Plenary: Laboratory Animals - Freeborn Hall (chair: T. Widowski)

Free papers: Laboratory Animals - 1100 Social Sciences (chair: M. Stauffacher)

Coffee at posters (authors of even-numbered posters stay at their posters) - Freeborn Hall (15:20-16:00)

Annual General Meeting of the ISAE - Freeborn Hall (16:00)

Banquet (19:00-24:00)

Free papers: Environmental Enrichment - 198 Young Hall (chair: R. Newberry)

Free papers: Social and Sexual Behavior - 198 Young Hall (chair: M. Ruis)

Wednesday, August 8th

Plenary: Influence of Genetics on Behavior and Welfare - Freeborn Hall
(chair: J. Swanson)

Influence of Genetics on Behavior and Welfare - 1100 Social Sciences
(chair: R. Murphey)

Coffee break (10:20-10:40)

Influence of Genetics on Behavior and Welfare - 1100 Social Sciences
(chair: A. Zanella)

Closing of Congress - Freeborn Hall (12:45-13:00)

Free papers: Nesting and Maternal Behavior - 198 Young Hall (chair: L. Lidfors)

Free papers: Abnormal Behavior - 198 Young Hall (Chair: N. Waran)

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Posters at a glance

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Companion animal behavior

Influence of genetics on behavior and welfare

Abnormal behavior

Cognition and learning

Conservation

Feeding and foraging behavior

Motivation and fear

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Physiology and stress

Preference testing and enrichment

Production

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Sexual and parental behavior

Social behavior

Welfare assessment

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Abstracts of talks, plenaries, and workshops in order of presentation

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Companion animal behaviour problems - getting the science right for their study

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Behaviour problems in companion animals tend to be viewed as specific conditions to be diagnosed and treated. However, there are potential problems of reliability and validity associated with the concept of behaviour problems as distinct entities, which this approach implies. Many behavioural problems are in fact extensions of normal functional biological processes associated with physiological and environmental regulation even though they may be inappropriate or inconvenient for other individuals who share that environment. They are not qualitatively nor sometimes even quantitatively different from normal behaviours and so cannot be distinguished from normal behaviours by any clearly defined features to make them a different category of behaviour. Many of the problems that arise when trying to impose a categorical system on something that exists as a continuum can be seen in current classifications of problem behaviour. We present our data from interviews, including case studies, with academic authorities in North America and Europe which illustrate this point. An alternative approach is to recognise the variability of the functional neuropsychobiological systems that control normal behaviour and how this explains a given state or response. This approach does not use diagnostic labels for patients but examines which, of a range of biological control systems within the individual, are involved in a given situation. Using this approach, not only can individual variability in response to both environmental and physiological interventions be understood, as illustrated by our own work on the effects of selegiline on behaviour (Mills & Ledger in press); but also the widely recognised inconsistent effects of pharmacological intervention possibly predicted more effectively. We therefore conclude that there is a need for a shift in the conceptualisation of behaviour problems if the science of animal behaviour problems is to avoid repeating the errors of human psychiatry.

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Clinical ethology: merging the fields of applied ethology and behavior therapy of companion animals

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Sun AM

Two disciplines are concerned with the behavior of domestic animals: applied ethology working primarily with farm animals, and behavior therapy concentrating on companion animals. Unfortunately, there has been little cooperation between the two fields, although they attempt the same: to avoid behavior problems in domestic animals. In veterinary terms this means identifying symptoms of behavior problems, analyzing their causation, establishing an exact diagnosis, and treating and preventing the problems.

In one field some aspects of this process are well developed whereas others are not, and vice versa. Thus, identification of symptoms by observation techniques and physiological measurements is well developed in applied ethology but less so in behavior therapy. Similarly, development of specific diagnostic tests or behavior tests (fear tests or tests for specific traits) is more advanced in applied ethology than in the behavior clinic. In contrast, treatment of behavior problems is the main objective of the behavior clinic, and is therefore detailed and varied. In applied ethology, however, treatment is mostly considered unethical and is therefore undeveloped. Finally, although the prevention of behavior problems has a high priority in both fields, it is mostly based on practical experience rather than scientific investigation.

To improve things we suggest that the two fields be merged under the term clinical ethology. Emphasis should be given firstly to preventive aspects (that is, preventive ethology) by analyzing the ontogeny of abnormal behavior, and secondly to therapeutic aspects. These include identification of symptoms, analysis of causation, exact diagnosing, and treatment based on elimination of symptoms or, better yet, elimination of causes, involving biometrical tools for processing information. Using this approach, we believe that both applied ethology and behavior therapy could benefit from each other and that a concerted effort to reduce behavior problems would mean improvement of the welfare of all domestic animals.

The emergence and encouragement of skills to facilitate early weaning in pigs

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Pigs in natural conditions wean gradually over 10-18 weeks of age. In commercial husbandry, they are weaned abruptly, at 3-5 weeks old, before skills to cope with weaning have emerged. These projects aimed to determine whether outdoor rearing enabled pigs to develop skills more rapidly, and whether appropriate enrichment of farrowing pens could accelerate the development of intensive indoor pigs, and hence facilitate early weaning. Groups of 4 indoor- and 4 outdoor-reared litters were observed through lactation and after weaning. Outdoor pigs were twice as active before weaning (in terms of time not lying) and developed walking/scampering, chewing vegetation, chewing other materials more rapidly, and, especially, rooting (Indoor: 5.31 vs Outdoor: 18.13% of time during pre-weaning week; with data matched by time period, t=6.33; p<.001 with 39 DF). Over the 4 days post-weaning, outdoor pigs were more active, fed more on the first day after weaning (Outdoor: 9.34 vs Indoor: 1.86% of time; t=6.18; p<.001 with 13 DF) and belly-nosed less (0.93 vs 2.62 incidents/h over Days 3 and 7; p<.001 by Binomial test with 60 compared time periods). They gained more weight over the post-weaning week (Outdoor: 1.83 kg vs Indoor: 0.92 kg; t=6.29; p<.001 with 115 DF).

Indoor piglets were given peat- and/or wood-chip-filled trays in their farrowing pens, in which to root and chew. Piglets with rooting materials were more active, chewed and rooted more (rooting in peat, bark, peat/bark and bare-surfaced trays: 5.13, 5.17, 4.41 and 0.65% of time respectively; ANOVA F=8.37: with 3,117 DF; p<.001). The few instances of belly-nosing and ear/tail chewing pre-weaning were mainly confined to controls (Chi-square=43.89: with 3 DF; p<.001). However, no form of enrichment facilitated any measure of post-weaning behaviour or performance. Pre-weaning provision of rooting and chewing materials to indoor pigs accelerated the development of some skills, but did not facilitate early weaning in these conditions.

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Stereotypic parrots fail the same psychiatric task as stereotypic autists and schizophrenics

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Sun AM

Stereotypies (abnormal, repetitive, and invariant behaviors) are common behavior problems in caged animals, including companion animals such as parrots. The mechanisms and welfare implications of stereotypy are unclear. Human drug-induced and psychopathological stereotypies involve basal ganglia dysfunction, as evidenced by characteristic inappropriate repetitive responding. We hypothesized that cage stereotypy involves a similar dysfunction. We predicted that, like stereotypies in schizophrenia and autism, cage stereotypy would correlate with inappropriate repetitive responses on a task considered diagnostic of basal ganglia dysfunction – the 'gambling task'.

Nine (four female; five male) captive-bred Orange-winged Amazon parrots were taught to climb to one of two food cups upon presentation of a visual stimulus. When the bird chose a cup, it was rewarded with a probability equal to 1 minus the side-bias in the previous 20 trials. For example if a cup was chosen in 16/20 previous trials, the probability of being rewarded if that cup is chosen is 0.2 (4/20). Although the correct side on any given trial is unpredictable, the best strategy is choosing both sides equally. 102 trials were recorded from each bird over subsequent one-hour sessions. The mean randomness of each chain was calculated using 3rd order Markov analysis. Home cage behaviour was videoed between 0900h and 1000h. The percentage of active time stereotyping was recorded.

Stereotypy varied from 0% to 39% of activity. As predicted, stereotypy was negatively correlated with mean chain randomness (GLM, blocked by sex: $F_{1,6}$=7.39; partial r=.729; p=0.035). High stereotypy parrots produced long sub-chains of repeats.

Thus parrot cage stereotypy, like human psychopathological stereotypies, correlates with poor performance on a psychiatric task diagnostic of basal ganglia disinhibition – a dysfunction associated with frustration and suffering in humans. Furthermore, this result shows that stereotypy is not equivalent to human Obsessive-Compulsive Disorder, in contrast to the predominant treatment rationale in veterinary medicine.

Thermoregulation of the nursery by early weaned piglets through operant conditioning

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Thermal environment is known to have large effects on the health and productivity of growing swine. This is especially critical in the case of newly weaned piglets who require warmer temperatures in the nursery environment. Studies have been conducted to investigate the thermal preference of piglets weaned at 21 and 28 days of age, but little is known about the thermal preferences of piglets early weaned at 12-14 days of age.

In each of four trials, eight piglets weaned at 12-14 days of age were observed for 20 days post-weaning in a study to determine the thermal preference in early weaned pigs through the use of operant conditioning. A lever box, equipped with both an operating and 'dummy' lever, was mounted to the pen wall. The operating lever, when hit, turned on a radiant heat lamp directly above the lever for 60 sec. and a gas heater for 90 sec. A data logger was used to record temperature every five minutes for the duration of the study. Hourly temperature was averaged for days 3-5, 10-12, and 17-19 post-weaning to determine thermal preference. The mean temperatures for days 3-5, 10-12, and 17-19 were 26.3C, 25.9C, and 24.9C, respectively. As shown in previous studies for thermal preference in pigs, the preferred temperature decreased during the late night and early morning. Temperature tended to increase twice during the day with a brief peak in mid-morning and a more sustained peak in the evening. The thermal preference of early weaned pigs, however, was higher overall than thermal preferences observed in older pigs and decreased with age.

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Standardized environmental management and fluoxetine hydrochloride for urine marking in cats: a double-blind, placebo-controlled clinical trial

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Sun AM

The effect of standardized environmental management and the efficacy of fluoxetine in reducing indoor urine marking were examined. Two weeks of baseline observations and 2 weeks of environmental management were completed using 47 cats. Environmental management resulted in an overall reduction in marking in cats meeting the 3 or more marks per week criterion during baseline (paired t-test, difference of square roots: t=-3.98; DF=39; p=0.0012). Females were more likely than males to reduce their numbers of markings by 50% or more (Fisher's exact test: 0.0033; p=0.0031). Cats who continued to mark 3 or more times per week were eligible for the drug treatment phase, receiving either placebo or fluoxetine for 8 weeks. Twenty cats were assigned to receive either drug or placebo. One cat from the drug group and 2 from the placebo group were excluded, leaving data from 17 cats for analysis. The difference in marking rate between drug and placebo groups was significant from weeks 2-8 (t-test, difference of square roots: t=-4.18; DF=16; p= 0.0007). For the drug group, there was a mean (± SE) of 8.6 (± 2.0) marks per week during environmental baseline that declined to 1.4 (± 0.4). Marking rates over the entire 8 weeks of treatment for the placebo group did not differ from the environmental baseline (t-test: t=-1.25; DF=7; p= 0.2523). This study showed a higher percentage of response than open-labelled studies of diazepam and buspirone, which may reflect effectiveness of the drug.

Effect of short-term separations on weaning stress in foals

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Early-life events can modify the HPA-axis' responsiveness to stressors. In rodents short-term separations and handling lead to intensified mother-pup interactions which in turn lead to a reduced stress response later in life. We investigated the impact of short-term separations on the response of foals to weaning. We hypothesized that separations would aid foals in regaining homeostasis post-weaning.

Beginning at approximately two weeks old, five Quarterhorse foals (T; 3 female, 2 male) underwent six ten-minute separations from their dam at two-week intervals. A control group (C; 3 female, 2 male) of five foals was not separated. Foals were weaned in pairs (1T, 1C) in separate stalls. Behavioral and physiological measurements were collected on the days pre-, during, and post-weaning. Behavioral observations occurred between 7.00-9.00h, 11.00-13.00h, and 15.00-17.00h. Heart rate (HR; Beats per minute, BPM) was measured from 6.30-18.30h and saliva samples for cortisol measurement were collected prior to observations and at 18.30h. All data were analyzed using ANOVA.

Seven behaviors, chosen for consistency between observations, were analyzed. Weaning caused a significant increase from day 1 to days 2 and 3 in the frequency of vocalizing ($F_{2,61}$=60.41; p<0.0001), defecating ($F_{2,61}$=6.72; p=0.0023), pawing ($F_{2,61}$=10.41; p=0.0001), investigating ($F_{2,61}$=4.32; p=0.0176), looking forward ($F_{2,61}$=54.46; p<0.0001), standing ($F_{2,61}$=33.39; p<0.0001), and walking ($F_{2,61}$=51.91; p<0.0001). There were no consistent behavioral differences between treatment and control animals. Cortisol levels did not differ between separated and non-separated foals. The first sample after weaning showed the highest cortisol level (mean 6.57±2.26 nmol/l). Weaning caused a significant increase in HR from day 1 to days 2 and 3 ($F_{4,54}$=6.48; p=0.0002).

This study thoroughly assessed weaning stress in foals. In contrast to other species, maternal separations did not affect the short-term response to weaning.

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Crib-biting in foals is associated with gastric ulceration and mucosal inflammation

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Crib-biting is a stereotypic behaviour performed by 5% of captive domestic horses. Risk factors for crib-biting, identified in epidemiological studies, include feeding high concentrate and/or low forage diets. Experiments have shown that such diets are likely to result in increased gastric acidity. We therefore propose that young horses initiate crib-biting in an attempt to produce alkaline saliva to buffer their stomachs when opportunities for alternative mastication are limited. The aim of this study was to determine whether there was an association between crib-biting behaviour and stomach condition in foals. We examined the stomachs of 15 crib-biting foals and 9 normal foals, using a video endoscope. Foals were then randomly allocated to a control or an antacid diet for a 3 month period. Behaviour was monitored by direct observation throughout the 3 month period, and foals re-endoscoped at the end. Foals were mildly sedated during endoscopy and suffered no adverse effects. Videos were scored blind by an independent observer. Crib-biting foals had significantly more inflamed, dry and ulcerated stomachs than normal foals on first examination (Mann-Whitney: U=36; N1= 15; N2= 9; $p<0.05$). Their stomachs also lacked normal folding on first examination, and were significantly smoother when re-examined (Mann-Whitney: U=11.5; N1= 12; N2= 7; $p<0.01$). Foals that received the antacid diet had fewer ulcers at the end of the trial (Mann-Whitney: U=27.5; N1=13; N2=9). Most foals showed a reduction in crib-biting but the reduction was more pronounced in foals that received the antacid diet, and reduction in crib-biting correlated with reduction in ulceration (Rank correlation: $r_s=.58$; N=12; $p=0.05$). We suggest that the stomachs of crib-biting foals were exposed to more acid conditions or were more sensitive to normal acidity levels than the stomachs of normal foals. The implications of this work in relation to oral stereotypies in other species will be discussed.

Sun AM

The simultaneous loss of milk and maternal contact compounds distress at weaning in beef calves

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Beef cattle in North America are commonly weaned by separating cows and calves, which terminates nursing but also prevents cow-calf contact and social interaction. Weaning is typically imposed when calves are no longer dependent on milk for survival, but it precedes estimates of their natural weaning age by 2-4 months. We investigated whether the behavioural response of calves to weaning was more an effect of stopping nursing or maternal separation. We experimentally isolated these variables by terminating milk transfer between cow-calf pairs while they were still together and then recording their response to subsequent separation. We observed a total of 16 beef cows and their 17 calves (224 days old) during daylight hours, under dry-lot conditions. We observed pairs for 2 days prior to treatment, recording nursing bouts and their general activity. Half the calves were then randomly selected to wear a Kant-Suk weaner, a hinged nose-plate that blocked teat access when the calf's head was raised to suck but swung clear permitting eating and drinking when the head was lowered. Other (control) calves nursed freely. The Kant-Suk device was worn for 4 days during which time the behaviour of cows and calves on both treatments was recorded. Cows and calves were then separated and observed for 4 more days. Following separation Kant-Suk calves vocalized 84% less (Mann-Whitney: U=68; N1=9; N2=8; $p<0.001$) and walked 79% less than control calves (Mann-Whitney: U=72; N1=9; N2=8; $p<0.001$) and spent 24% more time eating (Mann-Whitney: U=65; N1=9; N2=8; $p<0.01$) and ruminating (32%) (Mann-Whitney: U=55; N1=9; N2=8; $p<0.05$). Moreover, during the treatment period when they were prevented from nursing, Kant-Suk calves behaved similarly to controls and rarely vocalized. Our results show termination of milk feeding and segregation of cow-calf pairs are distinct components of weaning that contribute in different ways to the calves' response. Separating these two factors may better simulate the natural process and reduce weaning distress.

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Environmental enrichment prevents the development of abnormal behaviors and modifies fear responses in young Orange-winged Amazon parrots

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Biologically relevant environmental enrichment can significantly improve the welfare of captive animals by reducing abnormal behaviors, modifying fear responses and facilitating adaptation to the environment. Although parrots are popular companion animals and show a propensity to develop abnormal behaviors in captivity, there have been few studies of the effects of enrichment on their welfare.

We hypothesized that early environmental enrichment designed to facilitate foraging and locomotor behaviors would improve the welfare of young parrots by preventing stereotypy and feather plucking and reducing fear responses to novel stimuli. We also hypothesized that the same enrichment regimen would reduce stereotypy and feather plucking once established.

Sixteen Orange-winged Amazon parrots (*Amazona amazonica*) were assigned to either a control or an enriched cage at 4 months of age. Behavioral differences between the two groups were assessed via video camera at monthly intervals for one year; log transformed data were analyzed using a repeated measures ANOVA. The enriched group developed significantly less stereotypic behavior than did the control group ($F_{3,42}$=15.02; p<0.0005); after one year the mean percent of active time spent stereotyping was 3% in the enriched group and 11.7% in the controls. Enriched parrots also developed less feather plucking behavior ($F_{1,46}$=48.26; p<0.0005) and responded less fearfully to novel objects ($F_{1,14}$=8.00; p=0.014) and novel humans ($F_{1,14}$=11.67; p=0.004).

After one year, control parrots were given enrichments for four months. The parrots responded to the enrichments with a decrease in the performance of stereotypic behaviors, from 11.7% to 2.5% of active time ($F_{1,40}$=53.82; p<0.0005). Feather plucking was also significantly decreased ($F_{1,53}$=48.08; p<0.0005).

Our enrichment protocol effectively modified fearfulness and effectively prevented the development of abnormal behaviors. It also reduced the performance of established abnormal behaviors. These results indicate that appropriately designed environmental enrichment is a practical and effective means of improving the welfare of captive parrots.

Fenceline contact reduces the negative effects of weaning on the behavior and growth of beef calves

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One-hundred Angus/Hereford-cross calves in each of three years were randomly assigned to five treatments for seven days to determine the effect of different weaning techniques on their behavior and subsequent growth. Treatments were: 1) fenceline separation from dams - on pasture; 2) total separation from dams - on pasture; 3) total separation from dams - in drylot - preconditioned to hay; 4) total separation from dams - in drylot - not preconditioned to hay; 5) non-weaned controls - on pasture. At the end of the seven day post-weaning period, all calves were placed on pasture in large groups. On the day of weaning, calves in the fenceline and control treatments vocalized less than calves totally separated from their dams (ANOVA: $p<0.001$). In the three days following weaning, calves totally separated from dams on pasture spent more time walking (repeated measures ANOVA: $p<0.05$) and less time eating ($p<0.05$) than calves in the other four treatments. Calves in the fenceline group were more active (walking) than non-weaned control calves ($p<0.05$) but calves in these two treatments did not differ in time spent eating. Calves in the fenceline treatment spent the majority of their time within three meters of the fence separating them from their dams during the first two to four days following weaning. Thereafter, they were found at greater distances from the fenceline. Ten-week cumulative weight gains of the three totally-separated treatments did not differ. Fenceline calves gained 31% more weight in 10 weeks than the average calf in the three totally-separated treatments (49.9 vs. 38.2 kg; ANOVA: $p<0.05$) but were 23% lighter than the non-weaned control calves ($p<0.05$). It was concluded that providing fenceline contact between beef calves and cows at weaning reduces the negative effects of weaning on calf behavior and growth rate.

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Social cognition in the domestic dog

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Studies of social cognition have concentrated on humans, dolphins and non-human primates such as chimpanzees. If social intelligence has a function then a wider range of species may possess mental abilities such as object permanence, numerical competence, learning through emulation and theory of mind (or the ability to see the world from the perspective of others). The domestic dog in particular shows potential for such cognitive functions given its evolutionary ancestry and the potential for enculturation associated with domestication. Dogs evolved from wolves, which engage in co-operative hunting and division of labour, with strong stable bonds between individuals. Furthermore, the process of domestication and breeding may have selected for social intelligence in dogs (by accident or design), whilst many dogs are reared in human households where social intellect may develop in relation to human behaviour.

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This paper presents a number of simple studies into the cognitive abilities of domestic dogs. These use methodologies that have been used to investigate cognition in humans or other animals (e.g. Povinelli et al., 1991; Held et al., 2001) and have been adapted for use with dogs. Domestic dogs, for example, readily use social cues (other dogs and humans) as information sources about food location, but have difficulty in using abstract non-social cues for this purpose. Domestic dogs, however, only show the ability to distinguish between knowledgeable and unknowledgeable people (and not other dogs) when faced with a choice over food location. The degree to which these findings are indicative of simple non-cognitive conditioning or cognitive information transfer will have major implications for dog training, the domestic dog's quality of life and the comparative study of cognition.

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Can behavioural parameters in young horses be used to quantify aspects of temperament?

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The performance of horses, whether in sports or in leisure, depends on both their physical abilities and temperament. The aim of the present work was to measure individual variation and consistency in temperamental traits in young horses of the same breed and age, and reared under controlled housing conditions and management. A total of 41 Dutch Warmblood horses were tested with two behavioural tests, either relating to novelty (novel object test) or to handling (handling test). Horses were tested at four ages: twice within the first year and twice within the second year.

Within years, all behavioural parameters except two in the novel object test, and all behavioural parameters in the handling test, were positively correlated (Rank correlation: $.36=<r_s<=.81$; N=41; $p<0.05$). However, only a small number of behavioural parameters, were consistent over years. A principal component analysis (PCA) revealed underlying components of the individual behavioural parameters per test. The first component in the novel object test could be regarded as 'flightiness', the second as 'sensitiveness'. In the handling test, the first component was suggested to relate to 'patience', the second component to 'willingness to perform'. 'Flightiness' and 'patience' showed a positive correlation within years (Rank correlation: $.36=<r_s<=.65$; N=41; $p<0.05$). 'Sensitiveness' and 'willingness to perform' showed a significant positive correlation only within the first year (Rank correlation: $r_s=.44$ and $r_s=.57$ respectively; N=41; $p<0.05$). The temperamental trait 'flightiness' exhibited consistency over years as well (Rank correlation: $r_s=.49$; N=41; $p<0.05$).

It is concluded that the behavioural tests employed in the present study triggered wide inter-individual variation in behavioural responses, and revealed consistency of individual behavioural parameters in the short term and of underlying components derived from a PCA. Only a few behavioural parameters and the temperamental trait 'flightiness' exhibited long term consistency.

A Delphi-study into the scientists' assessment of the impact of housing and management on animal welfare

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There is a growing need to evaluate and, if necessary, adjust existing minimum standards for welfare, but attempts to formulate standards have been hampered by the apparent lack of a coherent framework to assess welfare based on available scientific knowledge. Twenty-two welfare scientists contributed anonymously to the formulation of such a conceptual framework and prioritized welfare issues in cattle, pigs and chickens. Evolution and domestication were identified as processes that have equipped animals with a number of behavioural and physiological control systems, including cognitive and emotional mechanisms enabling them to deal with changes in their environment. Welfare is reduced when animals fail to maintain any discrepancies between actual states and 'desired' states within acceptable limits.

Many measures are being used to assess welfare. A careful assessment of animal welfare, however, requires an integration of knowledge about both design features (such as space allowance) and performance criteria (such as aggression levels). It may be possible to weight performance criteria on the basis of their intensity, duration and incidence, and to weight design criteria on the basis of known relationships with performance criteria.

When applied to cattle, pigs, and chickens the conceptual framework supported the formulation of priority issues in relation to performance criteria, design criteria and entire housing systems.

When adequate stockmanship is applied, pathological states, abnormal behaviour and several forms of behavioural restriction were identified as the most important performance criteria for animal welfare. Listed as primary design criteria were the amount and quality of space (including appropriate subdivision into functional areas and flooring), social conditions (e.g. provision of social contact and protection from aggression), and the provision of suitable substrates. The most common intensive housing systems used in Europe, e.g. the Netherlands, as well as several alternative systems, may lead to serious welfare problems.

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A novel approach to evaluating performance-related behavior in prospective guide dogs

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The paper will describe the development and validation of a novel questionnaire method for assessing behavior and temperament in 1-year-old guide dogs. Volunteer puppy-raisers scored a total of 1097 prospective guide dogs on a series of 40 semantic differential-type, behavioral rating scales. Principal components factor analysis of these scores extracted 8 stable and interpretable common factors: stranger-directed fear/aggression; non-social fear; energy level; owner-directed aggression; chasing; trainability; attachment; and dog-directed fear/aggression. Three of these eight factors (stranger-directed fear/aggression, non-social fear, and energy level) exhibited moderate internal consistency (Cronbach's alpha equal to/greater than 0.72), while the reliabilities of the remaining factors were relatively low (Cronbach's alpha=0.53-0.61). The eight factors were then validated against the guide dog school's own criteria for rejecting dogs for behavioral reasons. The results of this analysis confirmed the construct validity of the puppy raisers' questionnaire assessments of their dogs, and suggested that such methods can provide a useful and accurate means of predicting the suitability of dogs for guiding work. Various modifications to the original questionnaire are proposed in order to enhance its overall reliability.

Animal welfare judging teams - can this be a way to interface welfare science with traditional animal science curricula?

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Animal evaluation courses have been part of animal science curricula for over 80 years. A need for skill in visual evaluation of conformation traits and appraisal of potential productivity traits produced the foundation for animal judging courses. An integral part of livestock judging competitions is presenting oral reasons, where the contestant explains to an adjudicator why the animals were placed as identified. Livestock judging has provided a level of objectivity and acceptance, and has a long-standing history with United States animal science departments.

We propose that the concept of developing student teams to educate young people about animal welfare, then establishing competitions for them to utilize these skills, may be a way to integrate animal welfare science into the mainstream of animal science curricula. Using as a model traditional livestock judging teams, a framework for establishing animal welfare judging teams would be set up. Students would take a background course in understanding farm animal species' needs, typical behavioral and physiological indicators of differing levels of welfare, and how to holistically evaluate facilities, stockmanship and management schemes.

The competition would unfold as follows: CD-ROM's of each production species would be prepared with physiological data, video clips, behavioral responses, etc. For example, a horse CD-ROM might contain a video clip of the animal's housing and its behavioral response to a handler's approach; the heart rate response to the handler's approach, still-shots of feedstuffs with nutrient analysis information and the animal's body condition score; records of vaccination, deworming, foot and dental care background; and time budget. Students would evaluate two scenarios for each species being judged, prepare their analysis, then make an oral presentation of why they feel one scenario demonstrates a higher degree of welfare than another. The persuasion in the presentation would be a key factor in scoring these students.

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Housing affects behaviour of domesticated dogs

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We compared the behaviour of dogs in households living in family houses with gardens (N=161) as opposed to living in apartments (N=123). Data from a questionnaire were analyzed using Chi-square test.

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The majority of dog behaviours under study were not affected by different types of family housing. Dogs living in family houses with gardens were considered both companion and working dogs more often than those kept in apartments (Chi-square=11248; DF=1; p<0.01). The family-house dogs destroyed the garden (Chi-square=13289; DF=1; p<0.01) and were viewed as a nuisance (Chi-square=6749; DF=1; p<0.01) more often. On the other hand, dogs living in apartments used furniture more often (Chi-square=25394; DF=1; p<0.01), and slept in beds of family members (Chi-square=27911; DF=1; p<0.01), they were anxious (Chi-square=11257; DF=1; p<0.01), played with family members at home (Chi-square=4846; DF=1; p<0.05), preferred tug-of-war games (Chi-square=5330; DF=1; p<0.05), were walked regularly (Chi-square=59924; DF=1; p<0.01), walked during the day (Chi-square=18637; DF=1; p<0.01), showed sexual interest in people (Chi-square=8470; DF=1; p<0.01), masturbated (Chi-square=6885; DF=1; p<0.01), and always sat on command (Chi-square=4867; DF=1; p<0.05).

Our survey shows that some behaviours of dogs are affected by the type of housing. Apartments in the Czech Republic are smaller than those in most European countries and about 1/3 that of the medium-sized apartments in the USA (Annual Bulletin of Housing and Building Statistics for Europe and North America 1998). Increased human-dog contacts in apartments with less space changes the human evaluation of dogs, and makes some once desirable behaviours seem undesirable, with consequences for the human-animal bond.

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Acute effects of method of tail docking on young calves

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Tail docking of dairy cattle is increasingly practised, especially on younger animals. Little is known of the effect on the animal's welfare. We examined the acute responses of calves to being tail docked between 7 and 17 days of age using a rubber ring or a hot docking iron. There were three treatment groups (rubber ring, hot docking iron and control) each with 12 calves. Blood samples were collected using jugular vein catheters. Plasma cortisol concentrations were measured -60, -30, and -2 min before treatment, and 30, 60, 120, 180, 240, and 300 min after treatment on d0. Seven samples were also taken at 60 min intervals on d+1 (23 to 29 hours after treatment). Behaviour was examined on d-1, 0, +1, +2, and +5. Milk intake, weight gain, body temperature and faeces scores were also monitored.

Rubber ring application caused an increase in tail grooming on d0 (ANOVA: $F=3.53$; $DF=2, 30$; $p<0.05$), d+1 ($F=4.88$; $DF=2,30$; $p<0.02$), and d+5 ($F=7.54$; $DF=2,30$; $p<0.003$) as well as shorter standing ($F=5.42$; $DF=2,30$; $p<0.08$) and lying ($F=3.83$; $DF=2,30$; $p<0.08$) periods, with higher frequencies of standing ($F=8.04$; $DF=2,30$; $p<0.02$) and lying ($F=7.32$; $DF=2,30$; $p<0.02$) on d0. No significant differences in plasma cortisol concentrations were found between any groups except for 60 min. after treatment when the rubber ring group exhibited a significantly higher concentration than the control group ($F=3.44$; $DF=2,30$; $p<0.03$). No other differences were found.

We conclude that tail docking with a rubber ring causes a mild behavioural and physiological response in young calves, possibly indicating mild discomfort. Tail docking with a hot docking iron causes even less of a response. Further research is needed to determine if there are any long-term effects such as increased stump sensitivity or chronic pain states.

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Behaviour of cats and humans incorporated into a model of a domestic cat population

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A stage-classified matrix model was developed for the cat population of England and Wales. The aim of the model was to investigate the dynamics of the owned and un-owned domestic cat populations with a view to evaluating the relative effectiveness of different management strategies, the ultimate goal being the reduction of the cat population growth rate to zero. The basic structure of the model was based upon features of the life history of the cat population and on the behaviour of humans interacting with the cat population. The cat population was divided into three basic types: owned, un-owned and cats in rescue. Parameters such as population density, fecundity and survival were found to change according to variations in the socio-economic status and behaviour of humans, rather than differences in the behaviour or status of cats. For instance, supplemental feeding by humans can cause increases in population density of between four and five orders of magnitude. The most important parameters within the model, in terms of reducing cat population growth, were found to be the reproductive success of cats having their first litter, the life span of adult cats and the survival of kittens to maturity. These are all parameters that are strongly affected by human behaviour. Data from a well-studied domestic cat population were used to investigate the predictive power of the model, as well as indicate which parameters are most important in terms of the accuracy of the model. In addition deficiencies in available data have been identified. Validation of the model under different conditions is now required to demonstrate its general applicability and predictive power. Results from the model suggest that neutering cats before they have their first litter is approximately twice as effective, in terms of reducing the population growth rate, as neutering an adult cat.

Behavioral and temperature measurements as indicators of chronic pain and sensitivity in tail-docked heifers

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Demonstration of improved hygiene, reduced labor, and greater milk quality has increased the popularity of tail docking dairy cattle in Canada and the U.S. Although recent research has suggested little evidence of acute pain, chronic pain has not been thoroughly investigated. In human amputees, incidence of increased limb surface temperature reliably differentiates phantom limb pain patients from pain-free patients. Our objective was to assess sensitivity and possible chronic pain in dairy heifers by behavioral and temperature measurements. Holstein heifers, 7 docked and 7 non-docked, from a previous neonatal docking experiment were tested. All fourteen animals were video taped during a test sequence of alternating cold (-9 degrees C), hot (54 degrees C), and neutral packs applied to the underside of the tail. Packs were placed approximately 30.5 cm from the tail head on all animals. Following this sequence, a pressure test was performed using a pin–pressure needle. A thermal image of the tail was taken using eMerge infrared imager prior to and after the temperature and pressure testing. Data were analyzed as a CRB design using PROC MIXED in SAS. Docked heifers tended to have higher surface temperatures following the test sequence than did non-docked heifers (Mixed Models: F=3.49; DF=1,8; p= 0.09). For docked heifers, the underside of the tail showed significantly higher temperatures than did the tip of the tail prior to (F=8.87; DF=1,10; p=0.01) and following (F=30; DF=1,10; p=0.0003) the test sequence. Docked heifers also showed substantially more stomping activity following the cold pack (F=7.27; DF=1, 8; p=0.03). However, docking had no effect on pressure sensitivity or the behavioral measurements weight shift, tail swing, and tail curve. Evidence of higher surface temperatures and increased sensitivity to cold suggests hyperalgesia, however, further research in neuroscience is required to confirm evidence of heightened sensitivity in docked heifers.

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Road traffic accidents and the welfare of domestic cats

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The aims of this study are to quantify the impact of road traffic accidents (RTAs) on the welfare of cats, and identify factors that may predispose cats to RTAs.

Data on 128 (117 owned, 11 stray) RTA cats were collected from 6 veterinary practices in Cambridge, UK, from March 2000 to February 2001. Owners of 67 RTA cats completed questionnaires about their cat's lifestyle (how much time it spent outdoors, previous experience of accidents). Control questionnaire data were collected on 1040 cats brought to practices for reasons other than RTAs.

Ninety three RTA cats (73%) survived, 27 (21%) died and seven (6%) were euthanised; the fate of one cat was unknown. Twelve percent of both RTA and control cats had been in an accident previously. Of the control population, 8% were confined indoors and were excluded from further analysis. RTA cats were significantly younger that controls (Mann-Whitney: z=-9.09; N1=954; N2=123; p<0.001; median age RTA cats=2 years, median age control cats=8 years). There were more intact and neutered males and fewer neutered females in the RTA than the control population (Chi-square: Chi-square=15.91; DF=3; p<0.001), and fewer pedigree cats (Chi-square: Chi-square=8.86; DF=1; p<0.01). RTA cats spent more time outdoors at night than controls (Mann-Whitney: z=-2.75; N1=624; N2=47; p<0.01). More accidents happened at night (46%) than during the day (36%), (18% time unknown). The distribution of coat colours within the RTA population was not different from the control population.

Road accidents are a common occurrence in cats, and an important cause of death. Among the population brought to veterinary practices, younger cats, males and cats that spend more time out at night are more likely to be in RTAs than neutered females, pedigrees and cats that spend less time out at night.

The effect of nose ringing on exploratory behaviour in gilts

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Outdoor sows with a nose ring can perform most of their natural behavioural activities except rooting. From a welfare point of view it seems paradoxical to allow surgical intervention such as nose ringing to prevent rooting. The behavioural and welfare consequences of rooting deprivation are not well documented. The present experiment examined the exploratory response by unringed, ringed and deringed gilts by repeatedly exposing the gilts to an unfamiliar box (6m x 10m x 0.3m) layered with 0.1 m sand, 0.1m chipped bark and 0.1m sand. Four months prior to the experiment, 16 gilts, eight of which had nose rings and eight of which did not, were housed in four fields, ringed and unringed apart. All gilts were tested over a period of twelve days. Two gilts from the same field (same treatment) were walked to the sandbox six times, with each test lasting one hour. On the day of deringing and two days later all gilts were exposed to the sandbox. The exploratory behaviours rooting, sniffing, manipulating, and chewing were observed during half-a-minute scans. The ringed gilts did not root in the sand; however, their mean frequency of chewing was significantly higher than that of the unringed gilts (GLM: $F_{1,2}$=31.20; 19.89 vs. 13.54; $p<0.05$). For all exploratory behavioural patterns summed up, no significant differences were found between ringed and unringed gilts. On the second day after deringing the gilts started to root and no significant difference was found between the incidence of rooting behaviour in unringed gilts and newly deringed gilts. We will discuss whether rooting behaviour can be replaced by chewing in order to explore an environment. We conclude that gilts prevented from rooting explored as much as rooting gilts, though rooting was the preferred exploratory behaviour. No indications of reduced welfare were apparent.

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Laboratory animals in applied ethology

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Applied ethology and animal welfare science have traditionally focused on farm animal species, and laboratory animals are still rarely the subject of study for applied ethologists. Instead, the welfare of laboratory animals has been studied within the framework of laboratory animal science, with little consideration given to the biology of the animals. Laboratory animals obviously fall within the scope of applied ethology and more studies with an ethological approach will help to improve the way these animals are housed.

The aim of this workshop is to gather researchers working with or interested in laboratory animal behaviour and welfare in order to review present knowledge and discuss important topics for research specifically on laboratory animals. The focus will be on rodents, but other species will be discussed according to the interest of the participants. Topics to be addressed in the workshop are:

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1) Behavioural genetics. (i) Is it possible to discuss inbred laboratory strains in the context of adaptation? (ii) How appropriate are comparisons with wild counterparts (ancestors)? (iii) Can the same indicators of welfare be applied across strains bred for different purposes? (iv) If not, what changes might have been introduced during artificial selection that makes these indicators inappropriate? (v) How do we deal with transgenic and knock-out animals?

2) The animal model. (i) Are animals housed under standard laboratory conditions appropriate models in biomedical research? (ii) How does the environment affect the biological functioning of the animals and what are the implications for research based on these animals?

3) Methodology. (i) How relevant are the traditional standard behavioural tests for animal welfare? (ii) Which information can be gained from previous research using these methods? (iii) Are more biologically relevant tests available or should new tests be developed?

A consumer's guide to consumer demand and preference measurement

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Assessing what animals will work hard for (e.g. the events they are keen to avoid and resources they are keen to approach) can yield important insights into welfare. However, experimental subjects' preferences can be affected by their test conditions (leading to poor external validity), or misinterpreted due to faulty experimental design or data analysis (leading to poor internal validity). Here we give guidelines on measuring preference, inspired by recent papers and the successes and failures of recent work on mice (HW), mink (GM) and other species. These guidelines will cover four areas:

1) The experimental arena. (i) How should this be designed? (ii) What are the pros and cons of a 'closed economy'? (iii) How similar to the 'applied situation' should it be?

2) How resources are offered. (i) What are the pros and cons of offering one resource at a time, versus several at once? (ii) Should the resource be offered in units controlled by the experimenter (e.g. fixed periods of access), or not?

3) Types of cost. We will discuss how costs should be validated, where they should be located, and what they should be like. Costs can vary in the type of learning required by the animal (classical versus instrumental), and in how they act as costs (some use up limited budgets, e.g. time or energy; others do not but are inherently aversive, e.g. pain, discomfort). Both of these attributes of a cost have implications for experimental design and interpretation.

4) Data collection and analysis. (i) Why don't economists use 'elasticity' to assess resource value? (ii) What do they use instead? (iii) What measures do workers in other disciplines (e.g. experimental psychology) use to infer affective value?

We will discuss how these considerations affect the type of data one collects, how it is analysed, and what artefacts each type of measure is prone to.

