ISAE'99

Proceedings of the 33rd International Congress of the International Society for Applied Ethology

17-21 August 1999

Lillehammer, Norway

NLH
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Edited by
K.E. Bøe, M. Bakken, B.O. Braastad

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The drawing on the cover is made after the painting «Birkebeinere» by K. Bergslien, 1869.

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ISAE'99 Programme

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10:30	**ISAE Council Meeting** in the meeting room "Messanin"
14:00 -22:00	**Registration, Poster installation**
20:00 - 22:00	**Welcome reception** in Lillehammer Art Museum

Wednesday18th August

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

Human-animal interactions in livestock production

Paul H. Hemsworth

Animal Welfare Centre, University of Melbourne and Agriculture Victoria, Victorian Institute of Animal Science, Werribee, Victoria, 3030, Australia.

Research in a number of livestock industries has shown that interactions between stockpeople and their animals can limit the productivity and welfare of these animals. Many of these interactions are routinely and, at times, habitually used by stockpeople. While these interactions may appear harmless to the animals, this research has shown that the frequent use of some of these routine behaviours by stockpeople can result in farm animals becoming highly fearful of humans. It is these high fear levels, through stress, that appear to limit animal productivity and welfare. This research has also shown that one of the antecedents of stockperson behaviour is the attitude of the stockperson towards interacting with his or her farm animals.

Intervention studies in the pig and dairy industries have shown the potential of cognitive-behavioural intervention techniques designed to specifically target those attitudes and behaviours of stockpeople that have a direct effect on animal fear and productivity. Selecting stockpeople on the basis of their attitudes and behaviour may also offer the livestock industries considerable opportunities to improve animal productivity and welfare. While these intervention studies in the livestock industries and handling studies on dairy cattle, pigs and poultry implicate stress in the effects of human-animal interactions on the productivity of commercial animals, other mechanisms may also operate in the livestock industries. For example, in the pig industry correlations exist between stockperson attitudes towards handling and some influential job-related characteristics of the stockperson, such as job satisfaction and work motivation. Thus human-animal interactions may affect the stockperson to the extent that some key job-related characteristics are affected, with implication for the work performance of the stockperson and, in turn, the productivity and welfare of the animals.

Research on human-animal interactions in the livestock industries has generally focused on the most obvious stockperson behaviours such as tactile interactions. There has been little attention paid to the more subtle interactions such as visual and auditory interactions. More extensive research is required to identify the full range of stockperson interactions that have implication for both farm animals and stockpeople. Furthermore, research is required to identify the rewarding elements of human-animal interactions for animals and how these can be utilised to alleviate some of the aversive interactions that are at times necessary in livestock production.

Training and selection procedures for stockpeople that target stockperson attitude and behaviour offer a considerable opportunity to improve animal productivity and welfare. This is the new direction for industries in which stockpeople regularly interact with livestock. Much has been done to improve genetics, nutrition, reproduction, health and housing but efforts to target the stockperson, who performs such a key function, have just begun. It is likely that both the livestock industries and the general community will place an increasing emphasis on ensuring the competency of stockpeople to manage our livestock.

Plenary papers

arranged by programme order

Aggression and behavioral plasticity

J.M. Koolhaas, K.Kato, P. Meerlo, A.Sgoifo, S.F. de Boer

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Welfare, health and disease are complex functions of the individual's coping capacity and the actual environmental demands. A wide variety of medical, psychological and animal studies demonstrate that individuals may differ in their coping capacities. Factors that have been shown to affect the individual coping capacity include genotype, ontogeny, adult experience, social support, etc. Researchers have tried for decades to determine the individual vulnerability to stress-related diseases using estimates of the individual coping capacity. One approach concerns attempts to classify coping responses into distinct coping styles. The present paper will focus on aggressive behavior as an important indicator and component of coping style. Studies of feral populations of mice and birds indicate the existence of two phenotypes, i.e. high and low aggressive males, which seem to play a role in the population dynamics of the species. These phenotypes may be less distinct or even absent in laboratory animals and farm animals due to the absence of natural selection pressure, artificial selection, domestication or inbreeding.

Several experiments indicate that high and low aggressive animals differ strongly in behavioral plasticity. With repeated experience, high aggressive males form a rather ridgid, routine-like behavior whereas low aggressive males seem to remain more flexible. Experimental evidence indicates that this dimension of behavioral plasticity may be important in the development of pathology. In a series of experiments we considered the possibility that the reduction of behavioral plasticity in a social situation may lead to pathological forms of aggressive behavior. These experiments focused on the behavioral changes induced by repeated experience of winning a social interaction in a resident intruder paradigm. An analysis of the sequential structure of the introductory aggressive behavior of male rats shows that a subcategory of highly aggressive males reduces the number of agonistic behavior elements with increasing winning experience. The sequential structure gradually becomes more simplified and independent of the actions of the opponent. The results show that with increasing winning experience, the social nature of the aggressive interaction disappears. These males develop a pathological and violent form of aggressive behavior. In less aggressive males, the sequential structure of the behavior does not change, and the aggressive interaction remains social in terms of action-reaction pattern between the two participants of the interaction. This experiment demonstrates that repeated positive outcome of social behavior reduces the contribution of feedback signals in the regulation of behavior, in particular in the high aggressive males, i.e. it reduces behavioral plasticity. This reduction of plasticity is confirmed in experiments that considers the question to what extent the capacity to cope with a negative outcome of social behavior, i.e. social defeat, depends on the degree of previous winning experience. It is well documented that a single social defeat induces a cascade of behavioral and physiological changes that may last for days and weeks. These changes are generally interpreted as a state of depression. Previous repeated winning experience seems to enhance the magnitude and duration of this depressive period. This enhancement of the depressive episode seems to be the ultimate consequence of reduced behavioral plasticity.

In summary, animals differ in the degree in which behavior is guided by feedback signals. High aggressive males seem to reduce the contribution of feedback, in particular after repeated positive outcome of behavior. In a stable environment, this seems to be highly

adaptive. However, in its extreme form, this routine formation may be maladaptive, leading to violent forms of aggressive behavior and a reduced capacity to recover from uncontrollable (social) situations. Therefore, applied ethology should focus on a further analysis of factors involved in behavioral plasticity.

How is welfare represented in the brain?

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The concept of animal welfare is traditionally related to the concept of chronic stress. Chronic stress symptoms, such as apathy, increased disease susceptibility, reproductive problems and 'out-of-normal-range' hormonal levels (e.g. cortisol) or organ weights (e.g. adrenals), are indicators of the absence of welfare: they indicate that the individual cannot cope with current (housing) conditions. By implication, therefore, welfare is defined as the absence of such symptoms with the (additional) assumption that animals can cope with current conditions (or that welfare is present) if no chronic stress symptoms are present. Welfare is thus defined negatively, i.e. through the absence of such negative indicators. Strictly speaking, however, only non-welfare is defined. In fact, one cannot logically conclude that non non-welfare is welfare: coping or welfare cannot be concluded from the absence of chronic stress symptoms *unless* chronic stress and coping/welfare are exclusively and strictly defined as one another's antagonists or as opposite ends of a single continuum. In this paper welfare is defined from the animal's perspective as the positive balance between positive (reward) and negative experiences (acute stress) or affective states. Poor welfare is accordingly a net negative balance. The state of this balance system in terms of sensitivity is crucial for the maintenance of the animal's 'economic» behavior: which motivational system must be activated at which point in time in order to get the maximum profit. A efficient cost benefit analysis implies the comparison and evaluation of consequences of behavior belonging to very different systems, for instance the probability of finding food must be compared versus finding water or safety. Such decision making implies that benefits are measured along a similar dimension. In general, hedonic properties of commodities (reward) are associated with high fitness properties thereof (functional level). It is assumed that expected reward is an important factor in determining which behaviour is to be executed. In the brain both endorphines and dopamine play a role in reward systems and are known to be involved in a variety of motivational systems. The plasticity of these neurotransmission systems – eg tolerance and sensitivity – are involved in the animal's behavioural sensitivity to rewarding and aversive stimuli. They may underlie adaptation of the organism in order to optimise its success in avoiding aversive stimulation and satisfying its needs. It is hypothesised here that the state of these systems in terms of its sensitivity represents the state of the animal in terms of need for reward or aversiveness for potential harmful stimuli. In other words they may be closely related to the state of the animal in terms of welfare. The state of reward systems can be measured pharmacologically by assessing the reaction to various rewarding drugs and behaviourally by assessing the reactivity response to rewards. We investigated whether reward systems change after acute and chronic exposure to stressors. As long as the animal has the ability to alter its sensitivity successfully tolerance and sensitivity will change systematically in relation to environmental challenges. In case of exposure to chronic stressors when no coping strategy is adequate in maintaining the balance of reward and aversive stimulation, it appears that an insensitivity to reward develops. This state has many similarity with «depression» like features. The state of these systems can be assessed by challenging them and measuring the intensity of the reaction. To this purpose we applied a Pavlovian conditioning schedule – in rats - to announce a reward and measure the anticipatory response of the animal during the interval between the conditioned and unconditioned

stimulus. We have investigated the anticipatory response to various rewards and demonstrated that characteristics of behaviours prior to the collection of reward are independent from the nature of the reward. Local administration of opioid antagonist into the ventral tegmental area blocked the display of these reward related behaviours. It appears that the mesolimbic dopaminergic projections are involved in the appetitive phase of motivated behaviour and mediate the «intensity « of the animal's need for reward. In other words they are a pivotal part of the neural substrate underlying welfare. These reward systems supervise the various motivational systems and alter their sensitivity in relation to preceding success or stress. This sensitivity can be behaviourally recognised and reflects the consequences of previous experiences. Isolated rats for instance showed an enhanced anticipatory response to an announced reward.

Rats which have been exposed to social defeat followed by isolation developed signs of 'depression» and among others did not anticipate to reward any more. These animals displayed deficits with respect to social memory and long-term potentiation, an electrophysiological model for learning. Treatment with antidepressive drugs (imipramine) restored the reactivity to reward. The therapeutical consequences of announcing and providing rewards on a regular basis on welfare are explored now and will be discussed.

Incentive: the neglected facet of motivation

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General introduction

Research in animal welfare science often involves investigations into the way in which animals interact with their environment. The priorities that animals assign to access to various objects and resources that exist, or may be provided, in their housing systems has been the basis for attempts to provide animals with environments more suited to their requirements. The concept of motivation has been the cornerstone of this type of research. Motivation has been described as the strength of a tendency to engage in behaviour when taking into account internal and external factors. The stimuli for this change in response tendency are external and internal events (Toates, 1986; Colgan 1989). These internal events have often been referred to as drives and the external cues are known as incentives. In animal welfare research, attention has largely been focussed on the importance of internal cues. Tied up with the concept of behavioural needs, it was proposed that if a particular behaviour pattern persisted in the absence of appropriate external cues, then the thwarting of this behaviour would pose a greater welfare problem than thwarting a behaviour that occurred only in response to external cues (Hughes, 1980; Hughes and Duncan, 1981). Although some of the tenets of this approach have been questioned (e.g. Jensen and Toates, 1993), the role of external factors in the control of behavioural expression has not received a great deal of attention. This may be partly because it is assumed that the external stimuli that guide behaviour are species- and situation-specific, and that correspondence between these factors are difficult to uncover. In contrast, internal stimuli that relate to physiological processes seem to have a generality across species. In this review, however, we will argue that general principles regarding external stimuli exist which clarify the effect that external stimuli have on the total motivation of the animal, and which have particular relevance for animals kept in artificial environments. We will concentrate on three areas. Firstly, how the effect of the external stimulus depends on previous experiences with that specific stimulus, and on the innate predispositions to it. Secondly, how the reinforcing effect of each incentive depends on both the expectations of the animal and on the alternatives present. Thirdly, how the reaction to a specific stimulus depends on the perceptual properties of other stimuli experienced.

These different aspects of incentives may help us to understand how different stimuli elicit different behaviours, or using a more cognitive interpretation, animals view and estimate the value of resources.

Incentive value learning

The central feature of this concept is the way in which the motivational state of an animal determines which value it will assign to a particular resource, such as a new food type when encountering it for the first time. Balleine (1992) reports a classical example of this type of learning. A number of rats were deprived of food, half of them were given a new type of food while in this high deprivation state, the other half only received their normal food. The rats were then changed to a low-deprivation state and trained to press a lever to obtain the new food type. There was no difference in acquisition or performance between the two groups. After the training they were changed to a high-deprivation state and then tested in extinction.

The animals that had been pre-exposed to the new food now had nearly twice as many lever presses as the group that had never tried the new food while hungry.

This means that hunger does not evoke or activate the response tendency directly but that the behaviour is evoked by an interaction between the motivational state and the incentive value of the resource. The incentive value is determined by a direct connection between the goal object and the motivational state through direct experience with the reinforcer while in that state. To know how desirable a given food is when you are hungry you have to have eaten it while hungry.

The phenomenon has been demonstrated for a number of different resources, e.g. food (Balleine 1992), water/sugar solution (Lopez et al. 1992) and heat (Hendersen & Graham 1979). For sodium the situation seems to be more complex (e.g. Dickinson 1986).

Very few species have been tested, with most of the studies being done on rats and on humans. There has been two studies on farm animal species. Nancy Coerse (1997) showed that incentive value learning occurs in laying hens. However, an experiment which aimed to determine whether piglets which first contacted creep feed while hungry assigned a higher incentive value to it than those that contacted it while sated showed no clear effect of incentive value learning. In this case, the piglets may have been motivated to obtain milk and not solid food, and not recognised creep food as edible (Lee et al., 1999).

The fact that the value assigned to a particular resource is dependent on the previous experience with that resource has a number of interesting consequences for agriculture and raises a number of interesting questions. How do animals, particularly young animals, learn about the new diets that are presented to them? Young pigs and chickens are routinely given a series of new diets during their growing period that vary in protein and energy levels appropriate to the animal's age. Is it possible to manipulate their feeding motivational state in order to reduce the impact of the change? Are there factors such as the precise features of the context and feed features that, by an association with the old diet, would enhance the transition to the new feed type? Do animals have to learn the value, not only of food, but of resources such as water, nest boxes and dust-bathing areas for hens, nest-sites for pigs?

Contrast effect

Intuitively, it would seem logical that the value of a particular resource is dependent on its physical characteristics, e.g., a sweet diet is assigned a higher value than a non-sweet diet, and a large meal is given a higher value than a small meal. However, as long ago as 1942, Crespi published a paper in which he challenged this view. In a number of experiments he had let rats run in a runway for a medium sized reward, when they were shifted to a larger reward they ran faster than animals that had only run for the large reward (positive contrast). When they were shifted to a smaller reward they ran slower than animals that had only run for a small reward (negative contrast). The running time was thus not a function of the reward size, but of the relative reward size. These types of behavioural contrast effects have become known as successive positive and negative contrast effects respectively.

There is a corresponding phenomenon known as the simultaneous contrast effect. In the most classical study by Bower (1961), rats were trained to associate one colour of an alley, e.g. black with a large reward, and another colour e.g. white with a small reward. The running times of these animals were then compared with those of animals trained with only one size of reward for both colours. In this experiment Bower found evidence for a negative contrast, i.e. the animals that had received both a large and a small reward ran slower than animals that had

received only small rewards. There was no positive contrast in this study, but other studies have shown it to occur within this experimental paradigm as well (see Flaherty 1996). As stated earlier, the behavioural contrast seen in this type of set up where the animals are trained alternately on small and large rewards is called simultaneous contrast, even though the animals strictly speaking do not have access to both sizes of resources simultaneously.

It should be noted that these are not short-term effects lasting only for one or two trials, but in some cases last for several weeks, although there is a large variation between studies.

As with the incentive value learning experiments most of the studies have been done on rats (with some additional ones done on pigeons), there has also been three experiments done on laying hens, two on adult birds (Petherick et al. 1990, Coerse 1997) and one on young chicks (Klangemo in prep). Widening the use of species to include e.g. pigs and cows would of course be interesting. An aspect that has so far received very little attention is whether the behavioural contrast effect is limited to when the two resources are of the same type, e.g. two types of food. If what mediates the contrast effect is the reinforcing value itself, independent of the resources associated with them, then this might have consequences for e.g. choice tests.

In many experiments that compare the nutritional value of food types, or of the animal's preference for them, the dietary treatments are given in a serial order, one after another. The measure of preference in these cases is often the amount of the food consumed. It is quite possible that a positive or negative contrast effect between the diets will exaggerate and distort the true preferences of the individuals tested. This situation may well be so in choice tests. While many authors have stressed the fact that these tests only provide an indication of the relative value of the resources presented (e.g. Dawkins, 1980), again, a contrast effect may cause the difference to be exaggerated.

Negative behavioural contrast is also often used as an indication of frustration (Crespi 1942, Flaherty 1996), a topic of large welfare interest.

Generalisation

In most experiments not dealing directly with discrimination animals are thought to perfectly recognise each resource and its value. As is well known, this is not how animals function in "the real world". Each situation is similar in some aspects to other situations experienced previously. What the animal expects from each situation, each stimulus configuration, is partly a function of that similarity. Animals generalise from one situation to the next. What concerns us here is how that generalisation occurs.

In one of the most classical studies of generalisation and peak shift, Hanson (1959) trained pigeons to peck at a key of a given colour (550 nm). When he changed the colour of the key the pigeons decreased their pecking rate, the more he changed the colour the more the pigeons decreased their pecking. This is of course what one would expect, as the stimuli becomes more different from the training stimuli the animal reacts less and less to it. Similar resuslts have also been found for other stimulus dimensions e.g.

When Hanson introduced a penalty for pecking at a colour of a longer wavelength (570 nm) however, not only did the pigeons stop pecking at that colour but they actually shifted their response pattern so that the peak responding rate occured not at the wavelength on which they had been trained but on a shorter wavelength (540 nm). The generalisation gradient around the maximum also grew sharper.

This is not the only instance of when animals react more strongly to a stimulus different from the one they were trained on. It also seems that there is a monotonic increase along the intensity axes (e.g. click rate, light intensity, and volume), similar to the one found for supernormal stimuli (Ghirlanda in prep).

In conclusion it is possible to affect the response pattern of an animal, not only by e.g. changing the contingencies between the stimulus and the reinforcer, but also by changing the reinforcements of other stimuli, not present in the test situation.

Concluding remarks

There are specific similarities between the phenomena, which we have described, in this short review. One of the most noticable is the similarity between the contrast phenomena and the peak shift. In both cases it seems as if the animal is not only reacting directly to the stimulus configuration encountered, but in some way comparing that stimulus configuration with other possibilities, e.g. a smaller/larger reward in the contrast studies and a shorter/longer wavelength and their values in the peak shift studies.

In some cases it is not clear how the different phenomena interact. For example in the case of generalisation and incentive value learning, one might have expected the generalisation gradient of e.g. hunger to be similar to other intensity gradients, thus enabling the animal to generalise from a low to a higher hunger level. This does not seem to be the case, but it is not clear why not.

The phenomena described seem quite robust for the motivational systems and species studied. It should be emphasised however, that most of the studies have only dealt with hunger and/or thirst in rats. It is therefore important that scientists working in applied ethology, with the diversity of species and motivational systems dealt with there, validate the theories in a broader sense.

This review has tried to show that motivation is not simply a drive that elicits a response as a consequence of the need of the animal. The way in which incentives affect motivation is not only determined by the incentives present in the situation but also formed by the expectations of the animal and the previous experience with a range of other stimuli. By incorporating and testing the theories of incentives in applied ethology we believe that both the science of applied ethology and the general knowledge concerning incentives will benefit.

References

Balleine B., (1992). Instrumental performance following a shift in primary motivation depends on incentive learning. J Exp Psychol: Anim Behav Proc 18(3): 236-250.

Bower, G.H., (1961). A contrast effect in differential conditioning. J Exp Psychol 62: 196-199.

Coerse N., (1997). Time spent searching for food and changes in running speed: incentive learning and contrast in the domestic hen. MSc Thesis.

Colgan, P., (1989). Animal Motivation. Chapman and Hall, London, England

Crespi, L.P., (1942). Quantitative variation in incentive and performance in the white rat. Am J Psychol 40: 467-517.

Dawkins, M.S., (1980). Animal Suffering: the science of animal welfare. Chapman and Hall, London.

Dickinson, A., (1986). Re-examination of the role of the instrumental contingency inthe sodium-appetite irrelevant incentive effect. Quart J Exp Psychol 38 B: 161-172.

Flaherty, C.F., (1996). Incentive relativity. Cambridge Univ Press, Cambridge.

Hanson H.M., (1959). Effects of discrimination training on stimulus generalization, J Exp Psychol 58: 321-334,

Henderson, R.W., & Graham, J., (1979). Avoidance of heat by rats: Effect of thermal context on rapidity of extinction. Learn Motiv 10: 351-363.

Hughes, B.O. (1980). The assessment of behavioural needs. In: The laying hen and its environment. Ed: R. Moss. Martinus Nihoff, The Hague.

Hughes, B.O. and Duncan, I.J.H., (1981). Do animals have behavioural needs? Appl Anim Ethol, 7, 381-393.

Jensen, P. and Toates, F.M., (1993). Who needs 'behavioural needs'? Motivational aspects of the needs of animals. Appl Anim Behav Sci, 37, 161-181.

Lee, H.F., Appleby, M.C. and Morgan, C.A., 1999. Effect of hunger and exploration on first consumption of solid food by piglets. Proc Brit Soc Anim Sci, 1999, p. 181. BSAS, Penicuik, Midlothian.

Lopez, M., Balleine, B., Dickinson, A., (1992). Incentive learning and the motivational control of instrumental performance by thirst. Anim Learn Behav, 20(4): 322-326.

Petherick, J.C., Watson G.M., Duncan, I.J.H., (1990). Failure of domestic fowl to show contrast in learning: the implications for welfare. Appl Anim Behav Sci 28: 265-272.

Toates, F., (1986). Motivational systems. Cambridge University Press. Cambridge, England .

Oral presentations

arranged by theme and programme order

Long-term effects of handling the blue fox during the post-weaning period

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The results presented here are extracts of a MSc thesis (Dalsgaard, 1998). The aim of the project was to investigate long-term effects of early handling and access to a whole-year nest-box on behaviour and reproduction in primiparous blue fox (Alopex lagopus) vixens. In addition attempts were made to estimate the welfare of the animals in the experimental situation. The project was carried out in the first reproductive year of the vixens. The overall results seemed to indicate that the early handling was of greater importance for the vixens' welfare than access to a whole-year nest-box and therefore this abstract concentrates about the results concerning early handling.

The subjects of investigation were 87 primiparous vixens who all had been used in a different project as cubs (Bertelsen, 1996). In the previous project all the cubs were weaned when they were 7 weeks old. After weaning half of the cubs were handled in an assumed positive way from 7 to 10 weeks of age 2 min^{-day}, 5 $days^{-week}$. The remaining half of the cubs was only subjected to human contact during the normal farm routines and acted as a control group.

The abstract presented here includes results from heat inspections, reproductive success and weights of vixens at the first insemination/mating. The reproductive success of the vixens was measured by the number of born and weaned cubs per mated vixens and by cub losses from birth until weaning at 8 weeks. Additional results presented include those from 3 stick-tests performed 7, 28 and 45 days after the last insemination/mating. A stick-test is a test where the animal is confronted with the observer and an object. In this project the behaviour of the vixen was observed immediately after inserting the stick in the cage and again after 20 seconds. Handled vixens came into heat earlier ($P < 0.01$) than vixens in the control group (27 vs. 35 days from March 12th). At birth there was no significant difference ($P > 0.05$) in the number of cubs between handled and control vixens (9.55 vs. 7.36), but handled vixens weaned significantly ($P < 0.02$) more cubs than vixens in the control group (7.20 vs. 4.88). With regard to weight at the first insemination/mating no significant differences ($P > 0.05$) were found between handled and control vixens (5739 vs. 5708 gram). The stick-tests revealed reduced fear response in the handled vixens compared to the control vixens in most test situations, though not all significant ($0.02 < P < 0.9$).

In conclusion the results indicate some long-term effects of the early handling on behaviour and reproduction. Handled vixens seemed less fearful towards humans and had an improved reproductive success compared to vixens in the control group. Reduced fear response and an improved reproductive success indicate that handled vixens are better adapted to their environment and therefore experience a better welfare than vixens in the control group.

Bertelsen N., 1996: Effects of early stimulation and access to a whole-year nest-box in blue foxes (Alopex lagopus). MSc in Ethology, Zoological Institute, University of Copenhagen.

Dalsgaard T.M.S., 1998: Long-term effects of handling and access to a whole-year nest-box on behaviour and reproduction in blue fox vixens (Alopex lagopus). MSc in Ethology, Zoological Institute, University of Copenhagen.

Extra contact with the stockperson modifies veal calves' responses to humans, handling and their productivity

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In animal production, the stockperson's behaviour can have major consequences on animals' reactions towards humans, their welfare and productivity. However, few studies have investigated the human impact on veal calves. This human impact could be of great importance, since the stockperson is the major stimulus in the barren environment of veal calves. The objective of our study was to investigate the effects of providing additional contacts to veal calves on their responses to people and handling, their general reactivity and productivity.

Twenty-two Holstein male calves, housed in individual crates from two weeks of age, were used. During the entire study, half of them received minimal contact with the stockperson (*Control*), while for the other half, the stockperson provided extra contacts for 2 minutes a day, stroking the calves after feeding and allowing them to suck his fingers (*Extra Contact*). At 13 weeks of study, reactivity of the calves to a surprise stimulus was observed, by using an opening umbrella, when calves were in their crate. At 15 weeks of study, calves' behaviour when handled and carried from the crate to a novel arena was observed. In this arena, the calves' behaviour was examined during 5-minute tests, on 3 consecutive days : calves were alone on day 1, with the stockperson on day 2, and with an unfamiliar person on day 3. Calves were slaughtered at 21 weeks. Growth rate was analysed and pH and glycolytic potential were measured on the Semimembranosus muscle, whereby the glycolytic potential estimates the muscle glycogen content prior to slaughter.

Calves did not differ in their reaction to the surprise stimulus. The first time they were carried to the arena, Extra Contact calves were less agitated ($P < 0.01$) and tended to defecate less ($P = 0.08$), than Control calves. However, the differences no longer persisted at the second and third test. No significant treatment differences were found in behaviour when calves were left alone in the arena. Compared to Control calves, Extra Contact calves had a shorter latency to interact with the stockperson in the arena, interacted more frequently and for a longer time with him ($P < 0.05$), and defecated less in his presence ($P < 0.05$). Extra Contact calves also interacted more frequently and longer with the unfamiliar person ($P < 0.05$). At slaughter, the Semimembranosus muscle of Extra Contact calves had a higher glycolytic potential ($P < 0.05$), compared to the Control calves, indicating a lower energy expenditure before slaughter in Extra Contact calves. No treatment effects were found on growth and meat pH.

In conclusion, stroking and letting the calves suck the stockperson's fingers seem to be perceived as positive by the calves : it improves the calf-stockperson relationship and reduces fear of unknown people and reactions to handling. This may have a beneficial effect on meat maturation.

Are docility and temperament identical concepts to describe the reactivity of cattle to human?

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The reactivity of cattle to human, often called temperament, can be measured on animals restrained in a crush test (Grandin, 1993, Appl. Anim. Behav. Sci., 36, 1-9). The ease of handling, so called docility, is evaluated by another test situation where the animal is free (Boivin et al, 1992, Appl. Anim. Behav. Sci., 32, 313-323). Both the temperament measured in a crush and the docility are genetically inherited in cattle (Fordyce et al, 1988, J. Exp. Agric., 28, 683-687; Le Neindre et al, 1995, J. Anim. Sci., 73, 2249-2253). However questions arise on the meaning of the two test situations. Is temperament measured in a crush related to docility? Are docility and temperament identical concepts for describing the reactivity to human beings?

To compare the validity of these test situations, genetic correlations have been investigated. Ten Limousine bulls' reactivity to humans have been evaluated by testing their daughters (n=245, i.e. about 25 heifers per sire) in a crush test and the docility test. For the crush test, 3 periods were recognised: first, the animal was isolated from its peers and restrained in the crush for 5 min, second, it was in the presence of an unfamiliar human at a distance of 1 m for 1 min, and third the human stroked it for 1 min. The docility test estimated reactions of the animal during restraint in a corral's corner for 30 consecutive seconds. For the crush test, an agitation score, which was a synthetic criterion including movements of legs, head and tail, was calculated for each period; for the docility test a synthetic score (docility score) was also computed (Le Neindre et al, 1995, J. Anim. Sci., 73, 2249-2253).

The results showed strong genetic correlations (means per sire) between the docility score and the agitation scores of the 2^{nd} and 3^{rd} period in the crush test (respectively $r=-0.95$; $p < 0.001$ and $r=-0.81$; $p < 0.01$). On the other hand, the agitation score of the 1^{st} period in the crush test is not correlated with the docility score ($r=-0.41$; $p=0.24$).
In addition, there was a significant effect of the sire on the docility score ($F_{9,235}=2.11$; $p < 0.05$) and on the agitation scores calculated for each period of the crush test (period 1 : $F_{9,235}=4.86$; $p < 0.001$/ period 2 : $F_{9,235}=1.88$; $p=0.05$ /period 3 : $F_{9,235}=2.55$; $p < 0.01$).

According to these results, the crush test when the human is present and the docility test are related: despite differences in the procedures, these two methods allow evaluation of cattle reactivity to humans. However, since the reactions towards the crush when the human is absent are not related to the reactions in the docility test, reactivity in a crush in absence of a human and docility seem to have different genetic bases and therefore are probably two different concepts.

Dairy cows' use of visual cues to recognize people

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Dairy cattle can recognize individual people and become fearful of people who handle them aversively. We tested whether dairy cows use visual cues to recognize individual people, using tethered, lactating Holstein/Friesian cows. In experiments 1 and 2, each cow was handled by two people, one of whom always handled the cow gently (speaking gently, stroking or giving food) while the other always handled the cow aversively (hitting, shouting). Handling sessions lasted between 1-6 min. We measured the distance each cow kept from each person in a standard 1-min test (minimum distance score=0, maximum=6). In experiment 1, the two people wore different coloured overalls (either red or yellow). After 10 gentle and 10 aversive handling sessions, the cows (n=14) stood further from the aversive handler than from the gentle handler (gentle vs aversive = 3.0 vs 4.8 ± 0.3, P<.01), showing that they recognized the two people. However, the distance the cows kept from the two handlers did not differ when both handlers wore the same colour (green) (2.7 vs 2.8 ± 0.4) or when they exchanged the colour of the overalls (3.1 vs 3.0
± 0.4) (P>.10). In experiment 2, the two handlers wore the same colour overalls. After 11 handling sessions, the distance the cows (n=12) kept did not differ between the two handlers (P>.10), suggesting that it is more difficult for cows to distinguish between people who are wearing the same colour. In experiment 3, the cows (n=12) were handled by only one person, who wore one colour while handling them aversively, and another colour while handling them gently. After 11 handling sessions, the cows stood further from the handler when the handler wore the «aversive» colour than when the handler wore the «gentle» colour (gentle vs aversive = 2.5 vs 3.5 ± 0.2, P<.01). Cows also stood further from an unfamiliar person when this person wore the «aversive» colour (gentle vs aversive = 2.1 vs 2.5 ± 0.15). However, cows stood further from the usual handler than from the unfamiliar person (P<.05), regardless of the colour worn. The results show that cows use visual cues (the colour of the clothing) to recognize people, and that they can use the colour of the clothing alone to predict how they will be handled. When the colour of the clothing is the only cue available, the cows generalize their attraction/ aversion to other people wearing the same colour. However, cows also use other cues to recognize people, when these are available. In this case, the cows may not completely generalize their attraction/ aversion to other people wearing the same colour. Cows may use different cues to predict how they will be handled by people from the cues they use to recognize individual people.

The effect of the social environment and human contact on veal calves' responses to humans

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The behaviour of the stockperson is an important factor in determining animals' responses to humans. Animals treated in a positive way by the stockperson show less avoidance and more approach behaviour to people. However, the social environment of the animal could play an additional role in determining their reactions towards humans. It is hypothesised that the human-animal relationship may be more strongly established in isolated animals compared to animals living with a conspecific. The interactive effects of social environment and the behaviour of the stockperson on veal calves' reactions towards humans, were studied.

Ayrshire male calves were used. Sixteen calves were housed in individual crates, another sixteen calves were housed by pairs in pens. The size of the pens were two times that of the crate. In both housing conditions and for the entire study, half of the calves received minimal contact with the stockperson, while the other half received additional contact with the stockperson. Additional contact included stroking and talking to the calf individually, at the feeding grille, for 60 seconds after the morning milk feeding and 30 seconds after the evening feeding.

The approach behaviour of each calf to an unfamiliar person was assessed for 2 minutes in their home environment at 13 weeks of the study. From one hour before and during the test, a wooden partition was placed in the group pens in order to separate the pairs. Group calves had been used to being separated during 5 days before the test. At 14 weeks the approach behaviour to an unfamiliar person was observed for 5 minutes in a novel arena.

When in their home environment, the individually housed calves tended to have a shorter latency to interact with the person, than group housed calves (9 ± 7 vs. 29 ± 39 sec, $P<0.10$), but did not spent more time interacting with her (86 ± 20 vs. 79 ± 37 sec, $P>0.10$). No significant effect of additional contact was noticed when the calves were tested in their home environment. When observed in the novel arena, calves that received additional contact spent more time interacting (63 ± 38 vs. 31 ± 23 sec, $P<0.01$) and interacted more frequently (14 ± 7 vs. 8 ± 6, $P<0.05$) with the unfamiliar person, than the minimal contact calves. No interactions between additional contact and living with or without conspecific were found.

It is concluded that providing additional contact affects the calves' responses to humans outside their home environment. Although the social environment of the calves tended to influence their responses to an unfamiliar person in their home environment, it does not seem to affect their responses to people when in a new environment. From this finding, it seems that the presence of a conspecific does not affect the human-animal relationship.

Effects of handling and the presence of different persons on the behaviour and heart rate of dairy cows during rectalisation

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Rectalisation (palpation of reproductive tract via rectum) and insemination of cattle are routine management procedures, but could be stressful for the animals, resulting in specific behavioural and physiological reactions. Moreover they may be dangerous for the humans involved because of defence reactions of the animals. The aim of the present experiment was to investigate the possible stress-reducing effect of the presence of a familiar person during rectalisation.

Twenty dairy cows were selected and allocated randomly into two groups. One group (handling group, n=10) was handled positively 5 minutes per day for 10 days distributed over a 3 week period by a person unfamiliar to the cows (handler). The other group (control, n=10) received only routine handling by different caretakers. The week after the handling period, rectalisation /insemination tests were carried out with each animal in four situations: (1) in presence of the handler, (2) in presence of the usual caretaker, (3) in presence of an unknown person and (4) alone. The observation period lasted 9 min, consisting of 1 min prior to, 4 min during and 4 min after rectalisation with shamed insemination. In situation 1 to 3 the person stood beside the cows shoulder during the whole period trying to calm the cows by positive interaction. In addition to behavioural observations, heart rate was recorded and faeces, for cortisol metabolites analysis, were collected. Behavioural responses reflecting restlessness (e.g. tailflicking, flinching, lifting a leg, head shaking) were recorded and grouped together.

In general, handled cows showed lower heart rates during the rectalisation test than the controls (75.6 vs 82.7 beat/min, $p<0.05$) and less kicking when alone ($p<0.05$). Furthermore, there was a significant effect of the situation on heart rate ($p<0.05$) and behaviour. The handling group showed less restless behaviour in presence of the handler than alone or with the unknown person ($p<0,01$), but no difference was found between the handler and the caretaker. In the control group, the frequency of restless behaviour was also lower in the presence of the handler than in all other situations, but effects were less distinct ($p<0,05$). Neither the caretaker nor the unknown person had a calming effect on the animals compared to the situation alone.

In brief, the handler was effective in lowering behavioural stress responses in both the handling and control group, but effects were more distinct in the handling group. Therefore besides familiarity differences between persons in the quality of interaction seem to be relevant. Additional handling had reduced stress responses and enhanced the calming effects of the handler during the test.

To conclude, previous positive handling as well as positive handling during the procedure could reduce stress for the animals during an aversive procedure like rectalisation and insemination.

The effects of play on the dog-human relationship: an experimental study

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It is often claimed that playing certain games can have a significant effect upon the dog-human relationship. Allowing dogs to win uncontrolled tug-of-war games is thought to increase the likelihood that they will attempt to become dominant over their owners and on this basis, controlled tug-of-war is used as part of the therapy to correct behavioural problems. This study experimentally tests this idea.

A preliminary experiment carried out on Labrador Retrievers (N=30) suggested that the playing of some games resulted in changes in the dog-handler relationship. For example, dogs playing Fetch games became more confident. However, no differences were detected between those dogs which won at tug-of-war and those which lost.

The main experiment examined the effects of perpetually winning and losing tug-of-war games upon individual dogs' relationships with a specific person. The subjects were 14 Golden Retrievers, (M=3, F=11, age=0.5-11 years). They belonged to a single breeding group, housed communally in a domestic environment. Each dog's relationship to the experimenter was assessed at the outset via a composite behavioural test which measured their reactions to the experimenter in twelve challenging situations. Each dog then played with the experimenter for two three minute sessions per day. They were divided into two groups; Group A dogs played tug-of-war games and were allowed to win the majority of competitions, Group B dogs lost most competitions. After 20 sessions, the dogs were re-tested and the treatment groups reversed. A further 20 sessions were followed by final testing.

Principal Component Analysis was used to combine the 52 behavioural measures taken during the tests into 9 factors which explained 67% of the total variance. A "Confidence" factor (corresponding to what is conventionally described as dominance) was identified which explained the greatest amount of variance. This was unaffected by whether the dogs won or lost at tug-of-war ($F(2,13)=1.6$, $p<0.2$). Other factors were altered by treatments; dogs were more "Obedient and Attentive" ($F(2,13)= 5.0$, $p<0.02$) towards the experimenter after tug-of-war play, regardless of whether they won or lost, and dogs increased in "Demandingness" ($F(2,13)= 9.6$, $p<0.001$) with increased familiarity to the experimenter. The ten most playful dogs were more "Attention-Seeking and Playful" after winning than after losing tug-of-war ($F(1,9)=5.2$ $p=0.05$).

These results suggest that, in the populations tested, whether a dog wins or loses tug-of-war games with a person does not affect dominance-related aspects of its relationship to that person. The commonly postulated effects may be restricted to a small proportion of "potentially dominant" dogs.

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Childhood experiences and attitudes towards animals:

a study of university students in Japan and the UK

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A considerable number of studies suggest that child-animal interactions are an important factor in the development of attitudes towards pets in adulthood. Attitudes towards pets develop during childhood, and pet ownership during that period seems to have an extremely important influence on favourable adult attitudes towards pets. Previous studies have shown that many other factors, such as gender, age and occupation, can affect human attitudes towards animals. Most were conducted in western countries, and the majority of the subjects were Caucasian. However, it is likely that human perceptions and attitudes towards animals are also influenced by culture and religion. The Japanese now have more than 10 million dogs and 7 million cats, but there have been few systematic studies on their relationships with domestic animals. Our study was designed to make a comparison between young people in Britain and Japan in both experiences of, and relationships with, companion animals in childhood, and current attitudes towards animals.

The questionnaire, comprising 47 fixed-choice, scales and open-ended items, was based on that designed by Paul and Serpell (Animal Welfare, 2, 321-337, 1993). The questionnaire was completed by 60 Japanese students (33 females and 27 males) aged 19 to 22 years (mean =20) old, and 74 British students (45 females and 29 males) aged 19 to 28 years (mean=20) old. The participants' state of pet ownership, as well as contact with other animals and their parent's attitudes towards pets in their childhood, were used as independent variables, while participants' current attitudes towards pets and other animals were used as dependent variables.