Workshop B - 198 Young Hall

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The impact of applied ethology in improving animal welfare

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In the 35 years since the SVE (now the ISAE) was founded, a large effort has gone into the investigation of the welfare of animals, particularly farm and laboratory animals. Recent actions to improve conditions for farm animals by companies such as chain restaurants, and for farm and laboratory animals by some governments, are encouraging and worth exploring. However, in spite of the very limited recent changes and the accumulation of a great deal of scientific evidence revealing shortcomings in existing conditions, the overall rate of change in the care of farm and laboratory animals has been extremely slow. Improvements to housing and husbandry standards that are based on sound science will be driven by public awareness of the issues, but tempered by traditions, the ethical environment, politics and economics. Decision making is often challenging because the same issues are being approached from different standpoints. The aims of this workshop are to share experiences and to consider the following questions:

(i) What responsibilities do animal welfare scientists have to ensure that the evidence they produce is considered by policy makers and legislators? (ii) What is the best forum for facilitating this transfer of information? (iii) Should animal welfare scientists be trying to convince companies (e.g. McDonalds Corporation) to require their suppliers to adopt welfare-friendly procedures or is this a job for animal protection advocates? (iv) Who should be funding animal welfare research and can the source of funding have a negative effect on the uptake of the results? (v) Is part of the problem that animal welfare science is not considered as good science by policy makers, legislators and perhaps even by other scientists, and if so, can anything be done to remedy this? (vi) Is there a role for the ISAE (rather than individuals members of ISAE) in all of this?

Workshop C - Freeborn Hall

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Animals don't bite the hand that feeds them: discrimination between humans by eleven different species

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It is hard to overestimate the adaptive importance of recognition - whether of food items, territory or individuals. In this talk, I will focus on the ability of a wide range of species, including birds, land and marine mammals, and insects, to discriminate between individual humans. I will then trace the implications of this ability for animal research and welfare. Although it is not surprising that so-called "higher" animals can tell humans apart, there is evidence that this ability is widely distributed phylogenetically, even among so-called "lower" animals. Much of the data I will present stems from research conducted at the University of Guelph during the past 8 years. Using preference testing, habituation of defensive behavior, and operant discrimination training, we demonstrate that rats, rabbits, chickens, cows, sheep, seals, llamas, emu, rhea, penguins, and honeybees all learned to tell people apart and to behave differently in the presence of different individuals. The theoretical implications of these findings are considerable. As Davis & Balfour (1992) argued, if animals can discriminate among the humans with whom they have regular contact, they can use these individuals as predictors of the salient events in their lives. Animals within research and/or agricultural settings are typically exposed to regular scheduling of hedonic events. These regularities set the stage for a form of conditioning described by Pavlov and his colleagues as "Person as CS" (e.g., Gantt, et al, 1968). This process involves conditioning to a specific person, rather than a generalized response to humans. Because Pavlovian conditioned responses (CRs) include both behavioral and physiological measures (e.g. alteration in heart rate, blood pressure, pituitary-adrenal arousal, immuno-activation), the possibility exists that research findings or their interpretation may be compromised when associations are formed. I will argue that many human-animal interactions hold the necessary conditions for unintended associations between us and the stimuli we present. We should be vigilant about the effects of such anticipatory or motivational conditioning within our research agendas.

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Visual perspective taking in domestic pigs

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If animals behave as though they have 'high-level' cognitive abilities, this may alter the way in which we perceive and treat them. We adapted a task used in primate research to investigate whether pigs are capable of taking the visual perspective of others, a skill that has previously been linked with having a 'theory of mind'.

In training trials, each subject pig (N=10) watched a 'food baiting event' from a start box; a researcher with a food bucket entered one of four corridors. The pig was then released from the start box and rewarded for entering that corridor. In unrewarded probe tests, the subject's view of the corridors was blocked, but it could see a 'seeing' companion pig who had visual access to the baiting event, and a 'blind' companion who did not, in start boxes to its left and right. After the companions had been released and entered corridors, the subject was released and we recorded which companion it followed. Companions were equally trained and unaware of the subject's task to prevent Clever Hans effects. Probe tests (N=10-12/pig) were separated by training trials.

Eight pigs followed companions less frequently than expected by chance (binomial tests on each pig: $p(k)=0.5$; $p>0.12$), due to specific corridor or centre/side preferences (G-tests: $p<0.05$; binomial tests: $p(k)=0.5$; $p<0.05$). However, one subject showed no positional bias, and a significant preference for following the 'seeing' rather than 'blind' companion (binomial test: $p(k)=0.5$; $p=0.018$), consistent with an ability to take the visual perspective of others. We shall discuss whether this indicates that pigs do have this ability, but that it can only be revealed if a subject is amenable to training, as well as general points concerning the adaptation of experimental methods across species and what visual perspective taking actually tells us about theory of mind.

Mon AM

The effect of early handling of young foals on their subsequent reaction to humans, novelty and the foal-mare relationship

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The natural behaviour of horses in response to danger is to take flight, and consequently human handlers can be injured. Reducing the flight response and general reactivity of horses is therefore likely to reduce the incidence of injuries to handlers. In this experiment we investigated the effect of handling foals in the first two days after birth on their subsequent response to humans, novelty and the foal-mare relationship.

Standardbred foals were assigned to one of two groups, handled (H) (N=22, 12 colts, 10 fillies) and control (C) (N=21, 10 colts, 11 fillies). Handling took place 3 times/day on days 1 & 2 for 10 minutes/session. Individual foals were gently restrained and stroked all over their body using bare hands and then a plastic bag and each leg was lifted once. C-foals received no handling.

The approach and leave behaviours of mare-foal pairs were observed at pasture during week 5 to evaluate their relationship. Mares of H-foals were less active in keeping the pair together than mares of C-foals (GLM: $F_{1,33}$=7.18; p=0.01). At six weeks of age all colts were introduced to an arena, together with their mare, and their reaction to a novel object and an unknown human tested. C-foals initiated more suckling bouts than H when no human was present (Wilcoxon: Z=2.44; N=22; p=0.01) indicating that they responded differently to the novel arena than H-foals. However, there was no difference between H and C foals in their exploratory behaviour in the arena. When a human was present in the arena H-foals tended to move further away from the mare (Z=-1.80; N=22; p=0.07) and had a shorter flight distance than C-foals (Z=-1.98; N=22; p<0.05).

Handling of foals in the first 2 days after birth appeared to affect the foal-mare relationship and alter their perception of humans at a later age but did not alter their response to novelty.

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Is the glass half empty or half full? A novel approach for assessing mental states in laboratory rats

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In humans, a bias in attention to and expectation of negative events is a common manifestation of a depressive mental state. We developed a novel cognitive test to investigate whether this pessimistic behaviour could be demonstrated in laboratory rats which may be experiencing a similar mental state.

Rats were trained on a two-tone discrimination task. One tone signalled a positive event (food), delivery of which required the animal to lever press. The second tone signalled a (comparatively) negative event (white noise) which the animal could avoid by refraining from pressing. After satisfying a training criterion animals' responses to novel 'probe' tones, intermediate in frequency to the training tones, were recorded. Responses to probes were measured in two housing treatments, undisturbed and disturbed, designed to induce a control and relatively negative mental state respectively in the animals. During the former, animals were disturbed once weekly for cleaning. The latter treatment involved the animals being removed from their home cage, once per day, for the duration of testing and placed in one of 5 other housing conditions. This treatment could be administered at any time of day, thus providing an 'unpredictable' disturbance for the animals.

GLM analysis revealed a significant interaction between treatment and tone ($F_{4,20}$=4.55; p=0.001). Animals experiencing disturbed housing made fewer responses to probes close in frequency to the training tone predicting food. A possible interpretation of this is that these animals are less willing to categorize novel probes as predictive of a positive event (i.e. are behaving 'pessimistically'). Alternative interpretations such as differences between the experimental groups in anhedonic response, hunger levels or training effectiveness were investigated, but no significant differences between groups were found.

Is there a relationship between fear of humans and social rank in Holstein cows?

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Fear responses to humans vary among animals, and can have a great impact on the production and welfare of farm animals. In this experiment we tested the hypothesis that the animal's social rank could modify its fear response to humans. Fear response to a person that treated the animals aversively was estimated using 11 lactating Holstein cows. The aversive person was hostile to the cows (a slap on the back and a shout to each cow) twice per day at the milking shed. A series of flight distance (FD) tests in the presence of an aversive or a neutral person was performed on pasture - where the cows spent most of their time - before, eight and 14 days after the treatment started. Total milk and residual milk (RM; after a 20 IU iv injection of oxytocin) were measured with and without the presence of the aversive person standing quietly in front of the cow, in a crossover design. Social rank in the herd was estimated using a sociometric matrix. In all tests except before the treatment started (p=0,51), cows kept a greater distance from the aversive than from the neutral person (ANOVA: $F_{1,21}$=31.38; p<0.0001). Dominant cows had a greater FD than subordinate cows only at 14 days of treatment in the test with the aversive person (Regression: R2=0.45; DF=10; p<0.02). There was no effect of treatment on milk production or RM. Dominant cows had higher RM than subordinate cows (repeated measures ANOVA: $F_{2,21}$=11.94; p<0.01). These preliminary results suggest that the fear cows have of people may be influenced by their social rank, and corroborate other studies showing that cows can discriminate aversive from neutral handlers. Under the conditions of this experiment, however, the mere presence of an aversive person did not affect residual milk.

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Non-invasively measured long-term temperature effects of social stress in rats

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Automated infrared thermography can be used for immediate and non-invasive detection of stress-induced skin- and tail- temperature changes (comparable to Stress Induced Hyperthermia). In previous studies with this new method we have found indications that latency and amplitude of these sympathetically modulated temperature responses differ between enriched and standard-housed rats. Here we use a social-defeat paradigm to test the hypothesis that the normal course of the temperature response to stress is altered in animals with reduced well-being. Social defeat followed by social isolation is known as a powerful stressor with many long- and short- term effects on behaviour and physiology. These effects show many similarities with symptoms of human depression and of reduced animal welfare.

We compared defeated (N=8) and sham-treated control rats (N=8) in several tests over time, but did not find clear behavioural differences. However, the defeated rats differed in their skin and tail temperature responses to various stressors. For instance, three weeks after the defeat, the rats were put into a novel cage. All rats responded with an immediate decrease in tail temperature, but the groups differed significantly in the speed of subsequent increase to normal levels (mean±SE for defeated rats: 0.26±0.03 degrees Celsius/min., for controls: 0.37±0.06; Mann-Whitney: $U=10$; $p<0.05$).

The results indicate that the social-stress paradigm has a long term effect on autonomic responses in rats. The results are in line with other studies in rats, which indicate that physiological measures are more sensitive than behavioural measures. Furthermore, the results show that our newly developed automated thermography method can be used to detect such a physiological indicator for reduced welfare, without being invasive to the animals. We will discuss implications of using this sensitive and promising new tool for monitoring of husbandry animals.

Man-animal relationships and sensitive periods in litters of pigs

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Increasing loose housing and extensive systems may result in pigs that are fearful and difficult to handle. We tested whether the age periods during which piglets become naturally familiar with the dam and with group members could be sensitive for the establishment of relationships to humans.

In other studies piglets have been isolated and forcibly handled, whereas this study was based on non-forced handling of the litter in its home environment, while presenting standardized visual, acoustic, tactile and olfactory stimuli. In 6 successive replicates, litters from 4 full-sib sows mated with the same boar were non-handled or handled 0-4, 8-12 or 22-26 days after birth for 10 min twice daily for the 5 days (6 litters per treatment). Other handling was minimal until pigs were tested individually at 100 days of age in a 180 sec approach test. The test arena was the passageway outside the pen, stretching 4m from the gate to where the experimenter (a known handler) sat.

Latencies to approach and to touch the experimenter were analyzed by the PHREG procedure (SAS), considering censored data and including replicate as a class variable (DF=8). Treatments did not differ in initial forward movement in the arena. Non-handled litters tended to take longer to approach within 1m of the experimenter (medians 48, 36, 35 and 31 sec for non-handled and treatments 0-4, 8-12, 22-26, respectively, Chi-square (Wald-test)=3,23; p=0.07) than handled litters. Litters handled day 8-12 were more reluctant to approach within 20 cm (medians 91, 86, none, 68 sec, respectively; Chi-square=11.45; p=0.0007). Only litters handled day 0-4 reached a median of 128 sec for touching. In the remaining groups more than 50% of data were censored (Chi-square=6.13; p=0.01). This is remarkable, as 0-4 day piglets were handled most often while asleep, and raises questions as to the significance of the different stimuli presented.

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Can welfare science be humane science? A perspective on research

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Scientific methodology is essential to the development of our knowledge of animal welfare. Indeed it is often the only means to understand an animal's experience of being used by humans. Welfare experiments may involve potential individual suffering of subject animals. While animal use in experimentation takes place within a stringent legislative/ethical framework in the UK, Europe and United States, new researchers may only encounter training in alternative methods once they have decided to use animals. This paper proposes that an examination of the ethical and practical issues surrounding animal use should be an explicit element of training for new researchers within applied ethology. The 3Rs of reduction, refinement and replacement provide a basis for critical analysis of animal use when designing experiments. Examples from current applied ethology research demonstrate the wide range of methods by which animal use can be minimised. For example, statistical considerations can maximise the power of an experimental design while minimising numbers of animals involved. Non-invasive physiological measures can be used, such as faecal corticosterone sampling. Much knowledge can be gained without creating experimental populations. Studies can be performed using pre-existing populations, such as zoos and farms. Methods from applied ethology and behavioural ecology are particularly suitable for this type of experiment. Epidemiological studies can identify factors influencing welfare in commercial animal production and narrow the focus of experimental research. Consideration should also be given to both humane procurement and disposal of subject animals. This paper does not propose the curtailment of welfare science. However, explicit consideration of alternatives to animal use allows researchers to examine the impact of their own work upon subjects and actively advocates minimisation of suffering. The methods outlined above also provide an opportunity for students with a range of ethical viewpoints to consider welfare science as a viable career.

The influence of different handling procedures on the sexual motivation of fearful and confident sows

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Sows with a predisposition for fearfulness towards humans may experience more aversive handling because fearfulness tends to prolong handling procedures. This may cause problems with heat detection due to reduced sexual motivation when humans are present. We investigated whether fear of humans induced by either handling or predisposition inhibited sexual motivation in general or only when a human was present.

The study comprised 54 sows that were classified as either fearful or confident based on 5 scores in a forced human-approach test during lactation. Half of the sows within each fear class were handled aversively during the last 6 days of lactation while the other half were handled gently. At weaning all sows were tested in a 3 min human-approach-test in their home pen. Around oestrus a test was carried out twice daily for sexual motivation with and without a human standing in front of the boar. The test measured the sows' motivation to stand close to the boar pen and to show the standing reflex in front of the boar pen.

The fearful sows took longer (GLM: $F_{1,49}$=5.4; p=0.02) (111 sec vs 65 sec) to approach a human within 0.5 m than the confident sows and that was also the case for the aversively handled sows compared to gently handled sows (GLM: $F_{1,49}$=2.7; p=0.10) (104 vs 71 sec). Results for sexual motivation showed that, if the fearful sows were handled aversively, the time spent close to the boar during oestrus when a human was present was significantly reduced (58 to 28% of test duration) (GLM-repeated measures: $F_{1,114}$=3.9; p=0.05), whereas there were no differences between test results with and without human presence for the other sows. In conclusion, aversive handling, particularly of fearful sows, inhibited the sows' sexual motivation in the presence of a human. This may complicate heat detection and make correct timing of insemination impossible.

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Transferring results of behavioral research to industry to improve handling, transport and housing of animals

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Knowledge learned from research has been effectively transferred to industry in some areas and poorly transferred in others. Knowledge that has been used to create a thing, such as a pharmaceutical or a piece of equipment, is more likely to be adopted by industry than a behavioral management technique that reduces stress to improve productivity. The author has observed during her career that some people will purchase a new cattle handling system which is designed with animal behavioral principles and they will continue to handle cattle roughly. People are more likely to purchase new equipment than use easy-to-learn low stress techniques for moving cattle. Even when financial benefits are clear, some people find it difficult to believe that a purely behavioral management method will really work. Many studies done during the last twenty years have clearly shown the benefits of good stockmanship on animal productivity. Unfortunately a large segment of the livestock industry has been slow to implement improved stockmanship. I would like to speculate that a possible reason why some people resist learning better stockmanship is because a good stockperson must recognize that an animal is a conscious being that has feelings.

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Ethologists, veterinarians and animal scientists need to spend more time transferring the results of their research to industry. Successful transfer of knowledge to industry often requires more work than doing the actual research. For a successful transfer to take place the method or equipment must be successfully used by the people who initially adopt it. If the new piece of equipment fails in the first or second place that adopts it, transfer to the whole industry may fail. Choose places that have management who believe in your research work. Researchers need to spend more time making their work relevant to industry by writing articles in popular and industry magazines. Speaking at producers' meetings and websites should also be used to transfer research results into practice. The steps for successful transfer of behavior research to the industry are: 1) Communicate your results outside the research community, 2) Be prepared to spend lots of time with the first place that uses your findings, 3) You must supervise other early adopters to prevent mistakes which could cause the method or technology to fail, 4) Do not allow your method or technology to get tied up in patent disputes.

Wood-Gush Memorial Lecture - Freeborn Hall

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Developing positive human-farm ungulate relationships, the other side of the coin

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There has been considerable emphasis placed on the role of the human as a key factor in determining the physical and emotional well-being of farm animals. Most scientific studies on the human-farm animal relationship have focused on reducing animals' fear of humans (Boivin et al.,1994, Hemsworth and Coleman, 1998, Rushen et al., 1999). However we should not only describe the negative aspects of the human animal relationship, but also consider the positive elements of such relationships.

It is often overlooked that relationships between humans and farm animals are developed between two species that differ in their means of communication and social behaviour. These inter-species relationships are probably based as much on contiguity and positive interactions as they are on negative experiences. The empirical knowledge of farmers and regular stock handlers emphasizes the importance of imprinting and socialisation of farm animals to humans at an early age. This has been demonstrated experimentally for birds and canidae (Lorenz, 1935; Scott, 1992), however scientific knowledge about imprinting and socialisation is very limited for farm ungulates.

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We will present several new studies performed mainly in our laboratories (1998-2001) which have demonstrated the effects of positive contact (mainly food and petting in association, Jago et al., 1998, Boivin et al., 2000), the existence of sensitive periods to human contact (i.e., the first days of age: Krohn et al., in press) and also the negative effect of the social environment of the animals on the development of a positive relationship between humans and farm ungulates (Boivin et al., 2001). We will question the possibility that a social relationship is established at all between farm ungulates and their caretakers, as emphasised in the theory on the domestication process (Price,1999). Finally we will consider the needs and risks in large ungulate husbandry of developing a social response to humans.

Environmental enrichment: from flawed concept to pseudo-science

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The concept of environmental enrichment has been adopted by animal welfare science in an uncritical way that is liable to bring this discipline into disrepute. In this theoretical paper, we recommend a more rigorous approach. We contend that the term "enrichment" is used misleadingly most of the time. First, it is used to describe improvements to the environment that supply the animals with basic needs. However, "enrichment" actually means the process of making richer and not the process of alleviating poverty. Therefore, describing these manipulations as "enrichment" is fraudulent, creating the impression that the environments already cater for basic needs and that the described manipulation enhances the animals' lives even further. Second, it is often used to describe any increase in environmental complexity regardless of the effect on the animal's quality of life.

It has been suggested that states of suffering evolved to motivate behaviour in "need situations" which require immediate action, whereas states of pleasure evolved to motivate behaviour in "opportunity situations" where there is a long-term benefit of performing the behaviour but no need to act immediately.

In designing animal environments, the first objective should be to provide the animal with all its basic needs and so eliminate or reduce states of suffering such as pain, discomfort, frustration and fear, e.g. providing a nesting site in a battery cage for laying hens. We suggest that this should be described as providing environmental requirements. When this is accomplished it may be possible to enhance quality of life even further by environmental manipulations that lead to states of pleasure. An example would be providing a dust-bath in a battery cage. We suggest that the term "environmental enrichment" be reserved for these latter manipulations. To be successful, all these manipulations require a thorough understanding of the animal's behaviour and motivational systems.

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Recent research on the behavior of horses during transport

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Recent studies on the behavior of horses have greatly increased our level of knowledge of their behavior during transport and stimulated a reassessment of some earlier hypotheses. It made intuitive sense that horses had a strong preference to face away from the direction of travel, although subsequent studies showed conflicting results. When a series of studies was conducted using a large semi-trailer that allowed for simultaneous comparisons of horses confined to stalls arranged in different orientations, leg movement and impacting or leaning on barriers or walls were not influenced by orientation. However, rear facing horses did slip more than horses that were forward facing or that were oriented at 45 degrees facing forward or backward. When horses were transported loose in individual pens, there was a slight, but not significant, preference (57% of the time) for facing forward. Overall a slight preference for a 45 degree orientation was also observed, with no preference for facing toward or away from the direction of travel when at that orientation. Recent studies in which loose groups of horses were transported at different densities over a standardized course showed that, when horses are transported at high density, they do not hold each other up. High density resulted in more injured horses, more injuries per horse, and more horses falling. Those that fell also spent more time down. Aggressive horses are a greater problem at higher densities because they often bite and kick other horses in a futile attempt to obtain maneuvering room. Experienced horses avoid contact with surfaces and maintain their balance independently of other horses during transport. The results from other relevant studies will also be reviewed.

An alternative approach towards developing species-specific environmental enrichment

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Environmental enrichment enhances the often barren or understimulating housing conditions of confined animals by providing them with an environment which meets more of their species-specific behavioural demands. The choice of environmental enrichment is often arbitrary, based more on economic, ergonomic or health related factors, than on the requirements of the animals themselves. A more targeted approach involves preference tests where animals are allowed to choose between different types of enrichment. However, the choices made will only be a function of the options offered. The present study offers a more fundamental and systematic approach towards the development of species-specific environmental enrichment.

This experiment aimed to identify the properties of enrichment which best satisfy the behavioural needs of pigs. The intensity of interactions with 73 different types of objects/substrates was studied in order to identify the properties that the favoured objects had in common. The objects were selected to possess diverse properties that were considered to be behaviourally rewarding to pigs, in that they stimulated different senses (e.g. touch, smell). To investigate the extent to which favoured characteristics were age dependent, each object was tested 3 times, presenting it each time to both a group of 3 weaner pigs and 3 grower pigs for a period of 6 days. The behaviour of the pigs was recorded using video and sampled to determine the level of interest in the objects (level of object directed behaviour) and its rate of habituation (decline of interest). Each object was described using 28 descriptors (e.g. fixed/moveable, edible/inedible, destructible/indestructible) and these were correlated with the behavioural observations obtained from the videos.

This approach will facilitate the design of environmental enrichment which incorporates the optimal combination of the properties consistently associated with persistent object directed behaviour.

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Ethical recommendations for the transportation of early weaned piglets

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Segregated early weaning, a management practice in which piglets are weaned when maternal antibodies are still protective, necessitates weaning at 10d to 18d and transportation to a separate site. Transportation of early weaned (17 d) piglets was studied as a welfare issue with the objective of making recommendations on duration and temperature. Transportation was simulated by placing 4-8 piglets in straw-bedded wooden boxes in temperature controlled rooms. Following simulated transport, piglets were placed in weanling pens. In each of two trials transport was simulated for durations of 0h, 6h, 12h (trial 2 only) and 24h. Transported piglets were held at 20C, 25C (trial 1 only), 30C (optimum) and 35C. Each trial utilized 96 piglets. Weaned piglets, transported or not, lost weight and required 5d to return to their weaning weight. In general, piglets transported for the longest time and at the temperature extremes lost more weight. In the first 24h, piglets transported for 0h (-0.35kg) or 6h (-0.36kg) experienced less weight loss than those transported for 24h (-0.45kg) (GLM: $F_{18,77}$=12.26; p<0.001). At 3d this weight loss pattern was still apparent (0h, -0.15kg, 6h -0.11kg, 24h -0.28kg (GLM: $F_{18,77}$=4.51; p<.001). Piglets transported at 30C (-0.32kg) and 25C (-0.34kg) lost less weight than piglets transported at 20C (-0.42kg) and 35C (-0.5kg) (GLM: $F_{18,77}$=12.26; p<0.001). By 5-7d treatments no longer differed (p>.05). Increased time (GLM: $F_{17,78}$=14.4; p<.001) spent drinking (0h, 2.3%, 6h 2.1% vs 24h 4.6%; p<0.001) in the first 24h post-transport reflected dehydration. The time spent feeding was also altered by transport time (0h, 1.3%, 6h 2.9%, 24h 1.0%) (GLM: $F_{17,78}$=5.29; p<0.001). Short periods of transportation enhanced feeding, indicting that reduced motivation to feed may be a problem in early weaned piglets. However, long transport durations inhibited feeding possibly due to dehydration and fatigue.

Increasing behavioral activity in broiler chickens through environmental complexity

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It has been suggested that increasing activity, such as by providing perches, may reduce leg problems in broilers. However, modern broiler lines make relatively little use of perches, and they therefore have little impact on the level of activity required to improve leg condition. We hypothesized that stimulating foraging behavior and increasing distance between resources would enhance locomotion and general activity of broilers.

One thousand eight hundred day-old male broilers were divided into 40 groups of 45 birds (10 birds/m²). Each group was assigned to one of 4 treatments in a block design with 10 replicates as follows. The Barrier treatment (B) contained two 1.0m long x 0.15m high and one 1.5m x 0.15m wood barriers placed between the drinkers and feeder, thus requiring birds to walk around or climb the barriers to gain access to resources. The Light treatment (L) consisted of bright colored moving lights projected on the pen floor for four 1 hr. periods/day throughout rearing. The Wheat treatment (W) involved wheat being dispersed on the floor from d8 to d17. Control birds (C) were maintained under standard management. Five birds/pen were observed for 3 minutes/wk from wk1 to wk6 and their behavior recorded. Data (means/pen) were analyzed using mixed model repeated measures ANOVA.

B birds tended to spent less time lying ($F_{3,9}$=3.86; p=0.05), probably due to the relatively high proportion of time they spent perching on barriers (17.1±5.3% at wk4). B birds undertook fewer eating and drinking bouts within observation periods ($F_{3,9}$=4.34; p=0.03). L birds spent more time eating ($F_{3,9}$=4.34; p=0.02). The behavior of W birds did not differ from the controls. L and W treatments did not enhance foraging and locomotion as expected ($F_{3,9}$=1.68; p=0.24; $F_{3,9}$=2.54; p=0.12, respectively). However, provision of barriers modified behavioral time budgets and may be a means to increase broiler activity and improve leg condition.

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Assessment of the effect of bovine appeasing pheromone on veal calves

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Stress may lead to a loss of yield or/and various infections. Veal calves are subjected to stressors resulting in losses in quantity/quality of the meat. Arrival at the fattener's and the last weeks before slaughter are both crucial points. To assess the effect of Bovine Appeasing Pheromone (BAP) on veal calves, we studied animals fattened on two separate farms. Calves were transported to the sorting center where they were weighed, graded, purchased and sorted. After a fattening period, calves were transported to where they wait before stunning. Two groups were created on both farms, A (treated with BAP) and B (placebo treatment), using 662 veal calves (90% males and 95% calves of mixed breeds). Treatments were reversed for the following batch of animals (crossover test). Administering BAP during the first 8 weeks and the last two weeks of a 21-week fattening period gave interesting results. Veterinary expenses were lower (in US$) in group A versus B, 2.62 vs 2.76 and 4.91 vs 6.40 respectively on the two farms, with a mean of 3.52 vs 4.78 US$/head (t-test: t=2.75; DF=660; p=0.006). There was a difference (t-test: t=1.858; DF=636; p=0.06) in fatness using a grade based on a 1 to 5 scale (A and B respectively for the two studied farms: 2.79 vs 2.93 and 3.09 vs 3.15). Finally, total food consumption was lower for the BAP treated group (respectively for the two studied farms, in kg: 259.6 vs 263.5 and 253.9 vs 263.4): 257kg vs 263kg (Mann-Whitney: U=37433; N1=407, N2=255; p<0.0001). This trial demonstrated the positive effects of BAP on both sanitary and zootechnical (including meat quality) data, and consequently on economic parameters. BAP and other appeasing pheromones should be considered non-toxic and as improving animal welfare.

The effects of space and straw on physiological stress and nestbuilding behaviour in pre-parturient gilts

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Research has shown that pre-parturient gilts in farrowing crates without straw have elevated plasma cortisol (CORT) and adrenocorticotropic hormone (ACTH), particularly around peak nest-building time, compared to gilts in straw-bedded pens. It remains unclear whether this physiological stress results from lack of straw or through space restriction. This study investigated the effect of space [farrowing crate (C) vs. pen (P)] and straw (S) vs. no straw (NS) using a 2x2 factorial design. Thirty-four catheterised gilts were moved from straw-bedded pens to one of the four environments 5 days before parturition. Frequent blood samples were taken via a catheter extension and behaviour was recorded. Penned gilts, irrespective of straw availability, performed more total substrate directed behaviour (8.05 and 15.15% of time for C and P, ANOVA on log transformed data: $F_{1,30}$=5.35; p<0.05) and spent more time walking than crated gilts (1.10 and 5.05% of time for C and P, ANOVA on log transformed data: $F_{1,30}$=47.18; p<0.001). Space also had an effect on ACTH and CORT across the entire pre-parturient phase, with C gilts having higher levels than P gilts irrespective of straw availability. This was particularly so at peak nest-building: between -7.5 and -4 hours, C gilts had higher levels of ACTH (12.25 and 1.9 pg/ml for C and P, ANOVA: $F_{1,29}$=7.50; p=0.01) and CORT (27.95 and 7.3 ng/ml for C and P, ANOVA: $F_{1,29}$=9.83; p<0.01) than P gilts. The only effect of straw was between –7.5 and –4 hours when there was a tendency for NS gilts to have higher levels of ACTH (p=0.056) and CORT (p=0.081) than S gilts. Overall it appears that space reduces physiological stress, perhaps through facilitating locomotion and/or substrate directed behaviour. These data suggest that space restriction, rather than lack of straw, has the greatest impact on pre-parturient gilts.

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Applied ethology in laboratory animals: new perspectives in the behavioural neurosciences

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Advances in molecular genetics and transgenic technology, especially in mice, now allow scientists to dissect the molecular mechanisms underlying complex brain functions, such as memory, anxiety and aggression, even in mammals. However, insight into the complexities of the interactions between genetic and environmental factors indicates that current approaches to the phenotypical analysis of mutant animals are seriously flawed in three main ways.

First, without systematic variation, rigorous standardization of the genetic and environmental background of the animals involves the risk of obtaining artefacts that are idiosyncratic to particular circumstances (Würbel, H. 2000. Nature Genetics 26, 263). Therefore, external validity of behavioural phenotypes might often be rather limited, which makes it difficult to justify the extensive use of animals for such experiments. Second, current standard housing conditions for rodents impose serious constraints on behaviour and brain development, resulting in aberrant or maladaptive brain functions (Würbel, H. 2001. Trends in Neurosciences 24, 207-211). Again, this has serious implications for both animal welfare and the validity of the research. Third, many of the behavioural test paradigms used to study complex brain functions ignore the behavioural ecology of the species and lack ethological relevance (Gerlai, R. and Clayton, N.S. 1999. Trends in Neurosciences 22, 47-51). Taking species-specific behavioural charcteristics into account when designing new behavioural tests could therefore lead to a better understanding of brain functions.

Importantly, all three issues are within the scope of applied ethology. Applied ethologists could therefore make significant contributions that would benefit both animals and research. By showing ways in which this can be achieved, I hope to be able to open up new perspectives for applied research in laboratory animals. This will hopefully strengthen the impact of applied ethology on animal experimentation, especially in the behavioural neurosciences.

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Priorities for the environmental enrichment of laboratory rats

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Laboratory cages can be enriched in three main ways: by increasing the size of the cage, increasing the number of animals in the cage or by providing cage furniture or other within-cage modifications. Published animal welfare recommendations tend to concentrate on the amount of space each animal should have access to, however, a continuing series of experiments suggests that social contact and cage furniture may be more important factors. In these studies rats' priorities were assessed by allowing them to work for or choose between different cage environments. Rats housed in pairs under standard conditions performed similar amounts of lever-pressing for access to standard cages, large cages and cages containing novel objects, but showed a much higher rate of lever-pressing for a cage containing three familiar conspecifics (demand was tested for each option in isolation, Wilcoxon: $z=1.992$; DF=5; $p<0.05$). When their preferences were carefully tested using a T-maze, rats also preferred cages that were larger than the minimum generally recommended (Binomial probability: DF=9; $p<0.05$), and these levels of preference were the same for isolated and group housed animals (paired t-test: $t=-.820$; DF=9; $p>0.05$). Finally, rats showed no preference for most common forms of cage furniture or 'toys' including sticks, balls, platforms and tunnels (Binomial: N=12; $p>0.05$). They did prefer cages with metal or perspex shelters and/or nesting material (Binomial: N=17; $p<0.05$), and pre-partum females preferred the deepest available opaque nest-box. I conclude that the highest enrichment priorities should be given to social housing of non-breeding stock and shelters/nesting material for all rats. Cages should also be somewhat larger than the commonly recommended per-rat minimum, but social groups could share space within a cage. Thus, current regulations that focus on space-per-animal might better provide for the rat's welfare by recommending an appropriately sized social group and then determining minimum cages for such a group.

Can differential fertility of male broiler breeders be explained by differences in reproductive and aggressive behavior?

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Male fertility in naturally mated broiler breeders varies greatly, and may be an inadvertent result of genetic selection. Identifying male behaviors reliably indicating fertility would allow maintenance of high-production strains without impairing fertility to the point where artificial insemination is required. We hypothesized a positive relationship would exist between reproductive behavior and male fertility, accompanied by an age-related decline in sexual display frequency. Additionally, subfertile males may use alternative mating strategies such as forced matings and increased aggression. We predicted fertility would negatively correlate with both forced matings and aggression. Two primary broiler breeder strains (N=30 males/strain; A and B) were studied from 30 to 50 wks of age. Percent fertility was determined by visual examination of the blastodisc of freshly-laid eggs. It was previously reported that Strain A had lower fertility. Observations were done by focal sampling (30 min total observation/male/period). The effects of age and strain on behavior were analyzed by mixed model repeated measures ANOVA. Strain A showed higher rates of wingflapping (ANOVA: $F_{1,58.4}$=8.98; p<0.05) and waltzing (ANOVA: $F_{1,57.9}$=6.13; p<0.05) than Strain B. Age negatively impacted wingflapping ($F_{4,54.3}$=2.68; p<0.05), waltzing (ANOVA: $F_{4,54.7}$=6.15; p<0.001), cloacal contacts (ANOVA: $F_{4,54.7}$=2.84; p<0.05), and total forced mating behavior (ANOVA: $F_{4,44.9}$=5.13; p<0.05). Age*strain interactions occurred in total reproductive behavior (ANOVA: $F_{4,54.1}$=2.95; p<0.05) and mounts (ANOVA: $F_{4,53.5}$=3.30; p<0.05), while total forced matings approached significance (ANOVA: $F_{4,44.9}$=2.58; p=0.050). Strain A males showing higher rates of total reproductive behavior tended to have higher fertility (linear regression: R=0.352; p=0.050), but also showed more forced matings (Kendall correlation: r=0.315; p<0.05). Although Strain A males exhibited more reproductive behavior, they had lower fertility than Strain B. This difference may be related to a problem with sperm transfer upon copulation. Results suggest that Strain A males mating unsuccessfully may continue copulation attempts, and possibly employ forced strategies as well.

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Aversion to inhalational anaesthesia and euthanasia in laboratory rodents

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Ensuring that induction of unconsciousness is humane is one of the most important criteria for acceptable anaesthesia and euthanasia. Therefore, we investigated the potential suffering associated with induction with the anaesthetics halothane, isoflurane and enflurane, and the euthanasia agents argon, carbon dioxide and argon-carbon dioxide mixtures, in laboratory rats and mice. The degree of aversion observed in 30 rats and 30 mice on exposure to low, medium and high concentrations of these agents was assessed by measuring the initial withdrawal time from the test chamber (Tw), total dwelling time in the test chamber over a period of three minutes (Td), and time to re-enter the test chamber after initial withdrawal (Tr). In addition, the frequency of aversion-associated behaviours was also measured.

The Td and Tw times offered the most effective assessment of aversion, and indicate that concentrations which are recommended for rapid and efficient induction are associated with some degree of aversion. Td times were the most effective for discriminating between agents, which could be ranked by type, and concentration. For rats halothane was the least aversive followed by enflurane, isoflurane and argon (GLM: $F_{6,184}$=20.5; p<0.0001) however, for mice, enflurane and halothane were the least aversive followed by argon and isoflurane (GLM: $F_{6,146}$=8.2; p<0.0001). Carbon dioxide and argon-carbon dioxide mixtures were by far the most aversive agents tested for both rats and mice (GLM: $F_{6,184}$=20.5; p<0.0001, GLM: $F_{6,146}$=; p<0.0001 respectively). In both species the level of aversion increased as the concentration increased (GLM: $F_{2,18}$=28.8; p<0.0001, GLM: $F_{2,18}$=25.2; p<0.0001 respectively).

This investigation strongly indicates that anaesthesia or euthanasia with carbon dioxide and euthanasia with argon-carbon dioxide mixtures is likely to cause considerable suffering before the loss of consciousness in rodents. This is unacceptable as there are as efficient and more humane alternatives available, e.g. halothane and argon.

Sexual competition among bulls of different age and seasonal changes in male sexual behaviour in a herd of beef suckler cattle

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Behavioural observations were carried out to obtain more information about sexual competition among adult bulls of different age classes. Sexual behaviour of 30 bulls (2-11 years) was studied within a Simmental herd (180 animals). The herd was kept under almost natural conditions (free range) for 18 years. Behaviour was recorded by direct observations (984 hours, 1997-2000) using both time and continuous sampling according to type of behaviour. Different social classes were determined according to results of aggressive interactions: alpha bulls (highest social rank, N=6); and bulls of higher (either within the herd; N=6, or solitary living, N=9) or lower (N=9) social rank. Data were analysed using Mann-Whitney U-Tests and only significant results ($p<0.05$) are presented.

Alpha bulls showed the highest rate of detecting oestrus (ano-genital sniffing) in cows. Higher ranking bulls controlled cows more often during oestrus than lower ranking bulls. Oestrus detection by higher ranking bulls was distributed evenly during the year. Lower ranking bulls controlled mainly in spring/early summer when most oestrus occurred. At that time the interest of bulls in oestrus cows was much higher than during the rest of the year. Guarding of cows during proestrus was highest by younger bulls, and during oestrus by alphas. However, solitary living bulls didn't compete for oestrus cows except when cows sometimes moved into their home ranges. Alpha bulls had most successful matings. Grazing duration of bulls was reduced when cows were in heat. Alpha- and high ranking bulls mounted oestrus cows less often than younger bulls, but more often mounted correctly. The number of mountings per cow in younger bulls was almost twice as high during spring/summer than throughout the year.

Altogether, age, body condition, social rank, and experience are the most important factors in competing successfully for cows.

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A better house for a mouse: a review of methods to improve laboratory housing

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Laboratory animal facilities have been designed to provide a standard environment where animals can be kept in good physical health while at the same time meeting economic and ergonomic considerations. Mice are generally kept in small 'shoebox' cages with nothing else but a layer of sawdust bedding. Recognizing the potential welfare problem with behavioural restriction in such a housing system, a number of attempts to improve the environment have been made, generally described under the term 'environmental enrichment'. Modifications of cages for mice usually consist of providing material for nestbuilding and structures which can serve as hiding places and/or for climbing. We have reviewed 35 studies carried out between 1986 and 2000, in which preferences as well as the effect of housing modifications have been studied. Preference and operant experiments show that mice prefer a more complex cage to the standard cage and that they work for access to nesting material. Experiments evaluating provision of nesting material show that mice make use of the material to make nests in which they rest, with effects mainly on body weight and food consumption. In contrast, increasing cage complexity seems to have effects on a range of physiological and behavioural measures. These effects are not always in the same direction, probably at least partly due to sex and strain differences and variation in how the cages were modified. Physiological measures and standard behaviour tests, such as open field tests, have often been used without ethological observations in the home cage, which makes the results difficult to interpret. We will give a critical discussion of different ways to evaluate housing effects and discuss the consequences of modifying housing conditions for laboratory animal welfare and for the outcome of experiments using these animals.

Behaviour and cortisol of dairy cows with a different number of cubicles available

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It is commonly recommended to house dairy cattle with a cubicle:cow ratio of 1:1. Some studies have shown that behaviourally this does not necessarily have a positive effect for the cows. Not much information on physiological responses under different cubicle:cow ratios is available. The aim of this study was to compare the behaviour and cortisol levels of three groups of cows with different numbers of cubicles available. Thirty Holstein-Friesian cows were distributed in 3 groups, G1=20 cubicles/10 cows (2:1), G2=10 cubicles/10 cows (1:1), and G3=5 cubicles/10 cows (1:2). The cows were observed for 276 hours in a cubicle house building. Relative frequencies of aggressive and affiliative interactions, as well as the behavioural synchrony of individual behaviour (walking, eating and lying) were calculated in the three groups. An adrenocorticotropic hormone (ACTH) challenge test was carried out to assess cortisol response of the cows. Four blood samples were obtained per cow in each group. No differences were found in the frequency of aggression between groups, however G2 (1:1) showed a clear tendency to be more aggressive (Kruskal Wallis: $p=0.07$). G2 also showed the highest frequencies of affiliative behaviour (Kruskal Wallis: $H=7.83$; $p<0.05$) and G3 (1:2) the lowest frequency for that behaviour. No differences were found in the behavioural synchrony of the three herds. No significant differences were found in the average cortisol levels after ACTH administration, however at the fourth sampling point G2 also had a tendency to show higher cortisol levels than the other groups (Kuskal Wallis: $p=0.07$). Certainly, the quality of bedding and the design of the cubicles could be affecting the results. In order to establish an ideal ratio, physiological responses should be taken into account.

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Motivation of laboratory rabbits for social contact

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The assumption is often made that female domestic rabbits should be housed socially because their wild ancestors are social. Motivation of laboratory rabbits for visual/minimal tactile contact with another rabbit was assessed using a weighted push-door in a runway to determine the maximum weight rabbits would push through. Eight singly housed female New Zealand White rabbits were used, which were 17 weeks old at the start of the experiment. Three experimental conditions were applied, with each rabbit working (a) to gain one minute of contact through a wire mesh with an 'unfamiliar' rabbit, (b) to gain one minute of contact through a wire mesh with a 'familiar' rabbit, with which they had been familiarised daily prior to testing, and (c) to gain no reward, as a control. One minute of contact was chosen as the reinforcement period after a pilot study had been carried out to determine an appropriate time. A Friedman two-way analysis of variance showed a significant difference between experimental conditions ($F=6.07$; $DF=2$; $p<0.05$). The rabbits pushed through heavier weights to reach the unfamiliar and the familiar rabbits (median=700g and 1250g respectively) compared to the control (Median=0g) (Wilcoxon signed rank: $T=4$; $N=8$; $p<0.05$; $T=1$; $N=8$; $p<0.05$, respectively). Of the one minute of contact allowed the test rabbits spent significantly more time near the rabbit than away from it during most of the trials.

Singly housed rabbits will work to gain visual/minimal tactile contact with both unfamiliar and familiar rabbits, and choose to spend more time near them than away from them. Although only allowed visual/minimal tactile contact for safety/welfare reasons, this study has implications for laboratory rabbit housing. It indicates that singly housed rabbits should at least be able to see other rabbits and if possible have tactile contact with them.

To what extent can pigs adapt to a spatially restricted food source?

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The number of pigs that can be fed from a single feeding space is important information for the swine industry. What affects the eating speed of pigs, and to what extent can pigs adapt their eating rate when feeding space is restricted? We determined the total duration of eating in a standard test using 12 grow/finish pigs eating from one space (8 groups total). Feed presentation affected the total duration of eating with pigs fed dry mash taking longer to eat than those fed wet/dry mash, dry pellets, or wet/dry pellets (106.1 vs. 68.0, 58.8 and 59.7 min/pig/day; ANOVA: $F=26.81$; $DF=3,4$; $p<0.05$).

Using the eating durations obtained in the first study, pens in the second study were stocked with the number of pigs (stocking density) that should theoretically result in the feeders being in use 95, 110 and 125% of the time during the grower phase, and 80, 102 and 125% in the finishing phase. We used levels greater than 100% to determine how well pigs could adapt to the resulting restriction. As stocking density increased, time spent eating per pig decreased. When treatments exceeded 100% theoretical feeder usage, intake was reduced. The intake of pigs fed wet/dry mash diets decreased from 1.90 to 1.73 kg/day in grower at 95 (19 pigs) and 125% (25 pigs) respectively (ANOVA: $F=14.59$; $DF=3,15$; $p<0.05$) and in finisher from 2.93 to 1.70 kg/day at 80 (18 pigs) and 125% (25 pigs) respectively (ANOVA: $F=17.73$; $DF=2,10$; $p<0.05$).

The results indicate that total duration of eating is affected by the form of the feed. It is possible to determine the number of pigs that can be efficiently fed from a feeder space by extrapolating from total durations obtained under standard conditions of 12 pigs per feeder space. Pigs have a limited ability to adapt their eating speed at higher densities in order to maintain feed intake.

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G x EEE: the missing link when breeding for welfare?

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Animal breeding may be as significant a factor in determining welfare as the systems in which we manage our farm animals. Recent work has demonstrated the welfare and economic benefits of widening breeding goals to include 'fitness traits' in dairy cattle.

One aspect which has received less attention, as far as welfare is concerned, is the interaction between the genotype and its environment (G x E). Generally, animal breeders place greater emphasis on overall genetic improvement in production traits than the development of genotypes for specific environments. In contrast, the interaction between the animal and its environment can be seen as a critical determinant of welfare, and that welfare will be higher the better the match between the genotype and the environment.

There are 2 broad strategies to resolve this apparent conflict. One is to breed for traits that increase adaptability across environments (thereby minimising G x E), for example, by selecting for reduced 'fear' or 'stress' responses. However breeding for general adaptability has the disadvantage that it can be used to breed animals to produce in what might be regarded as ethically unacceptable conditions.

We suggest an alternative strategy of applying broadly based selection goals incorporating 'welfare' (e.g. fitness) traits, within perceived 'high welfare' environments, such as the equivalent of Freedom Foods Standards. This would constrain selection within an 'Ethical Environmental Envelope (EEE)', and in effect maximise G x E by more closely matching genotypes to the EEE. There are grounds for believing that, provided environments are well enough defined, there would be re-ranking of sires with respect to broader breeding goals applied within an EEE. Actively breeding for G x E in this way is a strategy both for aligning breeding strategies with the development of ethical production systems and for reconciling welfare problems that arise where genotypes are relatively poorly adapted to an EEE.

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How genes and environment determine welfare

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Natural selection acts continuously, in the wild and on the farm. It causes organisms to adapt to their environment. The best possible adaptation exists when organisms are using all available metabolic resources most efficiently and achieve the highest fitness. It is reasonable to assume that well adapted animals have good welfare. Adaptation comprises two separable processes, with both usually acting simultaneously: the changes (behavioural, physiological) that occur during the animal's life, as well as the longer term, evolutionary (genetic) changes. The more individually variable animals are, the less will genetic changes be required.

Reduced welfare arises when the behavioural and physiological settings of animals are not in harmony with environmental stimuli. The goal of animal keepers should be to remove mismatches between the biological settings of animals and the stimulation they receive. The roles of behavioural adjustments, genetic changes, and environmental enrichment in removing mismatches are discussed in relation to the various purposes for which animals are kept.

Rapid genetic improvement of production in modern livestock has led to another welfare problem. Selecting animals on estimated breeding values has reduced the importance of animal phenotypes. As breeding values for production traits rise, progeny animals on many farms no longer have enough environmental resources to express their phenotypes fully. Reduced fitness follows. Although production diseases of modern animals are defined as being different from ordinary animals having not enough feed, physiologically their problems are identical: insufficient resources for their metabolic demands. While animals starving in a drought are clearly seen as a welfare problem, production diseases have been less widely recognised as such. I expect animal breeders to demand changes to breeding programs, once they realise that current breeding programs inevitably produce welfare problems unless breeding goals change fundamentally.

Nest building and farrowing in sows: relation to stress reactivity and influence of different farrowing environments and experience

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Nest building and farrowing behaviour of first and second parity L/Y sows (N=40) in different farrowing environments (crate vs. 'get-away-pen', GAP) were studied. The behaviour was compared with the performance of the same individuals in prepubertal tests of behavioural reactivity (open-field test, human test, food-competition test) and reactivity of the HPA-axis during the open-field test.

Nest building behaviour during both parities was found to be most functional in the GAPs, where the prepartum rooting period started significantly sooner (GLMM: $F_{1,27}$=5.72; p<0.05 and GLMM: $F_{1,27}$=4.33; p<0.05, respectively) and lasted longer (GLMM: $F_{1,27}$=8.33; p<0.01 and GLMM: $F_{1,27}$=6.57; p<0.05, respectively). During the first parity farrowing behaviour was strongly dependent upon the environment, e.g. the mean piglet interval (log transformed) was significantly longer in the crates (GLMM: $F_{1,21}$=5.55; p<0.05), indicating an increased environmental sensitivity in gilts as compared to second parity sows, where no environmental effect was found. Both farrowing and nest building behaviour, especially during the first parity, were correlated with prepubertal behavioural and physiological reactivity pattern [e.g., from 1st parity: immobility in human-test~activity during farrowing (Rank correlation: r_s=-0.49; N=38; p<0.01); the number of postural changes during nest building~rise in cortisol (Rank correlation: r_s= 0.44; N=35; p<0.01)]. Furthermore, there was a strong repeatability across parities in parameters describing activity during nest building and farrowing.

Prepubertal gilts reacting calmly in a stressful situation were timing their nest building more optimally than more actively reacting individuals. Activity during prepubertal tests was also correlated with being active during farrowing. We therefore conclude that behaviour during nest building and farrowing is influenced by stress reactivity, especially in inexperienced gilts, and that nesting performance reflects an innate pattern of reactivity in the individual that can be modified by environment and experience.

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Extreme inbreeding: effects for social communication between mice and implications for their husbandry and welfare

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Most domestic species are selected and inbred to ensure consistency between individuals. Consequently, animals of the same sex and strain are often virtually genetically identical. This may have profound consequences for welfare, husbandry, research and animal production. For instance mechanisms permitting recognition of individuals, relatedness and/or familiarity are likely to be genetically determined in most species, and are crucial for the appropriate modulation of social behaviour including competition and mate choice.

For many species scent marks are key to effective social communication. Wild-type mice deposit urine in their environment to convey discretely vital information to others (e.g. their identity, sex, relatedness, familiarity, diet, health and social status) through deposition frequency, patterns, and chemical components. Such information influences subsequent social responses.

In wild-type mice, individual identity is conveyed through genetically determined low molecular weight proteins (Major Urinary Proteins and/or MHC breakdown products). However, individuals within inbred strains are virtually genetically identical and thus possess the same 'individuality' profile, potentially affecting recognition, unless environmentally changeable scent components were substituted. We predicted they would not a) recognise and respond to odours from genetically identical (GI) mice as non-self, or b) recognise and accordingly modulate their social responses to GI cagemates (who should be familiar and tolerated); relative to unfamiliar and genetically dissimilar (GD) individuals. Inbred BALB/c males did not countermark odours of GI individuals (an index of recognition) but, like males from outbred strains, they countermarked odours from GD individuals (Wilcoxon matched-pair specific test: $T=33$; $N=8$; $p<0.025$). Unlike outbreds, BALB/c males failed to discriminate socially between familiar and unfamiliar BALB/c males (showing little aggression to both), but were more aggressive towards GD males (Wilcoxon matched-pair specific test $t23=-4.86$ $p<0.001$). The implications of these results for the husbandry and welfare of laboratory mice is discussed.

Does variation in the onset of maternal behaviour affect the strength of association between ewes and their lambs?

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Previous studies have shown that ewes of two breeds of sheep, Suffolk and Scottish Blackface, differ in their immediate post-partum behaviour. Blackface ewes show more persistent grooming, a higher rate of low-pitched bleating and less negative behaviour towards their lambs. These behaviours are thought to influence ewe-lamb bonding and the ewe's ability to recognise her lambs. We hypothesised that these differences would affect the strength of association between ewes and their lambs in the two breeds.

31 primiparous ewes (14 Blackface, 17 Suffolk) were given a 5 minute maternal choice test at 3 days post-partum. The ewes were tested using a Y-maze design and given a choice between their own and similar alien lambs. The test apparatus was divided into 5 zones, 3 associated with lambs (contact zones). Ewe location was recorded every 10 seconds. High-pitched vocalisation rate, first contact zone entered and times to reach contact zones and own lamb were also recorded.

Vocalisation rates did not differ between the breeds. Blackface ewes were quicker than Suffolk ewes to reach the contact zones (Mann Whitney: $U=327.5$; $p<0.05$) and their own lamb (Mann Whitney: $U=326.0$; $p<0.05$), and also more likely to approach their own lamb first (Chi-squared: Chi-squared= 23.845, DF=2; $p<0.001$). Blackface ewes spent longer than Suffolk ewes in the contact zones (T-test: $T=-2.08$; DF=28; $p<0.05$) and the zone adjacent to their own lambs (T-test: $T=-3.56$; DF=25; $p<0.005$). Suffolk ewes spent longer than Blackface ewes in the zone farthest from the lambs (Mann Whitney: $U=346.0$; $p<0.005$) and the zone adjacent to the alien lambs (Mann Whitney: $U=356.5$; $p<0.001$).

Blackface ewes were more attracted to any lamb than Suffolk ewes, seemed better able to recognise their own lambs and preferentially associated with them. This suggests that Blackface ewes form a stronger bond with their lambs during the post-partum period.

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Side effects of selection for high litter size on social-defensive behavior in mice

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After studying wild house mice and mice selected divergently for aggression, Benus (1988) stated that mice are genetically predisposed to use predominantly passive or active behavior in challenging situations. The generality of this hypothesis was examined by comparing the defensive behavior of a mouse strain selected for high litter size (H-strain: 21.5±3.5, mean litter size at birth ±SD) with the behavior of a randomly selected control strain (C-strain: 9.6±2.2). Fourteen animals were used per strain. The resident-intruder test used in the present experiment measures the defensive behavior that male mice express in response to attack by a larger aggressive resident in a novel test arena. In this test, immobility and flight represent the passive and active strategy, respectively.

There were differences between the strains in the frequency and percent of time in defensive behaviours. Five of the H-strain animals continued with exploratory behavior at least once while being bitten by the attacker. This lack of response to bites was never observed for the C-strain (Fisher's Exact Test, 2-Tail; p=0.04). The frequency of immobility and frequency and percent of time in flight were negatively correlated for the C-strain but not for the H-strain (immobility freq. and flight freq. C-strain: r=-0.59*, H-strain: r=-0.02, ns; immobility freq. and percent of time in flight, C-strain: r=-0.64**, H-strain: r=-0.04, ns).

These results show that selection has reduced the efficacy of flight and immobility behavior in response to attack in the H-strain. Based on Benus' (1988) theory, one would expect a negative correlation between immobility and flight. While this was true for the C-strain, it was not found for the H-strain. The present experiment illustrates that selection for resource-demanding production traits in mice may obliterate the adaptive genetically based intra-individual dimorphism in behavioral strategies hypothesised by Benus.

Frustrated nesting behaviour and its relation to extraneous calcium deposition on egg shells of White Leghorn hens

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The inability of hens to express normal nesting behaviour in battery cages can result in serious frustration. Thwarted nesting behaviour in light hybrid hens typically manifests itself as stereotyped pacing. Frustration is also known to cause retention of an egg beyond the expected time of lay. This results in an extraneous layer of calcium on top of the cuticle layer of a normal egg. In this study, we examined whether nesting frustration contributed to increased calcium deposition on egg shells. Light hybrid hens (N=120, 4/cage) were randomly assigned to one of three treatments; these were NB (birds given nest-box), NN (no nest-box) and F (access to nest-box periodically denied). Observations of pre-laying behaviour were taken over three consecutive mornings (or until we witnessed one oviposition for each bird of our sample) when hens were 28, 32 and 36 weeks old. As expected, birds given the opportunity to use nest-boxes spent the least amount of time pacing in the hour before oviposition (ANOVA: F=23.9; DF=2,2; p=0.04). Also, NN spent as much time pacing as F (orthogonal contrast: p=0.39). For calcium loss data, one egg from each cage was randomly collected over seven consecutive days when hens were 28, 32 and 36 weeks old. Extra-cuticular calcium was quantified by biochemical means. Contrary to expectation, the treatments did not differ from one another (repeated measures ANOVA: F=0.03; DF=2,18; p=0.97). Egg shells from birds exposed to different treatments yielded the same amounts of calcium. Pacing time by hens in each cage in the hour before oviposition did not correlate with extra-cuticular calcium (partial correlation: r=-0.86; p=0.34). It seems that hens denied access to a nest-box are sufficiently frustrated to show a behavioural response, but not sufficiently frustrated to cause them to retain their eggs long enough to have extra calcium deposited.

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Effect of genetic selection for loin-eye area on behavior after mixing in Landrace pigs

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Two genetic lines of Landrace gilts, previously selected for differences in ultrasound loin-eye area, were examined for behavioral differences after mixing with unfamiliar pigs. The line selected for increased loin-eye area (N=30) differed in loin-eye area from the contemporary random control line (N=32) by 11.25 cm^2. Pigs were transferred from the nursery to the growing facility at 55 ± 7 days of age and immediately mixed within genotype in pens of four unfamiliar pigs. Pigs were videotaped continuously for the first 14 days in the growing pens to record daily behavioral activities and agonistic encounters. Daily maintenance behaviors, including percent of time spent lying, exploring pen, feeding and interacting with pen-mates, were examined on days 1, 3, 5, 8, 13. Agonistic encounters were examined for the first 48 hours after mixing. Repeated measures ANOVA was used for all statistical analyses. Significant differences between the genetic lines were seen only on day 1 after mixing for percent time spent lying (select 65.16 ± 1.12%; control 70.11 ± 1.12%; $F=9.70$; DF= 1,14; $p<0.01$), exploring (select 24.83 ± 0.96%; control 20.51 ± 0.96%; $F=10.06$; DF=1,14; $p<0.01$), and interacting with penmates (select 3.14 ± 0.44%; control 1.52 ± 0.44%; $F=6.80$, DF=1,14; $p<0.05$). No differences were seen for time spent feeding on any day or for any behaviors after day 1. Differences were seen between the two genetic lines in 5 of the first 10 hours after mixing, with the select line overall engaging in more agonistic encounters than the control line (select 78.73 minutes of fighting, control 37.83 minutes of fighting, $p<0.001$). Our results suggest that there is a genetic relationship between loin-eye area and the ability to adjust to mixing with unfamiliar pigs. This may have negative implications regarding the welfare of pigs selected for lean growth.

Savaging in domestic sows and gilts: its relationship to aspects of the individual and her parturition

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Little reliable evidence exists about the correlates of offspring-directed aggression ('savaging') in domestic pigs. Seventy-seven crossbred females, housed in groups of 4-6 during pregnancy and crates for farrowing, were videotaped before and during 101 gilt (N=20) and sow (N=81) parturitions. Pregnant females participated in paired feed competition tests to determine their social dominance order. 'Standard' approach tests with a novel object and novel human, preceded by an acclimatization period, were performed during late pregnancy. The duration of farrowing and number of posture changes before and during birth were recorded, as was any piglet-directed aggression, scored as 0 (none), 1 (moderate) or 2 (severe). A score of 2 indicated that one or more piglets were injured or killed by their mother and/or intervention was required to control the aggression.

Piglet-directed aggression (scoring 1 or 2) occurred at 9 (8.9%, 6 gilts, 3 sows) parturitions; of these, 5 (5.0%, 3 gilts, 2 sows) scored 2. All females scoring 2 fatally savaged one or more piglets. Ten piglets (0.9%) died as a result of savaging. Gilts were more likely to display piglet-directed aggression (Chi-square: Chi-square=13.7; DF=1; $p<0.001$) than were sows. Farrowings at which females savaged piglets tended to be longer (Partial correlation: $r=0.20$; DF=89; $p<0.1$), and involved more posture changes in the preceding 12 hours ($r=0.27$; DF=74; $p<0.05$) and a tendency towards more posture changes during farrowing ($r=0.18$; DF=89; $p<0.1$), than non-aggressive parturitions. Piglet-directed aggression was not related to a female's dominance status. Savaging was associated with more time spent in the periphery of the arena during acclimatization for approach testing ($r=0.28$; DF=81; $p<0.05$) and a greater probability of urination during approach testing ($r=0.24$; DF=76; $p<0.05$). In conclusion, parturition and pre-parturient behaviour differed between aggressive and non-aggressive farrowings, and females who savaged may have been more fearful of novelty during pregnancy.

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Handling and stress response traits in cattle: identification of putative genetic markers

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The aim of the study was to identify genetic markers that are linked with behavioural and stress response traits in cattle. Two calf crops (total N=430) were born in consecutive years, using three Limousin x Jersey or Jersey x Limousin sires, back-crossed to either Limousin or Jersey dams. The cattle were managed on the one farm from weaning. From 20 months of age, the flight distance of each animal was measured individually in response to an unfamiliar human on three occasions at intervals of 1 month. The cattle were slaughtered at 24 months of age, with a blood sample being collected immediately prior to stunning. Following slaughter, a urine sample was also collected from the second age group only. Plasma and urine cortisol concentrations were determined as measures of animal stress response to pre-slaughter transport and handling at the abattoir. All animals were typed for 253 microsatellite marker loci, spaced as evenly as possible over the 29 bovine autosomes. The repeatability coefficient (r ± se) calculated by the ASREML procedure for the flight distance measures was 0.51 ± 0.03. The mean flight distance of progeny of sire 2 (10.4 m) was lower than that for progeny of sires 1 and 3 (11.7 and 12.5 m, respectively; ANOVA: $F_{2,411}$=9.16; p=0.0002). In addition, flight distance appeared to be linked to five microsatellite markers. Two genetic markers appeared to be linked to urine cortisol response and one putative marker was identified for plasma cortisol response to the stress of pre-slaughter handling. Further research will be conducted to confirm linkages, but these results demonstrate a genetic basis for some of the variation in cattle behavioural and stress responses to handling and indicate the potential for marker-assisted selection of cattle for particular behavioural and stress response characteristics.

Physiological correlates of abnormal oral behaviours in veal calves

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Individually housed veal calves typically develop stereotypic abnormal oral behaviours (AOB). We hypothesized that AOB may have a de-arousal effect, reflected in increased parasympathetic tone, and examined the relationship between AOB and both heart rate and pituitary-adrenocortical reactivity.

We used 36 male Holstein-Friesian calves, divided across six treatments involving different solid feeds given next to milk replacer. Behaviour and heart rate were recorded simultaneously at 12 and 22 weeks of age, around provision of milk replacer in the afternoon. At 20 weeks of age, (pituitary-)adrenocortical reactivity to synthetic ACTH and bovine CRH were assessed. Behaviour and heart rate were linked with the use of software which generated, for each calf, average heart rate (bpm) and the root mean square of successive inter-beat-interval differences (r-MSSD) during bouts of AOB longer than 10 seconds, and during connecting 10-second reference periods before (RPb) and after (RPa) bouts of AOB.

Level of AOB at 12 weeks, but not at 22 weeks, was significantly, and negatively, associated with adrenocortical responses, expressed as areas under the cortisol against time curves, to both ACTH (analyses of covariance: F= 5.66; DF=1,18; p=0.029) and CRH (F=11.28; DF=1,26; p=0.002). In comparison with RPb, but not RPa, average heart rate during AOB tended to decrease at 12 weeks (LSD after ANOVA on contrasts within animals: t=1.92; N=18; p=0.071), and was significantly decreased at 22 weeks (t=3.80; N=21; p=0.001). At 22 weeks, r-MSSD during AOB was significantly lower than r-MSSD during RPb (LSD after ANOVA on log-transformed contrasts within animals: t=2.28; N=21; p<0.05), but was not different from r-MSSD during RPa, indicating decreased parasympathetic tone during AOB relative to RPb only.

Our results suggest that stereotypic AOB in veal calves may not have a de-arousal function in the short term, but may be beneficial in terms of coping with chronic stress.

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Does genotype or maternal influence determine the behaviour of the neonate?

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Neonate vigour plays a fundamental role in establishing the ewe-lamb relationship and ensuring lamb survival. Maternal behaviour expressed at parturition does not alter the early behavioural responses of the neonatal lamb. In order to determine why individual differences in neonatal vigour occur the effects of sire, dam experience, and lamb factors (breed, sex and litter) on the behavioural development of neonatal lambs were investigated.

Data on the latency to perform righting, standing and sucking behaviours over the first 2 hours post-partum, were collected from 524 lambs born to the same 169 ewes and 22 sires over a period of 4 years. Ewes were originally obtained from 15 different flocks. Lambs were either Scottish Blackface (N=265) or Suffolk (N=259) breeds. The amount of time spent sucking and playing over the first 3 days of life were also recorded. The significant effects were determined by the Restricted Maximum Likelihood procedure to estimate components of variance.

Suffolk lambs were slower than Blackface lambs in all behaviours (e.g., seeking udder: log-transformed, Wald=72.1; DF=1; $p<0.001$). Within breed, birth weight and sire identity were significant determinants of neonatal lamb behaviour (e.g. Blackface lambs, standing: log-transformed, Wald=28.4; DF=10; $p<0.005$). For Suffolks, male lambs were significantly slower than female lambs to stand (log transformed, Wald=11.5; DF=1; $p<0.001$) and suck. Blackface lambs sucked less (Wald=8.2; DF=1; $p<0.01$) and played more frequently (Wald=9.0; DF=1; $p<0.01$) than Suffolk lambs. An increase in ewe parity was associated with a decrease in the frequency of sucking (square-root transformed, Wald=18.5; DF=3; $p<0.001$) and an increase in play (square-root transformed, Wald=19.1; DF=3; $p<0.001$) over the first 3 days.

The behaviour of the neonatal lamb immediately postpartum was determined by breed, the genetic effect of sire identity and events occurring during prenatal development, such as factors determining birth weight. Thereafter, lamb behavioural development was affected by dam factors.

Are oral stereotypies and abomasal lesions correlated in veal calves?

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Veal calves show stereotypies such as tongue playing and oral abnormal behaviours, and often have abomasal lesions such as ulcers and erosions. Stereotypies are considered a way to cope with a stressful environment. This theory seems confirmed by the fact that calves which show more stereotypies have less abomasal damage, although this relationship has been found in only one study (Wiepkema et al., 1987; Appl. Anim. Behav. Sci. 18: 257). The aim of this research was to evaluate the possible relationship among abnormal oral behaviour, abomasal lesions and rearing factors in veal calves.

Polish Friesian male calves (N=226) were used: 90 were fed a traditional all-liquid diet (C), 90 received 250 g/d of wheat straw (WS) in addition to the milk replacer, and 46 received 250 g/d of beet pulp (BP) in addition to the milk replacer. Forty-eight calves were individually housed (16 C, 16 WS and 16 BP) and 178 (89 C, 89 WS and 30 BP) were kept in group pens (3, 5 or 7 calves/pen) at the same density (1.8 m^2/calf). Observations (4 h/week, scan sampling every 2 minutes) were carried out at mealtimes at wk 2, 17 and 23 of the fattening period. Oral activity towards structure and bucket (biting, nibbling, sucking) tongue playing, and tongue rolling were evaluated. Abomasal samples were collected at slaughter. Histologically, abomasal lesions were classed as ulcers and erosions, and scored according to stage, size and duration. Spearman correlation was carried out on residuals of behavioral categories and abomasal lesions.

Calves showing more abnormal oral behaviors had fewer ulcers (N=219, r=-0.16241 p=0.0145), although there was no relationship between stereotypies (tongue playing and tongue rolling) alone and abomasal lesions. The results of this study do not completely elucidate the role of stereotypies in veal calves, but do point out the importance of using different indicators in assessing welfare.

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The development and social nature of feather pecking

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We studied the influence of social factors on the early development of feather pecking (FP) in two lines of White Leghorns (resulting from a commercial selection programme) that differ in their propensity to feather peck. In mixed groups the line difference in gentle feather pecking (GFP) developed within the first three days after hatching (Mann-Whitney: N1=N2=9; U=17.5; $p<0.05$). Severe FP occurs much later in life, and seems to develop from GFP, as it was initially only embedded within GFP bouts. We demonstrate that GFP has a strong social component. First, when feathers were presented (stuck to the wall at the chicks' height) in the home cage of the groups in a non-social context, the birds (even those from the high feather pecking line) showed hardly any interest in pecking at these. Second, GFP seems to be part of social exploration. Chicks from the high feather pecking line were either subjected to regular rehousing (controls) or regular rehousing plus confrontation with unknown peers (experimentals) between the age of 0 and 20 days. During this period GFP was more pronounced in the experimental groups than in the control groups (Mann-Whitney: N1=6; N2=12; U=14; $p<0.05$). Third, directly after these confrontations chicks tended to peck more at unfamiliar than familiar birds (Wilcoxon: N=12; Z=-1.779; $p=0.075$). Fourth, introduction of an unknown peer into a stable group of 8 week old chicks induced much more GFP specifically to this unfamiliar chick than to the group members (Wilcoxon: N=10; Z=2.752; $p<0.01$). Fifth, the increase in GFP after confrontation with this unfamiliar chick was much less pronounced (c. 50%) when the birds had been reared for four weeks with a foster mother than without a mother (Wilcoxon: N=10; Z=2.599; $p<0.01$).

Social transmission of cannibalism

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We hypothesised that social learning is involved in the transmission of cannibalism in domestic fowl. Evidence suggests that cannibalism, which involves the consumption of blood and other tissues of conspecifics, is redirected foraging behaviour. We randomly assigned flocks of White Leghorn pullets to one of two treatments: Experimental - flocks with trained demonstrators (N=9), and Control - flocks with naïve demonstrators (N=8). Two birds per flock were demonstrators and the remaining 10 hens were observers. For ethical reasons, we used a chicken model - a petri dish containing chicken blood covered by a membrane ('skin') - rather than real chickens as a cannibalism stimulus. We trained demonstrators in Experimental flocks to break the membrane and consume the blood. To assess the effect of proximity to the cannibalism stimulus during demonstrations, we randomly assigned observer pairs to one of two observer treatments: (1) observe through a fence and (2) observe within the same pen. We conducted five 10-min demonstration sessions and test trials over a period of 15 days when the birds were 41-55 days of age, and two further test trials at 63-64, and 91-92, days of age. Pairs that observed trained demonstrators breaking a membrane and consuming blood were more likely to perform this task when subsequently tested in the absence of demonstrators than control pairs (mixed model repeated measures ANOVA on ranked data: $F=4.82$; $DF=1,15$; $p=0.044$). Learning of the task was enhanced by demonstrations within the pen rather than through a fence ($F=8.99$; $DF=1,15$; $p=0.009$). This study provides the first experimental evidence that social learning can contribute to the spread of cannibalism (i.e. consumption of conspecific tissues) in flocks of domestic fowl. We suggest that stimulus enhancement and observational conditioning are the mechanisms involved.

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Genetics of dedomestication in large herbivores

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Domesticated large herbivores are often used as grazing machines to manage vegetation in nature reserves in the Netherlands. In large nature reserves such animals are given the opportunity to reproduce and behave without human interference. They are in a process of dedomestication, i.e. they become wild again and adapt to the environment. In a two-year project we aim to describe the dedomestication process in biological terms to contribute to the discussion about ethical treatment of these animals. Do we have to consider these animals as domesticated or as wild animals? To answer this question the self-sustainability of animals in dedomestication is reviewed using the available literature on feral and (semi-) wild large herbivores (horses and cattle). The literature mainly records the successes of feralization, showing that adaptation may take place very quickly. This suggests a significant learning component. The genetic component appears to be more difficult to estimate. There are indications that there is no genetic adaptation for certain traits (coat color, timing of birth, and antipredator behaviour), although strong selection (by extreme gales at high altitudes) occurs in feral horses (Berger, 1986), that must have a genetic impact on the population. In the Netherlands, selection may be taking place for instance due to foal mortality (Konik horse) and adult cattle mortality (Heck bulls dying in poor territories or bearing Scottish Highland cows dying when spring is late). Differences in survival of different breeds with different degrees and types of domestication histories allow speculation on the genetics of dedomestication. This will be illustrated using data showing differences in behavioural adaptation of Heck cattle (Auroch reconstruction, but of 75% Corsican origin) and Highland cattle to the Dutch climate. Behavioural genetics are now used to select new breeds for nature reserves that are better suited for successful dedomestication.

The veterinary, behavioural and welfare implications of bear farming in Asia

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More than 7000 bears (Ursus thibetanus, Ursus arctos, Helarctos malayanus) are held in close confinement in Chinese bile farms. These farms provide bile for traditional Chinese medicine (TCM) and other products such as shampoo, wine, teas and hangover potions. Bile is collected from the gall bladder of live bears through permanent gall bladder cannulae or fistulae. Although bear bile has been used in TCM for millennia, bile extraction from live bears began in 1985.

This paper provides an up-to-date assessment of the behavioural, veterinary and welfare problems associated with bear farming in Asia, based on information obtained by two recent independent surveys of 44 Asian bear farms holding 2,580 bears (37% of the total number held). Husbandry practices associated with Asian bear farms include early weaning, maternal separation, circus training of cubs, permanent extreme confinement in barren, unsuitable cages or enclosures which do not allow for the expression of normal behaviour, inappropriate substrates and social grouping, poor nutrition and severe surgical procedures combined with inadequate veterinary care and health surveillance. Acute and long-term stress effects on bear health and welfare such as chronic stereotypies, excessive inactivity, self-mutilation, absence of play, severely curtailed longevity, poor reproductive performance, cub survival and sperm quality, as well as high injury rates are documented and discussed. In addition, the physiological effects of bile removal on fat digestion, bile salt levels and absorption of fat-soluble vitamins are considered. It is concluded that the collective environmental challenges imposed by bear farming for bile extraction exceed the bears' adaptive limitations, and that husbandry requirements of animals with permanent gall bladder fistulae and environmental conditions necessary to maintain mentally and physically healthy bears in captivity according to internationally recognised standards, cannot be consolidated.

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Abstracts of posters ordered by subject and poster number

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Operant and two-choice preference applied to equine welfare

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Confinement of horses without opportunity for exercise is an important welfare issue. In order to determine if exercise is a behavioral need, two-choice and operant conditioning methods were used. In the two-choice preference test, 8 of 8 horses chose release in a paddock. When two-choice tests were administered every 15 minutes for a maximum of 3 hours, the horses chose to spend 30 minutes in a paddock with other horses and then chose their stalls. Horses chose only 15 minutes when they were released singly in the paddock. Having determined that horses would choose exercise in a two-choice preference test, we assessed the strength of motivation for exercise. Nine mares confined to a straight stall for approximately 23 hours of the day were operantly conditioned to press a panel to open the door of their stall at a fixed ratio (FR) for one of 3 rewards. The FR increased progressively each day until the horse extinguished the response. The rewards were Food, Companionship, and Release into the Paddock. Median breakpoints were 37 for Release, 191 for Food, and 56 for Companionship. There was a significant difference between Food and Release ($p<0.03$;Wilcoxon Signed Rank Test). To test motivation for forced exercise, 9 horses were trained in a Y-maze so that turning left meant exercise on a treadmill and turning right meant return to the home stall. When allowed to choose, 8 of 9 chose to return to their stall. The results using three different approaches to the question of equine motivation for exercise indicate that horses do not like forced exercise, but will choose the opportunity to exercise at will with conspecifics.

Separation anxiety and attachment of pet dogs to their owners

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Separation Anxiety (SA) is a behavior problem that may be directly affected by the attachment that dogs have to their owners. This study used a modified Ainsworth (1969) Strange Situation Test to study the attachment of dogs to their owners. The test exposed the subjects to periods of low stress (owner and dog in a novel room) and high stress (owner leaving the dog alone in room). Behaviors recorded included: percentage of time spent near the door, jumping on door, and vocalizing when the owner was gone from the room; and percentage of time spent jumping on and being near the owner during reunions. The authors hypothesized that dogs with a greater degree of SA would spend more time performing attachment-related behaviors than dogs without SA.

Thirty-five dogs and their owners were used in this study. The degree of Separation Anxiety was determined by using a questionnaire, with increasing scores indicating increasing degrees of SA. The dogs and owners went through a 30-minute test where each dog was in a novel room with the owner, the owner and a stranger, the stranger only, or alone.

None of the behaviors recorded were significantly correlated with degree of Separation Anxiety. An alpha of 0.007 was used since multiple tests were run. Statistical results when owner was absent: time spent near door (rank correlation: r_s=.294; DF=34; p=.043; power=.2286); jumping on door (rank correlation: r_s=.316; DF=34; p=.032; power=.2921); whining (rank correlation: r_s=.178; DF=34; p=.153; power=.075); and bark frequency (r_s=-.105; DF=35; p=.274; power=.0314]. During reunions, time spent jumping on owner [rank correlation: r_s=.35; DF=34; p=.02; power=.3483); and staying near owner (rank correlation: r_s=-.038; DF=34; p=.415; power=.0125).

These results suggest that attachment to the owner alone does not mediate Separation Anxiety. Other factors in dogs' experience and environment may be affect dog's susceptibility to SA.

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Treating animal behaviour problems with sex hormones: an animal welfare issue

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In England and Germany, the methods used to modify unwanted animal behaviour in veterinary practices were investigated by questionnaire. The samples were created by a systematic selection. Of the 216 questionnaires posted in each country, 66 replies from Germany (30.5%) and 76 from the UK (35.2%) were obtained and evaluated.

The majority of veterinarians in both countries considered hormones effective in treating behaviour problems, but English veterinarians do so significantly more for both cats and dogs. However, only a minority use cortisone, androgens and oestrogens. Progesterone is used by about 75% of veterinarians in the UK but by fewer than 50% in Germany.

There is evidence that the effectiveness of hormones is restricted to sexually dimorphic behaviours and that, even there, is of limited success (Hopkins et al. 1976; Hart 1980). Furthermore, the use of hormones has been shown to be accompanied by serious side effects, for example a high risk of pyometra, cancer of the mammary gland, and induction of diabetes mellitus in prediabetic patients.

It is common medical practice that methods with serious side-effects that are not very effective are discarded as soon as better treatments are available. In fact, in such cases the further use of such methods is considered a grave medical fault. In scientific research, as well as in human medicine, the principles of behaviour modification have proven to be highly effective (Köhlke and Köhlke, 1994; Martin and Pear, 1996). Some psychoactive medication used for the treatment of humans has been recently approved for use in dogs. Thus, to ensure the welfare of the animals in question, the use of sex hormones in the treatment of animal behaviour problems should be regarded as inappropriate and obsolete and abandoned in favour of behaviour therapy and modern psychoactive medication.

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Comparison of the perceptions of temperament in dogs by different members of the same household

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Rescue shelters in the UK are continuously striving to re-home the thousands of dogs (*Canis familiaris*) that are relinquished each year. Unfortunately, around a quarter of these dogs are returned to the shelter because the relationship with the new owner has failed. Temperament tests have previously been developed for use by rescue shelters in order to predict the type of behaviour a dog will display in a new home. Temperament testing depends on owner judgement of dog behaviour to validate these methods, which may be an unreliable criterion as it depends on owner perception of their dog's behaviour in the home environment.

In order to establish the reliability of this, we examined owner's perception of the same dogs by different members of the same household.

Owners of recently rehomed dogs were contacted through the Scottish SPCA and the National Canine Defence League (N=14). Two owners were asked to fill out a questionnaire regarding behaviours related to the traits of aggression, excitability, timidity, playfulness and obedience. Owners were asked to rate their dog's behaviour on a 1 to 5 Likert scale. Trait scores were compared using the Spearman Rank test: aggressiveness (Rho=0.863; $p<0.001$; N=14), timidity (Rho=0.812; $p<0.001$; N=14), playfulness (Rho=0.609; $p<0.05$; N=13), and obedience (Rho=0.818; $p<0.002$; N=13). Excitability did not produce a significant result (Rho=0.494; $p<0.10$; N=14). The high positive correlations between trait scores indicate that different owners have similar perceptions of the same dog. Therefore, unless owners have the same misconceptions, they are quite reliable in their interpretation of their dogs' behaviour.

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A web-based gateway to information on the optimal care and welfare of fish

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Fish are more commonly associated with households in the U.S. than are horses. Yet, these pets are given veterinary care less commonly than any of the less conventional pets; most owners rely on pet stores for advice on the care of their fish. Availability from professionals of accurate authoritative information on optimal care of fish is not convenient nor utilized by most people keeping fish as pets. Beyond being kept as pets, fish also are extremely numerous in research facilities, often outnumbering even the mice. Thus, many people from the general public to research scientists could benefit from timely and accessible information concerning optimal care and welfare of fish.