There were some differences between Japan and the UK: the British students seemed to have had closer relationships with animals in childhood than did the Japanese. They had significantly more pets ($U=1509.0$, $P<0.01$) and more animal-related experiences such as visiting farms ($Chi^2=26.6$, $P<0.001$), pet shops ($Chi^2=15.3$, $P<0.001$) and animal shelters $Chi^2=40.8$, $P<0.001$). Their current attitudes were also more positive ($U=1621.0$, $P<0.05$), and they showed a greater interest in animal welfare issues than did the Japanese students ($U=1391.0$, $P<0.001$). However, similar trends were found in both countries in the relationship between childhood pet-keeping and current attitudes: participants who either thought that pet keeping was beneficial (Japan: $rs=0.31$, $P<0.05$, UK: $rs=0.42$, $P<0.01$) or had a higher score on the Pet Attitude Scale (Japan: $rs=0.51$, $P<0.01$, UK: $rs=0.42$, $P<0.01$) used to own more pets, and also reported that their mothers had more favourable attitude towards pets. Open-ended responses also suggest that the roles of pets for children are similar in Japan and the UK. In conclusion, adult attitudes to pets or interest in animals seem to be greatly influenced by previous contact with animals and attitudes towards pets developed during childhood, in Japan as well as in the UK.

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The role of phenylethyl amine during positive human-dog interaction

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During the eighties Micheal Liebowitz, a psychiatrist, popularized the role of the neurotransmitter phenylethyl amine during positive human-human interaction. Apart from human love, other intraspecies affiliation behaviour only became a field of study on the neurotransmitter level during the nineties. In social and psychological human studies, dogs are often described as fulfilling a substitute role for other significant persons. The problem is that it is unknown whether the same physiological changes on the neurotransmitter level occur during interspecies affiliation behaviour and whether such changes occur simultaneously in both species.

The method to investigate the problem was to establish positive human-dog interaction in a quiet, neutral room and determine plasma concetrations of phenylethyl amine before and after intervention. The intervention consists of the humans interacting with well-tempered dogs by talking softly and stroking the dogs. The subjects were healthy humans (n=18), older than 18 years (20-55), 8 men and 10 women and healthy dogs (n=18) older than 2 years (3-10), 9 males and 9 females. Subjects were allowed to settle down in the experimental environment for 10 minutes. Blood pressure was recorded continuously with an automatic blood pressure apparatus in both species. Five stable readings were taken as a baseline and a drop of 5-10% blood pressure at five stable readings, were taken as after intervention. At both occasions blood was collected with a vacutube containing enzyme inhibitors. The blood was centrifuged and chilled to 4ºC. Plasma analyses were done on a high performance liquid chromatograph system where the catabolite of phenylethyl amine , phenylacetic acid, was determined.

The desirable decrease in blood pressure was obtained 5-24 minutes after interaction began. Results indicated that phenylethyl amine plasma concentrations changed significantly during positive interaction in both species (humans p=0.00, dogs p=0.00). This supports the social/psychological theory that dogs can act as substitutes for positive human interaction. It also supports the theory that a decrease in blood pressure could be a reliable indicator of neurochemical changes during positive interaction.

For the first time phenylethyl amine was determined as indicator of positive interaction on an interspecies basis. The implications are two-fold: first, although these results were based on healthy person's reactions, it may form the basis for animal-facilitated psychotherapy. The reason is that a measurable physiological change can now be used to evaluate a psychotherapeutic effect; second, if the physiological reaction is mutual, animals used in therapy can experience the same feeling of elation form the amphetamine-like neurotransmitter than humans. The facilitator (dog) experiences thus as much a good feeling as the patient and this is of importance from an animal welfare point of view.

Applied Chrono-Ethology –neurobiological background, methods and implications

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The organisation of life in time and consequently time patterns of behaviour and physiology are essentials, but still often underestimated aspects of the ecological niches of species. For animal maintenance, neglecting time as additional dimension may yield severe problems when specimens have been transported to new environments , e.g. to zoos or for agricultural use. Here the animals are exposed to local daily light cycles and seasonal rhythms which may have no or only slight similarity to their natural habitat. The relevance of light conditions is hardly accepted. For practical reasons only the daily routine of feeding and cleaning the pens determines light exposure. The animals are often in bad physiological conditions, display partly strange behaviour and suffer from sleep disturbances. According to a broad data-base of biomedical research many of these observations can best be explained by a disturbed internal clock system. Therefore, in those cases, chronobiological analyses and related concepts of maintenance offer a unique solution and potential implications in many fields of applied ethology in its widest sense. We will present data on different ungulate species, kiwi birds and reptiles.

Our paper will introduce the chronobiological background derived from intensive neurobiological basic research (on Zeitgeber receptors and coupling pathways in arthropods as model systems, as well as humans and rats) and outline the conceptual models of biological clock systems, including multiple feedback loops. Especially their nature as multi-oscillator systems which need both, internal and external synchronisation, demonstrates the meaning of natural Zeitgeber programs.

Examples of chrono-ethograms of various Zoo-animals (in cooperation with the zoos in Frankfurt, Kronberg, Köln and Antwerpen) and from the semireservat Schorfheide demonstrate on one hand the indicative power of analysing time patterns of behaviour long before irreversible physiological problems could establish. On the other hand, hereby we can emphasise the impressive advance in well-being of the animals by adequate light programs matching their natural habitat.

Biology of timing – an interactive CD including sections on chrono-ethology and chrono-ecology

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Planetary movements and the periodicities of environmental conditions have at all times been the background of the evolution of life on earth. All living beings have developed internal clocks anticipating these external periodicities. At the same time, life used these clocks to organise the time structure of both, body functions and ecological surroundings.

Chronobiology is the relatively new field of research dealing with the analysis of the internal clocks. It has always been an interdisciplinary field and comprised basic and applied science. In order to illucidate its history, general principles, basic models and latest issues concerning neuronal, genetic and molecular mechanisms and, especially, its significance for applications in biomedical research and clinics we have edited an interactive CD-ROM (in English, German and French). Contributions from colleagues, who are experts in different scientific disciplines (neurobiology, genetics, pharmacology, psychiatry, ethology, and mathematics) guarantee for reliable information. The medium allows for fascinating video-and sound-documents, interactive simulations of experimental conditions and first of all, self-selected information networks. Links to the internet will allow for additional information and actual updates of the knowledge presented here.

We included a section on chrono-ethology. Time pattern of behaviour, induced by the internal clock system, is indicative for well-being in animals, slight disturbances of the normal pattern may signal social or social problems before they have caused irreversible damage. This is of special interest when animals are kept in captivity in zoos and reserves. This chapter shows the main issues and methods of the field and several fascinating results. Examples of chrono-ethograms with model organisms give practical hints for data acquisition, data evaluation and supporting software programs. Each animal is introduced by a paragraph on its special biology and natural habitat (with spectacular videos on birth and early childhood).

The chrono-ecology section shows the multiple implications of biological clocks in regulating complex relationships at different levels. The evolutionary advantage of clock-controlled daily, tidal and annual rhythms is its power to synchronise individual and species-specific functions with geophysical and biological periodicities in the environment. They not only influence light exposure, temperature cycles and water consumption, but also the intraspecific (between e.g., sexual partners and family members) and interspecific relationships (between, e.g. predator and prey, host and parasite).

Our paper will demonstrate the chrono-ecology and chrono-ethology section of the CD (with contributions of N. Blaum (Frankfurt), D. Neumann (Köln), K. Scheibe (Berlin) and T. Rumbuchner (Frankfurt)).

At the same time we would like to initiate an international public domain data base with chrono-ethograms, which could be helpful for diagnosis of animal well-being by means of the time pattern of their behaviour.

Quantitative analysis of ultradian, circadian and seasonal time patterns of behavioural rhythms for the evaluation of well-being of animals in captivity and wildlife conditions.

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A chronobiological procedure has been developed for evaluation of living conditions, and behavioural and physiological states of free-ranging animals. It is based on recordings of activity and feeding with subsequent comparison of levels, daily patterns as well as daily and ultradian rhythms. For continuos recording of these behaviours from free ranging animals, a storage telemetry system (ETHOSYS) has been developed. Telemetric observations by means of this system were carried out on alpaca, sheep, Przewalski horse, roe deer, red deer and mouflon under various conditions. The time patterns of the different species were analysed macroscopically and by autocorrelation function and power spectral analysis. The different species-specific ultradian rhythms and their annual variation correlate to the nutritional strategy of each species. Especially for ruminants in stress-free conditions we found a stable ultradian structure of behaviour which was synchronized with the 24-h component of the spectrum. A more unstable adaptive time pattern was found in Przewalski horses. These animals show at least a tendency towards a stable rhythmic pattern. Activity as a multiple motivation behaviour was generally more variable than feeding which in most cases was of clear rhythmic and harmonic structure. Degrees of Functional Couplings (DFC) were used for quantitative comparison of rhythmic structures in activity and feeding. DFCs express the percentage of the circadian component and harmonic ultradian components in relation to all rhythmic components of a spectrum. Accordingly, they can be regarded as a measure of internal and external synchronization. They were found to be high in well adapted, healthy and undisturbed individuals but were lowered during periods of adaptation in all species and situations.
Przewalski horses showed mean DFCs (activity) of 85,5% during a two year period of adaptation, later values up to 90,3% were recorded. During the hunting period in the surroundings, these values dropped to 0%. The same effect occurred as reaction on a new shooting yard nearby. In alpacas we found DFCs (activity) of 88% during undisturbed situations. After an accident resulting in a small wound, the DFC dropped to 27,6%. In sheep, high parasite load led to lowered levels of activity and feeding. During the premortal period the harmonic components of feeding rhythms were lowered. They changed from 49,6% to 8,8 - 11,3% as early as 28 days before death. In a group of female red deer we observed a high level of social interactions. The alpha individual had a DFC of 88.1%, a subdominant individual a DFC of 61,2% and the omega individual a DFC of 55,9%.

We offer the biorhythmic approach to compare and evaluate the quality of living conditions of animals quantitatively. The approach can be applied to identify stress, disturbance and endangering situations. It can especially be used in free ranging animals but can also be applied to other conditions of animal maintenance.

The behavioural responses of laying hens to atmospheric ammonia.

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Ammonia gas is one of the most abundant aerial pollutants of modern poultry buildings with mean ammonia concentrations in broiler and layer houses of between 5 and 30 parts per million (ppm). The Ministry of Agriculture, Fisheries and Food in the UK (MAFF) recommends a chronic exposure limit for ammonia in poultry buildings of 25 ppm. This value is set on the basis of human safety rather than animal welfare and does not account for the birds' continuous exposure to ammonia. High ammonia concentrations reduce the health and performance of poultry. However, no evidence has previously been available to suggest whether poultry find ammonia aversive.

The objective of this study was to assess the behavioural responses of laying hens to various concentrations of atmospheric ammonia commonly found in poultry buildings. Six groups of six ISA brown medium hybrid laying hens (*Gallus gallus domesticus)* were given the choice of three ammonia concentrations (nominally 0, 25, 45 ppm) in a preference chamber over a period of six days. The location and behaviour of the hens were recorded by scan-sampling every 15 minutes via overhead video cameras.

The hens foraged (ANOVA, $F_{(2,22)}=4.85$, $p=0.018$), preened (ANOVA, $F_{(2,22)}=5.81$, $p=0.009$) and rested (ANOVA, $F_{(2,22)}=5.14$, $p=0.029$) significantly more in fresh air than in the ammonia-polluted environments. These behaviours were the most abundant and made up 69.2% of the total time budget, which in turn was significantly affected by ammonia. A significant difference was found between the time spent in 0 and 25 ppm (t-test, $p<0.05$, $df=22$) but not between 25 and 45 ppm (t-test, $p>0.05$, $df=22$). This suggests a threshold for ammonia aversion at or below 25 ppm.

This finding, in conjunction with the previous reports of detrimental effects on health and performance, suggest a need to re-evaluate the current exposure limits for ammonia in order to improve the welfare of laying hens in the future.

Utilizing artificial cover to improve use of pen center by domestic fowl

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In the wild, animals have access to cover, which can be utilized for resting or predator and conspecific avoidances. Cover is minimal in commercial poultry housing and suitable areas for resting and retreat for domestic fowl are limited. Typically raised in floor pens, chickens have a tendency to stay near pen walls. As a result, space utilization within an enclosure is not uniform and the central area is greatly underutilized. Overcrowding occurs around the perimeter which may adversely affect the health of the birds. The objective of the study was to find ways to improve use of the center. It was hypothesized that the provision of artificial cover in the center would increase the number of quality resting places and thus result in a more uniform distribution of birds within the pen.

Two thousand one hundred thirty 1-day old chickens were reared. The experiment consisted of 2 vertical cover treatments and 3 group sizes with 3 replications of each. All treatments were randomly assigned to 21 pens (8.93m2). The 2 cover designs were cover frame with mesh wall and cover frame without mesh wall. The cover frames (0.61m h x 0.61m w) were constructed from PVC piping. Two of the same cover treatment panels were positioned in the center of each pen. Control pens had no cover. Group sizes of 80 and 110 each were assigned to both cover treatments and the control. In order to test the effects of density, a third group size of 140 was included. However, due to limited pen availability it was assigned only to the cover panel with mesh treatment. Utilizing a grid coordinate system set up in each pen, observations on the use of space were taken of each pen 12 times per week from 4 to 44 days of age. The total number of birds using the central area of each pen (2.23 m2, 25% of the total pen) was recorded.

Results reveal that the number of birds located in the center of each pen was significantly affected by the presence of cover (ANOVAR, $p<0.0001$). For group size of 80, the mean (±SE) number of birds was 19.6±0.6 (25% of the total number of birds) for cover with mesh, 15.9±0.6 (20%) for cover without mesh, and 5.8±0.3 (7%) for no cover. For group size of 110, the mean number of birds was 23.5±0.6 (21%), 19.8±0.7 (18%), and 6.1±0.3 (6%) respectively. Group size of 140 resulted in a mean of 30.3±0.8 (22%) birds using the cover with mesh treatment. These results suggest that when birds are provided with cover the distribution of domestic fowl within the space will be more uniform throughout the entire pen. Further results will be discussed.

Effects of environmental enrichment on behaviour and physiology of growing pigs

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Although it is known that environmental enrichment improves pig welfare by limiting abnormal social behaviour and improving social skills, little is known about the effects of environmental enrichment on the physiology of pigs. Therefore, two experiments were performed using 48 pigs each, and the behavioural and physiological responses of enriched and intensively reared pigs were studied. Half of the pigs (6 groups of 4 pigs in each experiment) was reared under standard intensive conditions (0.7 m^2 per pig, no substrate), and the other half of the pigs (6 groups of 4 pigs in each experiment) was reared in larger pens (1.1 m^2 per pig) with strawbedding from birth until slaughter age.

It was shown that enriched reared pigs indeed spent less time on manipulative social behaviour (biting, nosing of littermates) in the home pen than intensively reared pigs at 21 weeks of age ($p<0.05$). Moreover, enriched reared pigs had a lower baseline body temperature ($p<0.05$) and a higher baseline salivary cortisol level ($p<0.05$) during the light period than intensively reared pigs.

In the second experiment we studied if the differences in baseline salivary cortisol concentrations were due to a different shape of the circadian rhythm in salivary cortisol. We showed that intensively reared pigs had a blunted circadian rhythm in salivary cortisol as compared to enriched reared pigs at 22 weeks of age. Intensively reared pigs had a lower salivary cortisol concentration than enriched reared pigs during the light period ($p<0.05$ between 6.00 and 18.00 h), but not during the dark period. Additional measurements showed that the difference in circadian rhythm in salivary cortisol between enriched and intensively reared pigs is age-dependent and becomes visible after 15 weeks of age. Blunted circadian rhythms in cortisol are often observed in situations of chronic stress or depression, and may therefore be an endocrine sign of decreased animal welfare.

Behavioural and physiological responses were also measured in response to preslaughter handling, mixing and transport to the slaughterhouse. Intensively reared pigs had a higher cortisol response to mixing at transport and being in lairage ($p<0.05$), showed more restlessness behaviour (walking, standing ($p<0.05$)) during transport and spent more time fighting in lairage ($p<0.05$) than enriched reared pigs.

The results of the experiments showed that rearing pigs under intensive conditions has negative consequences for pig welfare. Indications of decreased animal welfare like a blunted circadian cortisol rhythm, increased occurrence of abnormal behaviour, and a stronger behavioural and physiological response to preslaughter handling and transport were observed in intensively reared pigs as compared to enriched reared pigs.

Audience effect on the expression of frustration in the domestic laying hen.

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When thwarted or frustrated in a behaviour, laying hens often show increased stereotypic pacing and displacement preening and they give a specific vocalisation, the gakel-call. But it is not known how the occurrence of these behaviours is influenced by the presence of an audience (another bird or a human audience). This experiment investigated the effect of an audience on the expression of the gakel-call and other behaviours indicating frustration. The importance of the frustration condition of the audience bird on the expression of gakel-calls in the test bird, and vice versa, was also studied.

Twenty-four Lohman Brown Warrens were trained to feed in a test cage. Sixteen hens were used as test birds, the others as audience birds. The food-deprived test hens were tested for 15 min in a non-frustration situation (the bird was hungry and the food was available) and in a frustration situation (the bird was hungry but the food was covered by plexiglas). For both situations we had four different treatments; the test bird was alone, the test bird had the company of either a non-frustrated audience bird, a frustrated audience bird or a human audience. All birds were subjected to all treatments in a balanced way, one treatment per day. Between treatments all birds were trained for 15 min in the test cage with food available to prevent a carry-over effect between treatments. Besides vocalisations, behaviours indicating frustration, like stereotyped pacing, escape movements and displacement preening, were also recorded. When not tested, birds were kept in groups with free access to food.

During frustration the test birds gave significantly ($P<0.001$) more gakel-calls (19.3 ± 2.2 calls per 15 min; mean ± SEM) compared to the non-frustration treatments (5.0 ± 1.0). Also the durations of stereotyped pacing, escape behaviour and displacement preening were significantly higher during frustration (all, $P<0.001$). This supports previous evidence that the gakel-call is an expression of frustration. The frustrated test birds gave significantly ($P=0.02$) more gakel-calls when there was an audience present (Audience: 13.0 ± 1.5, No audience: 9.7 ± 2.3). Frustrated test birds also spent significantly ($P=0.04$) more time pacing when faced with a feeding audience bird (53.3 ± 14.0 sec) compared to when tested with a non-feeding, frustrated audience bird (28.4 ± 8.6 sec). In this situation pacing particularly took place in front of the plexiglas that separated the test cage from the audience cage, probably because the frustrated test bird tried to reach the other feeder from which the audience bird was feeding. Audience birds gave significantly ($P=0.02$) more gakel-calls when frustrated and faced with a frustrated test bird (27.8 ± 4.9) than when tested with a non-frustrated test bird (15.1 ± 3.3).

In conclusion, frustration of feeding behaviour clearly leads to an increase in the number of gakel-calls and other behaviours indicative of frustration. The presence of an audience (either a conspecific or a human) elicits more gakel-calls and increases the amount of stereotyped pacing. The frustration condition of the audience to a certain extent seems to influence the gakel-call and behaviour of a frustrated bird.

Rank order and aggression in repeatedly regrouped male and female pigs.

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In order to characterise aggressive behaviour in male and female pigs as an individual trait, a study was made of the consistency of the individual's aggressive behaviour and rank in different group contexts. In four successive replicates, 100 pigs of known lineage (half entire males, half females) were at an average live weight of 24 kg. randomly allocated to 10 pens of 10 pigs each. Further random reallocation took place at 4-week intervals (average weight 41, 67 and 94 kg. In each of the four 4-week-periods (P1 to P4) following regrouping, the pigs were observed in weeks 2 to 4 during standardised feed competition. Recordings included the frequency and intensity of individually initiated and received aggression. Based on the direction of aggression a rank order was compiled within each pen. Data were analysed by Mixed Model and correlation analysis in SAS. The frequency of aggression declined from P1 to P4 (P = 0.0008), due chiefly to a reduction in male aggression, although males were throughout more frequently aggressive than females (P = 0.0001), and also attained on average higher rank. Females, however, showed aggression of higher intensity than males (P = 0.005), with the highest intensity in P3 and P4. Amongst males high ranking pigs were most intensely aggressive, whereas in females, low ranking pigs were most intensely aggressive. Consistency in individual behaviour between periods was statistically significant, but not very strong. The correlation for aggression frequency increased from r = 0.24 between P1 and P2 to r = 0.47 between P3 and P4 in males, whereas the corresponding values for females were r = 0.39 and r = 0.49. The correlation for the pigs' rank decreased from r = 0.38 between P1 and P2 to r = 0.30 between P3 and P4 in females, but increased from r = 0.29 to r = 0.42 in males. Only females had consistency in the amount of aggression received (from n.s. between P1 and P2 to r = 0.31 between P3 and P4). The consistency between periods in aggression intensity was low, the highest correlation being 0,23 in males from P2 to P3. The correlations between rank and aggression intensity as well as between aggression frequency and aggression intensity were significant only in P1 and P2. In females the connection was even negative in P3 and P4. Rank and aggression received were more strongly correlated in males (from r = -0.62 in P1 decreasing to -0.45 in P4) than in females (ranging between r = -0.45 and -0.34), despite the females' being recipients of more aggression than males. In neither sex was the rank attained, or the amount of aggression initiated in a given period associated with the aggression received in the preceding period. The higher consistency as well as stronger connections between rank and aggressive behaviour in males point to higher stability and stronger role of status than in females. Females may be more adaptable to the current situation, as shown by less consistency and have to assert their position by an increase in aggression intensity.

Sexual motivation in relation to social rank in pair housed sows

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Social stress caused by e.g. high level of competition for food or space in group living animals may result in depression of reproductive success and in some species only the dominant animals will reproduce. The public interest in swine welfare has led to an increased number of group housing systems for sows. In such systems the individual competitive success of each sow within a group may have great influence on reproduction. However, knowledge upon impacts of social stress on reproductive success in swine are scarce.

We investigated the influence of social subordination on sexual motivation during oestrus in sows. Twenty four sows were housed in pairs (12 pairs) from 3 days after weaning in pens measuring 12 sqm. The individuals in each group were alike with respect to body weight. Another twelve sows were individually housed as controls in pens measuring 6 sqm. Video recordings were made of aggressive interactions during 48 hours after grouping. From these recordings the rank of each sow was determined. From day 4 detection of standing oestrus was performed in a back pressure test four times daily while a test for sexual proceptive behaviour was performed twice daily. The latter test was performed in a t-shaped area consisting of a long arm (2 m x 5 m) covered with straw, terminating in a goal area (2 m x 2,5 m) with concrete floor. On each side of the goal area was a separate stimulus compartment- one stimulus compartment being empty, the other housing a mature boar. The test duration was 10 min. Latency to and duration of time spent within the goal area close to the boar were observed. Additional, a test for sexual receptivity was carried out on the first day of standing oestrus. This test was performed by introducing the sow to a mature boar in his home pen. Sexual behaviour as well as fear related behaviour of both sow and boar were observed from introduction of the sows until mating was terminated.

The test concerning proceptive behaviour during oestrus showed that subordinate sows spent a significantly lower percentage of test time standing close to the boar (32 %) compared to the dominant sows (67 %) ($P<0.01$). Furthermore, the percentage of test time spent presenting in front of the boar was also significantly shorter for subordinate sows (15%) compared to dominant sows (42 %) ($P<0.01$). During mating a higher percentage of the subordinate sows (40 %) fled when mounted by the boar compared to dominant sows (0 %) ($p<0.05$) and a higher percentage of subordinate sows (58 %) vocalised in response to boar mounting compared to dominant sows (15 %) ($p<0.05$). These results indicate that social subordination has significant effects on sexual motivation in sows. Subordinate sows showed fear related behaviour in response to boar stimulation even though the sows were in standing oestrus. Thus, both heat detection and mating may be impaired in subordinate sows compared to dominant sows in group housed sows.

Early access to perches enhances spatial awareness in the domestic hen

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Early access to perches has been reported to decrease the incidence of floor eggs and cloacal cannibalism in loose housed layers (Appleby et al., 1988. Br. Poult. Sci., 29:351-357; Gunnarsson et al., 1999. Br. Poult. Sci., 40:12-18) A possible reason for this effect is that birds reared with perches acquire a better use of 3-dimensional space and so find raised nest boxes and escape cannibalistic attacks more easily than birds reared without perches. However, this has not been demonstrated experimentally. The aim of this experiment was to study the effect of early access to perches on spatial awareness, by testing whether birds reared with perches found food presented on different levels more quickly than birds that had later access to perches.

Thirty, day-old Hisex brown chicks were reared in litter pens (4 hens/m^2). The birds were split into two equal groups; one with access to perches (P+) and one without (P-). At 8 weeks of age all chicks were given access to perches and at 10 weeks all birds were mixed into one group. Additional perch training was performed until all birds were roosting at night-time. At 16 weeks, 10 birds from each treatment were individually tested in a separate pen where food was presented on a wire mesh tier 40 cm above the ground (T40). In a subsequent test, the food was presented at 80 cm above the ground but with the tier at 40 cm still present (T40/80). At 19 weeks of age, the lower tier was removed and the testing repeated with the food on the tier at 80 cm (T80), then with the food on a 160 cm high tier with the tier at 80 cm still present (T80/160). Before each test the birds were food deprived for 15h. The time from when a bird entered the pen until it reached the food was recorded and the maximum session length was 600 s. The results were analysed using Wilcoxon generalised tests for truncated data.

In situation T40, time to reach the food did not differ between birds from P+ and P-. All birds, except three, jumped immediately up to the tier. But, when the demand increased, the P+ birds were significantly faster reaching the tiers; (T40/80 - Wilcoxon χ^2=4.41; d.f.=1; $p<0.05$: T80 - Wilcoxon χ^2=6.93; d.f.=1; $p<0.01$ and T80/160 - Wilcoxon χ^2=8.03; d.f.=1; $p<0.01$). In the last task, only one of the P- birds reached the food compared to 7 of the P+ birds.

The P- birds did not lack the physical capability to fulfil the spatial task as the same physical skill was required for jumping up to 40 cm as was required for jumping from 40cm up to 80cm. Furthermore, all birds roosted on raised perches and there was no significant difference in average body weight between P+ and P- birds. Therefore, we concluded that rearing with early access to perches enhances spatial awareness in the domestic hen.

Feeding stall design and food type for group housed dry sows - effect on aggression and access to food

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The effect of feeding stall design (body, shoulder or no stalls) and type of food (wet vs. dry) on aggression and access to food was investigated in a 3 x 2 factorial experiment. Six groups of six pregnant sows fed 2.5 kg of concentrates daily, were subjected to all the six treatments, and the order of treatments were rotated systematically. In the last two days of each treatment period, the behaviour of the sows was video-recorded for 60 minutes from the start of feeding. The number of bites, total offensive agonistic behaviours (bite towards head/shoulder and body, bite towards vulva, push, threat, head knock), frequency of changing position at the trough (displacements and voluntary changes of position) and the access to trough were recorded. In the analysis, the observation period was divided into feeding (0-15) and post feeding (45-60 minutes).

During feeding, increasing length of stalls resulted in a significant reduction in the number of bites, total offensive agonistic behaviours, displacements and an increased access to the trough. Both during feeding and post feeding, the number of bites and total offensive, agonistic behaviours were lower on wet than on dry feeding, but there were no significant differences in the number of displacements or the access to trough. There was a significant interaction between type of stalls and type of food. The number of bites and total offensive, agonistic behaviours were lower on wet than on dry feeding in the shoulder and no stall treatment, but not in the body stall treatment. On wet feeding, there was no significant difference between body and shoulder stalls concerning the number of bites during feeding, nor was there any significant difference between stall treatments concerning the access to trough.

There was a significant relationship between social rank order and the number of bites received, displacements and the access to trough. Stall treatment did not affect the number of bites or displacements for the top ranked sows, but for the rest of the sows the number of these behaviours increased with decreasing length of stalls.

Impact of individual and pair-housing following social defeat on behaviour and physiology of growing gilts

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Aggression and fighting upon regrouping and mixing with unfamiliar conspecifics constitutes an important welfare problem in modern pig husbandry. The behavioural and physiological effects of loosing a fight were studied in the following way. Initially, pair-housed gilts (intruders) were defeated during a 15 min social confrontation with an aggressive noncongener (resident) in the home pen of the latter. After that, the social environment was manipulated by returning defeated gilts to their home pen in which they were either reunited with a familiar conspecific (always a barrow; pair-housing) or were housed alone (removal of the barrow; individual housing).

Physiological and immunological data revealed that gilts recovered faster from a social defeat when they were pair-housed. Social defeat induced a significant ($p<0.01$) acute increase in hypothalamic-pituitary-adrenocortical (HPA) activity, demonstrated by high plasma ACTH and cortisol (in plasma and saliva) responses (peak values at t = +5 min). ACTH did not differ from baseline concentrations from 30 min after defeat. However, while in pair-housed gilts cortisol concentrations in plasma and saliva did not differ from baseline levels from 30 min after defeat, the concentrations were still elevated at 60 min after defeat in singly housed gilts. In undefeated controls, concentrations of ACTH and cortisol were unchanged, except for a moderate increase (at t = +5 min.; $p<0.05$; return to baseline at t = +15 min) of salivary cortisol following individual housing. Immunological data revealed a significant decrease in % blood lymphocytes ($p<0.01$) and a significant increase in % blood granulocytes ($p<0.01$) one hour after defeat. Although leucocyte subset values were found not to differ anymore from baseline levels at one day after defeat in pair-housed gilts, shifts in subsets were still present in individually housed gilts, at one and three days after defeat (tendencies: $p<0.1$). No shifts in leucocyte subsets were observed at any timepoint in undefeated controls. Behaviourally, defeated individually housed gilts showed less habituation in a repeated novel environment test. Compared to a test prior to the treatments, latency times to leave a startbox were much and to the same extent reduced ($p<0.05$) in all animals at two days after defeat, but locomotions were reduced (significant decrease in defeated pair-housed gilts, $p<0.05$) in all but singly housed defeated gilts. The latter animals remained highly mobile. Their salivary cortisol response was at a similar level as in the first test, while in the gilts of the other treatments cortisol responses were significantly lower ($p<0.05$; tendency in individually housed controls: $p<0.1$).

Although other parameters have still to be evaluated, the described findings show that the presence of a familiar companion per se (irrespective of dominance relationships) enables a defeated pig to recover faster from the detrimental effects of social defeat. Thus, processes of social support seem to occur in pigs which emphasizes the importance of the social environment in coping with stress factors.

Short-term social memory in the laboratory rat: its susceptibility to disturbance

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The disruption of cognitive function by stressful elements from housing and husbandry systems could have potentially serious implications for the welfare of captive wild animals and domesticates. Recent work on pigs has demonstrated that elements of common husbandry procedures can have a disruptive effect on the retention of a spatial learning task (Mendl et al. 1997). If social memory is disrupted by husbandry procedures during the removal and subsequent reintroduction of individuals from previously stable social groups, then this may underlie the observed increase in aggression, and decline in welfare due to injury, when previously familiar animals are reintroduced.

In this study we used the social recognition test to determine the effect of potentially disturbing environmental stimuli on short-term social memory in laboratory rats. This test is based upon a comparison of behaviour, particularly investigation, between two exposures of the same individual to a subject animal, separated by an inter-exposure interval (IEI). A decrease in investigation in the 2nd exposure implies recognition of the individual. No decrease suggests that the subject's social memory of that individual has decayed over the IEI, and is the response seen when a novel individual is introduced.

The environmental stimuli used to investigate the effect of retroactive interference on social memory were selected to represent elements of standard husbandry and experimental techniques, and included: handling; the introduction of a novel conspecific; introduction to a novel environment; and introduction to a small novel environment. These were presented for a 5-min period, midway through the 15-min IEI. A significant drop in the investigation of the same juvenile between the two exposures for both the control treatment (1st exposure mean (SE=66.4 (7.7, 2nd exposure=41.3 (8.6, $t_9=2.98$, $P<0.05$) and introduction to a novel environment (1st exposure=77.8 (6.8, 2nd exposure=46.4 (5.3, $t_9=4.19$, $P<0.001$), indicated that recognition had successfully occurred, and that removal to a novel environment had not disrupted social memory. But there were no differences in the amount of investigation between the two exposures for the handling, small novel environment, and novel conspecific treatments (t-tests, $P>0.05$). This suggests that recognition of the reintroduced juvenile had failed to occur, and that these treatments had disrupted short-term social memory.

A final experiment demonstrated that the significant decrease in investigation observed when the adults were introduced into a novel environment was due to successful recognition of the juvenile, rather than because of the possibly suppressive effect of the treatment on behaviour, or general habituation to the test procedure. This was demonstrated by there being no significant difference between the amount of investigation expressed in the two exposures if a novel juvenile was introduced for the second exposure (t-test, $P>0.05$). The results of this study suggest that even routine husbandry procedures may be able to disrupt short-term social memory, and thus affect the welfare of captive social animals.

Changes of stress parameters in saliva of pigs during transportation

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Saliva collection is non-invasive and much more convenient to collect than blood or urine. Other advantages are easy handling of saliva samples and the possibility of frequent sampling without fixation or surgical preparation of the animals. In order to get accurate information about the animal's stress response more than one parameter has to be measured to validate the quality of stress. Aim of this study was to assess a «stress profile» of parameters in saliva to verify reliability and usefulness of saliva sampling. Five parameters were measured in short intervals to account for the fast and episodic nature of release of these stress hormones.

Ten German landrace pigs were used in this experiment. Seven animals were castrated males and three were females. They were five months old (ca. 80kg BW) and familiar with saliva sampling using cotton buds. Changes of stress indicators in saliva responding to two hours of transportation were assessed for five parameters: Cortisol concentration was analysed by RIA. Adrenaline, noradrenaline, dopamine and serotonin were measured by HPLC. The first saliva sample was collected at 07.45h, 15 min later pigs were loaded and transported for 105 min. Saliva was collected at 15 minutes intervals during and 15 min after transportation. Finally saliva was collected one and two hours after the end of the transport. Serotonin was examined only before and 15 min after transportation. For statistical analysis (SPSS 8.0.0) means and standard errors were calculated. Time differences of parameters were analysed by dependent t-test and correlations by the method of PEARSON.

There was a significant increase in cortisol concentrations during transportation 15 min after loading up to 15 min after unloading. Maximum cortisol levels (18.9±3.9nmol/l) were observed 60 minutes after loading. 1 h after transportation values were nearby basal cortisol concentrations (4.8±0.5nmol/l). Adrenaline value was highest 105 min after loading (383.9±108.6ng/lvs.243.0±45.9ng/l). Noradrenaline concentrations were significantly elevated 15, 60 and 75 min after loading and 15 min after unloading. Highest values occurred after 90 min (348.2±136.6ng/mlvs.51.0 ±13.2ng/ml). Percentage increase of noradrenaline levels were much higher during transportation (330.2% - 683.1%) than of adrenaline levels (120.9% - 181.2%). Dopamine concentrations started to increase significantly 15 min after loading (418.6±107.9ng/ml vs. 172.6±51.2ng/ml), reached basal values between 75 and 105 min after loading and increased once more significantly 15 min (1201.7±248.5ng/ml) and 2 h after unloading. Serotonin concentrations showed a highly significant increased level 15 min after transportation (12.6±2.2ng/mlvs.6.1±0.9ng/ml). Significant correlations occurred during transportation between the parameter cortisol, adrenaline, noradrenaline, and dopamine. In conclusion this study offers a new perspective in assessing and qualifying stress in animals. Validation of salivary cortisol has been described in literature for several species, but other parameters in saliva are quite unknown until yet. Taking this study as a pilot project it shows the tendency of some reliable parameters in saliva. Especially noradrenaline known as a plasma indicator of physical stress shows significance's even with such a small number of animals. More experiments about basal dates and validation with plasma are recommended.

Influence of pregnancy on fear reactions in ewes

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Fear reactions may vary according to the hormonal status of the reproduction cycle. For instance, high levels of progesterone, especially during pregnancy, have been associated with a decrease in fearfulness (and/or anxiety) in rodents and humans.

The effects of pregnancy on fear reactions of ewes were studied by comparing cyclic (**CYCL**; N = 22) and pregnant (N = 61) Ile-de-France ewes. Pregnant ewes were divided into three groups, each tested for fear at one of the following stages of pregnancy: 40th day (**D40**; N = 20), 80th day (**D80**; N = 22) and 140th day of pregnancy (**D140**; N = 19), this last group being thus tested a few days before expected parturition. These ewes were individually subjected to three fear-eliciting situations: isolation from conspecifics (**I**), a surprise effect (**S**) and the presence of a human (**H**). Thirty behavioural items were recorded, including animal's position, locomotor activity, eating behaviour, vocalisations, eliminative behaviour and interactions with the stimulus. To have a more synthetic view, a fear mark (ranging from -3.0 to +3.0) was calculated for each animal in the three situations, according to the method developed by Vandenheede et al. (1998) using a Principal Component Analysis: the higher the mark, the more fearful the animal.

Pregnant ewes (D40 + D80 + D140; N= 61) were significantly less fearful than cyclic ones in the **I** and **S** tests, as shown by their respective fear marks: **I**: -0.97 vs. -0.34 ($P<0.01$); **S**: -1.24 vs.-0.57 ($P<0.01$). However, no significant difference was found in the **H** test. When assessing fear reactions according to the stage of pregnancy, fear marks of either D40, or D80 or D140 ewes were consistently lower than fear marks of CYCL (except for the comparison between CYCL and D80 in the **H** test). The effects of pregnancy on fear reactions were particularly significant in the **I** test when D80 or D140 were compared to CYCL (fear marks: respectively -1.16 and -1.08 vs. -0.34 ($P<0.05$)), and in the **S** test when D140 were compared to cyclic ewes (fear marks: -1.10 vs -0.57 respectively; $p<0.05$).

In conclusion, pregnancy, at least in the latter stages, reduces fear reactions in sheep when confronted to isolation from conspecifics or a surprise effect. Changes in fearfulness during pregnancy may have evolved as an adaptative mechanism to ensure survival of the lamb.

VANDENHEEDE M., BOUISSOU M.F. & PICARD M. (1998) Interpretation of behavioural reactions of sheep towards fear-eliciting situations. *Appl. Anim. Behav. Sci.* **58**, 293-310.

Fear respones in piglets - an evaluation of methods

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In domestic species, fear reactions are involved in the adaptation to their environment and management. The range of potentially frightening events to which pigs are exposed includes changes in the physical environment, transport from a familiar and into a new environment, exposure to and handling by humans, isolation from litter mates, and mixing with unfamiliar pigs. A common element in all these situations is novelty, which could be considered as one of the most potent conditions leading to a negative emotional response in animals. Fear responses of piglets during handling have been studied to a great extent, but there is a considerable lack of methods for measuring fearfulness in other novel situations. The aim of this work was thus to evaluate different experimental methods of testing fear responses in piglets both by using a physiological and behavioural approach.

Diazepam (valium) is recognised as one of the most powerful benzodiazepines in reducing anxiety, and has been used in a number of operant experiments on pigs. In experiment 1, twelve piglets were subjected to three experimental tests, an elevated plus-maze, a light/dark and an open field test at the age of 6-8 weeks. Half of them were pre-treated with diazepam and the other half with saline (control). In experiment 2, 84 piglets (LY) from 9 different litters were subjected to the following experimental tests: a tonic immobility test at the age of 2.5 weeks and an elevated plus-maze, an open field test and a light/dark test at the age of 6-9 weeks.

Treatment with diazepam in experiment 1 increased the activity on the elevated plus-maze , i. e. the number of entries into the open arms ($P = 0.04$), the % of time spent on the open arms ($P = 0.07$) and the total number of arm entries ($P = 0.05$) compared to the control group. These parameters could thus be related to fear. There was no effect of diazepam on any of the other parameters in the light/dark or the open field test. The results from experiment 2 showed a significant, positive correlation between the number of entries into the open arms and the % of time in the lit section of the light/dark box ($R = 0.3$, $P = 0.01$) and the number of lines crossed in the open field ($R = 0.3$, $P < 0.01$). The number of entries into the closed arms was also positively correlated to the number of lines crossed in the open field ($R = 0.3$, $P < 0.01$). A long duration of tonic immobility was associated with a low activity in the elevated plus-maze, i.e. the number of entries into the open arms ($R = -0.3$, $P = 0.01$), the time spent on the open arms ($R = -0.3$, $P < 0.01$), the number of entries into the closed arms ($R = -0.3$, $P < 0.01$) and the total number of arm entries ($R = -0.3$, $P < 0.01$). From the PCA-analysis, two factors were retained for interpretation. Variables related to fear had the highest loading on factor 1, whereas variables related to activity showed the highest loading on factor 2. It was difficult to differentiate between the activity and the fear element in a single test, but when comparing the results from both experiments, the elevated plus-maze came out as the most promising method of measuring anxiety in piglets.