To address the need for up-to-date information on fish, a web gateway will be presented offering search templates for accessing refereed research literature pertaining to the care and welfare of fish. The search templates consist of stored searches on high- interest topics that are made available on the Web, allowing the user to conduct new searches in real-time. The templates are embedded in freely-available databases, including PubMed and AGRICOLA. For materials not retrieved by these templates, as well as standard recognized resources in this field, a detailed bibliography will also be available via the gateway. This would allow links to full-text information when available. These templates will be useful to pet owners, pet store managers, organizations of people interested in fish, and veterinarians. The templates are prepared based on a focus group of experts that identify and refine their primary needs for information, thus establishing their priorities for information access.

The behaviour and welfare of Zebra Finches under typical pet shop conditions

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The Australian zebra finch, *Taeniopygia guttata*, is the most common finch kept in captivity. They are naturally social, flocking around dawn before dispersing into smaller groups. Males and females establish strong pair bonds and court in relative privacy.

In the UK pet traders are legally bound only to ensure that birds can stretch their wings. Typically finches are kept in restrictive wooden cages with limited resources (e.g. food, water, perches) with group composition constantly varying as birds are sold. There has been little systematic study of the effect of such conditions on zebra finch behaviour and welfare. We studied eight mixed sex groups of seven birds housed in typical 'breeding' cages (48 x 30 x 38cm), subsequently both enlarged and decreased in size by 30% (treatment order balanced over groups). Birds were observed using time budget sampling, for 6 hours daily over 8 days per treatment. Post-experiment birds were re-homed into aviaries.

Aggression levels differed significantly between groups (Kruskal-Wallis: $H7=28.5$; $p<0.001$), being largely confined to a small subset of birds but occupying up to 24% of the early part of their day. Aggressors were typically paired males defending perches from unpaired males who were relegated to the cage floor (aggression received: time spent on floor; Spearman correlation: $r_s=0.36$; $N=56$; $p<0.01$). One aggressive female repeatedly feather pecked an unpaired male, enforcing separation on ethical grounds. Another seven birds showed individually characteristic abnormal repetitive behaviours including route tracing, spot pecking and peeping to adjacent caged birds. Altering cage size by 30% had little effect on behaviour, including aggression and repetitive behaviour, probably because all cages were too small for these birds. The implications of this, and enforced group structure, on the welfare of zebra finches in the pet trade will be discussed.

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Vocalizations of cockatiels (*Nymphicus hollandicus*) are affected by dietary vitamin A concentration

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Vitamin A (VA) deficiencies and toxicities are common nutritional problems of captive birds. Functional parameters for assessment of avian VA status were examined in adult female cockatiels fed diets with 0 (N=5; deficient), 2,000 (N=6; required level), 10,000 (N=6; typical dietary level) or 100,000 (N=6; excessive) IU VA/kg diet for six months. Prior to changes in standard clinical markers we perceived changes in vocalizations. To test for changes, each bird was removed from its cage, placed in an identical cage in a soundproof room, and acclimated for 2 min. Vocalizations were recorded (SpectraPLUS) for two min using an omnidirectional microphone. Vocalizations were analyzed (JMP, SAS Institute) for main effects of diet, date, diet*date and bird [diet] using a GLM. Total vocalization number increased in birds fed 100,000 IU compared to 2,000 IU (ANOVA: $F_{3,22}$=3.05; p<0.0001). This difference occurred in the first min and last 30 sec of the observation ($F_{3,22}$=3.05; p<0.05). In contrast, 0 and 10,000 IU significantly decreased the number of vocalizations ($F_{3,22}$=3.05; p<0.03), primarily in the first 30 sec ($F_{3,22}$=3.05; p<0.05). Average length of vocalizations was reduced in birds fed 0 or 10,000 IU compared to 2,000 IU ($F_{3,22}$=3.05; p<0.001). The peak frequency (Hz) was lower in birds fed 0 IU ($F_{3,22}$=3.05; p<0.002) and 100,000 IU ($F_{3,22}$=3.05; p<0.02) compared to 2,000 IU, and peak amplitude (dB) and total power (dB) were reduced in birds fed 0 IU compared to 2,000 IU ($F_{3,22}$=3.05; p<0.001). Therefore, VA status can affect vocalization behavior of cockatiels prior to changes in standard clinical markers and may be useful to evaluate nutritional status. Vocalization changes could be detected at levels of VA commonly fed to Psittacines (10,000 IU/kg diet). More severe behavioral changes occurred at VA levels (100,000 IU) that may be reached when drinking water is fortified with commercial vitamin supplements.

The selection of enriched versus restricted forage environments by stabled horses

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Many stabled horses are maintained in very different conditions from those in which they evolved. The diet of feral horses includes many grasses and browse species, however, most stabled horses are given a single forage.

In four replicated trials, twelve competition horses were introduced into each of two identical stables containing a single forage, or six forages for five minutes. To detect novelty effects, in the first and third trials the single forage was hay. In the second and fourth it was the preferred forage from the preceding trial. Trials were videotaped and 13 mutually exclusive behaviour patterns compared. After these sessions horses were allowed five minutes to choose between stables and duration in each compared.

Data were evaluated using Observer 3 and SPSS v8. Square root transformations normalised the data allowing GLM factorial ANOVA. Similar results were obtained from all trials, and some effects of monotony were detected. Hay was the least preferred forage throughout. Behaviour was significantly different between stables in all trials, e.g.; during the third trial in the single forage stable horses looked over the stable door more frequently ($F_{1,11}$=65.9; p=0.001), moved for longer ($F_{1,11}$=161.6; p=0.001), foraged on straw bedding longer ($F_{1,11}$=35.9; p=0.001), and exhibited behaviour indicative of frustration ($F_{1,11}$=8.5; p=0.014) more frequently. When allowed to choose, horses spent more time in the Multiple forage stable (arcsine transformed proportional data, t-test: t=19.8; DF=10; p=0.001).

In these trials behaviour in stables with single or multiple forages was significantly different. When allowed to choose, horses showed a preference for the multiple forage environment. Further study is required to determine whether these effects persist over longer periods. However, these trials indicate that enrichment of the stable environment through the provision of multiple forages may have welfare benefits for domestic horses, in reducing straw consumption and behaviour indicative of frustration.

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The influence of the owner on the development of aggressive behaviour in dogs

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Aggressive behaviour in dogs has become a major topic of scientific research in Northern Europe, particularly in England and France, and also in the USA. It ranks amongst the top problems presented to animal behaviour therapists.

Research into the influence of owner's interactions with their dog on the development of the dog's behaviour in general and problem behaviour, including aggression in particular, has yielded contradictory results. While some authors could not establish significant links between the way dog owners treated their dog and development of behaviour problems, others did. Furthermore, in animal behaviour therapy, the owners' behaviour has proved to be a major and very influential factor in influencing and changing the animal's behaviour, including aggressive behaviour.

In principal, aggressive behaviour in dogs can be considered normal, species-specific behaviour, essential for survival. Like all behaviours, it is the product of different factors. Learning and genotype both play an important role, as do physical and physiological factors like the dog's health, its hormonal and reproductive status, and the individual situation and context in which the aggressive behaviour occurs.

The degree of adaptability of a species depends to a high degree on the learning capacities of the individual. The variety of situations in which dogs live and the diverse tasks they accomplish for humans show that they, like humans, have a large capacity for learning throughout their lives. Thus, in dogs, aggressive behaviour is, to a large extent, influenced by learning. Because the principles of learning are relatively unknown to the general public and rarely applied deliberately and systematically in everyday dog training, normal human behaviour is bound to reinforce aggressive behaviour in dogs. This will be demonstrated in case studies.

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Dangerous dogs - and how to define normal aggression

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Since aggressive behaviour is part of their normal behavioural repertoire, any dog can behave aggressively and thus become dangerous. Biologically, 'normal aggression' serves to increase distance in time and space from an opponent and is a means to an end in conflicts over resources. 'Normal aggression' is as such adequate for the given situation and is decisive. Giving a species or a breed an ethological profile will be helpful in deciding whether there are differences in aggressiveness and whether there are breeds, or lines within a breed, that can be labelled 'abnormally aggressive'. The first step in gaining an ethological profile is acquiring an ethogram, followed subsequently by looking at behavioural ontogeny in the respective group and comparing different breeds with the wild ancestor. If there are inborn breed-specific differences in aggressiveness, dogs from proposed aggressive breeds should show attack or threat behaviours earlier during ontogeny then 'less-aggressive' breeds. Ethograms and data on behavioural ontogeny exist for: Siberian Husky, Bull terrier, Beagle, German Shepherd, Weimaraner, Labrador Retriever, Golden Retriever, Miniature Poodle, Standard Poodle, American Staffordshire Terrier, Fila Brasileiro, and European Wolf. Last year the Rhodesian Ridgeback was observed and compared to the other breeds by the author in looking at the first day of life, when each behaviour of the ethogram was seen first in a puppy. Data for all breeds are shown, compared and criticised. Statistical analysis was done using one- and two-sample t-tests. The Ridgeback did not show significantly earlier development of any behaviours that might be important for a guarding or hunting breed including agonistic behaviours, nor did the group of the proposed 'aggressive' breeds (Rhodesian Ridgeback, Bull terrier, American Staffordshire Terrier).

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A comparison of reactions of therapeutic riding and jumping horses to two different challenges

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Little research has been done to measure behaviour and stress in Therapeutic Riding horses (TRH). As individual reactivity and chronic stress can be assessed by exposing animals to novel stressors, we compared the reactions of TRH and jumping horses (JH) to two challenges.

Four TRH and four JH were restrained with a head hood for 1 hour (Phase 1) and exposed to a novel object (a garland) in Phase 2. Heart rate (HR) was recorded telemetrically, video-recorded behaviour was analysed with the "Observer". Lymphocyte proliferation was determined before and after each challenge. The mean (SD) HR during each behaviour was calculated. Analysis of variance with repeated measures, Kruskal-Wallis, and matched pairs Wilcoxon tests were used.

Phase 1. Horses spent most of the time immobile (TRH=1977±708sec; JH=2250±690sec) and alert (TRH=632±349sec; JH=862±377sec); there were no differences between the groups. HR varied with different behaviours (GLM: $F_{1,7}$=3,32; p<0.05): mean HR during 'pawing' was higher than during other behaviours ($F_{1,7}$=3,32; p<0.005). TRH when immobile had a mean HR higher than JH ($F_{1,1}$=9,25; p<0.05). An effect of time on HR during the test was found ($F_{1,11}$=8,73; p=0.0001). The average HR of TRH was 51 bpm higher than the basal value (Wilcoxon: S=26 Z=2,17p<0.05). In JH there was an increase of 58 bpm (S=26 Z=2,17; p<0.05). A decrease in lymphocyte proliferation in samples taken after the removal of the hood (S=88 Z=2,05; p<0.05) was found, with no difference between TRH and JH.

Phase 2. Horses were immobile for most of the time (TRH=513±165; JH=554±257sec) and TRH had a larger increase in HR (135 bpm, S=26 Z=2,17; p<0.05) than JH (64 bpm, S=26 Z=2,17; p<0.05) during the first minute after shaking the garland. The mean HR while 'exploring' the novel object was higher in TRH than in JH ($F_{1,1}$=5,99; p<0.05).

These results indicate that TRH reacted more but not extremely to the challenges.

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Predicting behavioral changes associated with age-related cognitive impairment in dogs

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Recognition and interest in the behavioral changes associated with age-related cognitive impairment in dogs is rapidly growing. The data for these studies were obtained by structured telephone interviews of owners of 180 randomly-selected canine patients of the Veterinary Medical Teaching Hospital at UC Davis. The interviews focused on signs of impairment in behavioral categories of orientation in the home or yard, social interactions with the owners, housetraining, and sleep-wake cycle.

The demographic study demonstrated a significant, age-related progressive prevalence of impairment in behavioral categories (two-tailed Fisher exact test: p range 0.001 to 0.004). The percentage of 11-12 year-old dogs that were impaired in at least 1 category was 28%, of which 10% were impaired in 2 or more categories. Of 15-16 year-olds, 68% were impaired in at least 1 category, of which 35% were impaired in 2 or more categories. There were no significant effects of gender (logistic regression: p range 0.26 to 0.85) or body weight (logistic regression: p=0.36) on cognitive function.

A second study, following up on the dogs from the original study, showed that impairment in any 1 of the 4 behavioral categories is predictive of further impairment (Chi-square for independence: p=0.012). Of dogs impaired in 1 category, 48% developed impairment in 2 or more categories 6-18 months later, significantly more than the 11% of dogs which were impaired in no categories that subsequently developed impairment in 2 or more categories later.

In correspondence to current thinking about the protective effects of gonadal hormones on Alzheimer's disease in humans, unneutered male dogs were significantly less likely (one-tailed Fisher exact test: p=0.035; two-tailed Pearson Chi-square test: p=0.03) than neutered dogs to progress from impairment in 1 category to impairment in 2 or more categories 6-18 months later.

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Disparity between dog owner expectation and experience: its effect on the owner-dog relationship

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Some UK animal charities receive back up to 27% of the dogs that they re-home with new owners. In approximately 75% of these cases, the reason given by owners is that they are dissatisfied with some aspect of the dog's behaviour. A study was undertaken with the RSPCA and Battersea Dogs' Home to evaluate how failure of dogs' behaviour to meet the owners' expectations correlates with ownership success.

Prospective dog owners registering with re-homing centres completed a questionnaire (Q1) regarding how they would expect their new dog to behave when they got it home. Responses to these questions were scored using Likert scales, which characterised different types of behavioural response (Aggressiveness, Excitability, Fearfulness, Obedience, Playfulness and reaction to being Isolated) to a range of stimuli. One month following adopting their new dog, these same owners were sent a second questionnaire (Q2). They were asked how this dog did actually behave using the same items from the first questionnaire. The discrepancy between expectation and experience (D) was calculated (Q2 – Q1; N=201). Ownership success was measured by whether the owner had considered or had actually returned the dog to the animal centre.

Although the temperament of dogs available was very similar to the temperament that prospective owners wanted, the results showed that unsuccessful relationships were characterised by significantly higher D values in 18 out of 34 items (Mann-Whitney: $p<0.05$; N=201). In particular, unexpected displays of aggressiveness, excitability and 'separation anxiety' were frequently associated with an unsuccessful relationship.

Since validated dog temperament tests have been developed for use in animal centres, it is feasible that more rigorous assessment of prospective dog owners' expectations prior to adoption will facilitate more effective owner-dog matching, subsequently reducing dog return rates. These procedures are currently being piloted at RSPCA animal centres throughout the UK.

Comparison of the elimination behavior of domestic cats (*Felis catus*) with elimination behavior problems at the litterbox and at the site of inappropriate elimination

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Each year an estimated 4 million domestic cats are euthanized in animal shelters in the United States. Approximately 23.5% of the cats relinquished to animal shelters had daily or weekly incidents of inappropriate elimination. Inappropriate elimination occurs when a cat eliminates in other areas of the house than in its litterbox. The elimination behavior of domestic cats with this problem was compared at the litterbox and away from the litterbox. A total of twenty single housed cats with elimination behavior problems were observed. A camcorder was positioned outside of the litterbox to record the sequence of behaviors of each cat prior to and during elimination and the behaviors exhibited afterwards. One camcorder was focused on the litterbox. A second and, if necessary, third camera were used to record the pattern of behavior at the sites of inappropriate elimination. The camcorders recorded the elimination behavior for 72 hours. Only 8 out of 20 cats were caught on videotape eliminating outside of the litterbox. The cats that eliminated outside of the litterbox spent significantly more time sniffing (GLM: $F_{1,7}$=11.227; p=0.005) and pawing (GLM: $F_{1,7}$=8.877; p=0.010) at the site of inappropriate elimination than at the litterbox. The cats spent significantly more time covering (GLM: $F_{1,7}$=6.00; p=0.028) after each elimination bout at the litterbox site than at the inappropriate elimination site. There were no significant differences found in time spent digging and investigating at both locations. The findings of this study indicated that the cats had different interests in and interactions with the substrate at the litterbox location and at the site of inappropriate elimination.

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Effect of gender and age on play behavior in kittens (*Felis catus*)

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Play behavior exhibited by the young of many species has been proposed to function as the practice of skills to be used in adulthood. Since male and female adult domestic cats have differing reproductive and social roles, it was hypothesized that male and female kittens would also exhibit differences in play behaviors that may be related to sexually dimorphic adult behaviors. The play behavior of 9 female and 7 male Siberian kittens (*Felis catus*) at a cattery was observed from age two through eight weeks to test hypotheses about gender and age differences in play. Each of the four litters was housed with the mother in a large indoor pen with constant access to toys. Each kitten was videotaped for 30 minutes in the morning and 30 minutes in the afternoon each week. The object and social play behaviors examined were: bite, kick, paw, pounce, stalk, and wrestle object or littermate; lift object; chase, flee, and side-step littermate. No significant gender differences were found for frequency of object and social play behaviors (independent samples t-tests: t=-1.668; DF=14; p=0.118, t=-2.366; DF=14; p=0.033). Males did not initiate bout of social wrestling more often than females (independent samples t-test: t=-2.834; DF=14; p=0.013). Similarly, males and females did not differ in social wrestling bout duration (independent samples t-test: t=-0.065; DF=14; p=0.949). Additionally, a kitten's preferred play partner was not the same as its preferred associate when not playing (Pearson correlation: r=-0.066; N=50; p>0.0038). Both social and object play frequency increased as a function of age (GLM: $F_{1,110}$=55.14; p<0.0001, $F_{1,110}$=39.83; p<0.0001). The data support the theory of play being practice for some forms of adult behavior.

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Neurotransmitter parameters during positive human-dog interaction

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There is limited information about physiological parameters during positive human-animal interaction. The hypothesis was that the plasma levels of neurotransmitters associated with interspecies affiliative behaviour would increase significantly during positive human-dog interaction in both species.

Human participants were self-selected dog-loving adults (19-55 years, average 30 years) of both sexes (males=8; females=10). Adult dogs (2-12years, average 6.4 years) of both sexes (males=7; females=11) that were highly socialized to humans were used. The experimental model was a pretest-posttest design; with participants as their own controls before and after intervention. Participants were allowed to settle down before blood was collected for the determination of plasma levels of selected neurotransmitters. After positive interaction between humans and dogs, blood was collected again and the plasma was analyzed in a polychrome diode array detector of a High Performance Liquid Chromatography System. An indication of when to collect blood samples was a decrease in blood pressure between 5-10%. Blood pressure readings were recorded as five stable readings over a two-minute period. Statistical analysis for significant changes was done using the Wilcoxon signed rank test.

Desired decreases in blood pressure were found in 5-24 minutes. All neurotransmitters increased significantly in both species, after positive interaction between humans and dogs. For humans: beta-phenylethylamine (Wilcoxon: T=1; N=18; $p<0.05$); dopamine (Wilcoxon: T=0; N=18; $p<0.05$); beta-endorphin (Wilcoxon: T=1; N=18; $p<0.05$); oxytocin (Wilcoxon: T=2; N=18; $p<0.05$); and prolactin (Wilcoxon: T=5; N=18; $p<0.05$). For dogs: beta-phenylethylamine (Wilcoxon: T=0; N=18; $p<0.05$); dopamine (Wilcoxon: T=0; N=18; $p<0.05$); beta-endorphin (Wilcoxon: T=0; N=18; $p<0.05$); oxytocin (Wilcoxon: T=1.5; N=18; $p<0.05$); and prolactin (Wilcoxon: T=28; N=18; $p<0.05$).

The possible implication for human-companion animal interaction studies is threefold: it broadens the physiological basis for affiliation behaviour, it could provide an added medical rationale for animal-assisted therapy and it indicates that dogs can have the same experience as humans during positive interaction. This is important from a welfare point of view.

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Auditory cognition of phonemic inflected commands in dogs

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Since dogs are used for a wide variety of purposes by humans, it is very important to acquire knowledge of the perceptual and learning abilities of dogs. In this study, seven dogs, mainly German Shepherds, were used as subjects to investigate the modality involved in a dogs' auditory cognition of commands, with the exception of visual cues such as hand signals.

Three kinds of verbal commands in Japanese, "Fú-Se" ("Down" in English), "Má-Te" ("Wait") and "Kó-I" ("Come") were used. Each command was altered or inflected phonemically as follows: no alternation or inflection (normal), change of the former consonant in the syllable (cons-f), change of the later consonant in the syllable (cons-l), pronunciation with cotton held in the mouth (cotton), change of the stressed phoneme (intonation), transcription of the natural voice command (tape-n), transcription of the artificial machine-created command (tape-a). Dog responses were assessed using recognition scores from 1 (no response) to 5 (complete response). The effect of interaction between the command and inflection was significant (ANOVA: $F=2.38$, $DF=12$; $p<0.05$). In all commands, mean recognition scores of tape-a (mean±SD: 1.10±0.31 in "Fú-Se"; 3.45±1.88 in "Má-Te"; 1.80±1.20 in "Kó-i") were significantly smaller only compared with the normal (3.95±1.43 in "Fú-Se"; 4.90±0.31 in "Má-Te"; 4.95±0.22 in "Kó-i") (Tukey test: all $p<0.05$), whereas there was no significant difference between cons-f and cons-l, tape-a and tape-n.

These results show that dogs can notice changes of consonants in syllables, but these changes appear to have no substantial influence on a dogs' auditory cognition. However, it seemed somewhat difficult for them to recognize the artificial machine-created commands.

Genetic analysis of on-farm tests of maternal behaviour in sows

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Many of today's pig breeding programs focus on increased number born, but do not put any emphasis on the sow's ability to take care of the litter. Piglet survival itself has a low heritability. It would be beneficial to find another trait connected to piglet survival but that is less influenced by environmental variation. In this field study, two behaviour measures were genetically evaluated as possible alternative selection traits: the sow's reaction to a piglet scream and the sow's reaction when her piglets are being handled by the caretaker.

The scream test was done on the farrowing day or the day after. The farmer played a recorded piglet scream, starting when the sow was lying on her side. Her maximum reaction was scored in four ordered categories: no reaction, looking, sitting or standing. The handling test was done on day 3-5 after farrowing, when farmers castrate and give iron. The sows' maximum reaction was recorded as: lying on side, lying on belly, sitting or standing.

The traits were analysed as number of posture changes performed by the sow. The model included herd, parity and litter size as fixed effects, and permanent environment and genetic effect of the sow as random effects. Eight herds and 707 purebred Swedish Yorkshire sows were included in the study, with 894 records for the scream test and 552 records for the handling test. The estimated heritabilities for the scream test and the handling test were 0.08 and 0.05 respectively. No significant phenotypic correlation between reaction in either of the two tests and total piglet survival was found. Before these tests may be considered for use in breeding programs more studies are needed in order to further standardise the tests and to investigate the genetic relation between test reaction and piglet survival.

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Different regulation of physiological and behavioral response to social stress in two genetically selected lines of laying hens

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Two genetic lines of White leghorn hens were selected for high (HGPS) and low (LGPS) group productivity and survivability resulting from cannibalism and flightiness in multiple-hen cages. The aim of this study was to examine whether the selection also alters behavioral and physiological responses to social stress.

The 9th generation of the selected lines was used in this study. Seventy hens from three lines were randomly kept in single- or 2-hen cages from 17- to 24-wk of age. The 2-hen cages contained one hen from HGPS or LGPS line and one from a commercial Dekalb XL line that was used as a standardized genetic competitor. Activities were analyzed from video using instantaneous sampling at 1-minute intervals for 30 minutes and continuous recording of aggressive pecking in a 10- minute period starting at 0800 daily. Concentrations of plasma dopamine and corticosterone were measured at age 24 wk. A differential leucocyte count was collected from blood smear of each hen.

The LGPS hens tended to be more dominant than the HGPS hens (binomial test: $p=0.14$), and to have shorter attack latencies (repeated measures ANOVA: $F=0.4$; $DF=2,18$; $p=0.067$). In addition, LGPS hens spent more time pecking at the feathers or body of another hen (damaging pecking) than HGPS hens (repeated measures ANOVA: $F=4.4$; $DF=1,28$; $p=0.04$). In contrast, compared with LGPS hens, HGPS hens had a lower heterophil/lymphocyte ratio in both single-and 2-hen cages (GLM SAS: $p=0.04$ and $p=0.008$, respectively), and lower plasma concentrations of dopamine and corticosterone in 2-hen cages (GLM SAS: $p<0.03$ and $p<0.007$, respectively). The results indicate that behavioral and physiological responses to social stress differed between the selected lines, and that HGPS hens maybe better able to cope with social stress. Each line's unique characteristic responses induced by stress suggest that the present genetic lines could be used as animal models for stress physiological observations.

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The epidemiology of barbering (whisker trimming) in laboratory mice

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Barbering is a common abnormal behavior in laboratory mice that may indicate poor welfare. Beginning with the whiskers, barbers pluck hair from their companions, leaving idiosyncratic patterns of baldness. However, little else is known about this behavior. We are therefore investigating the epidemiology of barbering by surveying mice housed at UC Davis, using a cross-sectional design. Here we present data from the first facility surveyed. Every animal was examined for barbering, and biological, environmental, and husbandry factors were recorded. Only weaned, group housed animals (N=1289) were included in the logistic regression analysis, which statistically controlled for confounding effects (e.g. room) and covarying factors in the analysis (e.g. age and breeding status). Age ($p<0.0005$), strain (chi-square=19.055; DF=9; $p=0.025$), and the interaction of sex and breeding status ($p=0.005$) were significant risk factors for this behavior. Barbering became increasingly common with age. The mean age of barbers was 149 days, versus 87 days for non barbers (ANOVA: $F_{1,1270}=9.25$; $p<0.0005$). Of strains commonly used in other laboratories, C57BL/6J mice were the most likely strain to barber (18.75% of individuals across the whole sample). Among stock animals, barbers were three more times likely to be female, while among breeders both sexes were equally likely to barber. Neither cage floor area, nor cage stocking density were significantly associated with barbering. Implications for husbandry, welfare, the validity of barbers as animal models, and parallels to trichotillomania (human hair-plucking) will be discussed.

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Investigation of temperament traits in cattle for quantitative trait locus (QTL) identification

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The temperament of animals affects the way they react to environmental challenge. Behavioural responses of cattle to handling and management systems on farms are presumed to reflect underlying temperament traits such as fear. As some temperament measures have a strong genetic component, selection for desirable behavioural responses could increase the ability of animals to cope with stressors encountered on farms. The aim of this study is to obtain reliable measures of temperament traits in cattle, and identify the chromosomal location of the genes involved in these traits. Behavioural data for quantitative trait loci (QTL) analysis must be shown to reflect underlying traits, by demonstrating repeatability and validity of tests, and show variation within the population.

Temperament tests were carried out on 50 10-month-old F_2 bull calves from a Holstein x Charolais resource herd. Four tests were used; a flight-from-feeder test (FF), a social separation test (SS), a novel object test (NO) and a handling test (H). The variables measured included locomotory, escape and exploratory behaviours, which are presumed to reflect underlying traits of fear, aggression and exploratory motivation. Each test was validated by comparing responses between tests, and was repeated 3 times per individual to assess repeatability.

Each test showed a wide range of behavioural responses within the herd. Repeatability values were found to be high for all tests. For instance, high repeatability was shown in FF scores (REML: r=0.524 ±0.080; N=48), and in duration of locomotion in the SS (Kendall's coefficient of concordance: W=0.740; Chi-square=84.26; DF=38; p<0.001). Data on cross-validation of tests will also be presented.

The variability and repeatability of these behavioural variables show that they are suitable for potential identification of QTLs. These results, along with those from another 400 calves, will be correlated with the genotyping of 200 microsatellite markers to localise QTLs for these traits.

Effects of early open-field activity and ambient temperature on the growth and feed intake of two strains of broiler chickens

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Increased activity improves broiler leg health, but also increases the heat production by the bird. This experiment investigated effects of early open-field activity and ambient temperature on growth and feed intake of two strains of broiler chickens.

Based on level of activity of 504 chickens in an open-field test on day 3 after hatching, the 72 most active and the 72 least active from each of two broiler strains (fast-growing Ross 208 and slow-growing i657) were allocated on day 13 to groups of 6 active or 6 passive chickens and housed in floor pens (1.0m x 1.6m) littered with wood chips and fitted with two heat lamps. Each group was fed ad libitum and subjected to one of three temperature treatments: two (H:H), one (H:C) or no (C:C) heat lamps turned on. Liveweight and feed intake were measured on a group basis fortnightly. All chickens were slaughtered on day 57. Data on feed intake, live-weight gain and feed conversion efficiency were analysed for each strain, with group as the experimental unit and with activity (N=2) and temperature treatment (N=3) fitted as fixed effects with interactions in a general linear model.

For both strains, early open-field activity had no effect on any of the production parameters measured. Temperature had significant effects on i657 broilers only, with H:H chickens eating and weighing less and having a better feed conversion ratio than C:C chickens, with H:C intermediate (Feed intake days 42-55: 81, 90, and 98g/d, $F_{2,18}$=7.58; p=0.004; Liveweight day 55: 1288, 1346, and 1398g; $F_{2,18}$=8.92; p=0.002). Corresponding overall treatment means for Ross 208 were 192g/d and 2927g.

The lack of effect of temperature on production parameters in the fast-growing strain could indicate that the feed intake of these chickens was already constrained, i.e. maximum physical intake capacity of the birds had been reached.

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Motivation of locomotion in different growing meat type chickens

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Reduction in exercise increases the occurrence of lameness in meat-type chickens. But it has not been established whether these modifications are induced mainly by genetic factors or by differences in body weight in connection with leg problems. In order to clarify this point the locomotor activity of different broiler lines was investigated.

A total of 80 male broiler chicks of three lines differing in growth rate, fast (F), intermediate (I) and slow (S), were kept in ten deep litter boxes containing 8 birds from day-old. Half of the F and I broilers were fed ad libitum (A), the other half were fed on a restriction schedule (R) to reduce their growth rate to the level of the slow growing birds (S). Individual locomotor activity was recorded using a videotracking system. Bone angulations of tibiae and femur were measured. The data were analysed using an ANOVA model (SAS Institute). Level of significance was $p<0.05$.

The ad libitum fed F, I, and S broilers reached 2961, 2537 and 1315 g of body weight. The body weight of restricted-fed broilers was similar to S. Angulation of the right tibia was higher in ad libitum fed F and I broilers compared to restricted-fed birds of both lines and the S line. The mean locomotor activity of FA, IA, and S broilers was 13.0, 17.3 and 29.4 meter/hour. The locomotor activity of S broilers was significantly higher. Body weight reduction increased the locomotor activity of FR and IR broilers by about 60% to 21.3 and 28.3 meters/hr. Though the FR and IR lines had similar body weight and tibia angulations, the activity level was lower in the FR line. It seems that genetic factors and body weight with higher levels of leg weakness affected locomotor activity.

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Reaction to novelty and frustration in high and low feather pecking lines of laying hens

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A propensity to develop feather pecking in laying hens may be related to the way they cope with stress and frustration. The aim of this experiment was to study the reaction of high and low-feather pecking hens to frustration in a double runway. In the double runway, the so-called frustration effect is expected: after omission of reward in the first goal box, animals run faster to the second goal box. Reaction to first exposure was also studied, because these birds possibly differ in reaction to novelty.

The lines used [high (HFP) and low (LFP) feather pecking lines] had been selected for egg characteristics and mortality, and differed consistently in their levels of feather pecking. For the reaction to first exposure, 30 hens per line were given full access to the runway (no reward) for 10 minutes. After first exposure, 10 hens per line were selected based on feather pecking behaviour in the homepen, and were housed individually. They were food deprived for 23 h and trained to run for two food rewards (5 mealworms) in the double runway (3 trials per day). After three days of training, they were frustrated in the second trial. Behaviour, vocalisations and running speed were recorded.

No differences were found in locomotion or vocalisations during first exposure. However, LFP hens had a shorter latency to ground peck (Lifetest: Chi-square=5.73; DF=1; p=0.017) and performed more bouts of ground pecking than HFP birds (ANOVA: F=7.41; DF=1,9; p=0.024). During day 1 and 2 of training, LFP birds tended to have a higher running speed than HFP animals (Chi-square: Chi-square=3.44; DF=1; p=0.064). During frustration, no differences were found. In conclusion, LFP birds started exploring the runway sooner during first exposure and tended to complete the task faster during training. There was no effect of frustration on running speed.

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Comparison of the behavior of Gifu native fowls and commercial hens in a novel environment

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The Gifu native fowl is one of the oldest and most famous native breeds of chicken in Japan and it has different behavioral characteristics from those of commercial laying hens (Ito et al., ISAE1998, ISAE1999, WPC 2000). The objective of the present study was to investigate the differences between the fear responses of Gifu native fowls and those of commercial hens in a novel environment.

Ten Gifu native fowls (GNF) and ten commercial laying hens (Hyline; CL) were used in this study. Each bird was moved from its home cage to the experimental room (230 cm x 180 cm) in which a red-colored hazard road sign had been placed on the floor as a novel object. Floor pecking, floor scratching, walking, standing with head flick, freezing and preening were observed by the instantaneous sampling method at 15 sec intervals for 10 min. The proportion was analyzed using a Mann-Whitney U-test. Calling was independently recorded and analyzed by the same method.

The proportions of floor pecking and standing with head flick in GNF (14.3%, 63.0%) were significantly greater than those in CL (0.5%, 9.0%) (Mann-Whitney: $U=17.5$; $N1=10$; $N2=10$; $p<0.01$ and $U=0$; $N1=10$; $N2=10$; $p<0.001$, respectively). On the other hand, the proportion of freezing was significantly (Mann-Whitney: $U=0$; $N1=10$; $N2=10$; $p<0.001$) greater in CL (88.5%) than in GNF (8.8%). Calling was not observed in CL. In GNF, the mean amount of calling was 6.4 times/10 min, which was significantly greater than that in CL.

These results suggest that GNF show exploratory behavior while CL are more motionless in a novel environment.

Alternative methods of beak trimming of laying hens in deep litter systems

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There is a growing discussion about the issue of beak trimming of laying hens. Legislation in Europe aims to prohibit beak trimming in due time, but no trimming will almost certainly increase the occurrence of feather-pecking and cannibalism. Beak trimming is therefore still allowed, but only in a more 'welfare-friendly' way at a very young age, i.e. within 10 days. Our institute investigated the effect of different methods of mild beak trimming on production, food conversion and physical damage. The treatments were: beak trimming at 0 (V-shape blade), 8 (V-shape blade) and 15 (straight blade) days of age, and no trimming (with extra management). Mild beak trimming did not result in growth retardation of the hens: reduced growth is normally observed after regular beak trimming. A lower mortality during the laying period was observed in hens which were treated at 0 and 8 days, compared to non-trimmed hens (15 versus 29%, respectively; ANOVA: $F_{3,4}$=4.67; p=0.09; LSD=9.7). Damage to plumage and skin caused by pecking was high in all treatment groups, but occurred most in untrimmed hens. Food conversion ratio (kg feed per kg egg) was significantly better in the mildly treated hens [mild (average) versus no trimming: 2.40 and 2.95; ANOVA: $F_{3,4}$=8.19; p=0.01; LSD=0.21]. Moreover, egg production was higher following treatments at 0 and 8 days (ANOVA: $F_{3,4}$=5.63; p=0.07; LSD=24.7) compared to non trimmed birds. The general impression was that mild beak treatments, and especially those at 0 and 8 days, resulted in less damage to the hen's physical condition and higher production than no trimming. However, to improve the effect of mild beak trimming, other combinations of the type of treatment and age should be tested, together with combinations of treatments and extra management.

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Forms and amount of stereotyped behaviour in adult farmed foxes

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Stereotypies are regarded as abnormal behaviours and an indicator of poor welfare in farmed animals. We have earlier published results of stereotyped behaviour of juvenile farm foxes, and in the present study we report the forms and amount of stereotyped behaviour in adult farm foxes. Silver fox (*Vulpes vulpes*) (N=12) and blue fox (*Alopex lagopus)* (N=12) vixens (age 1-4 years) were kept in traditional unfurnished cages. The behaviour of each vixen was analysed from one 24-h video-recording. A behaviour pattern was classified as stereotyped if it was invariant and repeated in form, lasted at least 15s, and had no obvious goal.

The stereotyped behaviour could be classified into three main categories: S1 locomotor stereotypies alone, S2 locomotor stereotypies with a neighbour and S3 manipulation of the cage. Silver foxes showed more S2 (1.4±1.6 min/24h; median 0.6) than blue foxes (0.5±1.6; 0) (Mann-Whitney: U=30; N1=12; N2=12; $p<0.05$), whereas there were no differences (US1=69.5; US3=63.5; N1=12; N2=12; NS) in S1 (3.6±3.5; 3.2 vs. 17.0±29.7; 1.9) or S3 (1.3±1.6; 0.6 vs. 3.0±4.4; 1.3). Blue foxes spent 7.0±10.6 (median 2.5)% and silver foxes 1.7±1.5 (1.6)% of their total active time in stereotyped behaviour (U=50; N1=12; N2=12; NS). There was some tendency for a correlation between total amount of stereotyped behaviour and activity in both species (Rank correlation: r_s=0.51-0.57; N=12; $p<0.1$).

Adults did not show the tail chasing that has been observed in juveniles, and S3 decreased and S1 increased from juvenile to adult stage in both species. Differences in S3 and tail chasing might be explained by play and replacing of teeth in juveniles, and classifying these as true stereotypies may be questionable. Increased S1 in adults may in turn reflect the long-term effects of the housing environment on the foxes' welfare.

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The effects of stereotypic pacing in circus tigers

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The effect of free time in an exercise pen on stereotypic pacing in circus tigers was investigated at two different circuses. Using a quasi-Latin square design, one set of three tigers from each circus was exposed to three separate treatments: 0, 20, and 40 min of free time in an exercise pen. Over the course of three days, each cat was subjected to each treatment and, except for practice or performances, held for the remainder in their travel cages. While there, 72 h of continuous video was taken of the cats for behavior analysis. For both sets of tigers, the three treatments did not have significantly different effects on pacing (ANOVA on arcsin transformed data: F1=2.32, DF=2 p=.18) while they were in their travel cages. Overall, each group spent an average of 5.3 ± 2.0% and 4.5 ± .76% of their time pacing respectively. In the exercise pen, the cats carried out most activity and play within the first 10-20 min, generally lying down the remainder of the time. During the 20-min treatments, the cats travelled 134.1 ± 23.3 m, while travelling 236.3 ± 85.8 m during the 40-min treatments.

In a separate experiment, three tigers from another circus were held in their travel cages and continuously videotaped for 72 h without being removed for exercise or performances. On average, pacing occurred 10.6 ± 2.7% per day during the time that the cats were observed. Although pacing occurred more during this experiment, the cats in the quasi-Latin square studies were used in two performances per day along with one practice session in addition to time in the exercise pen. Performances and rehearsals are important sources of additional exercise and stimulation that could account for why the tigers in the quasi-Latin square experiments paced less regardless of free time in an exercise pen.

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The motivation for performing 'Tail-in-Mouth' (TIM) behaviour in weaner pigs expressed by posture and behaviour immediately before and after TIM

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TIM is the oral manipulation of one pig's tail by another pig without obvious tail damage. TIM has been suggested to be a precursor of harmful tail biting. The objective of this experiment was to test the following hypotheses: (1) TIM is performed more frequently by a resting as compared to an active pig. (2) TIM occurs in relation to social- and environmental exploration.

Four groups of 24 ear-tagged and tail-docked pigs, from the age of five weeks, were divided into three pens: (a) 8 female pigs; (2) 8 castrated male pigs; (c) 4 female and 4 castrated male pigs. This composition was chosen because it has previously been shown that group composition is a significant factor in relation to TIM. The three pens were observed by video twelve hours once a week during four consecutive weeks. Each time a pig performed TIM the posture as well as behaviour before and after were recorded.

The results showed that pigs were more frequently lying down before (Chi-square: Chi-square=229; DF=9; $p<0.001$) and after (Chi-square: Chi-square=222; DF=9; $p<0.001$) performing TIM than being active. Furthermore, it was shown that the behaviours that occurred most often before (Chi-square: Chi-square=56; DF=18; $p<0.001$) and after (Chi-square: Chi-square=90; DF=28; $p<0.001$) TIM were ano-genital, social and environmental exploration. Additionally, these behaviours occurred with a higher frequency in the gender-mixed pens before (Chi-square: Chi-square=56; DF=18; $p<0.001$) and after (Chi-square: Chi-square=90; DF=28; $p<0.001$) TIM as compared to pens with females or castrated males.