Effects of selection on social defensive-behavior in mice

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To test the generality of Benus' (1988) theory that mice are genetically predisposed to use predominantly passive or active behavior in challenging situations, the defensive behavior of two mouse strains was compared. The H-strain was selected for large litter size, and has reached a plateau of 21.5±3.5 pups (mean litter size at birth ±SD). The randomly bred C-strain has an average litter size of 9.6±2.2 pups and was kept in the same laboratory as the H-strain over 101 generations. A resident-intruder test was used to measure the fear-related behavior which the mice expressed in response to attack by a larger aggressive resident in a novel cage at 11 weeks of age. The animals were tested in the elevated plus-maze and light/dark test at 9 and 10 weeks of age, respectively, prior to testing in the resident-intruder test.

In the resident-intruder test, the C-strain had the highest frequency (C-strain 24.4±1.46, H-strain 11.7±1.93; $t=5.27$, $p\leq0.001$) and per cent of time (C-strain 5.5±1.09, H-strain 2.0±0.50; $t=2.92$, $p\leq0.01$) in flight. The per cent of time in immobility was also greatest for the C-strain (C-strain 43.9±4.82, 29.2±4.86; $t=2.15$, $p\leq0.05$) but there was no significant difference between the strains in the frequency of immobility (C-strain 32.8±1.33, H-strain 34.8±1.45; $t=1.02$, n.s.), indicating that the H-strain exhibits immobility, but that this system of behavioral inhibition does not effectively inhibit behavior in the H-strain. The H-strain had the highest frequency of exploration (C-strain 15.6±2.30, H-strain 28.0±1.95; $t=4.09$, $p\leq0.001$) and a tendency to spend a larger per cent of time in exploratory activity (C-strain 23.2±5.28, H-strain 37.2±4.89, $t=1.95$, $p\leq0.06$). There was no difference between the strains in the frequency of fights (C-strain 27.2±2.57, H-strain 25.6±2.53; $t=0.44$, n.s.) or the per cent of time spent fighting (C-strain 3.8±0.79, H-strain 4.4±0.87; $t=0.45$, n.s.). Five animals in the H-strain 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; $p=0.041$). There were negative correlations between the frequency of immobility and frequency and percent of time in flight 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).

The results show that selection has reduced 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 theory of alternative predominant behavioral strategies in mice should therefore not be generalized to include all animal strains where artificial selection has taken place.

Objective measurements of fear in dairy cattle

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Differences in behavioural and physiological responses of cattle to both the open-field test and the novel object test are often considered to reflect individual differences in fearfulness. A problem with interpreting these measures is, however, that similar responses may be due to different motivations. Immobility, for example, may be the result of high levels of fear ('freezing') on the one hand but may also be expressed by docile animals, waiting quietly for their return to the home environment. To determine which measures objectively indicate fear, we pharmacologically validated both tests in dairy cattle using classical benzodiazepines.

Holstein Friesian heifer calves (age: 8-9 mo.; body weight 200-300 kg) were treated with the benzodiazepine derivative *Mederantil*® (0.2 mg Brotizolam/ml propylene glycol). The doses used were 0.0125 (n=8), 0.05 (n=8), 0.2 (n=8) and 0.8 (n=8) mg/100 kg liveweight. Twelve control animals received propylene glycol only. In 4 batches of 11 animals, calves were group-housed and habituated to both handling and being loosely tied in a cubicle for 30 min during the week before testing. Each second week, calves were tested individually. Fifteen min after a calf was blood sampled and Brotizolam or vehicle was injected (iv), she was led into a starting box and after 1 min (t=0) she was introduced into a novel arena (6 x 6 m, brightly lit, pressure-washed concrete floor, solid walls). At t=5 min, a plastic container was lowered from the ceiling and introduced in the middle of the arena, about 1.0 m above the floor. During the first 5 min (open field test) and the 10 min thereafter (novel object test) heart rate (Polar Sporttester®) and behaviour (video) were continuously recorded. Two blood samples were collected at the end of the test (t=15) and 10 min after the calf had returned to her home environment (t=25). Cortisol in plasma has been analysed using a fluoroimmunoassay. Movement (distance, time) and location (near startbox, centre, rest) of the animals was analysed from tape by colour tracking and motion analysis (Ethovision®).

In the novel object test, calves receiving the highest dose covered a larger distance in the whole arena as well as in the centre near the object ($P<0.05$). Compared with control calves they made contact with the novel object earlier and more often ($P < 0.05$) and had lower heart rates ($P < 0.05$) during both the first minute and the total 10 min after introduction of the novel object. In addition, plasma cortisol concentrations from t=15 to t=25 changed in a dose-dependent way. In the two highest dose groups cortisol concentrations already decreased whereas they further increased in control animals. In the novel environment test, however, no differences in distance walked, walking time and time spent in the centre of the arena, nor in heart rate (mean, maximum and deviation) between treatment groups were found. Preliminary results of this study indicate that: 1) in a novel object test, the contact latency, the number of contacts with the novel object, locomotion (distance, time) in the arena as well as in its centre near the novel object, heart rate and the rapidity of cortisol concentrations returning to baseline can be considered as objective measures of fear in dairy cattle; 2) in a novel environment test, however, locomotion (distance, time) and heart rate of dairy cattle can not unequivocally be interpreted as measures of fear.

Effects of serotonergic drugs on approach behaviour

in farm mink

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Controlled selection of breeding farm mink (*Mustela vison*) since 1988 based on their behaviour towards humans has created two genetic lines of mink with either a confident or fearful reaction towards humans compared with a control group.

In this study, mink from these two lines were administered either 1) a serotonin agonist, Buspirone, or 2) a selective serotonin reuptake inhibitor, Citalopram. The objective was to investigate the degree to which the behaviour-based selection has created differences in serotonergic controlled behaviours, indicating that the central serotonergic system of the animals may have been changed.

The experiment took place in 1998 using confident (CONF) and fearful (FEAR) female mink born in May 1996. Doses were: 0 (saline), 0.08, 0.31, 1.25, and 5 mg/kg mink per day for 21 days. Each group receiving drugs consisted of 6 animals from each of the two breeding lines (CONF/FEAR), and as a common saline group was used for the two drugs, the total number of mink was 108. In order to ensure continuos dosage and to minimise behaviour changes induced by surplus handling, the drugs were dissolved in physiological saline and administered by osmotic minipumps placed subcutaneously in the neck. Treatment and genetic line of animals were unknown to the experimenter until data collection was complete.

One-day scannings of activity and behaviour were performed a week before, during (day 18-21), and a week after the period of administration. Reactions towards humans (in stick test and Trapezov' hand test) and towards an object in the home cage were also scored for each individual. Live weight changes and feed consumption (food and water were freely available) were calculated over the entire period.

Differences existed between animals from line CONF and FEAR in test variables reflecting approach behaviour towards human and novel object ($p<0.05$). Compared to the saline group, both drugs reduced the time until first contact with a novel object. On average, this reduction were 60–80% for mink given Buspirone and 44–65% for mink given Citalopram at 5 mg/kg/day. Buspirone did significantly affect the number of animals showing approach/contact behaviour in the stick test ($p = 0.009$). In contrast to this, no significant overall effect of Citalopram were found ($p = 0.44$), even though a tendency to reduced avoidance was seen in FEAR females ($p = 0.07$). Based on the final statistical model (GLM), the effective dose (ED_{50}) to give a 50% increment of approach/contact was estimated to 0.9 for confident (line CONF) and 6.8 mg Buspirone/kg/day for fearful (line FEAR) mink, the last value extends the dose range used in this study. These ED_{50} values are based on a small number of animals and a simple test, and may therefore not be a good estimate. However, in conclusion the results indicates that differences may exist between these genetic lines in their sensitivity towards an anxiolytic drug manipulating the central serotonergic system.

How to test sows' motivation to nurse their piglets?

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This study validates an already existing test for nursing motivation in sows (Herskin et al., 1999). The general idea of the test is to measure sows' motivation to nurse in relation to motivation to feed, by letting sows choose between a small amount of feed versus nursing their piglets, after a successful nursing followed by a 70 minutes separation period. Latency until a nursing posture is assumed is measured (max. 10 minutes). However, it has not been documented whether the test is likely to reflect the motivation to nurse. Furthermore the effect of piglet behaviour and hunger level on the test result has not previously been investigated.

Fifty-two Landrace-Yorkshire sows were used for this experiment. Hunger (2 levels) and separation time since last nursing (70, 100 and 130 minutes) were studied in a 2x3 factorial design. At the end of the separation period the piglets and 1 dl of feed were presented simultaneously. A tape recording of nursing sows was played back in an attempt to standardise the stimulation of neighbouring sows. The behaviour of the piglets was sampled by interval sampling every 15 seconds and scored as either 1) 75% or more piglets being active towards the sow, 2) 75% or more piglets lying or 3) other activity. The test was performed at 1430 hours on either day 5, 6 or 7 postpartum.

When analysing the difference between the 6 treatments by survival analysis, it was found that less hungry sows were significantly faster to assume nursing posture after 130 contra 70 minutes since last nursing (202 s. vs. 443 s., χ^2=6.13, p=0.01). The same time dependency was not found in hungry sows. After the 130 minute interval less hungry sows were significantly faster to assume nursing posture compared to hungry sows (202 s. vs. 538 s., χ^2= 5.87, p=0.02). In both cases the activity of the piglets had significantly effect on the latency (χ^2=6.17, p=0.01).

The behaviour of the piglets was analysed separately for both hunger levels, did not differ with time since last nursing when the sows were hungry. In the less hungry sows the activity directed towards the sow was significantly increased with increased time since the last nursing (χ^2=6.58, n=26, p=0.04), whereas «other activity» was significantly decreasing (χ^2=8.12, n=26, p=0.02).

The relationship between separation time and latency to adapt nursing posture in less hungry sows suggest that the test reflects the sows' motivation to nurse. However, piglet activity affects the latency of the sow to assume nursing posture during the test. The piglet behaviour is affected by time since last nursing in the less hungry sows, suggesting a well functioning communication between sow and piglets compared to the hungry sows.

The results emphasise the necessity of registration the behaviour of the piglets and the importance of optimising and standardising the hunger level of the sows when performing the test. From a welfare point of view the results supports self-administering of feed by the sows, to prevent periods of weakened nursing motivation because of hunger.

Behaviour of the cow and calf at calving and its relationship to the calf's weight or death until weaning*

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Beef calf death and low weight may result from absence of, delayed or insufficient ingestion of colostrum. New-born weakness, poor maternal behaviour and cows presenting big udder/teats often delay the colostrum intake and, by these should have an effect on calf mortality rate. In order to study the relationships among these characteristics we observed 239 mother-young pairs at calving in four breeds (Nelore=129, Guzera=54, Gyr=27 and Caracu=29. They were observed from birth to first suckling or during 6 hours after birth, at pasture in a research farm. The percentage of time spent by cows licking and sniffing their calves (time taking care); the calves' latencies to stand up (representing calf weakness) and to suckle; cow's teat size (classified as small, medium and big); and calves' weight at 4 months old and at weaning and, mortality from birth to weaning were recorded. 3.7% of Nelore calves, 32.14% Guzera, 18.52% Gyr and 24.13% Caracu failed to suckle naturally; in these cases the first suckling occurred from 18 to 24 hours after birth, after help by herdsmen. The latency to first suckling was positively correlated with the latency to stand up [r_{Nelore}=0.61 (p=0.0001), r_{Guzera}=0.51 (p=0.0007), r_{Gyr}=0.53 (p=0.0078) and r_{Caracu}=0.34 (p=0.0929)] and, negatively correlated with the time spent by cows taking care [r_{Nelore}= -0.44 (p=0.0001), r_{Guzera}= -0.46 (p=0.0027), r_{Gyr}= -0.40 (p=0.0536) and r_{Caracu}= -0.65 (p=0.0005)]. Big teats occurred in all breeds (13.95, 51.55, 31.0 and 53.0% for Nelore, Guzera, Gyr and Caracu, respectively), but its statistical effects on the latency to first suckling occurred only for Guzera (Anova, F =4.197, p<0.05), probably due to differences in the breed's sample size and also because Nelore and Caracu calves were more active in teat seeking. From all the dead calves 0% of Nelore, 50% of Guzera and Gyr, and 100% of Caracu failed to suckle naturally. There were no significant correlation between the calves' weights (at 4 months old and at weaning) and the measured cow-calf behaviour. As expected, the cow-calf's behaviour at calving was related to calf death rate during the research period, but not to calf weight gain.

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Development of the behaviour of water-buffalo calves

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In a classic work, the water-buffalo (Tulloch, 1979) is described as a "laying-out", placentophagic species. The laying-out species typically nurse at relatively long intervals (4 - 8 h). In contrast, Tulloch found that the buffalo calf suckles very frequently (1 event/hour). In a preliminary study on the maternal behaviour of water-buffaloes we found a suckling bout every 7 hours. Therefore, an observational study was conducted with the purpose to examine the early behaviour of water-buffalo calves. Eight cow and calf pairs were randomly chosen from a 30 cow herd raised on a 10 ha pasture in the south of Brazil. The calves were observed at three ages: 0, 2, and 5 months. At each stage the animals were directly observed for 48 hours. Scans were made at 12 minute intervals, and the following behaviours were recorded: grazing, ruminating standing or ruminating lying, resting and others. It was also recorded whether the calves were alone, in groups of their own or mixed with the herd. Suckling bouts were recorded from the beginning to the end of the event. The suckling position of the calf and the identity of the cow were also registered. Data were analysed in SAS analysis of variance and the Tukey test ($P<0.01$) was applied to compare means. The time calves spent grazing, ruminating standing and ruminating lying increased with age ($P<0.0002$), whereas resting time decreased ($P<0.0001$). Suckling time averaged 7.1 min per bout and did not change with the age of the calves ($P>0.49$), but frequency did ($P<0,003$). Calves at their first month of life suckled more frequently (3.4 bouts/24 h) than at 2 or 5 months of age (1.6 bouts/24 h). Water-buffalo calves typically nursed from the back (82% of occurrence, $P<0.0001$) of the cows, putting their heads between the dam's hind legs. Calves were more likely to be in a group of their own at earlier ages than at 5 months ($P<0.0001$). At older ages they spent more time with the rest of the herd ($P<0.0001$). The overall activity of the calves increased with age. Grazing and ruminating time increased significantly, and the frequency of suckling decreased. The behaviour of the calves observed in this study is typical of the "laying-out" species: few bouts of suckling over 24 h, increased activity with age and periods of long separation from the mother at earlier ages.

How do sows distinguish own from alien piglets?

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Based on olfactory cues, sows can discriminate their own one-day old piglets from alien ones. We investigated whether sow distinguishes own piglets based on individual «personal» odours or based on some odour common to all piglets in her litter.

We used twenty sows individually housed in farrowing pens. Parturitions were induced in two sows on the same day. From each litter four piglets were selected after birth. For the next 24 hours, two of them (Own Nonsniffed) stayed with the litter, but were prevented to go near mother's snout. Two other piglets (Alien Sniffed) were suckled by their mother, but between nursings, they were transferred into the pen of the second sow, where she could sniff them through a wire mesh partition. At the end of manipulation period each sow was subjected to a 5-minute test in which she was given a choice between four anaesthetized piglets: Own Unmanipulated , Own Nonsniffed, Alien Sniffed and Alien Unmanipulated. We recorded the frequency and length of sniffing and the grunting rate of sow with respect to each of the manipulated piglets.

There was no difference between the frequency of grunting which the sow emitted when paying attention to the four types of piglets ($F_{(3,37)}$=1.14, p=0.346). We found a significant effect of piglet type on the duration of sniffing paid to it ($F_{(3,16)}$=3.94, p=0.014, means: Own Unmanipulated =19% of time, Own Nonsniffed=13%, Alien Sniffed =11%, Alien Unmanipulated=9%). Duncan multiple comparisons revealed that Own Nonsniffed, Alien Sniffed and Alien Unmanipulated piglets were not sniffed differently and all of them were sniffed less then Own Unmanipulated piglets. Number of visits to individual piglets was also affected by piglet type ($F_{(3,16)}$=2.71, p=0.055, means: Own Unmanipulated=14, Own Nonsniffed=11, Alien Sniffed=10, Alien Unmanipulated=8). Duncan tests confirmed a significantly higher number of visits to Own Unmanipulated than to Alien Unmanipulated piglets. No other pairwise comparison was significant. These results will be complemented by results of preference tests in which identically manipulated but unaenesthetized (vocalizing, moving) piglets were used.

Sows behaved towards Own Unsniffed piglets in the same way as towards Alien Unmanipulated piglets, but differently from Own Unmanipulated. They behaved towards Alien Sniffed in the same way as towards Alien Unmanipulated, presumably because the contact between them was not sufficiently frequent. We conclude that early recognition of own piglets by sows is probably mediated by the individual smell of each piglet rather than by some smell which is shared by the whole litter.

The Effects of Branches on Nest-Building Behaviour in Gilts

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Nest-building behaviour in sows appears to be both internally and externally controlled. Thus, the termination of nest-building may depend not only on physiological changes associated with the impending parturition, but also on feed-back from the nest. Sows that farrow in a semi-natural environment cease nest-building 1- 7 hours prior to parturition. No nest-building behaviour occurs after parturition has started and sows remain lying in the nest throughout most of the farrowing. In contrast, many intensively housed sows are restless during farrowing. It is possible that dissatisfaction with the nest causes a sustained motivation for nest-building.

To investigate whether the cessation of nest-building is affected by environmental feed-back we studied 42 gilts housed individually in pens designed to encourage natural nest-building. The gilts had access to straw in a rack (N=21) or to straw and branches in separate racks (N=21). The branches were bare, 2 - 4 cm in diametre and 40 - 75 cm in length. The racks were filled regularly and the sows thus had unlimited continuos access to nest-building materials. Observation was carried out using 24 h timelapse video recordings. Use of the provided materials for nest-building was recorded for all gilts. The interval from cessation of nest-building until birth of the first piglet (BFP) was also recorded. From 1 h prior to BFP until 2 h after BFP the behaviour of the gilts was analysed in detail. Additionally, 10 gilts were selected randomly among gilts with access to both straw and branches. On these gilts detailed behavioural observations were carried out from 24 h prior to BFP and the use of branches during the nest-building phase was analysed descriptively.

During nest-building all gilts used straw and all gilts with access to branches also used these. On average, gilts with access to branches ceased nest-building 132 minutes prior to BFP, whereas gilts with access to only straw ceased nest-building 58 minutes prior to BFP. The difference was significant (Log-rank χ^2 = 4, 32, df = 1, P = 0.04). In the group of gilts with access to straw only, nest-building behaviour was performed by more individuals during the interval from one h prior to BFP until 2 h after (Pearson χ^2 = 4.71, df = 1, P = 0.03), although the behaviour did occur also in some of the gilts with access to both straw and branches. When gilts performed nest-building behaviour during the first two hours of parturition this was negatively correlated with time spent in lateral recumbency (Pearson correlation coefficient = - 0.51, P = 0.0006) and positively correlated with number of postural changes (Pearson correlation coefficient = 0.51, P = 0.0006). On average, gilts that performed nest-building behaviour after BFP spent 54 % of the first two hours of parturition in lateral recumbency and carried out 16 postural changes. Gilts that did not perform nest-building behaviour during this interval spent 85 % of the time in lateral recumbency and carried out 5 postural changes. Provision of branches in addition to straw thus affected the preparturient and parturient behaviour of the gilts. This result supports the contention that the cessation of nest-building in sows is under environmental feed-back control. When only straw was provided the nests did not seem to have much of a lasting structure. However, when gilts had access to straw and branches they used both materials extensively and more structured and functional nests could be built. The construction of such nests may have been more effective in reducing the motivation for nest-building prior to the onset of parturition.