In conclusion, TIM is performed more frequently by a lying pig as compared to an active pig. Ano-genital, social and environmental exploration are the most frequent behaviours performed before and after TIM.

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Investigating the severity of stereotypy in captive bears

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Two processes have been proposed to make stereotypies severe in terms of frequency and degree of invariance: 1) developmental changes in the behaviour that occur with increasing time in captivity, e.g. 'establishment' (Odberg 1978); and 2) underlying features of behavioural control (Garner 2000, Garner & Mason subm.), similar to those implicated in the stereotyped movements of people with autism (Turner 1997). Using captive bears, we investigated the extent to which these two processes account for individual differences in stereotypy.

Asiatic black bears (*Ursus thibetanus*; N=8), and Malayan sun bears (*Helarctos malayanus*; N=6), individually housed in a government confiscation facility in Thailand, served as subjects. All were wild-caught shortly after birth and had been captive for between 5 and 11 years. Stereotypy frequency and 'rigidity' (an index of invariance), were quantified by scanning from observation hides. To assess behavioural persistence, all subjects were trained in a spatial discrimination task. At criterion, trials ceased being rewarded, and abnormal persistence was assessed from the ability to cease responding.

Mean stereotypy frequencies (as a proportion of observations) ranged between 0.02 and 0.51 (mean ±SE=0.22±0.04). Consistent with developmental changes in stereotypy, age significantly predicted both stereotypy frequency (GLM: $F_{1,8}$=5.44; partial r=0.48; 1-tailed p=0.024) and rigidity (GLM: $F_{1,8}$=6.53; partial r=0.67; 1-tailed p=0.017). Frequent stereotypies tended to be more rigid, even when age was controlled for (GLM: $F_{1,7}$=3.77; partial r=0.75; 1-tailed p=0.046). Consistent with a role of behavioural persistence, a positive relationship was found between stereotypy frequency (log transformed) and the number of trials it took bears to cease un-rewarded responding (GLM: $F_{1,5}$=4.41; partial r=0.46; 1-tailed p=0.045). Extinction rates seemed, however, unrelated to age or stereotypy rigidity.

These results confirm previous hypotheses concerning the 'establishment' of stereotypy with age and repetition, and the role of underlying (and possibly abnormal) behavioural persistence in stereotypy. They also indicate that these are two separate influences on stereotypy severity.

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Individual vibratory pagers to lead calves to an automatic milk feeding station

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A problem encountered with automatic milk feeding systems for calves is that many calves may visit the feeding station simultaneously. A novel solution to this problem is to use vibrating pagers attached to collars to individually inform calves of their feeding times, so that the calves visit the feeding station in a specified order, with only 1 calf at the station at a time.

In this study, 8 Holstein calves were each fitted with a pager attached to a collar. After the calves were fed colostrum for a minimum of 3 days, they were trained for 3 days. As each calf completed training, it was put into the group pen with a feeding station equipped with a single nipple where the feeding system was tested.

During training each calf was housed in an individual pen with a feeding station. A computer called the pager 8 times per day and caused a nipple to appear at the feeding station after each call. When the calf had learned to visit the feeding station in response to calls, the nipple would not appear until the calf was at the feeding station. During group feeding the 8 calves were each called 4 times per day at 6-hour intervals in a specified order.

The calves learned to visit the feeding station in response to calls 2 or 3 days after the start of training. In the group feeding period, there was a total of 1227 calls. The calves fed in response to 74.5% of the calls. In 5.1% of the calls, calves could not feed due to interference by pen mates. In the remaining 20.0% of the calls, the calves may not have noticed the vibration. We conclude that vibrating pagers can be used to systematize feeding of calves at feeding stations. Further research may help to improve the effectiveness (response rate) of this method.

The effects of an imprint-training procedure on six month old foals

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Foal imprint training is promoted in the horse industry to make horses friendlier and easier to train. Foal imprint training consists of several training sessions conducted shortly after birth. One hundred and thirty-one foals born in 1999 and 2000 were used in this study. Foals received no training sessions, one training session either at birth, 12, 24, 48, or 72 h after birth, or four training sessions: birth, 12, 24, and 48 h after birth. Timing of training sessions resembled that promoted by popular imprint training procedures. Training sessions involved rubbing the foal's body, rubbing the ears, spraying the foal with water, tapping the hooves, and haltering and leading the foal. At six months of age, each foal underwent a standard testing procedure which included catching the foal, attaching a heart rate monitor, exposure to the items from the earlier training sessions, and exposure to a novel stimulus. During the testing sessions, the time taken to complete exposure to each stimulus and the percentage change from baseline heart rate was recorded. There were no treatment effects for the time taken to complete exposure to the stimulus. When they were led, foals trained at 72 h only had a higher percentage change from baseline heart rate than those that were not handled, were handled for the four standard sessions, at 12 h only, or at 24 h only (ANOVA: $F_{1,21}$=8.70; DF=6; p=0.0001). When they were fly-sprayed, foals handled at birth only or at 72 h after birth only had a higher percentage change from baseline heart rate than those handled at other times (ANOVA: $F_{1,26}$=2.42; DF=6; p=0.05). There were no other treatment effects for percentage change from baseline heart rate. Imprint-training sessions, as conducted in this study, were not efficacious for foals at six months of age.

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Investigating indicators of pig social recognition and how these are affected by cortisol and age

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Stress hormones have a modulating effect on memory processes, perhaps through activation of hippocampal glucocorticoid and mineralocorticoid receptors. Our goals were to develop a social recognition test for use in pigs and to investigate how age and short-term increases in glucocorticoids (e.g. cortisol) affect the recognition process. Twenty-four female piglets were habituated to the testing arena, and randomly assigned to 2 treatments: saline (N=12) and cortisol (1mg/kg BW) (N=12) to maintain saliva cortisol levels higher than 50nmol/L. Piglets were injected intra-muscularly 15-min before the social recognition test. Piglets were exposed to same male piglet for 4 periods of 60-sec, separated by 10-min intervals. Then, these piglets were exposed to an unfamiliar male piglet for 60-sec. Each piglet was tested at 10 and 20 days old. We measured social recognition by% time investigating as used in rats (Burman & Mendl, 1999, Animal Behaviour 58, 629-634) and latency of first social contact (LFC). We predicted that, if recognition is occurring, time spent investigating a familiar animal should decrease across successive exposures and increase with the unfamiliar pig. Our results showed a significant decrease in% time spent investigating familiar animals across successive exposures in pigs at 10 days old (GLM: $F_{3,30}$=7.075; p=0.001). Twenty-day-old pigs also tended to decrease investigation of the familiar animal (GLM: $F_{3,24}$=2.812; p=0.061). Pigs at both ages showed an increase in % time investigating between 4th (familiar) and 5th (unfamiliar) exposures (t-test; 10 days: t=-4.915; DF=23; p<0.0001; 20 days: t=-4.516; DF=19; p<0.0001). Analyses of LFC data indicated no difference between age, treatment and exposures. There was no effect of cortisol treatment and age groups on the indicators of social recognition measured in this study. We have demonstrated a practical method for measuring pig social recognition which can be used to further investigate potential effects of cortisol and age on memory.

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Some cows recognize people by their faces, but it is not easy

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Previously we found evidence that cows recognize people by their faces but that they cannot correctly choose between two people when only the faces are visible. To further examine whether cows can recognize people when only their faces are visible, we trained 6 lactating Holstein cows with 2 people wearing the same colour clothing and standing within an operant chamber fully visible to the cows. The cows received concentrated food with molasses when they pushed a lever in front of only one of the people. The side on which the people stood was varied following a Gellerman series. The success criterion was 8/10 correct choices in two consecutive sessions (binomial test: $p<0.01$). With both people fully visible, 5 cows succeeded within the allowed 12 sessions. Following this, the two people stood within a life-size human-like mannequin, with only their faces visible. Only one cow of the five approached success (9/10 in one session, binomial test: $p<0.02$), even though all cows could continue to choose the correct person in control sessions when the people were fully visible. A further 6 cows were trained to discriminate two people who were first presented to the cows while standing in the mannequin. Only one cow reached the success criterion (binomial test: $p<0.01$) after extended training. Some cows can learn to recognise people by their faces but recognition of people is much easier when the rest of the body is visible.

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Does shearing influence social discrimination among familiars in sheep?

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We investigated whether the change in the appearance of familiars after shearing influenced agonistic behaviour in flocks and the rate of making the correct choice in a Y-maze discrimination test. The first experiment tested two groups of seven Suffolk sheep. The members of each group were tethered individually for three hours. They were then released simultaneously, and observed continuously for two hours (the control observations); any agonistic behaviour among the participants was recorded. After these observations, all but two sheep in each group were sheared. The sheared and non-sheared sheep were treated as before, and agonistic behaviour in the flock was then observed for periods of two hours immediately after the sheep were reunited, the next morning, and six weeks later. Immediately after release, agonistic behaviour among flock members quadrupled (from 2.4±1.4 to 9.3±5.0 times per flock). Subsequently, the number of agonistic interactions was the same as before shearing. In one group, aggression was frequently observed from a subordinate towards a dominant sheep.

In the second experiment, four non-sheared sheep were used as discrimination stimuli (Ds) and ten sheared sheep (Ss) were used to learn the discrimination. Each Ss learned which Ds to choose as a conditioned stimulus. Formula feed was an unconditioned stimulus. Each animal participated in 5 trials per day, until the learning criterion of four correct choices per day on two consecutive days was reached. After learning, Ss had to discriminate between an unfamiliar conspecific (non-sheared) and Ds before and after shearing. The correct choice rate was less after shearing than before shearing (Wilcoxon signed-rank test: T=17; N=13; p=0.02,). After shearing, threats and sniffing for the Ds were observed in the Y-maze. The results show that shearing disturbs discrimination among familiars over a short period and may influence dominance order within a flock.

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Effects of wildlife viewing on grizzly bear (*Ursus arctos*)

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Ecotourism and wildlife viewing are growing industries, and are frequently considered to advance conservation goals by giving an economic incentive to preserve wildlife and habitat. However, there is a possibility that tourist visitation may alter the behaviour of animals. The challenge is to balance the economic, educational and recreational benefits of tourist access against any negative effects on the animals.

I studied the behaviour of grizzly bears at the Khutzeymateen Grizzly Bear Sanctuary in northern British Columbia. From a small cliff above the estuary, I observed the time that bears spent feeding, travelling, and engaged in vigilance behaviours. I also noted the presence or absence of tourists in boats on the estuary.

Bears were present approximately half of the time, whether tourists were present (34/63h) or not (90/177h of observation). I recorded 190 visits by about 30 individual bears. Where tourists were present at least part of the visit, median visit duration was 58min and bears spent 59.0% of the visit feeding, 8.7% travelling and 19.7% alert; in the absence of tourists the median duration was 46min, and bears spent 57.5% feeding, 10.8% travelling and 19.2% alert. These differences were statistically insignificant [Wilcoxon 2-sample, N=41 (tourists) and 159 (no tourists), Z=1.00; p=0.32; Z=-0.52; p=0.60; Z=0.38; p=0.70; and Z=-0.41; p=0.68, respectively], unlikely to be of a biologically meaningful magnitude, and, with the exception of vigilance behaviour (difference=0.5%), in the direction opposite to that of concern from an applied perspective.

Thus, at the current levels of visitation in the Sanctuary, ecotourism activities do not appear to conflict with conservation goals.

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Assessment of the sampling time interval used to record the ingestive behavior of lactating Jersey cows

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The objective of the present study was to define the best sampling time interval for recording the ingestive activities of lactating Jersey cows.

Four Jersey cows of 400 kg liveweight were observed continuously during their second lactation for 24 hours per day, during five days per experimental period. Experimental periods began 30, 60 and 90 days after calving, totalling 15 days of observations. Cows were kept in a free stall and milked twice a day at 0800 and 1700h. Food was distributed at 0800, 1300 and 1800h. Ingestive behavior was defined as including time spent eating, ruminating and idling. Additionally, we determined the total daily number of periods of activity and daily mean duration for the three activities. Sampling intervals of 5, 7, 10, 15, 20, 30 and 45 min were compared with continuous observations.

There were no significant differences in daily total eating (ANOVA: F=0.44; DF=7,149; p=0.8776), ruminating (ANOVA: F=0.30; DF=7,149; p=0.9519) or idling time (ANOVA: F=0.33; DF=7,149; p=0.9376) between the different sampling time intervals compared to continuous observations. The number of eating bouts measured at 15-minute intervals or greater were lower (ANOVA: F=18.32; DF=7,149; p=0.0001;Dunnett=2.644) than the continuous observations and intervals of less than 15 minutes (11.7, 12.4, 11.9, 10.9, 9.6, 8.6, 7.4, 6.2, respectively for continuous and time intervals of 5, 7, 10, 15, 20, 30, 45 minutes). The number of ruminating periods measured at 20-minute or longer intervals was lower (ANOVA: F=10.97; DF=7,149; p=0.0001; Dunnett=2.644) than continuous observations and those intervals less than 20 minutes (14.8, 15.2, 14.4, 14.3, 14.1, 12.4, 11.5, 9.8, respectively for continuous and time intervals of 5, 7, 10, 15, 20, 30, 45 minutes).

The present results indicate that animals might be observed at sampling time intervals up to 15 minutes without losing important information.

Can sheep track depletion of food patches?

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Previous work indicated that sheep can use spatial memory to locate food patches. Here we studied whether sheep can track resource depletion. One hundred bowls, each containing 50g of concentrate food, were laid out at 4m intervals in a 50m x 50m arena. Replicate animals (N=5) were used in an observational study (i.e. only one treatment) that lasted 9 days. The animals were allowed 20 minutes in the arena each day. Movement patterns, time each bowl was visited and time spent at each bowl were recorded. At the end of a trial each bowl was weighed to determine how much concentrate had been eaten. If more than 33g had been eaten the bowl was not replenished the next day. The results were analysed by regression over days.

Over the 9 days, sheep showed a strong propensity to continue in the same direction as they had approached a bowl (chi-square=1588 on 7 DF; p=<0.001). Number of bowls emptied per day did not change significantly, thus total number of empty bowls increased significantly (slope=3.9; F=48.31; DF=1,39; p=<0.001). Proportion of empty bowls visited (excluding revisits) declined significantly (slope=-0.07; F=47.09; DF=1,39; p=<0.001). Total number of bowls visited per day and total distance walked per day did not change significantly. Distance (m) to find 5 or 10 food bowls increased significantly (slope=3.67; F=31.56; DF=1,44; p=<0.001, slope=5.70; F=24.22; DF=1,44; p=<0.001, respectively) but time taken to visit the first 5 or 10 food bowls did not change significantly. Proportion of empty bowls visited decreased significantly as the number of days since emptied increased (slope=-0.029; F=4.63; DF=1,39; p=0.038).

The results suggest that sheep do not immediately learn the location of depleted patches, continuing to resample them for a number of days before eventually ceasing to do so.

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Preference for grass and clover by dairy cattle: is free choice important?

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Previous research has shown that cattle, like sheep, show a partial preference for 70% clover in their diet when given free choice between adjacent grass and clover monocultures. There is a diurnal pattern to preference, which is stronger for clover in the morning and increases slowly for grass as the day progresses. Cattle (and sheep) offered adjacent grass/clover monocultures achieve higher daily intakes (and therefore higher production) than those offered mixed swards. The experiment reported here determined the role of free choice in diet selection and intake.

Two treatments, which ran from mid-June to late July, were used: 1) Free choice' (FC) between adjacent grass and clover monocultures; 2) Temporal allocation' (TA), where cows were offered clover only between morning and afternoon milking (07:00-15:00) and grass only between afternoon and morning milking (16:00-06:00) (i.e. following their natural diurnal pattern of preference).

There were three replicate groups in each treatment. At least three 'core' (i.e. 'measured') cows were maintained in each group. Each TA group received 0.57 ha of grass and 0.57 ha of clover. Each FC group received 0.57 ha clover and 0.28 ha grass. Continuous variable stocking was used to maintain a mean sward surface height of 6 to 8cm. The unit of replication for the statistical analysis was the group.

There were no significant differences in individual milk yield (ANOVA: $F_{1,4}$=4.47; p=0.102) or daily dry matter intake (ANOVA: $F_{1,4}$=1.03; p=0.368) between the two treatments. The proportion of clover in the diet of the FC group (78%) was higher than the TA group (67%) (ANOVA on angular transformed data: $F_{1,4}$=18.19; p=0.013).

The results demonstrate that free choice is not important in achieving high daily intakes from grass and clover monocultures, and suggests that 'temporal allocation' could be used on commercial dairy farms to boost milk yields from those obtained with mixed swards.

Mother's influence on food selection learning in goats

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We investigated how social learning and postingestive feedback interact to influence the foraging behavior of young goats. The mother influences food selection behaviors of her offspring, as does postingestive feedback from nutrients and toxins in the gastrointestinal tract. We determined whether kids would follow their mother's example even if food ingestion caused aversive postingestive feedback that resulted from ingesting food with high concentrations of tannins.

We offered foods simultaneously to the mother and her kid at two separate locations. Treatment 1 (N=8 kids): one location had food preferred by the mother, but the food available to the kid was high in tannin concentrations. The other location had food that the mother did not prefer, but the food available to the kid was low in tannin concentrations. Treatment 2 (N=7 kids): both kid and mother were offered low-tannin food at one location and high-tannin food at the other location. We measured kids' food intake in foraging bouts with the mother present and subsequently in 2 test periods without the mother.

Kids in treatment 1 ate more food with high tannin concentrations during exposure with the mother than did kids in treatment 2 [intake (g/kg BW *0.75) of high- vs. low-tannin food: GLM-procedure: group 1: 3.97 vs. 2.10 $F_{1,70}$=17.9 p<0.0001; group 2: 1.58 vs. 3.30 $F_{1,60}$=38.7 p<0.0001]. In the absence of the mother, kids generally preferred food with low tannin concentrations [Test 1: group 1: 2.59 vs. 4.90 $F_{1,56}$=39.7 p<0.0001; group 2 intake did not differ significantly: 2.89 vs. 3.10 $F_{1,48}$=0.4 p>0.05. Test 2: group1: 2.50 vs. 4.69 $F_{1,42}$=32.5 p<0.0001; group 2: 2.64 vs. 3.75 $F_{1,36}$=15.2 p<0.001].

Thus, the mother can facilitate acquisition of behaviors by her offspring, but continuation of the behaviors depends on the consequences to the individual. In our study, the aversive affects of tannins overrode the social influence of the mother after weaning.

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Foraging behaviour of a Mexican Hairless pig herd kept under agro-forestry conditions

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Arable farmers often regard outdoor pigs as disadvantageous for their crops, nevertheless, agroforestry systems have attracted the efforts of innovators and pioneers. The main objective of the present study was to describe the foraging behaviour of a Mexican Hairless native herd maintained under semi-extensive conditions, with the perspective of using this as a resource for low input swine systems trying to conserve this breed under threat of extinction. The system was based on herd of 120 pigs commingled with other species foraging together in a 130 hectare acorn forest, which included crop fields (corn or oats). Foraging behaviour was classified into 5 categories (rooting, digging, grazing, nosing and eating). The behaviour of each of 40 focal pigs was registered instantaneously at 5 min. intervals, during 1 min. for 6 hour periods per day throughout 10 months. Frequencies were analysed comparing differences between and within sexes, observational periods and grazing sites.

Rooting occurred, on average, during 40.8% of the overall observations. It tended to be three times higher in the females than in the males (30.5% Vs. 10.3%; Chi-squared=2.91; $p<0.05$). The results clearly indicate that there was a priority for rooting when the animals were in the forest, and during the morning. Also, eating was preferentially performed during the morning instead of the afternoon (17.4% Vs. 12.8%; Z=2.48; $p<0.05$), directed either at the forest or the crops. The poor daily weight gains obtained in the herd, combined with the low frequency of recording of eating (15.2%), led us to recommend that this particular herd should not be allowed to forage during the dry season, since food is scarce. It is well known that pigs increase their metabolisable energy for each kilometre walked, and most of the time the animals had to walk more than 5 km a day in order to find a good plot on which to graze.

Biorhythmic behavior of feed intake in growing/finishing pigs

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Using computerized feed intake recording equipment (FIRE) which permits the recording of feed intake of group penned pigs on an individual basis, a previous study of daily feed intake over time revealed a cyclic pattern. The feed intake cycle appears characterized by a period of increasing feed intake (trough to peak) (TP) followed by a period of decreasing feed intake (peak to trough) (PT). The objective of this study was to describe feed intake patterns of individual pigs and to determine the effect of gender and growth period on feed intake cycles.

Forty-two barrows and gilts were raised from approximately 32 kg to 100 kg in 4 pens in groups of 10-11 pigs. The FIRE was located in each pen. The data analyzed included daily feed intake on individual pigs fed ad libitum through the first 15 days (G1), middle 15 days (G2) and last 15 days (G3) of the total 45 day growth period.

The average number of biorhythmic feed intake cycles was not affected by gender, 12.7 versus 13.0 (ANOVA: $F_{1,3}$=0.41; p=0.63) for gilts and barrows respectively. The number of days PT and TP were not affected by gender and growth periods. No real differences were found in the change of daily feed intake PT being, 652.0, 732.2 and 770.7 (repeated measures ANOVA: $F_{2,76}$=48.77; p=0.2250) and TP 764.7, 761.24, 875.0 (repeated measures ANOVA: $F_{2,76}$=45.13; p=0.1324) for G1, G2, and G3 respectively. For feed intake, the increase from TP was significantly higher than the decrease from PT, 800.3 versus 718.3 (two-sample t-test: t=-2.06; DF=82; p=0.043).

These results show a tendency towards a biorythmic behavior of feed intake during growing/finishing which was not affected significantly by gender and growth period under the conditions of this study.

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Seasonal change of land-use strategy of free-ranging cattle in an agroforest without fencing

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Beef suckler cows (N=27) and 1 bull of Japanese Shorthorn were turned out from 11th May to 22nd October in 2000 in a unfenced national forest comprised of many lots (10.3 ±12.8 ha) of planted areas of Japanese cedars and surrounding natural forest (12.2±17.0 ha). The location of 3 cows was checked every 2 h by GPS (Lotek GPS 2000) for 164 days. Dry weights of available plants were measured in 6 points each in 8 vegetation categories in each month. 1) Rates of fixes were 18.9, 52.7, and 82.9% respectively, which mainly depended on failure of the link with the antenna and battery exhaust. 2) All fixes were surrounded by the minimum convex polygon of 869 ha, in which newly planted lots totalling 180 ha were heavily used. 3) Home ranges of individuals were 258±161, 174±55, and 140±130 ha in May, September and October, respectively, which were smaller than 513±146, 535±165, and 587±114 ha in June, July and August, respectively (ANOVA: $F_{4,10}=6.77$; $p<0.01$). Mean dry weights in 48 points were 109.8, 154.4, 133.5, 141.4, and 117.8 g/m^2 in May, June, July/August, September, and October, respectively. 4) Short distances under 1200 m between the central points of home ranges during one day and the next were 84, 84, and 89%; and long distances over 1800m were 4, 4, and 3%; in May, September, and October, respectively. In June, July and August, those were 50, 64, and 62 and 21, 13, and 15%, respectively. These results were almost the same as our previous visual observations. It is suggested that cows graze with an extended stay in a grazing site (win-stay strategy) in early spring and autumn when forage decreases in quantity or quality, and with a short stay (win-shift strategy) in summer seasons when forage quality and quantity are rich.

Resting and feeding behaviors of Holstein cows around calving: effects of parity

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Behavioral adaptations around parturition could be disrupted by intensive husbandry. However, previous experience could limit this effect. In this context, influence of parity on resting and feeding behaviors of Holstein cows was assessed by observing 8 heifers and 9 cows during 3 days before and 3 days after calving.

Cows stood up after calving sooner than heifers (13.4 min versus 68.9 min; Mann-Whitney test: Z=2.6; N=17; p<0.01). This was motivated by eating in cows (Spearman correlation: r_s=0.68; N=8; p=0.05), but by drinking in heifers (Spearman correlation: r_s=0.95; N=9; p=0.01). Heifers ate, drank and ruminated after calving later than cows (81.8 versus 19.5 min, 83.7 versus 44.2 min and 169.3 versus 74.2 min respectively) but these differences only approached statistical significance.

The mean daily proportion of time spent lying down was higher for cows (42.1±7.8%) than for heifers (31.0±7.6%) (Mann-Whitney test, Z=2.3, N=17, p<0.05). During the 3 days before calving, heifers preferred not to lie down on the left side (16.2±13.6%) but cows showed no preference (51.7±18.9%): these proportions differed significantly (Mann-Whitney test: Z=3.0; N=17; p<0.01).

Time spent eating and ruminating, and eating and drinking frequencies were not affected by parity. However, heifers ruminated daily more frequently than cows (24.0±3.7 versus 17.8?2.6; Mann-Whitney test: Z=2.9; N=17; p<0.01). Cows and heifers adopted different postures for ruminating. The proportion of lying time on the left side spent ruminating was much higher for cows than for heifers (38.5±14.2% versus 11.8±12.5%: Mann-Whitney test: Z=3.0; N=17; p<0.01). Indeed, heifers tended to prefer to ruminate in a standing position, as reflected by the proportion of standing time spent ruminating (26.7±7.1% versus 20.5±5.1%: Mann-Whitney test: Z=1.9; N=17; p=0.06).

Modifications in resting and feeding behaviors of cattle around parturition differed according to parity. This could reflect a more distressing effect of parturition in heifers, as is known for maternal behavior.

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Influence of feeder design on behavior and supplement intake of beef cattle

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Molasses is a commonly used feed supplement for pastured cattle. However, when it is provided ad libitum over-consumption often occurs. The purpose of this study was to determine if altering lick-wheels of molasses tanks affected supplement intake and cattle behavior. Twenty heifers were randomly assigned to one of 4 groups, which were randomly assigned to one of 4 treatments for 21 days using a Latin square design. Treatments consisted of Wide (W), Narrow (N), Wide-Restricted (WR), and Narrow-Restricted (NR) wheels. Wheel widths were 1.91 cm (N and NR) and 6.35 cm (W and WR). Restricted wheels were limited to 330 degrees rotation. Molasses intake was measured by weighing tanks twice per week. Video cameras recorded activity near each tank. Lick-wheel use, presence near tanks, and aggression, such as butting and charging, were recorded using The Observer on days 1, 7 and 14. Data were analyzed using a mixed model Latin square analysis (SAS). Treatment affected average molasses intake ($F=7.04$; $DF=3,4.9$; $p=0.03$). The W treatment consumed more molasses than the NR treatment ($p<0.05$), and there was a trend for N and WR treatments to consume more than the NR treatment ($p=0.06$). Period 1 had a trend toward less molasses consumption than Periods 2 ($p=0.06$) and 3 ($p=0.06$), and a slight trend towards less than Period 4 ($p=0.11$) ($F=4.77$; $DF=3, 5.53$; $p=0.06$). Period also affected presence near the molasses tank ($F=9.57$; $DF=3,5.89$; $p=0.01$), with more cattle near the tank during Period 2 than Periods 1 ($p=0.01$) or 4 ($p<0.05$). Aggression was not affected by treatment. No differences in duration of licking were seen, which is consistent with intake data because wide, unrestricted wheels may allow greater consumption in equal time. Results indicate that altering lick-wheels may affect molasses intake and cattle behavior, but further investigation is necessary to determine the duration of these effects.

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Indoor and outdoor experiments on cache-recovery behavior of the Formosan squirrel

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Formosan squirrels (*Callosciurus erythraeus*) have been propagating themselves in Japan. However, their behavioral habits are not well known. In this study cache-recovery behavior of the Formosan squirrel was investigated.

(1) Indoor experiment. A total of 54 squirrels were tested for their spatial learning ability. Acorns were put in a plastic tray at the end of one of the three arms (85 cm long) of an 'upside-down T-maze'. The arm in which the acorns were put was changed every three days. The squirrels could freely explore the maze for about 90 min per day. Whether squirrels got acorns or not and the number of their explorations were recorded. The proportion of squirrels reaching acorns on the first exploration was significantly greater than on the second or later exploration (CATMOD: c2=188.69: DF=6: p<0.001).

(2) Outdoor experiment. Cache-recovery behavior was observed at a forested area (about 520 square meters) in a Shinto shrine. Five California walnuts were given to each of four wild squirrels. Cache areas were recorded. The recovery of the cached walnuts was observed from 9:30 to 16:30 for five days. The microsites and types of plants within a radius of one meter of the walnut were compared with those all over the observation area. Although 15 of the 20 walnuts were cached, the squirrels that cached the nuts did not recover them. Seven walnuts were stolen by other squirrels. Three were carried out over time. Five walnuts remained for five days. Squirrels cached specific microsites where grasses, trees and fallen leaves intermingled (Chi-square test: c2=25.47: DF=7: p<0.05). They preferred a type of Japanese laurel for caching nuts (Chi-square test: c2=35.83: DF=15: p<0.05).

This study showed that Formosan squirrels are capable of spatial learning and cache nuts at specific sites, but they do not recover the nuts themselves.

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Utilization of domestic dogs as aversive stimuli to wild boar

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We conducted confrontation tests with domestic dogs and wild boars in order to determine whether the dogs have an ability to repel wild boars. The main point of our observations was to study whether wild boars express avoidance behaviour to a dog's actions. Five adult dogs and six wild boars were used. One dog was a female German Shepherd used by the police. The other dogs were mongrel companion dogs, three males and one female. The wild boars, three males and three females all about 16 months old, had been reared in captivity for at least 10 months before the experiment. The dogs and boars were well acclimatized to the test situation. Confrontation tests were carried out three times a day at 0800-900h, 1200-1300h, and 1600-1700h. Each dog confronted all the wild boars within two days. The dogs' barks and gazes to the wild boar increased during the confrontation. Moreover, individual differences (Kruskal-Wallis one-way ANOVA by ranks: N=30; H=26.44; $p<0.01$) were found in the frequency of the dogs' barks. Wild boars were frightened away from the dogs 43 times in total over 30 test sessions (mean=1.43, SD=2.79). In these sessions, the dogs barked (Chi-square test with Yetes' correction=20.59; DF=1, $p<0.01$) and turned their gaze (Chi-square=5.67; DF=1; $p<0.05$) toward the boar just three seconds before the boar was frightened away, more frequently than during observation periods when the boar was not frightened away. This indicates that a dog's bark and gaze are aversive stimuli for wild boars. The tendency to bark is well known to vary among different breeds and individuals, so it is recommended that suitable dogs are selected for repelling wild boars.

Assessment of handling practices used by the Bureau of Land Management for handling wild horses

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Wild horses on Bureau of Land Management (BLM) government owned land are rounded up periodically to prevent over grazing. During the roundups horses are sometimes injured when they are loaded onto trucks, sorted, vaccinated and branded with the BLM freeze brand. To assess how the horses were handled, the percentage of horses in each group that showed certain behaviors were counted. As each horse was worked through a race and squeeze chute for freeze branding, it was scored on a yes/no basis for full rears, half rears, kicks, falling down, flipped over, entry speed into the handling facility and hitting its head on a fence. Prior to training of the employees in quieter handling methods, the baseline behaviors for 40 horses were full rears 87% (35), half rears, not recorded, kicks 25% (10), falling down 12% (5), flipped over 5% (2), entry speed into the facility 100% run, and hitting a gate or fence 10% (4). After the employees were trained in quieter handling methods, the incidence of behaviors that could injure the horses was reduced. When the second group was scored the horses were trotted quietly into the working facility by the employees instead of being brought in at a run. Out of 33 horses, the incidence of full rears dropped to 5% (1), half rears 12% (4), kicks 0%, flipped over 0%, entry speed into the facility was a trot and only one horse (3%) hit its head on a fence or gate. Flight zone invasion by a person was a common cause of rearing. Small half rears are a sensitive warning signal which occurs before more serious accidents such as flipping over. The purpose of this abstract is to show how a simple scoring system could be used in the field to monitor horse handling and welfare.

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Influence of maternal experience on fear reactions in ewes

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The effects of maternal experience on fearfulness were assessed in ewes by comparing fear reactions of nulliparous (21 months old; N=19), primiparous (21 months old, one lamb reared; N=27) and multiparous (mean age: 4.5 ± 1.2 years; one to four litters reared; N=17) Ile-de-France ewes.

All ewes were individually subjected to three fear-eliciting situations: isolation from conspecifics, surprise effect combined with presentation of a novel object, and presence of a human. Tests were conducted on three consecutive days, in a familiar environment, and each lasted 4 minutes. Observations included measures of locomotor activity, localisation, feeding and vocalisations. A synthetic 'fear score', based on the most relevant variables, was also computed.

No difference emerged between the three groups in the isolation test, all ewes being relatively non fearful in this situation. In the surprise effect test, multiparous (Mann-Whitney on fear scores: $U=35$; $p<0.001$) and primiparous ewes ($U=412.5$; $p<0.01$) were both significantly less fearful than the nulliparous ewes. In the human presence test, multiparous ewes were significantly less fearful than nulliparous (Mann-Whitney on fear scores: $U=83$; $p<0.05$) and primiparous ($U=104.5$; $p<0.01$) ewes.

A single maternal experience thus induced a clear reduction in fear reactions of ewes as measured in the surprise test. Either age or several maternal experiences, or both, reduced fear of human presence.

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The potential factors causing responsiveness of dairy cows to humans in free stall barns

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The major factors that potentially cause responsiveness of Holstein cows in free stall barns were determined.

Behavioral observations were conducted with 150 lactating cows in three free stall barns. A total of 78 subjects was randomly selected in milking groups. Twelve behavioral measurements related to responsiveness to humans in the contexts of milking, inspecting and capturing were analyzed by a factor analysis. Initial factors were extracted by principal component analysis with prior communality estimates set to 1.0. The number of common factors was determined according to the scree criterion. The rotated factor pattern was calculated with orthogonal varimax rotation. Factor scores were estimated for each subject. Correlation coefficients were calculated between factor scores and milk yield. Analysis of variance was used to determine the effects of calving number, lactation stage and lameness on each factor score.

The scree plot showed four factors present. The measurements concerning flight response to humans and entry into the parlor had large loadings on the first factor. Time required to exit the milking parlor had large loadings on the second factor. The milking temperament score and staying area in the free stall barns at about two hours after morning milking had large loadings on the third factor. Stop frequency in the return alley from the milking parlor and response to an inspector had large loadings on the fourth factor. Thus the first to fourth factors were interpreted as 'fearfulness of humans', 'sluggishness', 'aversion to milking' and 'sensitivity', respectively. The factor scores of fearfulness of human ($r=-0.20$; $N=71$; $p=0.10$) and aversion to milking ($r=-0.22$; $N=71$; $p=0.07$) tended to correlate with milk yield. The scores of sluggishness and sensitivity were significantly different across calving number ($F=3.56$; $DF=3,63$; $p<0.05$) and lameness ($F=7.66$; $DF=1,63$; $p<0.01$), respectively.

These results suggest that four psychological factors could cause responsiveness of cows.

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The effect of confinement on motivation to exercise in young dairy calves

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The objective of this study was to determine if confinement of 8(±2)-day-old calves for varying lengths of time is associated with an increase in motivation to perform locomotor behaviors. Holstein heifer and bull calves (N=48) were used in a factorial design with two factors. Factor A was housing (individual confinement vs. group pens) and factor B was hours in confinement (6, 12, 24, and 48 h). Individual confinement was in 1.06 X 1.06 m pens, while group pens had a 3.68 X 6.09 m outside run and a 3.68 X 6.09 m covered area that also contained a 3.68 X 2.44 m area bedded with wood shavings. Before the experiment the calves were housed in the group pens. Twenty-four calves were used in each housing method, divided into four groups of six for the different hours in confinement. At the end of the treatments a blood sample was taken for lymphocyte counts and the calves were open-field tested for 5 min.

Walk, trot and distance travelled during the open-field test were higher in the calves kept in group pens (ANOVA: F=15.33; DF=1,40; p=0.0003; F=7.42; DF=1,40; p=0.011; and F=6.45; DF=1,40; p=0.04 respectively), but were not influenced by hours in treatment. Calves subjected to 48 h of confinement had greater incidences of kicking and falling (ANOVA: F=3.95; DF=3,40; p=0.014 and F=3.46; DF=3,40; p=0.02 respectively). Lymphocyte count (ANOVA: F=2.54; DF=3,40; p=0.029) was lower in the calves confined for 12 h, but there was not a trend across hours in confinement that indicated a consistent effect. Housing or hours in treatment did not affect canter, buck, buck-kick, rear, stumble, and vocalization.

This study suggests that two days of close confinement may not have been enough time for the effects to influence motivation of 10-day old calves.

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Do pigs have consistent personality traits?

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Recent experiments suggest that immobility in young pigs may be predictive of later aggressive and investigative behavior. The present experiment investigated immobility in young piglets in relation to measures of aggression and anxiety at 8 and 24 weeks as an attempt to identify behavioral elements for use in predicting later behavior related to welfare and production. Sixty-eight female animals from from stable litter groups were tested at 3 weeks of age in an immobility-test and then at 8 and 24 weeks of age in a novel object test and resident-intruder test. The immobility test was used to measure the duration of immobility shown by piglets in response to holding. The novel object test was performed by placing the test animal into a novel arena, into which a bucket hanging from a rope was dropped after 5 min habituation to the test arena. The resident-intruder test was performed in half of the home pen, in which an unknown female was presented to the test animal.

Duration of immobility in the immobility test tended to correlate with time spent within 0.5 m of the bucket at 8 weeks of age ($r=0.22$; $p=0.07$) but was not correlated with this measure at 24 weeks of age. Immobility duration was also correlated with duration of standing in the novel object test at 8 weeks of age ($r=0.49$; $p<0.001$) but not at 24 weeks of age. Immobility was also correlated with percent of time spent standing in the resident-intruder test at 8 weeks of age ($r=0.49$; $p<0.001$) but not at 24 weeks. Duration of immobility was not correlated with attack latency at 8 or 24 weeks of age. These preliminary results indicate that the immobility test had some predictive value for behavior at 8 weeks of age.

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How valid are measures of cows' fear of people?

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Cows' fearfulness of people has been evaluated using measures of the distance they keep from a person but the validity of these measures has not been demonstrated. We examined their validity by training cows to recognise a gentle and an aversive person, and testing them with two common tests. In the distance test, we measured the distance cows in tie stalls kept from a person standing in front of them. In the approach test, cows entered a pen with a person, and we measured the latency to contact and the distance kept. Thirty Holstein cows were given 22 treatment sessions of 2min (each including food rewards and petting by the gentle person and slaps and yelling by the aversive person). In the distance test, the cows distanced themselves more from the aversive than the gentle person in both home stalls and the unfamiliar stall (Wilcoxon paired sample tests: N=30; T=5 and 4 respectively; $p<0.001$ for both). However, distances in the two stalls were only weakly correlated (Spearman rank correlation; N=30; $0.43>r>0.002$). Twenty cows were tested using the approach test with the aversive, positive, and a neutral person. Latency to contact and distance kept were shorter with the gentle person than the aversive person (Wilcoxon paired rank tests: N=20; T=19 and 9; $p<0.0001$ for both), with intermediate values for the neutral person. Rankings of the cows in the distance and approach tests were not highly correlated. Both tests adequately reveal behavioural differences in the presence of gentle and aversive people. However, the lack of correlation between measures indicates that these are poor measures of individual diiferences between cows in terms of their fear of people. We suggest that distance tests are poor measures of fearfulness in response to a novel person due to the lack of motivation to approach the person.

Effects of different rearing of heifers prior to weaning at 8 weeks on subsequent responses to novelty in open-field tests

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Holstein heifer calves (N=92) were assigned to one of five groups after having been nursed by their dams for 24 hours: A) a hutch until 7 days of age followed by loose housing with a machine milk feeder until weaning; D) penned with dam until 7 days followed by loose housing with a machine milk feeder until weaning; H) a hutch, bucket feeding until weaning; M) penned with dam for the first 7 days followed by a hutch, bucket feeding until weaning; N) penned with dam for the first 7 days followed by penning with a nursing cow until weaning.