The effect of four different methods of introducing sows and piglets to a multi-suckling pen on behaviour patterns of importance for the piglet mortality.

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The piglet mortality in multi-suckling systems shows large variation between trials. At the Danish Institute of Agricultural Sciences piglet mortality rates (ranging from 0 to 12%) have been found in the multi-suckling pens in the period from introduction when the piglets are 11 days old until weaning at five weeks of age. Some of the deaths are caused by crushing and starvation, and the main part of the deaths happens within the first days after introduction to the multi-suckling pen. One causal factor may be the observed restlessness after the simultaneous and sudden mixing of three sows and their piglets. It lasts 1-2 days and is characterised by poor synchronization of nursings, interrupted nursings and many piglets trying to nurse other sows than their mother (cross-suckling). This unrest may be reduced by changing the method by which the animals are introduced to multi-suckling pens. Therefore, the effects of four different methods on nursing related behaviour patterns of importance for the piglets' health and survival were tested.

The sows were housed in groups of 12 or 24 during pregnancy. All sows farrowed in a get-away farrowing system separated from the multi-suckling pens. In the second week after farrowing 24 groups, each consisting of three sows with their piglets, were introduced to multi-suckling pens of 24m^2 with deep litter. The four methods of introduction were: A) Sows and piglets moved simultaneously on day 11 after farrowing; B) Sows and piglets moved simultaneously on day 14 after farrowing; C) Sows moved together and then, two hours later, all piglets moved together on day 11 after farrowing; D) Each sow and her litter moved separately at three-hours intervals on day 11 after farrowing. The piglets were weaned when they were five weeks old. The behaviour of the animals during the first 48 hours after the introduction was observed by means of 24-hour time lapse recordings. Analyses of variance were carried out (N=24). The results are presented as means per 24 hour.

Compared to the control treatment (A), all other introduction methods (treatment B, C and D) resulted in more initiated nursings in the sows housed in small groups during pregnancy (35.5 (A), vs. 42.9 (B), 42.8 (C) and 40.7 (D) initiated nursing per sows per 24h; P=0.01). However, when sows were housed in the large groups during pregnancy, an increased age (treatment B) resulted in a decreased number of initiated nursings compared to treatment A (37.6 (B) vs. 43.7 (A); P=0.02), but an increased nursing synchrony (the three sows suckle simultaneously in 80.2.1% vs. 41.2% of the nursings, P=0.0001). None of the introduction methods significantly affected the latency from introduction to first successful nursing, the number of successful nursings or the percentage of nursings initiated or terminated by the sow, or cross-suckling.

In conclusion, none of the methods of introduction were markedly better than the others. With respect to nursing synchrony and initiated nursings, we found interactions between introduction method and group size during pregnancy.

The use of stress induced hyperthermia for evaluation of fear in fox welfare research

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Mammals (such as mice, man and foxes) increase their deep body temperature in response to psychological stress. This increase has been termed stress-induced hyperthermia (SIH). Our earlier studies in farmed foxes showed that handling and fear of handling induced SIH, and that anxiolytic drugs (such as buspirone and diazepam) may reduce SIH. Furthermore, fearful foxes (withdrawing from humans) showed a SIH of a larger magnitude than foxes remaining in the front of the cage during the precence of man, which indicates a relationship between fear and SIH. SIH may thus be a useful new tool to measure fear and anxiety in studies related to animal welfare in farmed foxes.

The present study was performed to investigate the effects of 14 different putative environmental stressors on deep body temperature (T_b), and levels of locomotor activity in six 2.5 year old silver fox vixens six months after the reproductive season. Three of these vixens had lost all their cubs in the past two reproductive seasons, whereas the other three had weaned litters without harming them. From five days before the experiment started, the vixens were kept in an empty barn and isolated from environmental disturbances. Six different experiments investigated effects of contact with humans, four experiments investigated effects of exposure to unfamiliar foxes, and four experiments investigated effects of various noise stimuli. T_b and activity levels were monitored with surgically implanted radio telemetry devices. All registrations were performed during 90 min after stimulus presentation. The present study demonstrated that the presence of humans and the presence of other silver foxes, but not the exposure to loud noise, resulted in increased T_b . In the light of results from our previous studies, the increase in T_b was considered to reflect a SIH. Comparison of the SIH between the normally reproducing vixens and the previously infanticidal vixens revealed significant differences. The SIH response was most pronounced in the previously infanticidal vixens, whereas the levels of physical activity were lowest in this group. The present study indicated that important means to improve animal welfare in silver foxes should include an improvement of the general human-animal relationship and emphasises the importance of a stable social environment.

Vocalisation analysis and physiological correlates during the castration of pigs

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Castration is usually carried out on young male pigs by surgical means to prevent boar taint in older males. This operation involves tearing and cutting of the spermatic cord during the removal of the testes. This study was aimed to measure indices of pain during different castration methods by means of vocalisation analysis and physiological correlates. Piglets exhibit a variety of vocalisations under stressful conditions. The specific structure of these vocalisations may provide some information on the extend of pain experienced by the animal. The numerical analysis of calls provide a multiparametric description of call characteristics.

A total of 96 piglets from 24 litters out of a commercial herd were alloted to four different treatments between the age of d 7 and 19: a) castration without anaesthesia [C], b) castration with local anaesthesia [CA], c) fixation without anaesthesia [F], d) fixation with local anaesthesia [FA]. Plasma catecholamines (noradrenaline [ng NOR/ml], adrenaline [ng ADR/ml]) were analysed by HPLC (Waters) from plasma taken immediately after each treatment. Vocalisations were recorded with a calibrated microphone (B&K 4133) and a DAT recorder (SONY TCD-D8). Analysis was done with Entropics Signal Processing System (ESPS 5.0) software on a workstation (SGI Indy). Measurements included the following call features: call level [dB(L_{eq})] and energy [dB(SEL)], peak amplitude [dB], peak level [dB], standard deviation of energy within the call and occurrence of peak level relative to call duration [%].

Call structure within vocalisations of castrated piglets [C] changed during periods of tearing and cutting of the spermatic cord (call energy: 92.03 ± 0.41 vs 88.75 ± 0.31 dB before tearing; $P<0.01$). CA treatment reduced peak levels (CA: 95.09 ± 0.65 vs C: 99.35 ± 0.35 dB; $P<0.01$) and were not different from FA (92.9 ± 0.95 dB; $p>0.05$). The variation of energy within the call was also reduced (CA: 116167 ± 60401 vs C: 485094 ± 32372; $P<0.01$).

Plasma catecholamines were reduced in the CA treatment (CA: 8.5 ± 1.77 vs C: 13.9 ± 1.6 ng NOR/ml; $P<0.05$ and CA: 3.4 ± 0.72 vs C: 5.7 ± 0.67 ng ADR/ml; $P<0.05$). In addition, plasma NOR was correlated with the occurrence of the peak level relative to call duration ($r=0.51$, $P<0.001$) and the number of calls ($r=0.345$, $P<0.05$; Spearman rank correlation).

Correlations between call structure and physiological stress parameters indicate that these behavioural characteristics are useful for measuring stress by means of a non invasive method. Several parameters from numerical analysis of calls were found to be sensitive to stressful treatments during castration. Castration in combination with a local anaesthetic can substantially reduce the acute behavioural and physiological response to this procedure.

Can methods of acute pain reduction alter the chronic inflammatory response and associated pain to rubber ring castration and tail docking of two day old lambs?

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The acute pain associated with castration and tail docking of 2 day old lambs with elastrator rings (RR, n=5) was reduced by either local anaesthetic applied by needleless injection (RRla, n=5) or crushing the nerves from the scrotal and tail regions with a bloodless castrator (Brr, n=10). Twice weekly for 42 days after treatment, the size of, and presence of inflammation and pus at the lesion caused by the rubber rings was monitored. The behaviour of handled only (H, n=10), RR and RRla lambs was studied for two three hour periods 10d, 20d, 31d, and 41d after treatment. The group housed ewes and lambs were fed and two playboxes were placed in the pens between the two 3h observation periods. Lying and standing postures, modified with sleeping, ruminating, idling, sucking, eating, playing were recorded every 6min and the incidence of head turning to scrotum, tail, back, inside and outside the hindleg, foot stamping, easing quarters, tail wagging, getting up and down, gamboling and getting on the boxes were recorded continuously by four people.

In the Brr lambs, the tail lesion developed earlier [mean (±sd) peak lesion score Brr 11±3.2 day v RR and RRla 38±3.7 day] and healed earlier (Brr day 25±7.4, RR and RRla day 43±5.7) with the tail also dropping-off 10 days earlier than in RR and RRla treated lambs (25days). Pus was detected at the scrotal lesion in less than 40% of the lambs. The methods of acute pain reduction reduced the mean time for the scrotum to drop-off (Brr 29±7.1days, RRla 26±7.8days RR 35±6.9 days), the mean maximum size (Brr 16±0.9mm, RRla 18±3.0mm RR 18±1.8mm) and the mean score of the lesion (Brr 3.0±0.8, RRla 3.0±0.9, RR 3.2±1.0) but the differences were not significant ($p>0.05$). However, the time taken to reach the maximum lesion size and score was significantly ($p<0.001$) reduced in both groups of lambs where methods of pain reduction were used (Brr 9±4.0 day, RRla 12±3.6 day, RR 25±5.4day). During the four 6h periods after treatment, there was a significantly increased frequency of foot stamping (RR 13±13 v RRla 2±3 v H 2±2.5) ($p=0.013$), tail wagging (61±26 v 12±6 v 15±6) ($p<0.001$), head turning to the scrotum and inside hindleg (12±10 v 3±3 v 1±1) ($p=0.013$), abnormal lying ($p=0.015$), abnormal standing ($p=0.01$) and lying idling ($p=0.001$), postures in RR lambs compared with H and RRla lambs. The incidence of play ($p=0.003$), and normal standing ($p=0.018$), were significantly reduced in RR lambs. In 2 day old lambs, the incidence of active behaviours was low compared with that recorded in 42d old Scottish Blackface lambs treated in a similar manner. These results suggest that there were long-term benefits from the methods of acute pain reduction; the scrotal lesion developed earlier and healed earlier, and using local anaesthetic at the time of treatment reduced the incidence of pain behaviours during the 42days after treatment.

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Hippocampal glucocorticoids and their receptors are the mediators of behavioral responses to stress

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Glucocorticoids are the primary regulator of endocrine, autonomic, immune and behavioral responses to stress. The mammalian brain can metabolize steroid hormones and it can synthesize biologically active metabolites. Wide distribution of 5 alpha reductase and 3 alpha-hydroxy-steroid dehydrogenase (enzymatic systems that metabolize steroid hormones) has been identified in the brain of rodents, humans and monkeys. High glucocorticoid levels, particularly at an early age, causes permanent down-regulation of glucocorticoid receptors. Damage in brain hippocampal cells impair spatial memory and affect the regulation of the hypothalamic-pituitary adrenal axis. My hypothesis is that the role of plasma cortisol as a marker of stress has been overemphasized. Cortisol may be used by hippocampal cells to synthesize biologically active steroids.

Hippocampal tissue was collected, homogenized, and steroids were recovered using solid phase extraction. Hippocampal steroid profile was resolved using HPLC (high pressure liquid chromatography) fitted with a 4.6 X 150 mm C_{18} reverse-phase column. Cortisol metabolism was studied in hippocampal cells (35mg of tissue/ml medium), which were incubated for two hours with high (1000ng/ml) or low (100ng/ml) concentration of exogenous cortisol. After incubation the medium was centrifuged, the supernatant harvested and steroids recovered using solid phase extraction. The samples were dissolved in methanol and water and the compounds were identified using HPLC.

Glucocorticoids and mineralcorticoids were identified and characterized in pig hippocampal tissue. Cortisol, the main glucocorticoid hormone in the peripheral circulation of pigs, was present at very low concentrations. Compounds that are associated with cortisol synthesis and degradation were identified at significantly higher levels in the pig hippocampus when compared to cortisol. The HPLC chromatogram showed that, *in vitro*, cortisol was heavily metabolized by hippocampal cells. Only 31.6% and 43.4 % of the exogenous cortisol was recovered after incubating the tissue with high and low glucorticoid concentrations, respectively.

We characterized the steroid profile in the pig hippocampus. Cortisol metabolites were present at very high concentrations and their biological relevance warrants further research. Redirecting our research efforts into the assessment of central glucocorticoid levels may help to redeem the unsolvable unreliability of peripheral glucocorticoids levels as stress markers.

Assessing the behavioural needs of mink (*Mustela vison)* using three methodologies from human microeconomics

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We housed sixteen mink in multi-compartment cages with access to seven resources, including an empty cage, an alternative nest-site, novel objects, toys to chase and chew, and a bath full of water. Compartment-use was automatically recorded 24h/day by micro-switches on the entrance and exit doors connected to an Arachnid (Paul Fray Ltd) system. The setup and protocol were designed to address recent criticisms of consumer demand techniques (Mason, Mcfarland & Garner 1998).

In Experiment 1, we compared two microeconomics techniques, the measurements of price elasticity of demand and income elasticity of demand. These reflect the rates at which consumption falls when, respectively, the price of a commodity increases, or income decreases. To measure price elasticity of demand, we weighted the compartment doors by 250, 500, 750, 1000 or 1250g, each weight being imposed for one week. To measure income elasticity of demand, we cut the time budget available: each mink was allowed to interact with the resources for only 4h, 2h, 1h, 30 min or 15 min per day, each treatment being imposed for one week. A counter-balanced design was used so that the two experiments could be compared without order effects. The data were analysed using General Linear Models (Minitab 12).

As doorweight increased, the number of visits to the compartments decreased and some ceased being visited altogether. The visit elasticity was calculated for each resource as the slope of a log-log plot of visit-number versus visit-price. This was significantly lower (i.e. less elastic) for the water-bath and alternative nest-box than for other resources ($t=5.59$, $p<0.0001$ and $t=2.67$, $p<0.01$ respectively); and was significantly higher (i.e. more elastic) for the empty compartment ($t=3.92$, $p<0.0001$). The income elasticity of demand for the 4h budget, calculated as the relative change in use over the relative change in income, was least for the water-bath and novel objects ($t=6.32$ and $t=5.34$, respectively; $p<0.0001$). It was most elastic for the alternative nest-box ($t=4.83$, $p<0.001$), empty compartment ($t=3.98$, $p<0.001$) and the tunnel ($t=2.69$, $p<0.01$) Thus, although there were some not unexpected discrepancies, the two methods gave broadly similar results.

In Experiment 2, we used another microeconomics measure to ascertain importance: reservation price (the maximum value a consumer will pay to access a commodity: Varian 1992). Using sixteen new mink and a slightly altered array of resources (e.g. empty compartment replaced by food dish), the following doorweights were imposed, each for one week: 500g, 1000g, 1500, 2000g, 2500g, and 3000g. The weight at which each resource was abandoned was recorded. Data were analysed with pairwise non-parametric statistics. The reservation prices for food and the water-bath were highest, and not significantly different from each other. The lowest weights were pushed for the toys and a tunnel; the reservation prices for these resources were statistically indistinguishable.

Overall, therefore, mink defended their use of a number of potential enrichments and the elasticity of demand for access, income elasticity of demand, and reservation price all identified the water-bath as a preferred resource.

Drink or swim? Using substitutability and physiological responses to frustration to assess the importance of swimming-water for mink

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Previous experiments (Cooper & Mason 1999) showed that mink defend their use of a water-bath more than other potential enrichments. In Experiment A, we measured the urinary cortisol excreted by mink denied access to various resources, to see if physiological responses to frustration mirror behavioural measures of importance. 14 mink were each denied access to food, a water-bath, an extra nest-site and an empty cage for 24h, during which period urine was collected. Three days were left bewteen each treament, urine being collected on the third day as a baseline for the next deprivation. Urinary cortisol was assayed commercially by RIA, and corrected for creatinin concentration. Cortisol: creatinin ratios were log-transformed and then analysed with paired t-tests. They increased over baseline when food was denied ($t = 2.77$, $p < 0.05$) and when the water-bath was denied ($t = 2.75$, $p < 0.05$), but not in any other treatment. Thus although they gave less resolution, the physiological data mirrored behavioural measures of importance, confirming the validity of microeconomics techniques.

In Experiment B, we used the principle of substitutability to ascertain which features of the water-bath were important. As well as the opportunity to swim, the water-baths potentially gave our mink extra stimulation, more space, a different vantage point from which to monitor the surroundings, and the opportunity to drink at a faster rate than allowed by their water-bottles. If any of these was a full substitute for a bath full of water, providing them for free should abolish working for a water-bath. 15 mink were therefore given access to a floor-level water-bath, the entrance door to which was weighted at the maximum each animal would push for access (c. 2kg). In a similar, but empty, floor-level bath, mink were given novel objects or a bowl of water (which allowed drinking but not swimming). Each was provided for three successive days, and the effect on water-bath-use recorded. Providing novel objects had no significant effect on water-bath-use, showing that extra stimulation (+ extra space/being at floor-level) did not substitute for the water-bath. Providing a free bowl of water did cause some reduction, in contrast. It reduced both the number of daily visits to the water-bath (Wilcoxon $Z = 2.78$, $p < 0.01$) and the total time spent there (Wilcoxon $Z = 2.07$, $p < 0.05$), showing that one function of the water-bath was indeed as a source of easily-drinkable water. However, this was clearly not the only function: working for the water-bath was not abolished by the free bowl, with 14/15 animals still pushing a heavy weight to access it.

Overall, these two experiments show that in a closed economy, multi-resource test arena, mink work hard for a water-bath in order to drink and to swim (when their only other source is a water-bottle), and that when given a water-bowl for free, most animals still work hard just to swim. Frustrating access to the water-bath causes a significant increase in excreted cortisol similar to that seen when food is denied for 24h. Future work will ascertain the relevance of these results for mink housed in the absence of stimuli that might elicit swimming, i.e. for mink housed in commercial fur-farm conditions.

The effect of housing environment on responses of horses to initial training

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There are evidences, that learning ability may be impaired in animals housed in social isolation or barren environments. Horses on pasture have the ability to interact socially and are exposed to a complex environment. Horses kept in stalls have more contact with humans but often lack interactions with other horses and are exposed to a barren environment. Responses to initial training may be affected by housing conditions.

Sixteen, 2 year old Arabian horses were kept on pasture (P) (n=8) or in individual stalls (S) (n=8) for 90 days prior to this experiment. Twelve horses (6P & 6S), were subjected to a standardized «training procedure», carried out by two trainers in a round pen, and 4 horses (2P &2 S) were used as control. Training occurred for 28 days with behavior observations and blood sample collections occurring on days 0, 7, 21 and 28. The first week of training consisted of habituating the horses to the trainers, having a saddle on their back, being mounted, ridden and dismounted. For the remainder of the study horses were trained daily using positive and negative reinforcements. Control horses were released into the round pen and left to explore the environment for 30 minutes. Behavioral data were collected using video cameras. Frequently observed behavior were categorized and defined. Behaviors were decoded and analyzed using The Observer Software. The Polar Vantage NV ™ was used to monitor horses' heart rate continously. Blood samples were collected prior to entering the round pen (basal), end of training (pt),15 minutes (pt15) and 75 (pt75) minutes post training. Cortisol was monitored by R.I.A. Statistical analysis was conducted using SAS® Proc Mixed procedure.

After 30 minutes of handling the trainers were able to mount and ride the horse with minimal behavioral responses observed. Total training time (min; mean ± SEM) for the stalled housed horses was significantly higher than total time for the pastured horses (P: 19.7 ± 1.1; S: 26.4 ± 1.5; p = .0324). The stalled group required more time to habituate to the activities occurring from the start of training to mounting (i.e. sacking with blanket and saddle) (P: 7.3 ± .75; S: 11.4 ± .96; p = .0079). There was no difference between the groups during the riding portion (P: 8.5 ± .8; S: 9.7 ± 1.6; p = .3327). Frequency of undesirable behaviors such as bucks and jumps was higher in the stalled horses (P: 2.2 ± 1; S: 8 ± 2; p = .0351). Plasma cortisol concentrations were not affected by housing conditions (p = .5255). Pastured horses tended to have higher basal heart rates (Basal: P: 58 ± 3.7; S: 48 ± 3.7 bpm; p=.0771).

While the physiological data failed to identify differences among housing groups, the behavioral data suggests that pasture kept horses adapt easier to training than stalled horses.

Frequencies of behaviour problems and heritability of behaviour traits in breeds of domestic cat

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Although recent research has documented several positive effects of pet-keeping on the physical and psychological health of humans, problems with inappropriate behaviour of the pets may threaten these benefits. The aims of this study were to describe the behavioural characteristics, the frequencies of various behaviour problems, as well as the heritability of certain behaviour traits in domestic cat breeds. Behaviours related to the human-animal relationships, activity level, fear, and aggression were compared between Siamese, Persian, and the common non-pedigree domestic cat. The heritabilities of behaviour traits were calculated for the two pedigree breeds, each based on adult paternal half-sibs from about 20 breeding males. Questionnaires with a total of 109 questions were returned from owners of 245 Siamese and 286 Persian cats, as well as 230 non-pedigree cats and 70 cats of other breeds or mixed breeds. The return rate was 62.3% after a reminder. The average age of the cat owners were 42 years and 83% of the respondents were women. The frequencies of the various behaviour traits were reported on a 5-point scale from 'very often' to 'never'.

About 91% of the owners were very satisfied or satisfied with their cat. Siamese cats were reported to be more contact-seeking, staying longer in owner's lap, using more vocal communication, and be more playful and active than other breeds. Siamese cats showed more urine marking (spraying) and urination outside the cat toilet; 18% of Siamese cats, 5% of Persians and 3% of non-pedigree cats did this very often or often. Aggressive scratching or biting humans occurred very often or often in 10% of Siamese, 1.4% of Persian, and 6% of non-pedigree cats. Aggression towards other cats occurred in 15-16% of Siamese and non-pedigree cats, but only 5% of Persians. The non-pedigree cats more frequently behaved aggressively towards dogs in the household, but no differences in fear of dogs were reported. Often or very often fear of unfamiliar humans were reported in 17% of non-pedigree cats, 13% of Siamese, and 7% of Persians. Yet, Persians approached unfamiliar humans less frequently than Siamese cats, but more frequently than non-pedigree cats. Scratching furniture or other inappropriate objects occurred often or very often in 33% of non-pedigree cats, 27% of Siamese cats, and 13% of Persians. In general, fearfulness were most frequent among non-pedigree cats and least frequent among Persians.

The following behaviour traits showed the highest heritability estimates: The cat is active and playful (h^2=0.37); The cat seeks contact with unfamiliar humans (h^2=0.31); The cat seeks contact with unfamiliar children (h^2=0.25); The cat shows fear of unfamiliar humans (h^2=0.25); The cat shows fear of strong noise (h^2=0.22); The cat behaves friendly towards unfamiliar humans (h^2=0.17). This study showed that it is possible to estimate heritabilities of behaviour based on ordinally scaled parameters on questionnaires. Other behaviour traits including aggressions showed very low or no heritability. It is unknown to what extent this was due to the owners' imprecise knowledge of these traits in their cat. The highest heritabilities were found for playfulness, fear, and behaviour towards unfamiliar persons. These traits could be considered when selecting breeding animals in pedigree cat breeds, in order to increase further the proportion of cat owners which are satisfied with their cat.

Horse-riding accidents: When the human-animal relationship goes wrong!

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Accident surveys have indicated that horse riding is among the top 10 most dangerous sports and second only to motor racing if the severity of the accident is considered. While the recommendation to wear a safety hat may reduce the severity, it can not prevent accidents. To obtain a better understanding of the relative contributions of horse and rider, patients going to a hospital because of a horse related accident were asked to fill out a questionnaire about themselves, the horse, the management and training of the horse, and the circumstances around the accident. The aim of the study was to investigate the most common reasons for horse accidents and to identify possible ways to prevent similar accidents in the future.

Over a period of 3 years, 385 patients were questioned (response rate = 76%). The distribution of horse breeds was not significantly different from expected, although there were approximately twice as many accidents with large ponies (13%) compared to small ponies (6.2%). Probably linked to this result, we found that the 13-25 year age group of riders was over represented in our study (50%) compared to the expected (29%) from the distribution of Swedish Equestrian Federation members. When riders were asked to assess their own level of experience 65% assessed themselves as above average (4 or 5 on the 5-point scale) whereas only 13% considered themselves below average (1 or 2 on the scale). It may be that the people in our study were more experienced, riding under more dangerous conditions, but this finding can be compared with studies of car drivers where it has been shown that people in high risk groups have a tendency to think they are better drivers than others and over estimate their own capability. The results of our study may reflect that teenagers believe that they are better horse riders than they really are.

Accidents were divided into four categories. Pure accidents (33%) which would be difficult for the rider to foresee. The horse being frightened (27%) which probably reflects the horse's natural instinct to flee from danger. Misunderstandings between horse and rider (22%) of which 43% happened during show jumping. Disobedience was the fourth category of accident (18%). Several factors tended to influence the type of accident, but one important contributing factor was how much of the routine care and management the person did themselves. People involved in pure accidents and accidents caused by the horse being frightened did more of the management (median = 4 out of a maximum of 5) compared to people involved in accidents caused by misunderstandings between the horse and rider or the horse being disobedient (median = 2).

Although the survey is unable to demonstrate direct connections between housing or management procedures and accidents, it supports the notion that the experience of the rider and his or her familiarity with the horse constitute important safety aspects in horse riding.

The association between genotype, stereotypies and fecal steroids in mink

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The development of behavior abnormalities in mink is influenced by genetic background. Exposure to stress at an early age has been suggested to induce stereotypy development. In this study, the association between genotypes, stereotypy development and stress responses were examined. Direct observation of parents was carried out three times a week, for three months after mating. Forty offspring from the thirty minks were weaned, sibling grouped and then individually caged by 11–12 weeks of age. Direct observations (60 minutes for each animal) for two days after individual caging were carried out. Stereotypy development was monitored using direct, one-zero sampling observations (10 minutes for each animal), once a week, for three months. Fecal samples were collected before individual caging (baseline; day0) followed by daily twenty-four hour collection for four days (day1-4). Fecal steroids were extracted, then identified and quantified using high performance liquid chromatography. Data analysis was carried out using SAS® Mixed Procedure. Parents were classified as high (H) and low (L) level of stereotypies according to the three-month observation data collected after mating. Offspring were also classified as H and L according to the three-month observation data after individual caging. Criteria for H required at least one of the following stereotypic behaviors: left and right movement, up and down movement, head rolling or pacing. The occurrence of vocalization was recorded for two days after individual caging.

Chromatograms of fecal samples showed two distinct peaks identified as aldosterone and cortisol. Aldosterone concentrations on day1 (1.55±0.11 µg/mg feces) and 2 (1.34±0.08) were significantly higher than day0 (0.81±0.10; $p<0.0001$). The highest aldosterone concentration was exhibited on day3 (3.22±0.39; $p<0.0001$) followed by a decrease on day4 (2.52±0.16; NS). Similarly to aldosterone, fecal cortisol concentration increased on day1 (2.72±0.18) and 2 (2.424±0.11) compared with day0 (1.71±0.17; $p<0.001$), reached the highest concentration at day3 (3.65±0.43; $p<0.05$), and decreased by day4 (2.71±0.17; $p<0.05$). Offspring from parents showing high and low level of stereotypies were selected (HH; n=7, LL; n=13), and fecal steroid concentrations were compared. HH exhibited significantly higher aldosterone and cortisol levels on day2 ($p<0.01$), however aldosterone level on day3 was lower when compared to LL ($p<0.05$). Fecal steroid levels were compared between offspring with zero occurrence and with high frequency of vocalization (NV; n=11, V; n=11). On day3, both aldosterone and cortisol levels were significantly higher in NV than V ($p<0.01$, $p<0.05$ respectively). Offspring which developed high-level of stereotypies and low-level of stereotypies later on (H; n=10, L; n=10) were compared, and no significant difference in aldosterone or cortisol levels were observed throughout the sampling periods.

In conclusion, fecal adrenal steroids can be used as an indicator of stress, however, there was a three-day delay for the maximum concentrations to be reached of both aldosterone and cortisol in mink. Offspring from low stereotypic parents (LL) or animals that did not vocalize at the two-day observation period after individual caging (NV) showed higher concentrations of aldosterone and cortisol on day3. No association was observed between fecal steroid concentrations and later development of stereotypies.

Stone-chewing in outdoor pigs.

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Commercial pigs maintained outdoors spend a great deal of time standing chewing stones. Though the phenomenon is well-known and a few data have been collected incidental to other purposes, there has been no systematic investigation of its incidence in different circumstances, nor data to inform speculation about its possible function. We have examined the occurrence of stone-chewing and a range of other activities in Wild Boar in naturalistic conditions (WB), and in similar strains of commercial pigs in six different environments: in paddocks on arable (AR); on grass pasture with surface stones removed (G/RS); on grass with plenty of surface stones (G/ST); in an identical grass paddock enriched with a pile of straw, leafed branches and twigs, small standing trees and rocks (G/EN); and indoors in small straw yards, with (SW/ST) and without stones available (SW/NS). All groups were gestating sows fed a very similar concentrate diet to the same level and were observed for 3 hrs am and 3 hrs pm for 2-4 days.

The AR and SW/ST sows did most stone-chewing: they stood chewing stones or chewed stones while rooting 46.5% and 40.0% of the time respectively, which was significantly more than any of the grass-based groups, which ranged 28.9% to 18.3% ($p < .01$). Stone-chewing was almost non-existent in WB (overall, groups differed with $p < .001$). What WB, in their highly enriched environment, did more than other groups was rooting (17.6% of the time versus 10.0% in AR, 9.6% in SW/NS and 7.0% - 5.6% in the other groups: $p < .001$), rooting and chewing soil, roots and vegetation (2.9% vs not more than 1.2% in any other groups, excluding those rooting and chewing in straw yards: $p < .001$) and simply walking around. Similarly, when otherwise identical grass paddocks were enriched with other materials (G/EN vs G/ST), sows took advantage of the opportunity to chew straw from a bale delivered daily, and fresh branches, denuding them of leaves; but they chewed stones less (28.9% vs 23.3% in G/ST and G/EN respectively: $p <.05$). What AR sows, who spent most time chewing stones, were unable to do to any significant extent was to graze, which took up to 20% of the time in other groups.

Perhaps the best clues concerning the function of stone-chewing are given by what pigs do when they are deprived of the opportunity. In the straw yards, SW/NS sows chewed straw much more (23.4% vs 10.3% of time: $p < .001$), rooted more (9.5% vs 5.7%: $p <.01$), rooted and chewed straw more (6.0% vs 4.0%: $p < .05$), palpated and chewed bars, troughs and walls, often in stereotypic fashion more (0.8 vs 0.2%: $p < .005$), and both walked around, and lay inactive more of the time than SW/ST sows. On grass, G/RS pigs rooted, grazed, and rooted and chewed straw more than G/ST pigs. Though the 'cause' of stone chewing cannot be inferred, these data are compatible with the hypothesis that it is partly a response to a 'need to chew', and partly a function of having little to do, in barren environments like plain earth fields, and either doing it to reduce boredom or performing a stereotype in response to stress.

Does poor litter quality frustrate brown layers and cause feather pecking?

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Hens are known to feather peck both when they are deprived of litter and when they are thwarted from accessing litter, for example by the use of Perspex barrier (Kim-Madslien & Nicol, 1998; Proc. 32nd ISAE Congress, 177). However, feather pecking can still occur when hens are provided with unhindered access to litter. One explanation is that hens might be frustrated by poor litter quality if they do not receive adequate feedback when performing dustbathing and/or foraging. This study proposed that severe feather pecking would be lower in hens given a substrate suitable for dustbathing and foraging (enriched litter) compared to those given a relatively unsuitable substrate (bland litter). The effects of deprivation (litter removed) and thwarting (litter covered with Perspex) were also examined.

Thirty-six mature ISA Brown hens were housed individually in pens that minimised opportunities to ground peck except in designated litter areas. Hens were provided with one area containing wood-shavings mixed with peat and food pellets (enriched), and another containing fresh wood-shavings (bland). The hens were randomly allocated to one of six treatments; TEB (thwarted from accessing enriched and bland litter), DEB (deprived of enriched and bland litter), TE (thwarted from enriched litter, access to bland litter), DE (deprived of enriched litter, access to bland litter), TB (thwarted from bland litter, access to enriched litter), and DB (deprived of bland litter, access to enriched litter). Feather pecking was assessed on days 10 and 13 after imposing treatments by presenting each hen with four securely clamped wing feathers (c.f. Bessei et al., 1997; proc. 5th Europ. Symp. Poul. Welf., 74-76) for a 10 minute assessment period. The effects of thwarting and deprivation were similar and so data were combined (TEB and DEB, TE and DE, TB and DB) to examine the effects of litter quality. Data from days 10 and 13 were also combined as the pattern of pecking behaviour was similar on both days.

The median percentage time spent pecking the clamped feathers severely was significantly greater both for hens without litter (5.0 %) and with bland litter (3.75 %) compared to those with enriched litter (0.3 %) ($z= -2.8$, $P < 0.01$; and $z= -2.6$, $P < 0.01$, respectively). Litter quality did not affect mild feather pecking. During the treatment phase, bland litter significantly reduced the median percentage time spent litter pecking compared to enriched litter (e.g. day 10: 6.5 % vs. 57 %, $z= -3.1$, $P < 0.01$). Compared to the baseline period, when hens had enriched litter, providing no litter caused hens to spend more time feeding (e.g. day 13: 1.3 % vs. 6.0 %, $z= -2.2$, $P < 0.05$) and pecking at their pen and other objects (e.g. day 13: 2.1 % vs. 28.4%, $z= -2.5$, $P < 0.05$). Similarly, providing only bland litter caused hens to spend more time feeding (e.g. day 13: 0 % vs. 4.2 %, $z= -1.9$, $P < 0.06$) and pecking at their pen and other objects (e.g. day 13: 1.1% vs. 8.5 %, $z= -2.9$, $P < 0.01$). This study suggests that litter quality is important to hens, and that a substrate must provide feedback for dustbathing and/or foraging to reduce the risk of severe feather pecking.

Assessing motivational strength using areas under the demand curve

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The assessment of motivational strength is basic to understanding behaviour and is important in animal welfare research. Dawkins (1983) put forward the elasticity of demand as an index of motivational strength, and this measure has come to be widely used. But Houston (1997) has recently demonstrated mathematically that the area under the demand curve should be a more accurate index than the elasticity of demand. I have built upon Houston's position in three ways.

1) By presenting a non-mathematical argument to the same end.

a) Elasticity of demand confounds compensation with satiation. A region of low elasticity on the demand curve is said to represent a determination to maintain consumption in the face of price increases, but it could equally represent a disinterest in consuming more when the price falls.
b) Elasticity of demand fails to account for expenditure as a proportion of income. The proportion of her income that the subject is prepared to spend on a commodity is an index of the sacrifice she is prepared to make in order to obtain it and hence of its value. The more of her income she spends on this commodity, the less she will have remaining with which to purchase other commodities. Expenditure is the product of price and quantity purchased. It corresponds to an area beneath the demand curve. Elasticity of demand, being derived from the slope of the demand curve, is not an index of expenditure.

2) By drawing upon economic theory to ascertain the best measure of area and how it can be calculated from experimental data.

An area under the demand curve known in economics as the consumer surplus has certain bounds on the demand axis. Rather than measuring the value of a commodity, it measures the value of a given quantity of the commodity. The upper bound is set equal to the quantity which is to be evaluated, while the lower bound is set equal to zero. The consumer surplus is calculated by integrating the demand function between these bounds.

3) By arguing that this area measure is much more versatile than the elasticity of demand.

Because the consumer surplus measures the value of a given quantity of a commodity, it can be used to extract much more information from a demand curve than can the elasticity of demand. It can measure: a) how much more value an animal attaches to the first unit of one commodity than to the first unit of another; b) how the value of consuming a further unit of a commodity declines with the number of units already consumed; and c) how many units of one commodity are worth the same as one or more units of another commodity. Measure (c) reveals how much of one commodity would compensate an animal for not having access to a given quantity of the other.

Effects of vacuum and real dustbathing bouts on dustbathing motivation in domestic hens

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Dustbathing occurs as a vacuum behaviour even in the apparent absence of salient stimuli such as dust or feathers, indicating the importance of the behaviour. In an earlier paper, we reported a study of hens in cage systems (Lindberg and Nicol 1997, Appl. Anim. Behav. Sci. 55: 113-128) and suggested that vacuum dustbathing might be an adequate substitute for real dustbathing, since hens with access to a substrate still chose to vacuum dustbathe on the wire cage floors. Dust deprivation effects have been well documented: with increasing deprivation, the latency to start dustbathing decreases and the duration increases once hens are again given access to dust. In this experiment we investigated the effect of vacuum and real dustbathing on
dustbathing motivation in litter-deprived and non-deprived hens. Litter-deprived hens were kept on wire floors and were only able to vacuum dustbathe, while non-deprived hens had access to litter at all times.

Two treatments were used: 'litter-kept' and 'wire-kept'. Each treatment included four groups of 5 ISA brown 40-week old laying hens kept in 3 m2 pens with either litter or wire floors. Testing was preceded by 6 weeks' exposure to the home pen treatments. The time of real or vacuum dustbathing, respectively, was recorded. The hens were tested by placing them in litter-floored test pens at specific times after their previous dustbathing bout, to investigate the effect of this bout on their dustbathing motivation. Tests occurred at 24 h, 4 h or 2 h after the observation of a dustbathing bout in the home pen.

Wire-kept hens dustbathed significantly more in the littered test pens (24 h test mean 54.6 min; 4 h test mean 31.8 min; 2 h test mean 41.3 min) than in their home pens (means 17.5 min; 12.2 min; 8.4 min), whereas litter-kept hens dustbathed almost exclusively in the home pens (means 22.4 min; 25.3 min; 19.4 min). Dividing bouts into 'long' (>15 min) and 'short' ($\leq$ 15 min) bouts showed that there was no significant difference between litter- and wire-kept hens in the home pens, i.e. both treatments resulted in bouts of similar length, with differences only in numbers of bouts. Thus the dustbathing behaviour of wire-kept (litter deprived) hens was remarkably similar to that of litter-kept (non-deprived) ones in terms of individual bouts. The time since the previous vacuum dustbathing bout significantly affected the duration of dustbathing during testing only in wire-kept hens ($p=0.0004$), with a higher total duration in the 24 h test, followed by the 2 h and 4 h tests. We conclude that vacuum dustbathing has little effect on the hens' motivation, either because the non-litter substrate is too inadequate or because the vacuum behaviour motor patterns differ too markedly from those of the real behaviour, resulting in a lack of functional consequences.

Foraging behaviour and activity in red junglefowl (*Gallus gallus*) and in domesticated breeds.

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During the last century breeds of poultry have undergone heavy selection for reproduction and growth. It is likely that this has caused unintentional modification in behaviour. The aim of this investigation was to study changes in activity and foraging behaviour in domesticated hens when compared to red junglefowl. Three different breeds were studied in semi-natural conditions where the birds were offered *ad lib* food from sites where the food was freely available and from sites where the birds had to search and scratch for the food (which was mixed with wood shavings). The breeds used were (1) Red junglefowl (*Gallus gallus*), (2) Swedish bantam, which is a domestic breed that has not undergone selection for production traits and (3) Hy-Line, a white leghorn laying hybrid, selected mainly for food conversion.
The birds behaviour and location were observed three times per day (6 h/d), three days per week between 7-18 weeks of age.

Junglefowl and bantam obtained a significantly higher proportion of their food from the site which required some effort. The opposite case was true for the Hy-Line. Overall, bantams performed significantly more foraging and explorative behaviour than Hy-Lines. There was a tendency for the junglefowl to perform more explorative behaviour compared to the Hy-Line. The Hy-Line was also significantly more inactive and less social than the unselected breeds. The results indicate that selection for growth and reproduction in poultry have had behavioural side-effects: Laying hens appear more energy-conserving in their feeding behaviour, show a lower general activity and less social behaviour. Further studies are needed in order to understand what this means in terms of adaptability and capacity to cope with various environmental and social challenges.