Testing commenced with calves at 28 weeks in an unknown arena marked off into 9 squares. Calves were singly subjected to four 5-minute tests (T) on 2 consecutive days. The same unfamiliar person sat by the wall in square 4 facing the arena during T1 to T3. A multi-colored ball was hung as another novel object above the midpoint of the arena at the height of the calf's head during T3 and T4.

The ranking of animals with regards to the total number of sniffing and approaching to the person was as follows: M, D, H, A, N. Differences were significant (ANOVA: $F_{4,87}$=3.77; p=0.008) between M, D and N. In T4, group M displayed the greatest (ANOVA: $F_{4,87}$=2.65; p=0.042) amount of bumping into the ball (88% animals) and group N (29.4%) the lowest.

Overall, heifers from groups D and M approached and sniffed the person the most while heifers from group N did so the least. Exploratory behaviour was expressed the most in M, D and A, and the least in N. Preweaning environment greatly altered responses to novelty 20 weeks later.

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Developmental change in activities of dairy heifer calves to humans

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Calves (N=117) on four dairy farms were observed for developmental changes in activities to humans. All calves experienced similar rearing conditions: (1) after birth until weaning at about 2 months, beginning individual pen (BIP), where they were housed individually and fed milk and milk replacer; (2) after weaning until grouping at about 3.5 months, late individual pen (LIP), where they were housed individually and fed hay, silage and concentrate feed; (3) after grouping until 5 months, beginning group pen (BGP), where they were housed in groups of 2-5 animals and fed hay, silage and concentrate feed; (4) from 5 to 7 months, later group pen (LGP). The number of calves that touched an experimenter who stood straight just in front of their pens for 10 min was recorded on 6 separate days over 3 months. Latency to touch and time spent in activities during touching such as licking, sucking, biting and rubbing were also measured.

There were no significant differences between periods in the latency to touch and the proportion of touch to non-touch calves. The time spent touching gradually decreased from 142.5±148.3 seconds (mean±SD; N=19) during the BIP to 40.5±56.0 seconds (N=28) during the LGP (Tukey test: $p<0.05$). Effects of period on activities were significant (MANOVA: L=0.580; F=4.70; DF=12,262; $p<0.001$). The time spent sucking was greater during the BIP (53.0±77.8 seconds; N=19) than during the other three periods (LIP: 0.0±0.0; N=19, BGP: 3.7±9.7; N=40, LGP: 0.3±1.7; N=28; Tukey test: $p<0.05$). The time spent biting reached a ceiling during the LIP (47.1±77.6 seconds; N=19) and decreased to 5.9±19.8 seconds (N=28) during the LGP.

These results suggest that the activities calves show to humans seem to reflect a change of feed rather than show the development of an affinity of calves to humans.

Individual behavioural characteristics in pigs: a comparison of different behavioural tests

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Individual differences in coping style may have consequences for production, health and welfare. Therefore, individual behavioural differences in pigs and consistency of test responses were studied. If behavioural differences reflect coping characteristics, behaviour could be predicted over time and across situations.

A backtest was performed on 315 piglets at 3, 10 and 17 days. On day three, groups of 10 piglets were formed, based on first backtest scores: HR (scores>3), LR (scores<3), MISC (scores 0-10) or O (original litters) to determine if group composition would influence coping behaviour. Groups remained intact after weaning at 4 weeks. A human approach test (HAT), a novel object test (NOT) and an open door test (ODT) were performed in the home pen with 221 pigs at 5-7 weeks (6 HR-pens, 10 MISC-pens, 4 LR-pens and 4 OR-pens) and with 188 pigs at 10-12 weeks (5, 8, 5 and 4 pens, resp.); 94 animals were tested twice.

Correlations were found between backtests day 3-10, 3-17 and 10-17 (Correlation: r=.0.27, 0.31, 0.48; N=315; p<0.0001), and between HAT-NOT, NOT-ODT and HAT-ODT at 5-7 weeks (r=0.44, 0.40, 0.24; N=221; p<0.05) and at 10-12 weeks (r=0.35, 0.31, 0.18; N=188; p<0.05). Results for HAT, NOT and ODT were not affected by group composition at 5-7 weeks (GLM: $F_{3,16}$=0.24, 0.46, 0.81; p=0.9, 0.7, 0.5) or at 10-12 weeks ($F_{3,15}$=1.8, 2.0, 1.3; p=0.2, 0.2, 0.3). Within the MISC pens, backtest score and HAT at 5-7 weeks were positively related ($F_{1,81}$=7.21; partial R-square=0.03; p<0.01). Group dominance structures and the cross-fostering procedure probably influenced coping behaviour. This will be investigated further.

This study suggests consistencies in pig behaviour over time and across situations, so coping would be (partly) a trait variable. Since correlations are below one, we suggest that factors such as time and situation are also important in determining an individual's behavioural reaction.

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Effect of one or two companion sheep on the stress response of isolated sheep

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The objective of this study was to determine the number of companions that sheep require to minimise the stress associated with isolation from the flock. Twelve 3-year-old Suffolk ewes were used. Every test day, one, two or three ewes were randomly chosen to be visually separated from the flock for 20 min, in a familiar pen 20 m distance from their original pen. One of the animals that remained in the flock was randomly chosen as a control. The dependent variables measured were: number of steps, serum cortisol levels, body temperature, and heart and respiration rates before and after the 20 min. isolation test. Number of vocalisations and urinations were also recorded. Results showed that individual separation induced significant increases in respiration rate (43.3±10.5 to 84.0±23.8 breaths/min; Friedman two-way analysis of variance Fr=9.33; DF=3; $p<0.01$), serum cortisol concentration (0.7±1.1 to 2.4±1.6 ng/ml; repeated measures ANOVA; F=3.92; DF=3; $p<0.01$), number of steps (189.7±75.3 to 262.2±152.2 steps; Friedman two-way analysis of variance Fr=8.99; DF=3; $p<0.01$), vocalisations (0.5±0.8 to 38.5±22.1; Friedman two-way analysis of variance Fr=12.63; DF=3; $p<0.01$) and urinations (1.3±0.7 to 3.0±1.3 for control and isolated sheep, respectively; Friedman two-way analysis of variance Fr=10.02; DF=3; $p<0.01$). This effect declined to basal levels (control animals) when a single companion animal was present. No advantages were seen with two companion animals. It was concluded that the welfare of sheep is improved if animals are separated from the flock in groups of at least two members.

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Salivary cortisol response of heifers to hoof trimming, exercise and social mixing

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Salivary cortisol was measured in heifers subjected to three trials intended to produce mild physical and social stressors. Six groups of five heifers were housed in totally slatted-floor pens (3 x 3.5m). Initially, we determined the correlation between salivary and plasma cortisol to be 0.88 (N=39; p<0.001); four samples of each type at 1-hr intervals on 10 heifers. In trial I, 10 heifers were subjected to hoof trimming. Salivary samples were collected; 1) in home pen, 2) after movement to trimming location, 3) entry to trimming chute, 4) after trimming, 5) after group returned to home pen, and then 6) 0.5hr, 7) 1hr 8) 2hr, and 9) 3hr afterward. Mean (standard error) cortisol values for the nine samples respectively were 0.79(0.15), 4.17(0.99), 3.42(0.79), 2.69(0.56), 6.13(1.23), 1.49(0.19), 1.39(0.35), 0.62(0.20), and 0.30(0.10) nmol/l. Movement itself caused a rise in cortisol (samples 1 vs 2). The highest value was sample 5 (average 27min post-trimming), possibly from combined effects of exercise and trimming. In trial II, all heifers were given a 1-hr group exercise period in an outdoor arena (6 x 7m) on two occasions with saliva taken before and after. Means (se) were 0.54(0.08) vs 0.55(0.06) nmol/l, indicating that social and exercise stressors were either absent or fell between sampling. In trial III, three groups were mixed on two occasions and moved to an outside paddock (0.3ha) for 1hr. Saliva was taken before mixing, after return to home pens, and 0.5, 1, 2, and 4hr afterward. The mean (se) cortisol values were 0.55(010), 2.37(0.51), 0.83(0.10), 0.50(0.05), 0.79(0.13), and 0.53(0.11) nmol/l, respectively. All heifers were socially active and cortisol increased, but values were less than movement alone (trial I). We found salivary cortisol a relatively easy sampling method that correlated well with plasma cortisol. In our trials cortisol indicated heifers experienced little to moderate stress.

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Comparison of 3 different analgesic techniques for velvet antler removal in farmed wapiti, *Cervus elaphus*

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The objective of the study was to compare the efficacy of three methods of pain management on the degree of stress and pain in farmed wapiti during velvet antler removal. Three analgesic treatment regimes were performed, consisting of simple tourniquet compression analgesia (COMP, N=15) or electrical analgesia (EA, N=18) that depended on transcutaneous electrical nerve stimulation versus ring block analgesia using lidocaine (CONTROL, N=15). A second objective was to examine the effectiveness of using a pre-capture nutritional therapy (including serotonergic precursors, NUTR), to attenuate stress. Forty-eight male wapiti were used in a balanced 3 x 2 factorial design (3 analgesic methods and 2 nutritional therapy methods). Samples of blood and saliva collected immediately pre-cut, during cutting (cut) and 4 hours later (post-cut) were analyzed for metabolic parameters including plasma and salivary cortisol and haematology measures. The animal's reaction to the initial saw cut was observed and any reactions were recorded (aversion). Results indicated that for all samples salivary cortisol levels were found to be significantly reduced by use of precapture nutritional therapy ('pre-cut' t-test; t=1.77; DF=44; p=0.042, 'cut' t-test; t=3.39; DF=35; p=0.0009, 'post-cut' t-test; t=2.00; DF=37; p=0.026). The frequency of aversive responses in analgesic treatments indicated that lidocaine was the most effective method of pain control during antler removal (Chi-square: Chi-square=10.5; DF=2; p<0.01). There was evidence of a nutritional therapy by analgesic interaction. Salivary cortisol concentrations were significantly elevated in cut samples compared to pre-cut for COMP and EA animals that didn't receive nutritional therapy (COMP t-test; t=-2.33; DF=9; p=0.022, EA t-test; t=-1.85; DF=16; p=0.041). Irrespective of treatment, there were significant increases in neutrophil/lymphocyte ratios for all animals (t-test=-6.306; DF=190; p=0.0005), the most statistically significant change was observed in the EA treatment (EA t-test; t=-4.49; DF=70; p=.0005, COMP t-test=-3.487; DF=58; p=0.0005, LIDO t-test; t=-2.82; DF=58; p=0.003).

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The effect of ACTH on salt appetite in growing pigs

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In rats, mice, rabbits and sheep, exogenous adrenocorticotropic hormone (ACTH) leads to a marked increase in sodium appetite. It has been suggested that if pigs show a similar response to stress, an appetite for salt could increase their attraction to blood and contribute to the development of tail-biting. The aim of this study was to examine the effects of ACTH on salt appetite in growing pigs. Twelve individually housed Yorkshire pigs (45 kg) were divided into three groups of four. Group 1 had free access to water, 0.5M NaCl and 0.5M KCl solutions; Group 2 to water, 0.5M NaCl and 0.25M NaCl solutions; Group 3 to water, 0.25M NaCl and 0.125M NaCl solutions. The experiment was divided into three periods: a baseline period of 3-5 days, an ACTH-treatment period of 5 days, and a post-treatment period of 4-5 days. During the ACTH-treatment period, each animal was given one intramuscular injection of 50 IU long-acting synthetic ACTH (Vetoquinol) twice daily. Water intake increased during the ACTH-treatment period from baseline of 2.69 ± 0.17 l/day to 4.43 ± 0.28 l/day in all groups combined (paired t-test: $t=8.34$; $DF=11$; $p<0.0001$) and then decreased during the post-injection period (paired t-test: $t=3.76$; $DF=11$; $p=0.003$). There was no change in salt intake in group one during the ACTH-treatment period (paired t-test: $t=-0.99$; $DF=3$; $p=0.39$). However, in groups two and three, the intake of salt solutions decreased from baseline values of 0.16 ± 0.03 l/day and 1.14 ± 0.36 l/day to 0.05 ± 0.01 l/day and 0.63 ± 0.29 l/day respectively (paired t-test: $t=-3.48$; $DF=3$; $p=0.04$; paired t-test: $t=-3.16$; $DF=3$; $p=0.05$). Salivary cortisol concentrations were higher during the ACTH-treatment period compared to the baseline and post-injection periods (paired t-test: $t=8.16$; $DF=11$; $p<0.0001$; paired t-test: $t=7.24$; $DF=11$; $p<0.0001$). Although increases in salivary cortisol and water intake were observed, exogenous ACTH did not elicit a sodium appetite in growing pigs.

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Behavioral and physiological responses after intracerebroventricular infusion of CRF or AVP in calves

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To determine the central roles of corticotropin releasing factor (CRF) and arginine vasopressin (AVP) in calves, we investigated whether intracerebroventricular infusions of CRF or AVP could mimic the stress response of calves.

Four calves were assigned to each of 9 treatment groups. They were infused intracerebroventricularly with 0.5 ml of artificial cerebrospinal fluid (aCSF) or with 0.2, 2, 10 or 20 nmol of bovine CRF (bCRF) or AVP dissolved in 0.5 ml aCSF into the third ventricle over a period of 30 min. Observations were conducted for 120 min after the start of infusion.

Significant differences among treatment groups were observed in oral activities, i.e., abnormal licking (between aCSF- and bCRF-treated groups, Kruskal-Wallis: k=5; N=20; H=9.97; $p<0.05$) and tongue playing (between aCSF- and bCRF-treated groups, Kruskal-Wallis: k=5; N=20; H=13.470; $p<0.01$ and between aCSF- and AVP-treated groups, Kruskal-Wallis: k=5; N=20; H=16.61; $p<0.01$). The number of vocalizations differed significantly between aCSF- and bCRF-treated groups (Kruskal-Wallis: k=5; N=20; H=14.89; $p<0.01$). There were also significant differences in other activities such as neck outstretched and head up, rubbing and head shaking. The higher the dose of the substances, the more frequently the activities above were observed. The cortisol response increased dose-dependently for both peptides. Compared at the same dosage, CRF tended to be more potent in stimulating cortisol secretion than AVP at 2 (Student's paired t-test: t=2.60; DF=3; p=0.08) and 10 (Student's paired t-test: t=3.06; DF=3; p=0.05) nmol infusion. In contrast to non-ruminant species, we have not found activation of the sympathetic nervous system in either calves or sheep as indicated by heart rate and rectal temperature.

The results suggest that central CRF and AVP in calves do not induce sympathetic nervous system activation but do induce simultaneous activation of adrenocortical and behavioral functions.

Behavioural and electrophysiological characterisation of sleep in sheep

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Electroencephalographic (EEG) recordings have been used to study sleep in humans and have many potential applications in animal welfare studies, e.g. for investigations of husbandry factors affecting sleep and the assessment of fatigue during and after transportation. We have adapted simultaneous behavioural and non-invasive electrophysiological recording techniques previously used in humans to recognise and quantify stages of sleep in sheep.

Pairs of Finn X Dorset ewes were housed in adjacent single pens with a 12hL:12hD daylight cycle using artificial and infrared lights. Surface skin electrodes were connected by leads to datalogging equipment attached to a harness on the sheep. Electroencephalogram (EEG), electro-oculogram (eye muscle activity, EOG), electro-myogram (EMG) (muscular activity in the neck, jaw and hind-leg) and time-lapse video recordings were made over 24h periods. Sleep analysis software was used to view simultaneous recordings of each physiological variable. Time spent lying down with and without the neck relaxed was recognised from the leg and neck EMGs and from the video recordings. Jaw activity that generated EEG artefacts was recognised from the jaw EMG. A spectral analysis (frequency and amplitude) of EEG and EOG recordings was then undertaken to recognise sleep and wakefulness and to quantify the time spent in each stage of sleep. The mean (s.e.) results obtained from three recordings per sheep on six sheep expressed as a percentage of a 24-h period were as follows: REM (rapid eye movement) sleep 2.8 (0.21), Non-REM sleep 14.5 (2.38), lying down with head up 31.3 (4.28) and lying down with neck relaxed 26.2 (5.13), N=6.

The percentage times spent sleeping are consistent with previous reports that used invasive methods. Combining behavioural observations with electrophysiological recordings can increase precision compared with sleep scoring using posture alone and determines both the quality and quantity of sleep.

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Behavioural indicators of individual stress responsiveness in dairy cows

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Dairy cows show remarkable individual variation in their responses to challenging situations. Here, I tested whether behavioural characteristics of cows in their home pen predict their individual stress responsiveness.

The undisturbed behaviour (total amount of locomotion/standing, mean duration of lying periods, behavioural regularity) of 31 dairy cows (parity 2.7 ± 2.4) was recorded for 4 days in their cubicle house using telemetry. Agonistic interactions were directly observed at the feeding rack. In addition, the individuals' reactions towards a visual obstacle, a tail fixation, and a startle stimulus (air-puff) were recorded in the home pen. Recordings of the undisturbed behaviour and the behavioural tests were repeated three times at monthly intervals, starting at week 22.3 ± 5.5 of lactation. The stress responsiveness was estimated by recording the behaviour and by analysing saliva concentrations of cortisol taken at -20, 0, 20, 40, 80 min throughout a separation test of 20 minutes.

Whereas measures of undisturbed behaviour were highly correlated across repetitions (rs from .414 to .826), the responses in the behavioural tests were not (rs from .080 to .782). A Principal Component Analysis combined the parameters of undisturbed behaviour in the first component and the reactions towards the behavioural tests in a second component. In the separation test, the 8 cows with the highest values for the first component (long lying periods, low locomotor activity, high regularity, high agonistic scores) had significantly lower cortisol concentrations than the 8 cows with the lowest values for this component (Mann-Whitney: $U=12$; $N1=N2=8$; $p<0.05$). The behavioural parameters in the separation test were related neither to the cortisol concentrations nor to the behavioural measures obtained in the home pen.

These results suggest that, in particular, the temporal organisation of behaviour in the home pen predicted the adrenocortical responsiveness to environmental challenge.

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Characterizing the responses and environment of circus elephants (*Elephas maximus*) during transport

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Elephants in North America are commonly loaded in transport vehicles and moved to new locations at frequent intervals throughout the entire year. To characterize the physiological response of circus elephants (Asian, *Elephas maximus*) to transport, blood was collected from twelve elephants from four different circuses over five transport sessions (three by truck, two by railcar) and analyzed for plasma cortisol concentrations. Control samples were obtained during non-active periods for comparison. Body temperatures during transport were recorded at five-minute intervals using ingested dataloggers. To assess the transport environment, temperature and relative humidity within and outside the transport vehicle were recorded during each trip at five-minute intervals. Measurements of ammonia and carbon monoxide were also made at various times during each trip. A significant difference was not detected (t-test: t=.84; DF=26; p=.41; power=.1116) between pre- and post-transport cortisol concentrations when compared with controls. Body temperature averaged 36.0°C (± 1.01 SD) and never rose above 37.5°C in spite of outside temperatures exceeding 37.8°C, indicating that there was adequate ventilation. Temperature inside the transport vehicle averaged 26.1°C (± 4.34 SD). Variation in temperatures was considerable as the length of the trips ranged from 1.5 to 72 hours. The circus elephants in this study appear to be acclimated to transport. The elephants were loaded and unloaded with little difficulty. Direct and video observations revealed that the animals drank, ate, and lay down. The temperatures within the transport vehicles were well within the animal's normal threshold and do not impose a significant environmental stressor. However, wide variations exist in transport methods across the circus industry and further research is needed to formulate appropriate guidelines.

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Environmental enrichment and aggression in commercial broiler breeder production

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Commercially reared broiler breeders show high rates of aggressive head pecking, particularly in juvenile birds aged 14-18 weeks. Mortality due to aggressive head peck injuries is a welfare concern for commercial producers. Prior research has demonstrated that provision of environmental enrichment during the late rearing phase reduces aggression in one commercial strain of broiler breeders, the Ross 508 (King, L.A., Proceedings of 34th ISAE Congress, Brazil, 2000). The current experiment assesses whether the same enrichment leads to reduced aggression in a more widely used commercial breeder strain, the Ross 308.

Ross 308 pullets (N=16,000) were reared from 0-18 weeks old in two deep-litter houses on a commercial farm. Each house was divided into six pens. Environment, flock parameters and husbandry were not significantly different between pens. Half the pens per shed contained an added enrichment of plastic-wrapped bales of wood shavings (bale density=1 bale per 100 birds). Birds used the bales to peck, forage and perch. At 18 weeks old, behavioural data were collected on video from cameras positioned above each pen. Four focal samples, length 10 minutes, were collected per pen at even intervals throughout one day. One bird per sample was identified at a random position on a gridded monitor screen. All aggressive head-pecking interactions involving the focal bird were counted during the sample period and these were totalled per pen per day. Aggressive head peck rates were calculated as events per bird per hour. Rates of aggressive head peck interactions were compared between treatments using a GLM: aggression rate ~ enrichment + house + enrichment *house, with house as a random factor. Enrichment significantly reduced aggressive head-peck rate ($F_{1,1}$=2738.78; p=0.01) from 15.92 (±0.58) to 9.38 (±0.6) pecks/bird/hour. The bale enrichment may improve welfare by reducing aggression during rearing.

Environmental enrichment in broilers, individual behaviour and mortality

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The relationship between behavior and epidemiology is an important study area in poultry production systems.

The aim of this study was to compare 4 environmental enrichment treatments for broilers under uncontrolled conditions, by measuring behavioral synchrony, individual behaviors toward different elements, and mortality. This study was carried out on an experimental farm in Mexico City. Ross x Ross line chickens (N=220) were divided into five treatments (44 birds / 4 m² / treatment). Treatment (A) plain environment, (B) plastic toys and fresh alfalfa, (C) dustbath, (D) perches, and (E) the combination B+ C+ D. The number of chickens eating, drinking, resting and exploring were recorded as well as the frequencies of perching, dustbath use, and pecking directed to toys and alfalfa. Behavioral and scan samples were used during 120 hours (25/h/treatment).

There were no differences in the percentages of birds eating (Kruskal-Wallis: N=20; H=5.57; p>0.05), drinking (Kruskal-Wallis: N=20; H=3.49; p>0.05), resting (Kruskal-Wallis: N=20; H=5.57; p>0.05) and exploring (Kruskal-Wallis: N=20; H=2.85; p>0.05) among treatments. Although the use of enrichment devices was notorious in each treatment, the post-hoc comparison did not reveal differences in the use of devices between (E) and the other treatments (Mann Whitney: p>0.05). A negative correlation was found between mortality and toy and alfalfa pecking (Rank correlation: r_s=-.449; N=4; p<.05) and total pecking (Rank correlation: r_s=-.431; N=20; p<.05). The cause of mortality in all cases was ascites.

The results showed that there was a positive effect when pecking behavior to a substrate was allowed. It is possible that individual susceptibility to ascites is related to exploratory behavior. It will be necessary to study the possible relationship between health and environmental enrichment in broiler husbandry in more detail.

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The behavior of growing pigs reared in an intensive production system with and without wood-shavings

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Intensive housing conditions have greatly altered the availability of resources that allow pigs to carry out species specific behaviors. Bare concrete floors, found in conventional housing for growing pigs, prevent pigs from showing behaviors that they are highly motivated to perform. This restriction may be causing considerable welfare problems. Thus, alternative production systems and management procedures are needed to improve both animal welfare and performance. Accordingly, the quality of intensive pig production systems can be improved and behavioral observations are an indispensable tool for this.

The objective of this experiment was to study behavior of pigs reared in an intensive system, with or without wood-shavings, during the finishing phase. Eight groups of six commercial hybrid pigs were randomly allocated to four pens with and four pens without wood-shavings. The wood-shavings bedding was 15 cm deep and was changed when there was excess humidity. Pigs (80 kg average weight) were video recorded during sixteen periods of twenty-four hours. The behavior of the pigs was classified into eleven exclusive behavior categories: feeding, drinking, standing, rooting, chewing pen, playing, fighting, sitting, lying and defecating. The frequencies of behavioral categories were estimated for two traits using univariate analysis of variance with probabilities generated by randomization testing.

In pens with wood-shavings, pigs rested ($p=0.07$) with a higher frequency. Pigs reared in pens without wood-shavings chewed the pen ($p=0.096$), rooted ($p=0.098$) and accessed the trough ($p=0.115$) more often. Thus, pigs reared in pens without wood-shavings showed higher frequency of behaviors indicative of poor animal welfare.

Nipples, bells and troughs: the aquatic requirements of domestic ducklings

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The majority of table-duck breeds are derived from domesticated mallards (*Anas platyrhynchos*), a dabbling duck associated with open water in the wild. Two drinker systems are commonly seen in commercial duck production; nipple drinkers (USA), which allow ducklings to drink and possibly shower and open drinkers such as troughs and bells (UK), which allow ducklings to drink, and may allow dabbling, head-bobbing and paddling. We investigated the value that ducklings place on different drinkers using techniques developed for the assessment of behavioural priorities in animals.

Ducklings were reared with access to four types of drinker, nipples, shallow bells, deep bells and troughs. A cost could be placed on access to each drinker by raising the height of the barrier that had to overcome to reach the drinker. Six groups of four ducklings were tested between 4 and 8 weeks of age with the costs of 0, 75, 155, 195 and 255mm over 24 hours with free return to a 'home' pen containing food and straw.

Ducklings showed a higher preference for the trough and a lower preference for the nipples throughout the trial. Raising the barriers reduced the number of visits to all drinkers, but ducks paid a higher price for access to the trough (Median maximum cost of 195mm, Friedman test: $S=57.8$; $DF=3$; $p<0.001$), than for either of the two bell drinkers (Median of 135mm), and paid the lowest cost for the nipples (Median of 75mm).

These results indicate that ducks place a higher value on wider, deeper drinkers that allow a wider range of drinker-related activities than nipple drinkers alone. Work continues to investigate alternative means of assessing the value of drinkers and consequent implications for behavioural deprivation in duckling husbandry.

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Effects of environmental enrichment on the pecking, scratching and dust-bathing behaviour of broilers

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In order to determine if enriched areas would stimulate dust-bathing, substrate pecking and scratching behaviour by broilers, 150 focal birds were continuously observed for 10 minutes each from 1200 to 1600 hours while they had access to two $2m^2$ areas from their $8m^2$ home pen (for about 100 broilers) with an electrical brooder and hay nets. The extra areas had sand in one half and cut straw (pen substrate) in the other half, and were additionally illuminated by plant lamps There were three replicates, and observations occurred during 5 weeks. Another 149 focal birds were observed in the same way in an unenriched control pen.

In 72 of the 150 observations, 'enriched birds' spent some time in the extra areas (sand: on average 31%, straw: 30%, vs. open pen: 25%, under brooder: 14%). They dust-bathed during 13% of these observations on sand, 0% on straw and 4% in the home pen. Scratching bouts/hour did not differ between sand (14.1), straw (7.6), and home pen (15.3; Wilcoxon Matched Pairs). Birds pecked significantly more often per hour (1149.2) on sand than on straw (265.2) or in the home pen (141.2; $T=47$; $N=26$; $p<0.01$, and $T=71$; $N=37$; $p<0.001$), suggesting the importance of substrate rather than illumination. However, there were no differences between 'enriched' and control birds in pecks/hour (enriched: 375.7; N=150; control: 223.0; N=149; two-way Mann-Whitney: $U=11100$; $p=0.9$; post-hoc power=0.64) or dust-bathing occurrences (enriched: 9.3%, control: 5.4%; two-way Chi-Square=1.7; DF=1; $p=0.19$; post-hoc power=0.25). While this may be due to stimulation of controls by sight and sound of 'enriched birds' or the inability to record pecking under the brooder, it is also possible that the enriched areas did not stimulate additional pecking and dust-bathing, but that birds merely directed their behaviour preferably to them, especially to the sand.

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The preferences of ducklings and turkey poults for different illuminances in relation to age and behaviour

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In a free choice experiment, the preferences of commercial ducklings and turkey poults for four incandescent illuminances (<1, 6, 20, and 200 lux; Osram, 60W, pearl) were tested when they were two and six weeks old. Four replicate flocks of 12 birds were given access to four compartments illuminated with each of the different light treatments continuously for six days. The illuminances were changed daily between the compartments. After two days conditioning, the birds' location and behaviour was recorded at 10-minute intervals over 22 hours. Nine and 12 defined behavioural categories were recorded for the ducklings and poults respectively.

Ducklings spent significantly more time occupying the three brightest light environments at two and six weeks old, and the least time in the dimmest (ANOVA; F=2.76; DF=3,60; p=0.030). Illuminance had a significant effect on the partitioning of behaviours amongst the treatments. At two weeks old, locomotion and environmental-directed pecking occurred most often in 6, 20 and 200 lux; whereas at six weeks preening and feeding also occurred more often in these light environments (Logit transformed; ANOVA; F=2.74; DF=24,740; p<0.001).

Turkeys spent most time in the brightest environment at two weeks old, but in 20 and 200 lux when 6 weeks old (ANOVA; F=37.8; DF=3,60; p<0.001). This change in overall preference was reflected in the partitioning of the behaviours amongst the light environments. At two weeks old, all behaviours were observed to occur most often in the brightest illuminance. At six weeks old resting and perching were seen more often in 6, 20 and 200 lux; whereas all other activities were seen more in the two brightest light environments (Logit transformed; ANOVA; F=4.50; DF=33,1232; p<0.001).

Ducklings and turkey poults had significant but differing preferences for illuminance, implying that some spatial or temporal variation in the ambient illuminance of housing would be consistent with their preferences.

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Welfare effects of housing farmed silver foxes (*Vulpes vulpes*) in large outdoor enclosures

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Enrichment of the social and physical environment was used in two experiments (Exp.1 and Exp.2) in attempts to improve the welfare of farmed silver fox cubs. Experimental cubs (E-cubs, N=24 in both experiments) were housed in sibling groups (two male and two female) with (Exp.1) or without (Exp.2) their mother in outdoor enclosures (50-112.5 m^2). The control cubs (C-cubs, N=48 in Exp.1, N=24 in Exp.2) were housed singly in traditional fox cages (1.2 m^2).

In Exp.1, serum cortisol level after ACTH administration and mass of adrenals were higher in E-cubs than in C-cubs (ANOVA: F=9.40; DF=1,68; p=0.003 and F=8.51; DF=1,66; p=0.005, respectively) indicating the negative effect of including the mother in the housing system. When the mother was left out of the family units (Exp.2), no difference in HPA-axis activity between E-cubs and C-cubs was found.

Gastrocnemius muscle succinate-dehydrogenase activity was higher in E-cubs than in C-cubs (Exp.1: F=33.15; DF=1,66; p=0.000), but this possible beneficial effect of extra exercise did not have a positive effect on the overall stress profile of these cubs. On the other hand, E-cubs had increased stress-induced hyperthermia (Exp.1: F=55.55; DF=1,68; p=0.000, Exp.2: F=9.16; DF=1,44; p=0.004) indicating stronger acute fear reaction to the presence of a human. Furthermore, in contrast to C-cubs' activity rhythm, where the highest activity was during work-day hours, the activity rhythm of E-cubs, especially in late autumn, resembled the nocturnal activity pattern of the wild red fox, with the main active phase during the evening (Exp.2, repeated measures ANOVA: F=30.13, DF=2,9; p=0.000).

In conclusion, social tension in group-housed silver foxes can be partly overcome by altering group composition. However, housing farmed silver fox cubs in outdoor enclosures may not to be beneficial due to the individual feralization of the animals leading to increased fear of humans.

Effects of cage partitions on feather condition and the productivity of commercial laying hens and Gifu native fowls

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The open-side cage is popular in Japan, so the effects of partition types on feather condition and productivity in hens were determined in this study. Sixty-four birds (ISA White aged 7 months and Gifu native fowls aged 19 months) were allocated to open-side, solid-side, half-solid-side (upper) and half-open-side (lower) types of cages with wood panels. Each bird was housed in one type of cage for 28 days separately over two periods. Feather condition was ranked from 0 (no damage) to 3 (seriously damaged) on the neck, breast, wing, back, and tail of the birds, in order to assess the aggressive pecking. Production data were collected daily.

Although the sum of feather scores was not different between partition types, mean scores were significantly different on the breast at the 1st period (Kruskal-Wallis: $H=11.10$; $DF=3$; $p<0.05$) [half-solid-side (upper) cage < half-open-side (lower) cage, Sheffe's test: $p<0.05$] and on the wing at the 2nd period (Kruskal-Wallis: $H=10.49$; $DF=3$; $p<0.05$) [solid-side < half-solid-side (upper) cage, Sheffe's test: $p<0.05$].

The effect of interaction between species and partition types on the weight of eggs was significant (ANOVA: $DF=3$; $F=156.32$; $p<0.01$) [native/ the other cage < Native/ half-solid-side cage, Tukey test: $p<0.05$]. The number of eggs (ANOVA: $DF=3$; $F=3.47$; $p<0.05$) [half-open-side (lower) cage < half-solid-side (upper) cage, Tukey test: $p<0.05$] was significantly different between cage types. Feed intake did not differ between cage types.

Although a solid-side cage may prevent feather damage, visual isolation from conspecifics could be stressful for laying hens. If so, a half-solid-side (upper) cage might be better for reasons of production and visual access.

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Effects of free-stall dimensions on preference and stall usage

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Dairy producers are faced with a variety of recommendations for free-stall design, but the effects of these design options on cow behavior have received little systematic research. In a series of experiments we have assessed the effects of free-stall design on preference and stall usage. In one experiment, we compared published recommendations for free-stall width (130 cm vs. 110 cm) and length (270 cm vs. 225 cm) in a 2 x 2 preference test. 15 multiparous, pregnant Holstein cows were individually housed with access to 4 free-stalls. After 1 week of access to all 4 stalls, preference was determined by stall use and lying times, recorded for 24 h. Each animal was then restricted to each stall, in a random order, for 2 days, and preference was then re-tested. Cows had previous experience with smaller stalls, but showed no preference based on stall dimensions (Friedman, $F=4.68$, $DF=3$ $p>0.1$). However, when the cows were restricted to each of the 4 stalls, they spent approximately 1.5 h / day longer lying down in the wider stalls, but there was little effect of stall length on lying time (ANOVA, $F=7.64$ $DF=1,42$ $p<0.01$). Both length and width influenced the time cows spent standing with only their front hooves in the stall. Cows spent almost 2 h / day longer in this position in the smallest stall relative to the largest (ANOVA, $F=8.47$, $DF=1,42$ $p<0.01$). These results indicate that cows may not have strong preferences for stall dimensions, but these features still influence behavior and possibly the welfare of the animals.

Environmental enrichment and anticipatory behaviour: improving and measuring welfare

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This study was conducted to confirm the general assumption that environmental enrichment is rewarding to rats and to demonstrate a possible tool for welfare improvement and indication. Behavioral activation in anticipation of a reward represents the activation of reward centers in the brain. The level of activation depends both on the incentive value of the reward and the state of the animal which is influenced by its history (welfare/stress). Therefore, the anticipatory response (AR) is chosen as a measure for the perception of enrichment and it is investigated how the AR is influenced by different previous experiences.

Anticipatory behavior was evoked in a conditioning paradigm by which rats were trained to form an association between a stimulus (conditioned stimulus; CS) and a reward (unconditioned stimulus; US). The AR was measured by the number of behavioral transitions displayed in the interval between CS and US.

Experiment I. The test group was transferred to an enriched cage and the control groups received a neutral (standard cage), positive (sex) or negative (wire-mesh cage) US. The AR for the enriched cage was similar to that for sexual contact (Mann-Whitney: U=63; N=12; p=0.603). These AR were significantly different from that for the neutral ($p<0.01$) and the negative US ($p<0.01$).

Experiment II. The AR to sucrose of standard and enriched housed rats was compared. From this it appeared that the AR was significantly stronger in standard housed animals than in enriched animals (p=0.002).

The results indicate that the incentive value of an enriched cage is analogous to sexual contact which is generally considered to be rewarding. The stronger AR in standard housed rats probably reflects an increased sensitivity to rewards, which might be caused by the deprivation of the opportunity to display species-specific behavior. The anticipatory response may therefore be indicative for the state of animals in terms of well-being.

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Olfactory enrichment for captive lions (*Pantera leo*) and tigers (*Pantera tigris*), using synthetic feline facial pheromone

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Environmental enrichment is fast becoming a common practice in zoos as the need for increased sensory input is recognized. Few enrichment studies have involved the use of communicative odiferous substances. In this study a synthetic analogue of the domestic feline facial pheromone (Feliway, Cevavet, France) was applied to enclosures of captive tigers and lions in order to increase natural positive behaviours, decrease abnormal behaviours and determine a possible social function of the substance by comparing differential responses between tigers and lions.

Eighteen subjects were observed for three periods: pre-treatment, treatment and post-treatment, with each period lasting 2 days. One ml of Feliway was sprayed at 10 pre-selected locations per enclosure each day of the treatment period. The frequency of 26 behaviours, 3 types of activity and subjects' location were recorded. Non-parametric statistics were used as analysis showed that the data were not normally distributed. In tigers, significant decreases in spray-marking (Friedman: $S=8.0$; $N=9$; $p<0.02$) and head rubbing (Friedman: $S=6.0$; $N=9$; $p<0.05$) were observed in both the treatment and post-treatment compared to pre-treatment periods. In lions, a significant increase in pacing was observed in the post compared to treatment period (Friedman: $S=6.9$; $N=9$; $p<0.03$), although this change in behaviour was apparently correlated with the weather (correlation: $r=-0.468$; $N=9$; $p<0.0001$). Lions and tigers differed significantly in head rubbing response (Mann-Whitney: $U=63.0$; $N1=9$; $N2=9$; $p<0.02$).

It was concluded that, although results did not reflect a classic enrichment response, modification of scent-related behaviours upon treatment of enclosures suggests that Feliway may have communicative properties even in large cat species, although lion and tiger pheromones many not be analogous with those of the domestic cat. Although the chemical structure of the facial pheromone differs between domestic and large cats, research has suggested that there may be a generic 'felid' component of the compound, which may offer some explanation for the differences in response between domestic and large captive cats.

Developing enrichments for gamebirds: use of five different environmental enrichments by juvenile bobwhite quail

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The gamebird industry in the United States rears tens of thousands of bobwhite quail annually. These birds are used to restock natural populations depleted by hunters. The rearing conditions of bobwhites are crowded and barren, similar to those of domestic chickens, but little attention has been paid to improving their environment. In this study, bobwhites' use of five different environmental enrichments was examined at three developmental stages. A box shelter, dustbath, vertical plastic screens with 33% and 66% opacity, and a 'teepee' of wooden slats were provided from 8 days of age to 2 pens of birds. Enrichment use was evaluated by scan sampling at four, nine, and fifteen weeks at four different times throughout the day. Data were square-root transformed and the degree to which observed use at each age deviated from that expected by chance alone was calculated for each enrichment. These values were analyzed with an ANOVA blocked by pen and time of day. There was a significant interaction between age and enrichment type ($F_{20,263}$=2.02; p=0.007). 95% confidence intervals for each enrichment were compared to that of empty space at each of the 3 ages. Bobwhites of all ages tended to avoid the box shelter, the only enrichment commonly used by industry. Older birds spent more time near the 33% opaque plastic screen and the teepee than they spent in empty space. The extent of use of the other enrichments did not differ significantly from the use of empty space. This increasing preference for partial screening at ground level is discussed with reference to the excessive aggression reported to be common among captive bobwhites as well as this species' ecological niche. Both issues should be taken into account in developing meaningful enrichments for these gamebirds.

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Light quality and the behaviour and welfare of broiler chickens

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Domestic fowl evolved in a complex light environment, providing both spatial and temporal variation in light intensity and spectral composition, amongst others. This is in sharp contrast to the artificial light environments currently employed for broilers.

Commercial light environments may affect the welfare of broilers through interactions between physiological and behavioural parameters. For example, physiology may affect behaviour if morphological changes in the structure of the eye in response to abnormal lighting may affect a broiler's ability to extract information from its environment such as another bird's identity or intent. Equally, behaviour may affect physiology if inactivity caused by inadequate lighting increases the incidence of leg disorders.

Numerous studies have investigated the effects of different commercial light environments on broiler production and welfare. However, many (i) confounded colour balance and illuminance, (ii) measured illuminance inappropriately, (iii) only investigated a limited number of factors and (iv) only included currently employed light environments.

We propose that a novel approach is necessary, which marries ecological, behavioural and visual considerations to develop more appropriate light environments for broilers in the future. For example, in terms of colour balance, we may hypothesise that (i) broilers prefer a spectral environment approximating natural daylight in which the broilers' ancestors evolved (evolution hypothesis), (ii) broilers prefer an environment matching their spectral sensitivity (visual hypothesis) and (iii) broilers prefer any light environment in which pertinent features are easily recognised or discriminated (behavioural-plasticity hypothesis).

Novel, interdisciplinary studies of behaviour, physiology and perception in relation to broiler welfare in artificial as well as natural light sources may provide a sound scientific basis for future research, guidelines and legislation for the lighting of broilers.

Lack of a general behavioural strategy in dairy cows

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During management procedures on dairy farms there could be some cows which are very consistent in their reactions and choices but others which are not. A greater or lesser consistency of reaction or choice could be an indicator of cow temperament or strategy and an aspect of this might be a general tendency to be predictable. To test this hypothesis we have studied some aspects of dairy cows' behaviour and the milk yield of these animals. The study was conducted at Cambridge University Farm, in a two-sided tandem milking parlour. The data were collected during the daily management routine from 70 cows during at least 25 milking sessions. The following variables were considered: side chosen (SC), entrance order (EO=1 to 4, being the first to the fourth group on each side), cows' reactivity during premilking udder preparation (CR), time spent fitting the milking cluster (FT), milk yield (MY) and duration of milking (DM). The standard deviations of SC, EO, CR, FT, MY and DM were used to rank the cows and run the data analysis. The Spearman coefficients of correlation were calculated. The cows were classified in three groups according to their variability in SC (high consistent group=0.166±0.069 units of standard deviation; some consistent=0.351±0.031; and non consistent=0.469±0.032; ANOVA: $F_{2,67}$=276.351; p<0.001). We did not find any difference among SC groups in the standard deviations of EO, CR, FT, MY and DM (e.g. CR ANOVA: $F_{2,67}$=0.143; p=0.867; FT ANOVA: $F_{2,67}$=2.113; p=0.129). There was a significant correlation only between MY and DM (Rank correlation: r_s=0.509; N=70; p<0.001). These results indicate that there is an individual tendency of each dairy cow to be predictable for some reactions or choices, but unpredictable for others. Hence we found unpredictability rather than predictability as the general aspect of temperament.

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Automatic milking in combination with grazing on dairy farms in The Netherlands

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The introduction of automatic milking systems (AMS) on dairy farms as a substitute for the conventional milking parlour, demands a change in herd management by the farmer to fully benefit from the system. The milking frequency may increase, which is beneficial for milk yield. However, substantial financial investments are involved, and optimisation of milking efficiency, and therefore use of AMS capacity, is required. Giving cows the opportunity to go to pasture for grazing during the summer season may reduce this capacity usage. However, zero-grazing year round is under discussion, because of animal welfare and the wish of the Dutch society to see cows at pasture. To learn more about the possibilities and conditions for the use of AMS in combination with grazing, an observational study involving 25 Dutch dairy farms was carried out in 1999. Grazing circumstances (i.e. distance from barn to pasture, number of successive grazing days in one pasture lot) varied between farms.

No difference in average percentage cows collected from pasture between and within farms was found (Chi-square: Chi-square=2.7; DF=8; p=0.95). However, it was found that when cows were allowed to graze in one pasture lot longer than one day, the percentage collected cows was higher on the first day than on the following days (Chi-square=54.5; DF=9; p<0.001). Furthermore, it was found that the percentage collected cows was affected by pasture distance (14% more cows per km; Chi-square=5.3; DF=1; p=0.021). An effect of pasture distance on average milking frequency per cow was also found (0.17 less milkings per km; Chi-square=7.2; DF=1; p=0.007), using data from four farms having free cow traffic between barn and pasture (no collecting). Overall, the results indicate that automatic milking in combination with grazing is possible, although there are some negative effects on the use of the AMS capacity, which need further research.

The effect of monochromatic green compact fluorescent light on broiler behaviour and performance on a commercial farm

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Monochromatic green lights (ca 550 nm) are being marketed to broiler chicken producers because they have been shown to enhance growth and to reduce activity, and it has been suggested that green light "keeps the birds calmer". This study compared the growth, behaviour and injuries of broilers reared in pens illuminated by either monochromatic green or white compact fluorescent light on a commercial broiler farm.

The study was conducted in a two-story barn with two pens per floor. Each pen housed approximately 6800 birds. The producer had retrofitted one half of the barn (1 pen/floor) with the green lighting. Light intensities in the pens ranged from 1 to 10 lux (standard light meter). Three full crops of birds were studied over a 6-month period.

Each week, body weights were recorded from a random sample of birds (1%). During week 5, the birds were also assigned scores for number and severity of skin scratches on different areas of the body. The growth curves for birds in green and white light were identical (ANOVA: F=0.06; DF=1, 66; p=0.78). Birds reared in green light had more moderate-severe skin scratches in the area surrounding the tail than birds reared in white light (Chi-square=4.83; N=544; DF=1; p=0.028).

On days 36 and 38, the responses of birds to a person walking through the pen was recorded during a standardized test at 8 sites in each pen. In pens lit by green light, the numbers of birds within 0-0.5 m (Chi-square=16.6; N=564; DF=2; p=0.001) and 0.5-1 m (Chi-square=16.8; N=564 scans; DF=2; p=0.001) of the person were greater than in pens lit by white.

Green lighting did not enhance growth but did appear to influence behaviour as there were differences in injuries and flight distances between the lighting treatments.

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Does milking frequency and energy concentration of the diet affect time budgets of high yielding dairy cows?

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We investigated whether management procedures used to increase milk production - milking frequency and level of concentrate in the feed - affect the time budget of dairy cows.

We used 38 Danish Friesian cows in a 2 x 2 factorial experiment [two versus three daily milkings; low (25%) versus high (75%) concentrate in the diet]. The cows were housed in tie-stalls and fed a total mixed ration for ad libitum intake. The cows were blocked in ten blocks according to expected date of calving and lactation number and randomly assigned to treatments within block. The behaviour of the cows was observed for 24 hours at week 6 after calving. Analysis of variance was performed using the Mixed Procedure of SAS.

The cows fed a high energy level spent less time eating than cows fed a low energy level (289 versus 381 min/day; DF=1,23; F=21.8; $p<0.001$) and they tended to spend longer time lying down (739 versus 668 min/day, DF=1,23, F=2.61, p=0.12). The cows fed a high level of concentrate spent more time resting (i.e., lying down not ruminating) than cows fed the low level of energy in the diet (386 versus 238 min/day; DF=1,23; F=38.0; $p<0.001$).

Three daily milkings increased the eating time compared to two milkings (355 versus 315 min/day; DF=1,23; F=4.15; p=0.053), but there was no difference in lying time (688 versus 718 min/day; DF=1,23; F=0.45; p=0.51) or time spent resting (lying down not ruminating) between 2 and 3 daily milkings.

The results suggest that increased milk production obtained by three daily milkings or increased energy concentration in the diet does not reduce lying time and time spent resting.

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Effect of bovine appeasing pheromone on young bovine performance

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The trial objective was to assess the effect of Bovine Appeasing Pheromone (BAP: a synthetic pheromonal complex) on 'broutards' from weaning until their departure to final fattening. French 'Broutards' are young cattle that are first raised in France, and then are exported. The study was performed on 2 groups of young cattle (N=32) weighing from 250 to 500 kg. Group A was treated with BAP whereas group B was given a placebo. The treatment is similar to the type of solid block generally used as a 'salted block'.

There was no statistical difference between the groups in weight on arrival (Mann-Whitney: U=115.5; N1=N2=16; p=0.86). The breeders were impressed by the ease of handling of A group animals, for example when they were weighed. Indeed, the principle of the appeasing pheromones is to aid in preventing stress. The treated group grew faster, allowing them to be sent to fattening after 196 days (D196), as opposed to 217 days (D217) for group B. Groups A and B differed in weight at D196 (Mann-Whitney: U=70.5; N1=N2=16; p=0.03). Daily weight gain from D0 to D196 differed significantly between A and B (Mann-Whitney: U=41.0; N1=N2=16; p=0.001). Over the whole period (D0 to D196), there was a transposition of the weight/age ratio between the beginning and the end of the protocol, which also demonstrates that that BAP treated animals had a better weight gain over the period. In conclusion, there could be several possible effects of BAP on feedlot performance: improved behaviour, economic, gain and faster growth. Results on a larger scale are needed to confirm this efficiency; these are underway.

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Beak trimming compromises the ability of laying hens to eat

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The effect of beak trimming on feeding performance of eight month old hens was investigated by comparing ingestion success between five ISA Brown hens, trimmed as chicks to remove no more than 30% of the original beak length, and five intact birds. The hens were filmed using a high-speed video system, whilst eating from pellets spread over a surface in a single layer (monolayer) and a deep pile (multilayer).

Trimmed hens were less successful at ingesting pellets when eating from the mono- and multi-layer than intact hens (for both comparisons: Mann-Whitney: U=0; N1=5, N2=5; $p<0.01$). Trimmed hens ingested pellets in only 16.4% (sd 11.8) and 68.2% (10.2) of total pecks for the mono- and multi-layer respectively. Intact hens achieved success rates of 84.0% (sd 3.2) and 89.8% (sd 4.5) respectively. One trimmed hen failed to eat any pellets from the monolayer. The trimmed hens performed better with the multilayer than with the monolayer (Wilcoxon: T=15; N=5; $p<0.05$). For the five trimmed hens, severity of beak trimming was negatively correlated with success rate in the monolayer treatment (Rank correlation: $r_s=1$; N=5; $p<0.01$). Video analysis of intact and trimmed birds eating highlighted the problem. The intact hens exhibited a sequence of behaviours during a peck that was well-timed, accurate and fast - at least eight distinct phases per peck and up to three pecks per second, whereas for the trimmed hens this was severely disrupted.

These data further strengthen the argument that beak trimming of laying hens severely impairs their ability to interact with their environment and highlights the desperate need to find alternative methods for controlling pecking damage in poultry species. In some circumstances, trimmed hens may have difficulty in eating the presented food, which may be frustrating. These data are also applicable to other beak-related behaviours (e.g. preening) which may be similarly disrupted.

Effect of udder massage at the end of milking on residual milk and mastitis infection in cows

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The amount of residual milk (RM) after milking interferes with milk secretion and can predispose to mastitis. To test the hypothesis that udder massage at the end of milking may affect RM and, therefore, mastitis incidence, we carried out two experiments. In experiment 1, in a commercial farm, 52 cows (average 4480 kg/cow/lactation) were blocked for parity and stage of lactation, and randomly assigned to one of the treatments: massage or no massage of the udder at the end of milking. Total milk and RM (after a 20 UI iv injection of oxytocin) were measured twice, with one-day interval, 2 months after the treatments started. Additionally, a group of 12 cows were randomly selected and their treatments were switched over; RM was measured one week later. Mastitis was evaluated weekly during 3 months, using the California Mastits Test. In experiment 2, in an experimental farm, a group of 10 cows (average 6200 kg/cow/lactation) were randomly allocated to the same treatments as in experiment 1, in a switch-over design. RM was measured twice with one-day interval, five days after the treatments started, and 3 days after treatments were changed. Before starting the experiment, the usual management in farm 1 did not include udder massage at the end of milking, while in the experimental farm this was a common practice.

RM was not affected by udder massage in experiment 1 (mean=1.41, SE=0.19 kg), nor in experiment 2 (mean=1.03, SE=0.32 kg). Udder massage had no significant effect on mastitis incidence (Chi-square; DF=1; $p<0.42$). The incidence of mastitis in experiment 1was 11/26 among the cows receiving udder massage and 14/26 among the cows not receiving udder massage. We conclude that udder massage at the end of milking has no effect on RM and does not affect mastitis incidence, at least under the conditions used in these experiments.

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The mother-offspring distance as an indicator of the cow-calf attachment from birth to weaning

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Some studies have suggested that mother-offspring distance increases progressively from birth to weaning. These distances could be an indicator of the development of cow-calf attachment and the gradual nature of weaning. The objective of this study was to evaluate this in beef cattle. A total of 198 cow-calf pairs (99 per year) were observed from birth to weaning, four times during 1998 and 1999. All calves were born from Nellore cows sired by Nellore, Simental, Aberdeen Angus, and Canchim bulls. The purebred Nellore calves and their dams were kept in two production systems that differed in the number of animal units [AU; defined as a liveweight animal (cow-calf pair) of 450kg] per hectare: intensive (5 AU/ha) and extensive (1 AU/ha). The crossbred groups were kept only in intensive production systems. The cow-calf distances were assessed by scoring distances from 0 to 25 meters, following a 6 levels scale. The distances were recorded 6 times per day (at 7, 9, 11, 13, 15 and 17h). For the statistical analysis the scores were square root transformed. Data were analyzed using the least squares method, with a model that included the effects of year (Y), system (S), Y x S, cow-calf pair within Y x S (error a), hour of the day (H), S x H and the covariable age of the calf (linear effect). There were no differences among systems (GLM: F=1.61; DF=4,188; p=0.1731). Despite the significant effect of S x H (GLM: F=2.89; DF=20,4395; p=0.0001), there was a trend for increasing distance between cow and calf with hour of the day, for all systems. As expected, the distances between cow and calf increase with the calves age (F=17.14; DF=1,4395; p=0.0001; regression equation Y=1.2189 + 0.00077X). These results support the assumption that the mother-offspring's distance could be an indicator of the calf attachment. Financial support: FAPESP.

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The farrowing crate limits the effectiveness of functional sow maternal behaviour

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Previous studies have indicated that the sow (*Sus scrofa*) has at least two behavioural strategies for avoiding crushing piglets in open farrowing pen systems. The sow can change postures infrequently, or be more aware of where her piglets are when she lies down, moving piglets aside if necessary.

This experiment investigated whether sows use these two behavioural strategies to avoid crushing piglets in the farrowing crate system. The behaviour of 96 parity one gilts, 63 of which were also observed in parity two, were observed for 24 hours post-birth of the first piglet (BFP).

Sows showed individual consistency between parities one and two in the frequency of standing up (repeated measures REML, F-test on stratum variances: $F=1.8$; $DF=95,58$; $p<0.05$) and lying back down again ($F=2.4$; $DF=99,56$; $p<0.001$). These behaviours were strongly associated with an increased incidence of crushing (repeated measures REML on log-transformed data: chi-squared=34.0; $DF=3$; $p<0.001$; chi-squared=28.3; $DF=3$; $p<0.001$, respectively).

Sows were also consistent, over parities one and two, in how frequently they made nose to nose ($F=2.2$; $DF=89,47$; $p<0.005$) and nose to body ($F=3.2$; $DF=96,51$; $p<0.001$) contacts with their piglets. These behaviours, when combined with other piglet-directed behaviours (e.g. root piglets, look at piglets), were not associated with a reduced risk of crushing when performed prior to lying down (repeated measures REML on log-transformed frequencies: chi-squared=1.8; $p>0.05$).

Thus, piglet-directed pre-lying behaviour does not have a functional role in improving piglet survival in the farrowing crate. It is concluded that farrowing crates may limit the impact of functional maternal (piglet-directed pre-lying) behaviour in improving piglet survival.

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Fertility of estrus induced with the 'ram effect' in lactating and dry Corriedale ewes during the non-breeding season

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It is well known that a low body condition affects fertility in sheep. We evaluated the effect of lactation -which affects the body condition- on the response of Corriedale ewes to the 'ram effect' during the non-breeding season. Seventy-five ewes that lambed 60-90 days before the trial started and remained with their lambs (L group) and 59 dry ewes (D group) were available. Initial body condition was lower in L than in D ewes (2.91± 0.08 vs 3.42± 0.07 for L and D respectively; mean±SEM; Kruskal-Wallis; test statistic=25.7; p<0.001). On Day -30 (Day 0=introduction of rams) ewes were isolated from rams by a minimum distance of 1 km. On Day 0 ten marking rams and 20 ewes with hormonal induced estrus were introduced to all ewes. Estrus was checked twice daily from Day 0 to 5, once daily on Days 8, 11 and 14 and twice daily from Day 17 to 30. Pregnancy was determined by transrectal ultrasonography 35-40 days post-estrus. Frequencies were compared by Chi-square test. Ewes came into estrus in two periods: Days 1 to 5 (15 L and 12 D; DF=1; Chi-square=0.002; ns) and 17 to 30 (49 L and 43 D; Chi-square=2.0; ns); overall estrus was 64/75 (85.3%) and 55/59 (93.2%) for L and D groups respectively (Chi-square=2.1; ns). Pregnancy rates were 0/15 and 5/12 (41.7%) for L and D groups respectively (Chi-square=7.8; p<0.01) for Day 1-5 estrus, and 30/43 (69.8%) and 29/49 (59.2%) for D and L groups respectively (Chi-square=1.1; ns) for the 17-30 Day period respectively. Overall pregnancy rates were 29/64 (45.3%) and 35/55 (63.6%) for L and D groups respectively (Chi-square=3.97; p<0.05). We conclude that estrus response to the 'ram effect' was similar between both groups, but the fertility of the induced estrus was lower in lactating ewes.

Why do naked mole-rats shove their pups?

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Adult naked mole-rats (*Heterocephalus glaber*) display an unusual behavior toward juveniles: they shove the pups vigorously with their muzzles in and around the colony's nest. We investigated the circumstances and probable function of this behavior by studying two captive colonies for 17 months. Breeders shoved pups more often than nonbreeders (G-test: G=744.73; DF=1; $p<0.0005$), the breeding female did the most pup shoving (G-test: G=511.56; DF=1; $p<0.0005$), shoving peaked coincident with weaning (0.082 ± 0.035 shoves/min/pup), and pups always responded to shoving by becoming active. Initially, we thought that shoving was a manifestation of weaning conflict. However, breeders also shoved their young before and after weaning. Moreover, shoving increased dramatically when an observer was present in comparison to videotaped observations with no one in the colony room (ANOVA: $F_{1, 96}=9.509$; $p=0.003$). Being shoved when an environmental disturbance occurs may sensitize pups to potentially dangerous stimuli and encourage them to flee. We tested this hypothesis by dividing two litters and raising half the pups (N=6) in semi-isolation, where they were seldom shoved. The isolated pups from each litter were housed together; an older juvenile sibling was placed with the pups to maintain chemical contact with their natal colony. When litters were reunited 9-13 weeks later, the experimental (unshoved) pups were less likely to avoid the site of a disturbance (the nest) than were the control (shoved) pups that had been raised in their natal colony (Wilcoxon: N=18; $p=0.046$). Shoving of pups does not fit previous models of parent-offspring conflict, dominance reinforcement, or work incitation in naked mole-rats. Shoving appears to teach pups to recognize danger and flee. These results suggest that certain zoo housing protocols (e.g., continuously playing music to dampen sudden sounds and vibrations caused by zoo visitors) may result in increased shoving by adults, the implications of which merit consideration.

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Effects of heat stress on sow nursing behaviour and consequent litter performance

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Sows exposed to temperatures exceeding their thermoneutral zone (12-22°C) decrease voluntary feed intake and increase body weight loss, consequently milk production decreases. Success of milk ejection during lactation, an alternative indicator of lactation performance, varies between 69 and 77% of all milking attempts of sows in a thermoneutral environment (Jensen et al., 1991, Appl. Anim. Behav. Sci. 31, 195-209). We hypothesized that the number and frequency of successful milkings are decreased during periods of heat stress. Twenty-four multiparous (L x Y) lactating sows nursing 10 piglets, litter size adjusted by cross-fostering, were used in a randomized block design to determine the effect of environmental temperature on sow nursing behaviour. Sows were housed in standard farrowing crates at 20°C (C) or 30°C (HS). Sows were provided ad libitum access to feed and water throughout the study. Sows and piglets were videotaped for 8 h daily on day 3, 6, 9, 12, 15, 18, and 21 of lactation. An unsuccessful milking was defined as a nursing attempt where milk ejection was absent. Milk ejection was defined as the nursing phase during which piglets assume stance position with characteristic rapid sucking. Preliminary results for 12 sows on day 3, 6, and 15 of lactation indicate no difference in the intervals between successful milkings between HS and C sows; 57.5 min and 61.0 min, respectively (repeated measures ANOVA: F=0.46; DF=9; p=0.51). The odds ratio of a successful milking from HS and C sows was 1.35 (ANODE: 2=1.28; DF=1: p=0.26). There was a decrease in successful milkings from day 6 to day 15 in HS piglets (ANODE: 2=6.58; DF=1; p=0.01), but not in C piglets (ANODE: 2=0.39; DF=1; p=0.53). Preliminary results indicate an age dependent decrease in the number of successful milkings in the HS environment. This may help explain the impaired lactation performance of sows under heat stress.

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Observation of breeding activity of a mixed age group of bulls in extensive range conditions

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More than 250,000 beef cows in Saskatchewan, Alberta, and Manitoba are sent to extensive, federally owned pastures for summer grazing and breeding (average ratio of 30 cows per bull). We studied the relationship between dominance rank and breeding activity of a mixed age group of bulls under these conditions. Seven Charolais bulls, 4 (N=1), 3 (N=4) and 2 (N=2) years of age, were pastured with 202 cow-calf pairs. Each day 2-3 observers individually followed randomly selected focal bulls and collected instantaneous samples at 5-min intervals (0600–2000 h). All breeding activity and aggressive interactions were recorded to determine dominance rank. A total of 226 h of observation were completed in the first 21 days and 323 h during a second 28-day period. High dominance ranking tended to be correlated with older age (Rank correlation: r_s=-0.7769; N=6; p=0.069). Frequency of copulations for dominant and submissive bulls in the first period was 4.9 and 1.6-copulations/10 h observation (Mann-Whitney: U=2; N=3; N=3; p=0.38) and in the second period was 0.93 and 0.96-copulation/10 h observation (Mann-Whitney: U=6; N=3; N=4; p=0.86) respectively. The submissive bulls tended to check more cows than dominant bulls in the first period (3.9 and 1.9 estrous checks/h; Mann-Whitney: U=9; N=3; N=3; p=0.080) and second period (2.5 and 1.4 estrous checks/h; Mann-Whitney: U=12; N=4; N=3; p=0.051) respectively. Dominant bulls were observed to displace and mate estrous cows that had first been detected by lower ranked bulls, possible evidence of a strategy by dominant bulls to use low-ranking bulls as heat detectors. Infrequent events included lower ranking bulls herding cows away from a more dominant bull and cows that stood to be mated by dominant bulls ran away from submissive bulls, but were literally mated while running. These results suggest that bull breeding strategies are in part dependent on individual bulls' dominance ranking.

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The effect on their behaviour of the age at which dairy calves are separated from their mothers

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In intensive dairy production, calves are normally separated from their dams within 24 h post-partum. The main reason that early separation is adopted is that farmers feel that disturbance to both cow and calf is greater if they are left together longer. However, no objective evaluation appears to have been made. Six Friesian cows and their calves were separated at 24 h (1.D) and 6 were left together until 96 h post-partum (4.D). All calves were observed for 3h in the middle of the day on days 2 (immediately after separation of 1.D calves), 5 (immediately after separation of 4.D calves), 8 and 11.

No aspect of behaviour differed significantly between calves with and without dams at 24h. In both groups, changes that followed separation only emerged over the period 1-3 days after separation. Separation resulted in a reduction in the mean proportion of time lying inactive: in 1.D calves, 52.8% of time on day 5 vs 79.7% on day 2 (Repeated measures $t=3.39$; $p<.02$ with 5 DF). In 4.D calves, the effect developed more slowly: 70.5, 66.8 and 53.0% on days 5, 8 and 11 respectively. Frequency of vocalization increased over the three days after separation: 24.3 incidents/calf on day 5 in 1.D calves compared to 1.80 on day 2 (Rm $t=11.57$; $p<.001$ with 5 DF) and 11.60 on day 5 in 4.D calves ($t=3.59$; $p<.02$ with 5 DF), which in turn rose to 24.8 incidents/calf on day 8 (Rm $t=5.96$: $p<.005$ with 5 DF). Sniffing at fittings and chewing straw rose little in 1.D calves, but were each significantly higher on days 8-11 in 4.D calves. 4.D separation affected a somewhat wider range of behaviours than 1.D, and trends suggested that effects arose more slowly but persisted longer in 4.D calves.

Social rank of the cow affects the sex of her offspring

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In uniparous, polygamic species, only dominant males mate, leaving a greater number of offspring in a lifetime than dominant females. A dominant female has more chance to leave dominant offspring than a subordinate one. Therefore, a dominant female has a better chance to spread her genes over generations by having male instead of female offspring. A subordinate female, on the contrary, would ensure some descendents by having female offspring. This hypothesis, first raised by Trivers and Willard, has been proved in deer. We hypothesized that the cow, a uniparous and polygamic species, would express this characteristic. This experiment was carried out on four Holstein established herds of 10, 15, 18 and 35 lactating cows on pasture. From these cows, 80 calves were produced because two twin pairs were born. The social rank of each animal was calculated using a sociometric matrix. All occurrences of agonistic interactions between pairs within the group were recorded in 2-hr observation sessions, after food was offered. The instigator and the recipient were recorded in each encounter, and the sum of all interactions yielded a positive or negative result depending upon whether the individual won or lost most fights. For each herd the range of maximum to minimum scores was divided by three, and each cow fell into one of the three categories. Then, all the cows were pooled per category to analyze the relationship between social rank and sex of their offspring, which was recorded just after birth. Male:female ratios were 13:05 for dominant, 17:17 for intermediate and 8:20 for subordinate cows (chi-squared: DF=2; p=0.014). Our data suggest that there is an effect of social rank on the sex of the offspring in the domestic cow. This preliminary experiment justifies a study with a larger number of herds, which is required to generalize this conclusion.

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Effect of supplementary tryptophan on aggression of growing pigs following regrouping

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Pigs are regularly regrouped and mixed on commercial farms. The resultant fighting between unfamiliar individuals is a welfare concern and may be detrimental to productivity. Excess dietary tryptophan has been reported to modify aggression and reduce stress responses in domestic animals. The rationale for this is that tryptophan is the primary precursor of serotonin, an inhibitory neurotransmitter in the central nervous system. This study was conducted to determine whether a short term of excess dietary tryptophan could effectively reduce the aggression that follows re-grouping of pigs. A total of 192 growing pigs (BW=28.3±4.9kg) were tested in two identical trials. Each of the three experimental diets was imposed for 4 consecutive days. The diets consisted of the same ingredients, except for tryptophan which was included at levels of 0.11% (control, standard recommendation), 0.23%, and 0.43%. Aggression tests were conducted on the 3rd and 4th days of the dietary treatment. Pairs of unfamiliar pigs on the same dietary treatment were regrouped and observed for 1 hour by trained observers. The results showed that excess dietary tryptophan reduced total fighting time to 1/3 of that in the control group (random block ANOVA: F=3.80; DF=2, 41; p=0.03). Duration of inverse parallel pressing was decreased significantly in pigs with high tryptophan diets (random block ANOVA: F=3.54; DF=2, 41; p=0.04). Pigs in high tryptophan treatment groups also tended to spend less time in mutual biting (random block ANOVA: F=1.98; DF=2, 41; p=0.14). It is concluded that feeding excess dietary tryptophan for a short period reduces fighting duration and intensity of pigs following re-grouping.

The effect of environmental context on laboratory rat social recognition

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Moving an animal from the environmental context in which it learns a task to a different context can reduce performance. If contextual cues are able to influence animal learning and memory, then aspects of animal memory may be disturbed by routine husbandry procedures. For example, mixing familiar conspecifics in an unfamiliar context may lead to social recognition failure, and subsequent inappropriate aggression. We therefore investigated whether contextual change could influence social recognition in adult female laboratory rats.

We introduced the same stimuli - samples of soiled bedding from an initially novel conspecific - to 24 rats on five occasions to provoke an habituation response, based on a reduction in the total amount of stimulus investigation (seconds). We then tested the rats once with both the now-familiar stimulus and a simultaneously introduced novel stimulus, either in the same, a different (but familiar), or an entirely novel context, to see if the familiar stimulus was still recognised. A significant preference for investigating the novel, rather than the familiar, stimulus indicated recognition. No such preference suggested recognition failure.

All rats showed reductions in stimulus investigation across the five introductions to the same stimulus (repeated measures GLM: $F_{4,80}=23.97$; $p<0.001$). Whether tested in the same, or another, context, there was an overall preference for investigating the novel, rather than the familiar, odour ($F_{1,18}=32.16$; $p<0.001$). However, further analysis of an interaction between test context (same/different/novel) and stimulus-type (familiar/novel) ($F_{2,36}=2.97$; $p=0.077$) revealed that rats tested in a novel context showed no preference for the novel stimulus (Wilcoxon: T=30; N=8; p=0.107; power=0.4094). They also showed reduced overall levels of stimulus investigation ($F_{2,36}=6.86$; $p<0.01$).

These results suggest that laboratory rat recognition of conspecific odour is not disrupted following a switch to a different environmental context, provided that context is already familiar.

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Goat buck dominance and social hierarchy in Mexican tropic conditions

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Goats are growing in number in the Mexican tropics in extensive systems. Adult and young males and wethers fight for resources in the same flock all year, affecting the potential production on farms.

We studied social hierarchy and behavioral traits of dominance in goat bucks and their relations with female presence and physical features. We worked with 12 bucks in two groups: one in permanent contact with females separated by a fence (MF) and the other group without female presence (MM). We constructed a dyadic interaction matrix, determined the linearity coefficient and dominance index, and recorded physical aggression and aggression without contact. A hierarchical design with repeated measures was used, with four replications. Behavioral traits and physical features were correlated with social behavior measures.

The linearity coefficients were 0.92 and 0.99 for the MM and MF groups respectively. Physical contact occurred in 59.7% of the aggressive acts and 40.3% were without contact. The encounters we recorded included pushing (39.9%), fighting (17%), threats/ intimidation (17.4%) and submission that came after a movement by another goat (12.7%). The dominance index was in the range between 0 to 56.74, and the aggression range was from 0.6 to 10.5 per buck, with significant differences between individuals (ANOVA: $F=113.82$ and 19.92 respectively; $DF=10,36$ $p<0.01$); there was no significant female effect (ANOVA: $F=0.02$ and 0.002 respectively; $DF=1,36$ $p<0.05$). We found a high correlation between weight and both dominance index and total aggression ($r=0.93$ and 0.95 respectively; $N=12$; $p<0.01$) and also between scrotal circumference and aggression ($r=0.93$; $N=12$; $p<0.01$). We concluded that bucks trend to have a social structure that is a highly linear hierarchy in which dominance is expressed more by physical aggression involving contact and less by aggression without contact. The buck's position in the hierarchy is highly related to weight and scrotal circumference.

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The relationship between consistent choice of one side of a milking parlour by dairy cows and their behaviour in novel and competitive situations

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Two groups of twelve dairy cows were identified from a herd of 150 cows according to the proportion of times they voluntarily entered their preferred side of a parlour during 25 milkings - Consistent cows (C) 91% (range 86-97%), and Inconsistent cows (IC), 60% (range 50-71%). We examined whether this related to behaviour in a novel environment (indicating tolerance to different parlour sides) and their success in a competitive environment for food (indicating their ability to dominate other cows for access to their preferred side). They were observed in the novel environment (an open pen; OP) for 15 minutes post- milking and then subjected to the food-competition test (FC), where they were joined in the pen by another cow (the same in all tests) and a food bucket. This lasted for 15 minutes maximum or until interactions/ feeding ended.

In the OP, C cows spent longer standing motionless (665 s) than IC cows (521 s) (ANOVA: DF 2,22; SED p=0.02), but the time spent sniffing the pen and the number of steps and vocalisations was similar. In the FC test, C cows took less time to start feeding (70 s) than IC cows (137 s) (ANOVA: DF 2,22; SED 32.4; p=0.04) and were more in control of the food bucket (C 151 s, IC 19 s, ANOVA: DF 2,22; SED 31.5; p=0.01). They also instigated more aggressive interactions (C 3.4, IC 0.6, ANOVA: DF 2,22; SED 0.75; p=0.05) and tended to push the other cow more times (C 2.8, IC 0.5, ANOVA: DF 2,22; SED 0.61; p=0.06). IC cows stood inactive for longer (222s) than C cows (373 s) (ANOVA: DF 2,22; SED 43.3; p=0.01). Thus there was limited evidence that cows consistently entering one side of the parlour are more fearful in novel situations, but clear evidence that they have greater ability to dominate other cows to gain access to resources.

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Vocal communication between cows and calves in extensive range conditions

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Cow-calf pairs (208) from 7 local farms were studied at a community pasture. Calves were 2 to 10 weeks old at the beginning of the two-month study. Two observers recorded the behaviour of 44 pairs once each from the end of one nursing to the end of the next (interval between nursings 4 hr 59 min ±16 min, nursing duration 12.02 ±3.07 min, mean ± standard error given throughout). Numbers of vocalizations by cows and their calves were highly correlated (Spearman; $r=0.61$; $N=44$; $p<0.001$). The number of vocalizations by calves was highly correlated with nursing intervals (Spearman; $r=0.41$; $N=44$; $p<0.01$).

During 19 observation sessions, the cow and calf became visually separated (separation time 41.35 ± 8.42 min). Most separations occurred when the cow moved away grazing, while the calf lay down and did not rise to follow (11 of 19 pairs). Pairs that separated averaged 17.1% of their time apart and 10.1% of time searching for each other before reuniting. The proportion of time they spent apart was negatively correlated with calf age (Spearman; $r=-0.57$; $N=19$; $p<0.02$). Searches during which the cow vocalized averaged 69.0 ± 15.13 min compared with 14.4 ± 6.05 min when the cow was silent (Mann-Whitney; $U=48$; $N1=5$; $N2=11$; $p<0.05$). Calves that vocalized at shorter intervals while searching achieved shorter search times (Spearman: $r=0.56$; $N=19$; $p<0.02$). Time from the end of visual separation to nursing was 63.58 ±16.6 min.

The relationship between vocal activity of cows and their own calves suggests that they are communicating specifically with each other. The link between vocal activity and search times indicates that vocalization is involved in locating each other in an extensive environment.

Effects of early play experience on play behaviour of piglets after weaning

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We hypothesised that play experience gained by piglets during early ontogeny would affect their ability to cope with weaning stress. Specifically, we predicted that: (i) weaning would initially result in low play levels and (ii) better coping ability would be reflected by a more rapid increase in play levels with time after weaning. We manipulated play experience in three pre-weaning treatments: (1) Obstacles (play with littermates restricted by barriers throughout the 2.1 x 1.8 m home pen and a 1.7 x 1.5 m observation pen into which each litter was placed during seven 30-minute periods between 8 and 23 d); (2) Littermates (unobstructed play with littermates in home and observation pens); and (3) Aliens (unobstructed play with littermates in home pen, and with littermates and non-littermates in observation pen). We expected the treatments to affect coping ability as follows: Aliens>Littermates>Obstacles. Two males and two females from each of eight litters per treatment were housed together after weaning at 24 d. On days 1, 3 and 5 after weaning, they were placed in the (unobstructed) observation pen for 30 minutes. The frequency of locomotory play (scampers, pivots, head tosses, flops and paws) was lowest on day 1 and increased thereafter (mixed model repeated measures ANOVA on ranked data: $F=144.25$; $DF=2, 42$; $p<0.001$). The frequency of social play (non-injurious bites, levers and 'push-overs') also increased with time after weaning ($F=11.85$; $DF=2, 42$; $p<0.001$), as did the frequency of transitions from standing to self-handicapping positions (sitting, kneeling or lying, $F=28.17$; $DF=2, 42$; $p<0.001$). There were no significant treatment or treatment by time effects on any of the play measures. As predicted, weaning resulted in an initially low level of play. However, we found no evidence that different play experience before weaning affected play levels among littermates in the first week after weaning.

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Social tactics of pigs in a competitive foraging task: the 'Informed Forager' paradigm

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The level of sophistication of an animal's social tactics can inform us about its cognitive abilities and about the kind of social situation in which it is likely to suffer. Field observations suggest that feral pigs adopt rank-dependent foraging tactics and adapt their foraging behaviour to changing group composition and food distribution patterns. Our aim here was therefore to test experimentally the social tactics used by domestic pigs in a competitive foraging situation.

Sixteen pigs foraged in pairs in an arena with food hidden in one of eight monopolizable buckets. Pigs were housed in pairs with their foraging partner. Each pair was tested several times (range: 22-45 trials). Before each pair trial, one of the pigs, the 'informed' pig ('I-pig') was given privileged knowledge about the food location during a solitary search trial. The 'non-informed' pig ('NI-pig') was naive during pair trials, but heavier than its informed partner and able to displace it from the baited bucket. By focusing on the NI-pigs, we show that pigs are able to exploit the knowledge of others by following them to a food source. All eight visited a greater proportion of buckets immediately after their informed partners than expected by chance (binomial tests on each pig: $p(k)=0.125$; all $p<0.0001$). This increased their foraging efficiency. They required fewer bucket visits to find the food than expected of a random searcher in pair trials (Z-tests on each pig: Z-values from –7.38 to –3.46; N from 22 to 45; all $p<0.01$), but not in solitary search trials (Z-tests: Z-values from –0.18 to 0.38; N from 5 to 26; all $p>0.05$). This suggests an adaptive switch in social foraging tactic as predicted by phenotype-limited producer-scrounger models. Logistic regression analyses showed that some I-pigs adjusted their behaviour predictably to that of the exploiting NI-pigs.

Factors affecting agonistic interactions of pigs after grouping in pens with an escape box

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To determine the factors affecting agonistic interactions after grouping, 24 pigs were allocated to six pens with an escape box. Half of the pigs were experienced in using the box before. One male and one female pig were transferred as intruders from each pen to another pen where residents existed. The number and duration of agonistic interactions were larger and longer on the first day after grouping. The effect of interaction between the experience in the box and being transferred on the number of pigs attacked was significant (ANOVA: $F=4.46$; $DF=1$; $p<0.05$). The pigs that had no experience in the box and who were transferred were attacked more than the pigs that had no experience in the box but were not transferred (Sheffe's F test: $p<0.01$). The number and duration of aggressive interactions were significantly larger and longer toward unfamiliar individuals than toward familiar ones (t-test: $T=-6.41$; $DF=23$; $p<0.01$, Wilcoxon: $T=13$; $N=24$; $p<0.01$, respectively). The number of aggressive interactions toward the same sex of pigs was significantly larger than that toward pigs of the opposite sex (t-test: $T=3.20$; $DF=19$; $p<0.01$). There was a tendency for a negative correlation between the number of agonistic interactions on the first day and the range of body weights among pen mates (correlation: $r=-0.78$; $N=6$; $p<0.10$). In conclusion, grouping with unfamiliar individuals should be avoided, but the following methods could reduce agonistic interactions: (1) previous experience of the intruders with the escape box, (2) no previous experience of the residents with using the box, (3) mixing sexes, and (4) varying body weight range.

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Social dominance relationships in captive scimitar-horned oryx, *Oryx dammah*

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Social relationships in two herds of captive Scimitar-horned oryx at the National Zoological Park's Conservation and Research Center in Front Royal, Virginia, USA were examined based on agonistic behavior. Each herd consisted of one vasectomized male and a group of females. Data were collected on 35 days over a 6-month period, resulting in 104.5 hours of observation for each herd. Contrary to previous reports, the dominance hierarchy of each group of females was not strictly linear. Dominance index values (percent wins) for each female were negatively correlated with the ranking obtained through a hierarchy matrix based on maximizing wins above the diagonal (Rank Correlation: Herd 1, r_s=-0.91; N=13; p<0.01; Herd 2, r_s=-0.93; N=9; p<0.01). Body weight was significantly correlated with hierarchy rank among females in Herd 1 only (r_s=-0.72; N=13; p<0.01). Rates of agonistic encounters between females per hour were relatively low (0.39 and 0.52 respectively for Herd 1 and Herd 2). Mothers were dominant to daughters in five out of seven occurrences. Herd 2 contained older females, and home pasture and number of animals remained constant throughout the study. Herd 1 contained two juvenile females (under the age of 1 year), had one female that died in July, and was moved to another pasture in May. We suggest that the higher incidence of hierarchy reversals in Herd 1 resulted from a combination of factors, including juveniles improving their individual standing in the herd and the death of the older female. Finally, preliminary results indicate that lower-ranking females tended to be located further from the group center than higher-ranking animals. Social and spacing relationships of captive wild ungulates have implications for welfare-related decisions for their species and for related domesticated animals.

Early predictors of dominance ability in domestic heifers of the Hérens breed

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Many studies have looked for predictors of dominance in various species. However, to our knowledge only short-term predictors have been investigated. Cows of the Hérens breed, selected for its fighting tendency, constitute an original model to study the possibility of predicting dominance ability at an early age.

Physical characteristics, several aspects of social behaviour, reactivity to fear eliciting situations, and docility towards humans were assessed in 28 heifers at 6 and 18 months of age. These heifers were reared from birth in 4 permanent groups. Dominance of the 28 subjects was estimated at 30 mo. The animals were first observed in groups containing 4 unfamiliar animals, each originating from a different rearing group. All possible combinations of 4 previouly unacquainted heifers (N=49) were observed for 2 hours over a 14 day period. Each heifer was tested in 7 new groups of 4 at 2-day intervals. After the completion of these regroupings, all animals were put together and observed for 2 hours. The 28 heifers were then allocated to 2 classes (dominant or subordinate) by means of a multifactorial correspondence analysis followed by a cluster analysis. Early indicators (combinations of variables) of adult dominance ability were assessed among the variables measured at 6 and 18 months, by a succession of linear discriminant analyses. The discriminant function which best predicted the dominance class either at 6 or 18 months included only variables from the fear eliciting tests. This function allowed accurate prediction of the dominant or subordinate position of a heifer in 94.7 and 92.2% of the cases respectively. The less fearful a heifer was, either at 6 or 18 months, the more dominant she was at 30 months of age.

These results are in accordance with the previously reported importance of emotional reactivity in dominance relationships in cattle.

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Behavioral plasticity of social strategies in the domestic fowl

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It has been suggested that a hierarchical social system in the domestic fowl (*Gallus gallus domesticus*) will only be established when the chances of re-encountering the same birds are relatively high. At large group sizes this probability is small, and it has been proposed that birds in such groups become more tolerant. This work examines the effect of group size on the ontogeny of aggressive behaviour in domestic fowl. Groups of 15, 30, 60 and 120 day old White Leghorn-type chicks (replicated four times) were placed in enclosures measuring 3, 6, 12 and 24 m^2, giving a constant density of 5 birds/m^2. Focal observations of 12 birds/pen were carried out during 5 age periods from 3 to 18 weeks of age. Our results indicate a significant reduction in threats (mixed model repeated measures ANOVA on pen means transformed to square-roots: $F_{3,6}=3.97$; $p<0.05$) and pecks ($F_{3,6}=5.38$; $p<0.05$) given per bird as group size increased. A low coefficient of variation (CV) in the frequency of threats received (log-transformed data: $F_{3,6}=5.75$; $p<0.05$), and a similar trend for pecks received ($F_{3,6}=3.53$; $p=0.06$), indicates that a relatively high proportion of birds received aggression in the large groups. By contrast, a tendency for a high CV in aggression given in large groups suggests that only a few birds in these groups (despots) delivered most of the aggression whereas a majority of birds were non-aggressive (i.e. tolerant). Our results suggest that domestic fowl in large groups have the behavioural plasticity to switch from attempting to establish dominance over every other group member, a strategy that would require many interactions, to an energy-conserving tolerant strategy with low numbers of aggressive acts delivered per bird.

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Development of tests to identify socially aggressive sows

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In order to develop a practical method for identifying sows which show high levels of aggression in a group, three different tests were investigated: an excitement test (EXC), monitoring the reactions of each sow when covered with a blanket for 1 minute and subsequently presented with a novel object for up to 4 minutes; a simulated intruder test (SIT), monitoring the reactions of each sow when a stuffed sow-head was presented to the sow for 4 minutes, simulating attack if the sow moved towards it; and a social test (SOC), during which agonistic encounters during grouping of 7 sows were recorded. SOC was carried out 3 weeks after insemination, and sows subsequently remained in these groups. EXC and SIT were carried out on individually housed sows on the day before SOC. Sows (N=100; parities 2-4) were tested during two consecutive parities (test rounds), and in the second test round were grouped according to their reactions in the EXC test. Data from the tests were compared to 48 hours of observation of agonistic encounters 4 weeks after grouping.

No significant relationships were found between the reaction of sows in SIT and the level of aggression shown 4 weeks after grouping. In the second test round, groups containing more than two sows, and which were assessed as potentially aggressive based on the EXC test, had a 30% higher level of aggression than groups with two or fewer such sows ($F_{1,6}$=30.3; p=0.002). However, the EXC test showed low levels of repeatability (calculated from variance components). The number of aggressive encounters initiated by a sow in the SOC test showed a moderate level of repeatability both between test rounds (0.55) and between groups (0.48). The corresponding values after only 30 min SOC test were 0.50 and 0.31, respectively. Thus, 30 min of observation of aggression at grouping may help to identify potentially aggressive individuals.

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Behavioural indicators of pain associated with lameness in cattle

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Lameness is a debilitating condition in which the affected animal attempts to reduce the weight borne by a particular limb. It is currently ranked as the third most important disease affecting the UK dairy industry estimated on the basis of economic loss to the farmer and welfare of the dairy cow. The annual incidence of lameness in the UK was recently estimated at 56% with a 20% prevalence rate. Foot lesions cause approximately 90% of cattle lameness. Most of these occur on the lateral digit of the hind feet. Pain is a serious component of lameness, which is often masked by the instinctively stoical nature of cattle. This can lead to delayed detection of lameness and can result in treatment without due acknowledgement of the pain experienced by the lame cow. The most common treatment protocol involves restraint of the limb whilst the digital horn is pared and the defect explored, often resulting in the exposure of sensitive corium. Behavioural observations are useful for gaining insight into how an animal copes with its environment and imposed stresses. When the pain experienced by the cow during locomotion is sufficiently great obvious lameness can be detected and treated. However, lame cattle adopt several pain-related behavioural changes to redistribute weight or minimise discomfort in the early stages of the condition, and for the duration of the episode. These changes are often overlooked. Reduced speed, spinal arching, lowered head carriage and rotation of the digits are among the behaviours used by the cow to alleviate the pain of lameness. These have been validated in terms of repeatability, inter-observer consistency and association with the presence of lesions on the feet. Identification of these changes will allow earlier detection of lameness, increased awareness and control of pain and improved welfare of the lame cow.

Association between leg pain and dustbathing behaviour in broiler chickens

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The aim of the investigation was to study the association between leg pain and dustbathing behaviour in broiler chicks. The study included three batches of 48 chicks (Ross 208). Ten of the 144 chicks, however, died during the experiment.

On arrival the chicks from each batch were randomly allocated to 12 different cages measuring 45 x 45 x 45 cm (4 chicks per cage) and colour marked for individual identification. On days 3-15 all chicks were trained daily on sand. On days 15-19, 22-26 and 29-30 dustbathing behaviour was observed for one hour. An hour before observations chicks from alternative cages were subcutaneously injected with methadone (0.2-0.5 mg/Kg) to reduce pain (treatment group) or a similar amount of isotonic salt solution (control group). On days 37-38 dustbathing behaviour was observed without giving any type of treatment. The influence of treatment was analyzed using a linear regression model.

The chicks in the treatment group displayed significantly ($p<0.001$) more vertical wing-shakes (25.9/h) than the control group chicks (16.1/h). In the control group, the frequency of vertical wing-shakes was significantly ($p<0.001$) influenced by walking ability and tibial dyschondroplasia (TD), whereas in the treatment group it was not. Thus, the increase in the frequency of vertical wing-shakes for the treatment group as compared to the control group was 12.5/h (98.4%) for chicks with a gait score greater than 0 (a gait score of 0 indicates normal mobility), and 6.5/h (32.7%) for chicks without impaired walking ability. Similarly, the frequency of vertical wing-shakes was 13.4/h (110.7%) and 6.1/h (30.3%) for chicks with and without TD, respectively. On the day 37-38 observations, the two groups did not differ with respect to the amount of vertical wing-shakes.

The results indicate that impaired walking ability and the presence of TD is associated with pain reducing the tendency to perform dust-bathing behaviour.

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Behaviour of piglets towards challenging situations: the effects of farrowing conditions

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At weaning piglets are confronted with drastic environmental changes. They are housed in a new environment, and are mixed with unfamiliar piglets. Multi-suckling systems offer a complex environment and allow social contact between piglets from different litters. In this study we tested if piglets raised in a multi-suckling system (MU) differed from piglets raised in a single-suckling system (SI) in their responses towards separation in a novel environment (NOV) and social confrontation with unfamiliar piglets (SOC).

Experiments were done with 107 piglets raised in MU (N=55; 9 litters) or in SI (N=52; 7 litters). Animals were tested either in the week before (N=52), the first (N=37), or the second (N=18) week after weaning in both tests. The parameters recorded in NOV were combined using Principal Component Analysis. In both experiments a General Linear Model was used to test the effects of housing conditions and time of tests on the behaviour.

In the NOV the MU piglets showed significantly lower scores for the 1st component, which explained 24.6% of total variance and combined the number of vocalisations and locomotor activity (VOC/WALK; GLM: $F_{1,100}$=18.86; p<0.0001). After weaning these differences were weaker, but still existed. In the SOC, MU piglets had significantly shorter naso-nasal contact to the unfamiliar piglets (GLM: $F_{1,99}$=10.02; p<0.01) and tended to need less time to contact them (GLM: $F_{1,99}$=2.61; p=0.11).

The lower scores for VOC/WALK in the NOV indicate that MU piglets responded to the separation with weaker signs of distress than SI piglets. In addition, MU piglets seemed to assess unfamiliar piglets faster. We assume that the complex social and non-social environment of the multi-suckling system may lead to a better preadaptation of piglets for weaning challenges.

A behavioral comparison of individual and paired New Zealand White rabbits housed in standard laboratory cages

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Despite their gregarious nature, rabbits used in research are often housed individually due to concerns about aggression and disease transmission. The cages in which they are housed are often small, restricting movement. Pairing rabbits in double sized cages represents a potential option to improve welfare by providing increased space and social stimulation. We compared the behavior of female New Zealand White rabbits (*Oryctolagus cuniculus*) housed either individually (N=4) in cages measuring 61 x 76 x 41 cm or in non-littermate pairs (four pairs) in cages measuring 122 x 76 x 41 cm. Each rabbit was observed using focal animal sampling five times per week for five months. Affiliative (allogrooming, cuddling, nuzzling), aggressive (chasing, lunging), abnormal (digging, floor-chewing, bar-biting), and maintenance behaviors (eating, grooming, resting) were recorded. The rabbits were kept under a reversed photoperiod (lights on 2200-1200); observations occurred between 0800-0900, 1200-1300, and 1600-1700. Data were analyzed using a repeated measures GLM. Individually housed rabbits showed an increase over the five months in the amount of total time spent engaged in abnormal behaviors, from 0.032% to 2.3%. While pairs also showed an increase (from 0.1% to 1.62%), the increase was not as great as that of the individually housed rabbits (time x treatment: $F_{1,45}$=7.31; p=0.009). The proportion of total time spent in aggression also increased, from 0.038% to 0.414% ($F_{1,39}$=8.71; p=0.005), which is not surprising since the rabbits were maturing and establishing their adult social relationships. Minor bite wounds and barbering were observed, and two pairs had to be separated due to persistent bite wounds. Thus, although pair housed rabbits developed less abnormal behavior, injurious aggression occurred in some pairs. Both types of behaviors are welfare concerns and more detailed research is needed to determine whether pair-housing can improve the welfare of rabbits. Future research will focus on the behavior of rabbits paired in floor pens.

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Swimming water for farmed mink: essential or not?

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The deprivation of essential behavioural needs is often given as a potential reason that farmed animals show behavioural disorders. One such ethological need of farmed mink that has been suggested to lead to behavioural disorders is swimming. Mason et al. (2001, Nature) showed that mink will work hard for access to water in a consumer-demand test, and that cortisol levels increase after 24 hours of deprivation of water. The aim of the present study was to answer the question as to whether mink miss swimming water even if they had never access to it.

To answer this question, 56 female mink juveniles were raised in the presence (P) or absence (A) of swimming water. All P-subjects were deprived of swimming water from December 2000-April 2001 and housed under the same conditions as A-subjects. Three parameters were measured which are indicators of stress. First, tail-suckling behaviour was monitored from 14 until 50 weeks of age. Second, at 42 weeks of age (February 2001) all subjects were observed for the performance of stereotypies. Third, the sensitivity for reward was measured by a Pavlovian conditioning paradigm (Frijtag et al. 2000, Behavioral Brain Research) at the ages of 16 and 22 weeks, respectively.

P-subjects showed significantly more tail-suckling than A-subjects (Mann-Whitney: $U=248$; $N1=28$; $N2=28$; $p<0.01$) after deprivation in winter. This difference between experimental and control group did not exist before deprivation. On average we found significantly more stereotypical behaviour in P-subjects than in A-subjects (Mann-Whitney: $U=264$; $N1=28$; $N2=28$; $p<0.05$). The data on Pavlovian conditioning, thus far, do not reveal a difference in A- and P-subjects with reference to sensitivity to a rewarding incentive.

These results suggest that the deprivation of a once-experienced waterbath can result into long-term stress effects, but that mink may not miss water when they have never had access to it.

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Effects of transport and mixing at weaning on the behaviour of piglets

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In Danish multi-site production, newly-weaned piglets are transported and litters usually mixed. We investigated the effects of transport and mixing on behaviour patterns reflecting aspects of piglet welfare.

A 2 x 2 factorial experiment was conducted under farm conditions with mixing and transport (30 min) as the two factors. Immediately after weaning at 3½ weeks, piglets were mixed and/or transported, or just weaned, (day 0). On day 49, piglets from all four treatments were mixed with strangers and transported. Behaviour was recorded by direct observation during transport (days 0 and 49), and by 24-hr time-lapse video in the weaning pens (days 0, 7 and 49). Data were analysed by mixed linear models or Kruskal-Wallis test.

On day 0, piglets lay less ($F_{1,38}$=21.8; p=0.0001), sat more ($F_{1,38}$=38.6; p=0.0001) and changed posture more often ($F_{1,38}$=6.18; p=0.017) during transport as compared to those not transported. Mixing had no effect on fighting during the first 30 minutes after weaning, whereas transport reduced fighting in both mixed (Chi-square=8.0; DF=1; p<0.005) and non-mixed (Chi-square=4.7; DF=1; p<0.03) piglets simultaneously compared to piglets not exposed to transport. Treatments had no effect on lying or sitting during transport on day 49.

In the weaning pens, the frequency ($F_{1,20}$=13.9; p=0.001) and duration ($F_{1,20}$=5.53; p=0.03) of fighting bouts were increased in mixed piglets as compared to non-mixed piglets on day 0, whereas there were no effects on days 7 and 49. Treatments did not affect lying, belly-nosing, chain-chewing, or the general level and synchronisation of activity in the weaning pens.

In conclusion, although piglets showed discomfort during transport, we found only transient effects of mixing and transport on the behaviour patterns recorded. A final conclusion about the effects of mixing and transport on the welfare of newly weaned piglets awaits results concerning the physiology and the health of the piglets.

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Factors influencing the lying behavior of dairy cows in cubicle houses

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The aim of the study was to determine the influence of some cubicle characteristics on cow resting behavior on commercial farms. Behavior was recorded by direct observations (7-8 hours after morning milking) on 36 dairy farms. Sixteen behavior variables were related to cubicle size, length from rear curb to neck-rail, floor softness, and type of cubicle dividers. Results will be illustrated using some examples.

Increasing cubicle size (length x width) decreased the percentage of attempts to lie down (Spearman's-Rho-correlation; Rank correlation: r_s=-.666; N=36; p<0.001) resp. attempts to stand up (r_s=-.616; N=36; p<0.001), the number of ‚tripping' before lying down (r_s=-.506; N=36; p<0.05), the percentage of cows raising with forelegs first (r_s=-.657; N=36; p<0.001), raising with head-sideward (r_s=-.657; N=36; p<0.001), knocking against cubicle partitions while standing-up/lying-down (r_s=-.553; N=36; p<0.001), the preparation-time to lie down (r_s=-.513; N=35; p<0.01), the lying-down duration (r_s=-.539; N=36; p<0.01), and increased the maximum number of cows lying simultaneously (r_s=.516; N=36; p<0.01), and the number of cows ruminating while lying (r_s=.456; N=36; p<0.01). Increasing length from rear curb to neck-rail decreased time between entering the cubicle and lying down (r_s=-.534; N=32; p<0.01).

In cubicles without vertical posts, cows lay more frequently with stretched forelegs (Mann-Whitney: U=65; N1=17; N2=17; p<0.01), stretched hindlegs (U=78,5; N1=17; N2=17; p<0.01), or in a fully stretched position (U=31,5; N1=17; N2=17; p<0.001) than in cubicles of Newton Rigg or mushroom type. Furthermore, the overall lying time was longer (U=85; N1=19; N2=16; p<0.05). In cubicles with straw mattresses, more cows laid at the same time than in cubicles with rubber mats with little bedding (U=77; N1=18; N2=18; p<0.01).

It can be concluded that bigger cubicles, a softer floor and more spacious partitions can have a positive influence on cow's resting behavior ('cow comfort').

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Do laboratory mice chew to escape?

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The welfare of laboratory mice is highly influenced by the quality of their home cage. The level of an animals desire to escape from the home cage may prove to be a useful measure of their welfare. Many methods of improving welfare involve preference testing. I aimed to look at the problem from the other perspective i.e. which conditions do mice wish to avoid?

One type of behaviour that might reflect attempts to escape from a captive environment is bar chewing. I have carried out two experiments to investigate whether this is an escape response among laboratory mice. Firstly, 6-7 week old mice were housed in a modified cage for 8 days; the cage contained three sets of bars (85mm x 115mm). Two sets of bars provided a link to the outside, one of which opened daily, while the third was fixed internally. Chewing behaviour was shown almost exclusively at the external bars (Wilcoxon matched sets test: $Z=4.21$; $N=32$; $p<0.001$) and more chewing was directed towards the opening bar ($Z=2.67$; $N=32$; $p<0.01$). In the second experiment, cages contained two external bars that differed in their attachment, allowing discrimination between bars that could open daily, which were loosely hinged and could be rattled by the mouse, and those that did not open, which were fixed firmly. Mice discriminated strongly between the two types of bars, spending more time at the bars that moved whether escape was permitted ($Z=8.46$; $N=32$; $p<0.001$) or not ($Z=4.42$; $N=32$; $p<0.001$). However those animals that could escape showed a stronger preference for the unstable bar (non-parametric 2-way ANOVA: $H=5.27$; $DF=1$; $p<0.025$). This suggests that mice chew at cage bars as an escape response. The measurement of escape behaviour could be used to assess differences in responses to cages of varying quality.

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Breeding carnivores in captivity: factors affecting juvenile mortality

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Juvenile mortality in zoos is a potential welfare problem, and can also reduce the effectiveness of captive conservation programmes. Focusing on the Carnivora, our aim is to determine the causal factors of juvenile mortality in captivity. Data were compiled from the annual breeding records of the ten most recent years published by the International Zoo Yearbooks (1988-1997). Juvenile mortalities were calculated for over 500 zoos, and used to generate median mortality rates for 98 species (12 species being excluded as having 5 records or fewer). These values were found not to correlate with the mortality of young in the wild (Gittleman, unpublished data), showing that the causal factors in captivity often differ from those in the wild (paired t-test: t=3.48; N=16; p=0.003). Furthermore, our data revealed that identifying these factors is important: juvenile mortality rates of endangered species (i.e. as listed by the IUCN) in captivity are higher than those of non-listed species (One-Way ANOVA: $F_{1,96}$=7.62; p=0.007). Some species (e.g. the African hunting dog and polar bear) had consistently high levels of juvenile mortality, while others (e.g. the brown bear and American mink), had consistently low levels, suggesting that species differ in their ability to thrive in captivity. One predictive aspect of species biology was found to be minimum home range size: species with large minimum home range sizes had the highest juvenile mortality when brought into captivity, along with high levels of stereotypy (CAIC regression: $F_{2,16}$=3.71; p<0.05; Rank correlation: r_s=-0.589; N=21; p<0.01) (Clubb and Mason, Proc. 34th Int. Cong. ISAE, p.38, 2000). Other key aspects of species biology will be presented at the meeting. Most species had very variable levels of juvenile mortality, differing greatly between zoos. This suggests that husbandry factors are also important. Also, some zoos had high levels of mortality for all carnivores held, while others had consistently low levels. Reasons for this will be discussed.

Development of a human-animal test for assessment of the relation of group housed calves towards humans

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The human-animal relationship is an important factor when considering animal welfare at the farm level. In this study a human-animal test for assessment of the behavioural response of group-housed calves towards humans was evaluated. Group housed calves (N=148) on six commercial farms were tested at the time that they were fed concentrate in their crib. The behavioural response of the calves to an approaching test person touching the shoulders and the head of the calf successively was scored as either acceptance or avoidance (Score 0: Avoidance of approaching test person; Score 1: Acceptance of presence of test person; Score 2: Acceptance of shoulder touch; Score 3: Acceptance of head touch). Every calf was tested on two consecutive days; the responses of all calves were tested towards both the known stockperson and an unknown test person. Reliability was evaluated based on two observers' registering all the calves' response simultaneously but independently (inter-rater agreement), and the unknown test person testing all the calves on a third day (repeatability).

For calves fed concentrates the test was considered applicable for on farm assessment of the response of group housed calves towards humans. This conclusion is based on the high inter-observer reliability [mean scores 2.36 (observer 1) vs. 2.39 (observer 2); degree of concordance 87.7%; weighted Kappa coefficient 0.82] as well as high repeatability [mean scores 2.48 (test day 1) vs. 2.34 (test day 2); degree of concordance 64.4%; weighted Kappa coefficient 0.31]. Further, there was no influence of age of the calves [mean scores 2.33 (9-12 weeks of age), 2.75 (17-20 weeks of age), 2.46 (21-24 weeks of age), 2.22 (25-28 weeks of age); Chi-square p>0.5] or identity of the test person [mean scores 2.44 (familiar test person) vs. 2.37 (unfamiliar test person); degree of concordance 62.2%; weighted Kappa coefficient 0.36]. A significant effect of farms (Chi square p=0.0002) is interpreted as test sensitiveness.

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The lying behaviour of pigs: a basic study

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An experiment was carried out to study lying postures, space occupation and% space-sharing (as a consequence of huddling behaviour) in pigs. Information about these lying characteristics is necessary in order to assess the space requirements for pigs, e.g. in the event (inter)national authorities pass legislation on minimum space requirements. The study included two replicates of 8 groups (8 pigs). Pigs were housed at thermoneutral conditions in 8 m^2 pens. Two types of flooring were studied: pens with 60% solid sloped floor and 40% slatted floor and pens with 60% solid arched floor and 40% slatted floor. Lights were on from 0630 until 1830. Feed and water were available ad libitum. Behaviour of the pigs was recorded for 48 hours on video at approximately 30, 50, 80 and 100 kg live weight. General activity, lying posture (sternum, half-sternum, lateral recumbent) and% space-sharing were scored by 20 min. scan sampling. The results confirmed that pigs lie down for a great part of the day. On average more than 80% of the pigs lie down. There were no differences between replicates (GLMM: DF=1; waldstatistic=2.78; p=0.095) or floor types (GLMM: DF=1; waldstatistic=0.06; p=0.802). The weight category did affect the lying behavior of the pigs (GLMM: DF=3; waldstatistic=9.18; p=0.027): the percentage of pigs that lie down increased with weight. During the night (18:40 to 06:20), the fully lateral recumbent lying posture was predominant and unaffected by floor type (GLMM: DF=1; waldstatistic=0.47; p=0.493). A significant interaction was found between replicate and weight category (GLMM: DF=3; waldstatistic=12.21; p=0.007). The percentage of space that is shared with other pigs was on average 33.7, 28.1, 28.3 and 31.0 for 30, 50, 80 and 100 kg pigs respectively. Average space occupation for these weight categories when lying was 0.30, 0.46, 0.64, 0.76 m^2 per pig.

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Fractal measures of behavioural complexity in chickens - a potential welfare indicator?

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Stressed animals commonly show alterations in the frequency or duration of particular behaviours. There may also be an alteration in the temporal pattern of behaviour which could provide extra diagnostic information, yet which is rarely measured. Fractal analysis provides a measure of behavioural temporal complexity, which has been shown to alter (decrease) during biologically costly situations such as pregnancy or parasitism (Alados et al, 1996. Animal Behaviour, 51: 437-443). Such alteration in behavioural complexity could potentially be used as a welfare indicator in confined animals and experimental work is currently being undertaken to assess this possibility. This experiment aimed to examine behavioural responses to mild acute stressors in chickens.

Juvenile laying hens were observed undisturbed in their home pen, in a novel arena or following a short period of mechanical restraint and a blood sample. Detrended Fluctuation Analysis (DFA) was chosen as a suitable fractal technique, having been successfully applied to behaviour patterns previously. DFA was used here to assess the pattern of fluctuation between vigilant and nonvigilant behaviours, which occurs reliably and was deemed likely to alter under stress. When compared to home pen behaviour, the fluctuation pattern increased in complexity in the novel arena (t-test: $t=-4.44$; $DF=22$; $p<0.001$) and following restraint ($t=-2.42$; $DF=16$; $p=0.028$). Total time spent vigilant was also increased in the novel arena ($t=3.74$; $DF=22$; $p=0.001$) but not following restraint ($t=0.78$; $DF=16$; $p=0.45$). In conclusion, DFA appears to provide a novel measure of temporal behavioural complexity in chickens. In contrast to studies of more chronic situations in other animals, acute stress causes an increase in behavioural complexity. This increased complexity occurs regardless of whether behavioural duration also changes. When duration does not alter, fractal analysis appears to offer a measure of more subtle changes in behavioural organisation. Funding was provided by the Universities Federation for Animal Welfare.

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A decision support system to assess the welfare status of pregnant sows

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A computer-based decision support system for welfare assessment in pregnant sows was constructed. This system uses a description of a husbandry system as input and produces a welfare score on a scale from 0 to 10 as output. Pregnant sows were chosen as a case in the search for a formalised (i.e. structured, transparent, yet flexible) procedure to 'objectively' assess the overall welfare status of farm animals in relation to the housing and management system based on available (and undisputed) scientific knowledge. The procedure to construct the welfare model and to calculate welfare scores is described. Decision making is based on the needs and distress of the animal and thus from the perspective of the animal.

The welfare model was validated using expert opinion in that there is a substantial agreement between pig welfare scientists and the model about the ranking of housing systems and, to a lesser degree, about the weighting of attributes of housing systems. The most important welfare-relevant attributes concern aspects of social contact, space, and substrate. The housing systems were roughly divided into low-, mid-, and high-welfare systems. Low-welfare systems were conventional housing in individual stalls and tethers, while high-welfare systems in our data set all provided substrate and outdoor access.

For practical applications further development of the decision support system is recommended, as well as ongoing validation, upgrading and extending of the model, e.g. to other species. The results show that integrated welfare assessment based on available scientific knowledge is possible.

Influence of flooring in voluntary cubicles on the behaviour and welfare of group housed sows

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In some loose housing systems cubicles are used for lying and feeding while a slatted area is used for roaming and dunging. Traditionally cubicles were solid floored but slats are extended into the cubicles in newer units. The objective of this study was to assess the influence of flooring in cubicles on sow behaviour and welfare.

One month post-service 32 sows were assigned, in groups of four, to pens with either slatted (S) or solid floored (SF) cubicles (2.0 x 0.6m each) and a slatted loose area (2.9 x 2.44m). During 6hrs of observation on days 2, 8, 28 and 55, sow posture and location was recorded by scan sampling at 5min intervals and aggressive behaviour was recorded by behaviour sampling. Skin damage at 19 locations was scored from 0 to 5 on the same days.

The proportion of observations in which sows were lying did not differ between treatments. However, S sows lay in the voluntary cubicles for a significantly lower proportion of observations than SF sows (Mann-Whitney: U=202.0; N1=16; N2=16; $p<0.02$). Forty-five per cent of the observations of S sows lying in the loose area involved contact with one or more sows. S sows were involved in a significantly higher number of agonistic interactions than SF sows (U=362.5; N1=16; N2=16; $p<0.001$). Accordingly they had significantly higher levels of skin damage on day 28 (U=164.0; N1=16; N2=15; $p<0.01$).

Slatted floors in voluntary cubicles discourage sows from using them for lying. Hence use of the loose area for lying is high which increases the potential for aggression. Where cubicles have solid floors sows choose to lie in them rather than in the slatted loose area even though lying in the loose area facilitates communal lying. Thus sow welfare is improved if solid floors are used in voluntary cubicles.

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Influence of lying behaviour patterns on lameness prevalence in dairy cattle herds

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Lameness causes pain and discomfort to the cow and therefore is regarded as a serious welfare problem in dairy cattle. The importance of lying behaviour for claw health is controversial (Berry et al., 1998, Proc. 10th Int. Symp. on Lameness in Ruminants, Lucerne/Switzerland, 56-57; Galindo & Broom 2000, Res.Vet.Sci. 69, 75-79). It was therefore the aim of this field study to investigate relationships between lying behaviour and lameness prevalence on commercial dairy farms.

Lameness scores were recorded twice during the winter housing period on 28 northwestern German dairy farms (7 deep litter and 21 cubicle systems, mean herd size 49 cows) using a locomotion scoring scheme. Lying behaviour was automatically recorded once for 48h in 8 to 10 healthy focal cows per farm.

Lameness prevalence differed significantly (Kruskal-Wallis: Chi-square=14.08; DF=3; p=0.003) between deep litter (4.0%±1.4; N=7) and cubicle (concrete: 13.0%±1.4; N=5/rubber mats: 15.8%±2.2, N=11/matresses: 12.3%±2.5, N=5; mean±SEM) systems . There were no significant correlations between total lying time, number of lying bouts or mean lying bout length and the percentage of lame cows in the herds. The number of lying phases that were not interrupted for longer than 10min tended to be negatively correlated with lameness prevalence (Rank correlation: r_s=-.36; N=28; p=0.059). However, the proportion of lame cows was significantly correlated with the variation coefficient of total lying time within the herds (Rank correlation: r_s=.42; N=28; p=0.029). Analysis of variance (GLM) revealed no influence of lactational state or parity on lying behaviour of individual cows.

In conclusion, our on-farm data revealed no effect of mean total lying time on lameness. However, the increase in lameness prevalence with increased within-farm variation in total lying time indicates that further research is needed to understand the underlying reasons and improve the on-farm situation with regard to welfare.

Eye white may indicate emotional state on a frustration-contentedness scale in dairy cows

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Research on welfare indicators has focused primarily on indicators of poor welfare, but there is also a need for indicators that can cover the range from good to poor welfare. The aim of this experiment was to identify behaviour elements in dairy cows shown in response to a frustration situation as well as elements shown as a response to pleasant stimuli.

The subjects of the study were 24 randomly selected Norwegian Red dairy cows, 12 in each group. In an 8-minute test, access to food and frustration of feeding were used as positive and negative situations, respectively, to reveal behaviour elements reflecting positive and negative emotions. The cows in the positive stimulus group were fed normally from a square wooden box. When cows in the negative stimulus group were introduced to the stimulus, the box had a Plexiglas top with holes so that the cows could both see and smell the food but were not able to reach it.

All the frustrated cows showed at least one element of behaviour from the categories of aggression, stereotypies, vocalization, and head shaking. These behaviour patterns were never observed among cows given food. The percentage of white of the total visible eye area was calculated by measuring the two orthogonal diameters of both the total visible eye and of the iris using a ruler placed on the monitor when the recorder was stopped and the picture frozen. The two areas (total eye and iris) were calculated using the formula for an ellipse. The percentage of white of the total visible eye area was larger in the food deprived cows compared to the cows that were fed (Wilcoxon: $N=12$; $p<0.001$). This behaviour element may therefore be a dynamic indicator of emotions in dairy cattle on a frustration-contentedness scale.

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A non-invasive method for recording EEG from unrestrained calves

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Very little is known of sleep patterns in farm animals, partly because of the difficulties in obtaining electroencephalographic recordings (EEG) from them. The EEG is usually recorded from restrained animals using subcutaneous needle electrodes or skull implants. Our aim was to develop a non-invasive method for registering EEG from unrestrained calves.

Six weaned calves were housed in pairs in 2.5 x 2.8 m straw-bedded pens. Their mean (SD) age was 97(3) days and weight 89 (13) kg. Before recordings began, the animals were adapted to handling and to the specially constructed harnesses for 3 weeks.

The calf was sedated (xylatzine, 0.06-0.1 mg/kg iv) ca. 24 hours before recording began. Hair was shaved and 10 electrodes were glued on (AquaBond): 4 electrodes on the forehead in a square and 1 in the square's center (EEG), 1 behind the horns (reference), 2 on the lateral side of the eyes (EOG, electro-oculography), and 2 at the distal end of the neck muscles (EMG, electromyography). The electrode leads were attached, fixed and led inside a fabric tube along calf's neck to the recording device. The head and neck were covered with a rubber net.

The 8-channel EEG and 2-channel EMG were recorded using an ambulatory polygraphic EEG recording device (Embla, Flaga) placed in a harness hanging on the calf's back and balanced with a counterweight. Recordings were taken from one calf at a time from 0700-1430 and 1530-0700. The recorded signal was interpreted using the Somnologica program (Flaga). The calf's behavior was observed at the same time, and periods of sleep and wakefulness were identified.

The obtained EEG signal allowed a rough descriptive classification of the animal's state of vigilance. Periods of sleep could be distinguished from awake periods, although REM sleep was difficult to identify. This method thus allows the non-invasive study of sleep of freely-moving animals.

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Minks' demand for resources in the absence of eliciting cues

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In consumer demand experiments, animals are presented with resources and their strength of preference assessed. Results are used to infer the preferences of farm, lab or zoo animals, but if resources in experiments act as incentive cues, they could enhance motivation to interact with them, exaggerating their inferred importance. We investigated the effect of resource cues and secondary cues (from doors leading to resources) on the motivations that mink displayed for four resources (food, bath, social contact, toy). Eight mink were each tested in three treatments: (i) Baseline: resources close to point of payment, and reached via resource-specific doors; (ii) Secondary-Cues Only: resources screened and reached via resource-specific doors; (iii) No-Cues: resources screened and reached via single door - minimising secondary-cues. Costs were imposed by weighting the access doors, and motivation assessed from each mink's consumer surplus (area under the visits: cost demand curve), maximum price paid and total expenditure (c.f. Mason et al. 2001). Data were log-transformed and analysed with General Linear Models. Treatment did not significantly affect maximum prices paid, nor total expenditure. It did affect consumer surplus (GLM: $F_{2,69}$=7.36; p=0.001), which was highest in Baseline (t=2.44; p=0.014) and lowest in No-Cues (t=3.76; p<0.001). Furthermore, for total expenditure, there was a significant resource-treatment interaction ($F_{6,69}$=2.85; p=0.016), mirrored as a trend in consumer surplus ($F_{6,69}$=2.13; p=0.060). Toys were particularly valued in Baseline, when visible to the animal at the payment point (t=3.2; p=0.020 and t=2.46; p=0.016 for expenditure and consumer surplus respectively); while social contact was relatively little valued in Baseline, perhaps because neighbours could already be inspected from the home cage (expenditure: t=2.24; p=0.028). Animals' motivations to interact with resources are altered by the presence of resource and secondary cues. Furthermore, this affects different resources to different extents, indicating that the rank ordering of animals' preferences can be affected by test conditions.

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The relationship between disturbed suckling behaviour and clinical appearance in litters of 2-week old piglets

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Successful suckling is necessary for piglets to thrive. This study compares disturbances in the suckling behaviour to the clinical appearance of the piglets at litter level.

During a 12-month period 337 litters of 2-week old piglets from ten commercial pig herds were observed during one nursing bout. The number of piglets that did not suckle during the milk let-down period, and the number of restless piglets fighting and vocalising during nursing, were recorded. Further, the occurrence of diarrhoea or respiratory symptoms (panting, coughing, sneezing) at litter level as well as the numbers of poorly thriving piglets, lame piglets and piglets with skin lesions were recorded.

The proportion of restless piglets was correlated with the proportion of piglets that did not suckle (rank correlation: r_s=.21; N=337; p<0.0001). Further, the proportion of piglets that did not suckle was correlated with the proportion of lame piglets (partial rank correlation: r_s=.11, p<0.05). The proportion of restless piglets was 13% in litters with respiratory symptoms vs. 9% in litters with no symptoms (Wilcoxon: Z=2.11; N1=56; N2=281; p<0.05), and the proportion of piglets that did not suckle was 5% in affected litters vs. 3% of piglets with no symptoms (Z=3.02, p<0.005). The proportion of very unthrifty piglets was 7% in litters with diarrhoea vs. 3% of piglets with no symptoms (Z=2.27; N1=22; N2=315; p<0.05). The proportion of unthrifty piglets was correlated with the proportion of piglets with skin lesions (partial rank correlation: r_s=.18; N=337; p<0.005) and lameness (r_s=.21; p<0.0001).

Respiratory disease and lameness in litters seemed to disturb suckling behaviour, and clinical disorders generally affected thriftiness of the piglets. However, a disturbance in suckling behaviour observed in one nursing bout apparently did not influence the overall thriftiness of the piglets.

Behavioural and welfare differences of sows and piglets raised under intensive outdoor or confined systems

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Husbandry systems may affect the behaviour and welfare of animals. We compared the behaviour of sows and piglets raised intensively under outdoors or confined systems, aiming at identifying differences in the behaviour of the animals that may indicate differences in their welfare.

The behaviour of sows and their litters (N=8/treatment) was recorded by direct visual observation during 3.5 h in the morning and 3.5 hours in the afternoon, totalling 168 observations per day. Sows were observed on the day before parturition, while sows and their piglets were observed for 1 day after birth, 2 days at 10-12 days and 2 days at 19-21 days after birth. Results were analysed by ANOVA (DF=1).

While pre-parturient outdoor sows spent a larger amount of time on nesting behaviour, exploring and feeding ($p<0.001$), confined sows spent most of their time inactive, standing, sitting or laying ($p<0.001$), and performed a higher frequency of abnormal behaviours ($p<0.01$). Outdoor lactating sows spent more time exploring, walking and feeding ($p=0.002$) than confined sows, which spent more time inactive sitting and laying ($p<0.002$) and drinking ($p<0.001$). Time spent nursing did not differ between treatments.

Outdoor piglets spent more time grazing, eating concentrate and exploring ($p<0.04$) than confined piglets, which spent more time laying, interacting with their mothers, displaying abnormal behaviours and fighting, and on nursing behaviours like udder massage and fighting for teats ($p<0.001$), but not suckling.

In the confined system sows and piglets did not perform a series of activities that were displayed by outdoor animals. This may have led confined animals to redirect their motivation to other behaviours considered abnormal. Outdoor intensive pig production, a growing system in Brazil, proved to be a good alternative to the challenges imposed by confinement on the welfare of sows and piglets.

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Predicting dominance aggression in the domestic dog. Is it possible and are there benefits?

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A proportion of homing attempts of dogs from animal welfare centres fail and many are returned, re-homed or euthanised. These events are distressing for both the dog and owner. It may be possible to prevent this outcome if behaviour problems and difficulties in a new home could be identified prior to homing. Aggressive behaviour is particularly unacceptable in pet dogs.

A previously validated temperament test was performed on 201 dogs at Scottish Society for the Prevention of Cruelty to Animal centres. The S.S.P.C.A. policy is to not home dogs with aggressive tendencies. Test data was manipulated to calculate a 'Potential for Dominance' (PD) score for each dog in attempt to predict future 'dominance' aggression. Dogs with high PD scores (n=51) were included in the study group; half were controls, receiving only the usual verbal advice on homing and the remaining dogs were homed with advice leaflets dealing with dominance. Dogs considered not 'potentially dominant' (n=150), were included to allow comparisons with the study group. A total of 150 dogs were re-homed. Questionnaires were posted out after one month and 66% were completed and returned.

PD scores correlated with mean reported aggression (Spearman Rank Correlation $P<0.001$), although most aggression was inter-dog. High PD scores were gained by mostly male dogs (Mann-Whitney (W), $P=0.0001$), those that were sexually intact, (W, $P=0.036$) and by those that 'mounted' (i.e. showed sexual behaviour) in the home environment (W, $P=0.02$). No effect of providing leaflets was observed although sample size was very small.

Overall, the temperament test had potential for predicting only general aggression within the home environment. However, the fact that aggression was reported by several owners of PD dogs suggests that present methods to detect problems could be improved. Limitations of the test should be acknowledged but benefits of these types of temperament tests have yet to be fully explored.

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