Selection against fear in farmed blue foxes

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Decrease in fear of humans and smaller brain due to hereditary changes are some known results of the domestication process. Decrease of fear, in turn, is assumed to decrease stress sensitivity and enhance reproductive performance. A simple behavioural test, a feeding test (FT) has been shown to measure foxes' fear of man. FT is based on the hypothesis of hyponeophagia, i.e. that fearful animals do not start to eat in a fearful situation. The aim of the present experiment was to study whether it is possible to decrease fear of foxes, i.e. promote their domestication by selecting breeding animals according to their behaviour in FT.

At the beginning of the experiment genetically similar selection and control lines of blue foxes were formed, 30% of animals eating in FT in both lines. Both lines consisted of 100 females and 10 males. In the selection line, the selection of breeding animals during three generations was based on breeding value for confident (not fearful) behaviour measured by FT. In the control line, the selection was based on breeding values for fertility (40% of selection volume), fur quality (30%), body size (15%) and colour clarity (15%). Only one year old females and males were accepted for the next generation. New breeding animals were selected only within lines. Reproductive performance, stress sensitivity and brain mass of the two lines were assessed for the third generation foxes.

Percentage of females which did not conceive or lost their cubs before the cubs were 2 weeks old were 16 and 28 for the selection and control lines, respectively (P=0.084, Chi-square). Litter size was similar for the selection line and the control line (6.9±3.2 vs. 6.7±3.1, P=0.67, ANOVA). Percentage of cubs eating in FT in the selection line and in the control line were 71 and 42 (P<0.001, Chi-square), respectively. Selection line foxes had larger brain (41.6±3.3 g) than control line foxes (40.0±2.5 g, P<0.05, ANCOVA heart weight as the covariate). Selection line foxes had also lower urine cortisol:creatinine ratio (2.0±0.6) than control line foxes (2.8±1.4, P<0.01, ANOVA). There were no differences between the selection and control lines in stress-induced hyperthermia, i.e. increase in T_{re} after handling (0.3±0.4, 0.4±0.4, P=0.54, ANOVA), or adrenal weight (325±63 mg vs. 316±66 mg, P=0.54, ANCOVA), respectively.

The present results demonstrate that the behaviour of blue foxes in FT is hereditary. As a result, it is possible to decrease fear of blue foxes towards human by selection based on FT. At the same time, stress level and number of barren females and females which loose their cubs seem to decrease. In contrast to Hemmer's theory of domestication (Hemmer H: Domestication, Cambridge University Press, 1990), decrease of fear was connected to an increase, rather than to a decrease, in brain mass.

Effects of selection for domestic behaviour on socio-sexual interactions and steroid hormone levels in silver fox males

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Silver foxes bred in captivity show dominance of defensive responses to human contact. Genetic selection for tamability and against aggression and fear towards human produced a population of domesticated foxes better adapted to captive conditions (Belyaev, 1979). In previous investigations it was found that domesticated silver foxes were characterised with a number of changes in the reproductive function. However, effects of artificial selection for domestic behaviour on socio-sexual interactions between males and females and their hormonal control have not yet established in silver foxes. The main aim of this report was to elucidate possible effects of behaviour selection on agonistic and sexual components of reproductive behaviour and hormonal responses to opposite sex in silver fox males. Adult sexually experienced males from a control (n=6, C) and domesticated population (n=19, D) were used. All animals were kept in individual cages without any direct contacts with females. The males were placed with individual females during the nonbreeding (September) and the breeding season (January and February). They were allowed to interact with females in the males'home cages for 1 hr in the morning. The anestrus female was introduced to the male in September and January, and the oestrous (receptive) female was used in February. During the exposure, the sexual (mounts) and aggressive (conflict and boxing postures, and direct attacks) behaviours and ano-genital investigation were recorded. The blood was taken from the experimental males a day before and just after the exposure to females. The plasma samples were assayed for testosterone, oestradiol and cortisol.

The levels of aggressive and sexual interactions in pairs varied with season and the reproductive status of a female. The total number of aggressive contacts was maximal when anestrus female was introduced to the male (C: 6.8±1.7 acts/hour and D:15.0±2.0 in September and C: 11.2±1.5 acts/hour and D: 18.4±2.8 in January). The introduction of a receptive female resulted in decreased aggressive behaviour in pairs (C: 2.0±2.0 acts/hour and D: 5.3±0.9, February). Domesticated males always showed higher aggressiveness towards a female in comparison to the control ($P<0.01$). Sexual behaviour in pairs increased during the breeding season and it was maximal when a receptive female was introduced to the male. Domesticated males exhibited less sexual activity towards a receptive female in comparison to undomesticated males (C:12.5±5.4 mounts/hour and D:2.3±0.5 in February, $P<0.05$). Considerable season variations in the plasma levels of testosterone and oestradiol with the maximal concentrations in February were observed. During the reproductive season, the basal testosterone levels were higher in control males than in domesticated ones (C: 4.24±1.14 ng/ml and D: 2.45±0.29, January; C: 12.03±2.61 and D: 4.94±0.49, February, $P<0.05$). Both groups of males responded to the introduction of anestrus female with significant increase in the plasma testosterone and oestradiol levels being lower in domesticated animals compared to the control while the increased testosterone level after the exposure to a receptive female occurred only in domesticated males. It was concluded that behavioural selection reduced sexual and increased agonistic behaviour during bisexual encounters. Relatively low hormonal levels and responses to a female in domesticated fox males during the reproductive season may explain their peculiarities in reproductive behaviour.

The effects of sward height and distance between barn and pasture on the behaviour of dairy cows when grazing is combined with voluntary automatic milking.

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The possibility for grazing in the summer season is an important condition for many farmers who want to change to fully automatic milking. An unique element in the combination of grazing and fully automatic milking on a voluntary basis is that cows at pasture have to return to the barn by themselves several times a day to be milked. The extent to which cows return to the barn is affected by the sward height, as a measurement of the amount of grass in the pasture, and the distance between the pasture and the barn. These factors have been studied in two experiments with a group of 24 Holstein Friesian cows. An automatic milking system (AMS) was continuously available in a barn adjacent to a pasture of approximately 10 ha, which was divided into 10 plots of 1 ha each. The cows were allowed to spend up to15 hours at pasture daily. Water was only available in the barn.

The experiment concerning sward height was divided into four periods of four days. At the beginning of each 4-day period cows were given a fresh plot. Grazing reduced the sward height, so after 4 days, cows were moved to another fresh pasture. The plots did not differ in distance to the barn. The results showed that at lower sward heights cows paid more visits to the AMS, were milked more often, and spent more time indoors ($p<0.01$) and at the feeding gate ($p<0.05$). Total lying and grazing time were not affected by sward height.

The experiment concerning distance between the pasture and the barn was divided into 4 periods of 5 days. Cows were given a fresh plot at the beginning of each 5-day period, but the amount of fresh grass available was more or less the same on each day, because every day an electrified wire was moved, giving the cows access to a fresh strip of grass. The distances between the barn and the plots ranged from 146 to 360 m. The results showed that distances between the pasture and the barn did not affect the number of AMS visits, but the cows spent less time lying and more time standing or walking at the central alley between the pasture and the barn at more distant plots ($p<0.01$).

In both experiments, cows preferred to lie in the pasture rather than in the cubicles, and tended to visit the barn group-wise and to enter the AMS in close succession. As a consequence, in the period that the cows had access to the pasture, there were peaks in AMS visits, and the AMS was unvisited for several hours .

Comparison of behavior and welfare in weanling horses under two industry-practiced weaning methods

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Weaning foals marks a stressful event in horses' lives. Limited research exists regarding different housing methods post-weaning and the long-term implications on horse behavior and welfare. The purpose of this study was to monitor behavior and physiological stress markers in horses weaned individually in solid partition box stalls versus horses weaned in groups and housed in paddocks. Both treatments underwent maternal deprivation stress, but the stalled weanlings had the additive effects of social isolation.

Quarter Horse weanlings, average age 4.5 months, were weaned in 13.4 m^2 box stalls(n=6) or in groups of three in a 992.2 m^2 paddock with very limited grazing forage and an open shelter available (n=6). Weanlings were fed concentrate and hay to NRC recommendations. Behavioral observations were recorded two days/week for the duration of the 56 day study. Scan samples were recorded every five minutes on each observation day (n=35 scans/horse/day). On each observation day, fecal samples were collected for a noninvasive measure of glucocorticoid metabolites. Glucocorticoid metabolites were extracted from fecal samples and their levels determined using an enzymatic assay measuring 11, 17-dioxoandrostanes.

The ethogram of paddock-reared weanlings was significantly different than stalled weanlings ($P<.0001$) and was more complex. Paddock-reared horses that had the option of engaging in a broader range of behaviors selectively spent 19.2% of their observed time grazing, 89.1% of their time within 10m of their paddock mates, and 3.3% of their time actually in a social encounter; e.g. mutual grooming. Stalled weanlings spent 20.3% of their time lying down, versus 2.8% in the paddock-reared treatment (different at $P< .0001$). Paddock-reared weanlings did engage in standing rest a higher percentage of the time (30.2% vs. 14.3%; $P< .05$). Aberrant behavior; e.g. licking the stall or shed wall, chewing the stall or shed wall, kicking at the stall or shed wall, or pawing tended to be higher in the stalled weanlings versus the paddock-reared weanlings (2.9% vs. 0.1%; $P< .1$). Fecal 11, 17-dioxoandrostanes concentration increased in response to weaning ($P< .005$). 11, 17-dioxoandrostanes levels increased four fold from basal to five weeks post-weaning (7.2 – 27.5 ng/mg feces); however, no treatment difference was ascertained. No significant differences were observed in health status or growth rate. Stalled weanlings were observed to have a more aesthetically pleasing coat and hoof quality at the conclusion of the study.

Based on more complex ethograms in pastured horses, lower activity levels in stalled horses, and more aberrant behavior in stalled horses, we conclude that the paddock-reared weanlings had better welfare than the stalled weanlings.

The effect of early weaning from milk replacer on the behavior and production of calves

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In order to investigate the effect of early weaning from milk replacer on cross sucking and other oral behaviors in groups of calves, an experiment was carried out on 48 male and female dairy calves. They were divided into 8 groups each of 6 calves. Milk replacer was fed from teat-buckets twice daily, and the calves were constrained in the barrier for 15 minutes around feeding. The calves had free access to standard concentrate (max 1.5 kg per day) and hay. Half of the groups were weaned at the age of 13 weeks (late weaning) and the other half at the age of 6 weeks (early weaning). The calves were videorecorded for two consecutive days at the age of 6, 13 and 20 weeks. The frequency of oral behaviors was scored continuously. The animals' weight gain and feed consumption were also recorded. At the age of 20 weeks a novel object test was performed individually in their home pen. Latency to contact the novel object and time spent manipulating the object was recorded.

The mean frequency of sucking and licking the naval and genitals of other calves was highest the first two days following weaning, but it did not differ between the two treatments (weaned late: 4.9 ± 1.4; weaned early: 4.0 ± 1.8). At the age of 20 weeks the mean frequency had decreased in both treatments. Sucking and licking the mouth or ears of another calf was low throughout the experiment. Sucking and licking other parts of the body remained constant over age without any significant difference between the treatments. The frequency of sucking and licking the pen fittings was highest the first two days following weaning, but again, there was no effect of weaning age (weaned late: 8.8 ± 2.3; weaned early 13.5 ± 2.5). At the age of 20 weeks, however, the calves weaned early tended to perform the behavior more often (weaned late: 3.0 ± 1.1; weaned early: 6.0 ± 1.0). Self licking was the most frequently performed behavior but there was no difference between the groups weaned late and early (age 20 weeks, weaned late: 35.8 ± 6.9; weaned early: 29.2 ± 3.7).

The calves weaned early performed significantly more tongue-rolling at the age of 20 weeks (weaned late: 0.2 ± 0.0; weaned early: 2.2 ± 1.3; $P = 0.02$). In the groups weaned late the frequency of the behavior did not change over age, but in the groups weaned early, the mean frequency increased with age indicating that the stereotypy develops over time. Only few animals performed the behavior often and they were weaned early. The individual variation of tongue rolling was large.

The calves weaned early tended to spend more time manipulating a novel object than the calves weaned late, suggesting that the calves weaned early were more motivated to explore the environment.

At the age of 20 weeks the calves weaned late weighed significantly more than the calves weaned early (weaned late: 143.8 kg ± 1.9; weaned early: 133.9 kg ± 2.4; $p = 0.02$), however, the weight gain in both groups was good.

In conclusion, the results indicate that the occurrence of sucking behaviors decreases after weaning irrespective of weaning age from milk-replacer.

An increase in space allowance increases early play behaviour in group housed dairy calves

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Play behaviour may be used to indicate the presence of positive feelings and good welfare in juveniles. In dairy calves kept in pens, lack of sufficient space may inhibit the performance of play. Firstly, the present study investigated if an increase in space allowance increases the occurrence of locomotor and social play behaviour in calves, and secondly, if calves kept with a low space allowance perform more locomotor play when released individually in a large area.

Ninety-six dairy calves in 6 repetitions were housed in groups of 4 in pens with either 4 m^2/calf, 3 m^2/calf, 2.2 m^2/calf or 1.5 m^2/calf from 2 weeks of age. The occurrence of locomotor play and social play in the home environment were recorded continuously for each individual calf during 24 h at 5, 7 and 9 weeks of age. The variables were analysed using mixed models. The effect of space allowance was tested by an F-test using the interaction between space allowance and repetition as the error term. The effect of week was tested by an F-test using the interaction between space allowance, repetition and week as the error term. In addition, the duration of locomotor play was recorded for all calves during an individual 10-minute open-field test in a 10 m x 4.5 m arena at 4 at 10 weeks of age, and analysed effects of space allowance by Kruskal-Wallis one way analysis of variance.

At 5 weeks of age calves kept with 4 or 3 m^2/calf performed more locomotor play in the home environment than calves with 2.2 or 1.5 m^2/calf (68, 73, 38 and 39 seconds for 4, 3, 2.2 and 1.5 m^2/calf; $F_{3,15}$= 3.40; P<0.05). In weeks 7 and 9, no effects of space allowance were found. Locomotor play decreased over the weeks (54, 29 and 19 seconds for weeks 5, 7 and 9; $F_{2,40}$=17.98; P<0.001), but social play did not (133, 170 and 143 seconds for weeks 5, 7 and 9). During the open-field test at 10 weeks of age, calves from pens with 1.5 m^2/calf performed more locomotor play than calves on the remaining treatments (10, 6, 15 and 28 seconds for 4, 3, 2.2 and 1.5 m^2/calf; χ^2_3= 10.54; P<0.02).

The present study shows that an increase in the available space above minimum requirements increases the occurrence of both locomotor play behaviour at an early age. Given that the performance of play is associated with positive feelings for the calves, then additional space is of significance for the welfare of the animals, although calves may not experience negative feelings if spatial constraints inhibit play behaviour. However, when given optimal opportunity to perform locomotor play during release in a large arena at 10 weeks of age calves from the smallest pens used this opportunity more.

The rôle of light intensity in feeding preferences and behaviour of domestic layer fowl

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Light intensities, similar to those sometimes found in commercial poultry houses, were assessed for their effect on feeding behaviour. In experiment 1, the preferences of 10 mature domestic layer fowl (ISA Brown) to eat food in four light intensities (<1, 6, 20 and 200 lux) were assessed for both freely available food pellets and pellets mixed with sand and gravel (hidden). Each bird was allowed to eat for five minutes from both food sources. After every minute the lights were extinguished and the food re-lit under a different intensity. Overall, the birds preferred to eat under the highest light intensity and avoided the lowest (5.5, 9.1, 9.3, 15.3s respectively for increasing light intensity, sed=2.75, $p<0.01$, df=3, REML). There was no additional effect of whether the food was hidden or freely available.

In experiment 2, the strength of motivation to eat freely available food lit at an intensity of 200 lux or <1 lux was assessed. Each of nine layers was trained to peck one of two panels which allowed them access to food behind a trap-door. For five birds, pecking at a panel behind which was a small light source, allowed them to eat in 200 lux while pecking at an alternative, dark panel only allowed them to eat in <1 lux. This schedule was reversed for the remaining four birds. Three treatments were then imposed; (1) a fixed ratio (FR=1) where one peck to either panel opened the trap-door; (2) a variable ratio (mean=5 pecks, VR=5) imposed on whichever panel allowed access to the brightly lit environment (alternative panel FR=1); and (3) similar to (2) but with VR=10. Each bird was allowed 40 choices on each treatment. In treatment 1, the birds mainly opted to eat at 200 lux (mean 34.9 times, se=5.13). In treatment 2, this mean fell to 14.2 (se=6.16) times and 10.4 (se=5.05) in treatment 3. There was a significant difference between treatments 1 and 2 ($p<0.01$, n=9, Wilcoxon matched pairs test) but not between treatments 2 and 3.

In experiment 3, the effect of the same four intensities as in experiment 1 on detailed feeding behaviour was assessed. Nine layers were allowed to eat from a pre-weighed food source for four minutes. The food trough was attached to a force transducer to measure the force with which they pecked. After each minute (from the time the birds made their first peck) the light source was extinguished, the intensity changed and the food source replenished. The amount of food consumed differed between the light intensities (1.3, 7.5, 7,4, 7.1g/minute respectively for increasing intensity, sed=1.39, $p=0.013$, df=3, 21, ANOVA) as did the number of pecks (35.6, 125.0, 123.1, 125.4 pecks/minute sed=14.6, $p<0.01$, df=3, 21, ANOVA). However the amount consumed per peck did not vary. The force with which the birds pecked appeared to vary with intensity but not significantly (5.3, 6.6, 7.0, 6.6N, sed=0.62, $p=0.08$, df=3, 21, ANOVA).

In conclusion, the fowl exhibited a strong preference to eat in high light intensities and avoided low intensities. This motivation was strong, but elastic as cost (≡number of pecks needed for access) initially increased, although was inelastic (conserved) at even higher costs. The fowl were either less inclined or unable to eat as efficiently in low light intensities as they were in higher light intensities.

Dispersal behaviour in farmed foxes housed in connected cage system

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In the wild, offspring generally disperse from their natal territory prior to reaching sexual maturity. In farm environment the space is limited while food is always available. Under these circumstances, dispersal of littermates appears to provide no direct benefit. However, the underlying mechanisms preventing dispersal too early and subsequently promoting it in nature are based on evolutionary strategies and therefore may operate on farms as well.

In this study we monitored social behaviour of silver (Vulpes vulpes) and blue fox (Alopex lagopus) families from weaning until maturity in a cage system in which as many standard farm cages were connected together with openings as there were members in the families.

In four silver fox families of a vixen and her 5 cubs each, the social behaviour changed during the autumn. While in July around 60 % of the family members were resting simultaneously and in one cage or in two adjacent cages (45-50 % of time), the percentage of individuals resting simultaneously dropped below 10 % already in August and only rarely (<5 % of time) all family members occupied one or two cages only. In October, the family members typically were dispersed over the whole space available spending most of their time alone (36 %) or in pairs (63%). Aggressive encounters between family members were absent in July, but increased gradually from 8 aggressive acts/4 families per observation day in August to 72 in the end of October. In the families of 3 multiparous and 4 primiparous blue fox vixens and their 5 cubs each a similar trend as in silver fox families was observed. Group preference index (GPI) (0=all singly, 100=all together) of primiparous vixens decreased from 39 in August to 24 in September and to14 in November, while multiparous vixens with their 29 days older offspring preferred separation already in August (GPI=18). Vixens preferred to be alone 50 % of their time in August and > 60 % in November, whereas the cubs preferred separation about 20 and 40 % of their time in August and November, respectively. Unlike in silver foxes, aggressive encounters were rare in blue foxes.

We conclude that social tension increases gradually in the fox families during the autumn leading to dispersion of the family members provided the space available allows this. Although both species spaced out as the season progressed, aggression was a problem in silver foxes only. We hypothesise that this is due to species differences in the biology: in the wild, Arctic foxes live in an open environment with unpredictable food sources. Once a large carrion is traced, all individuals can eat rather that fight. Wild red foxes, however, live in a more covered environment with a more predictable food supply. Thus encounters with conspecifics are less likely, and once they occur they may be more severe.

Will Domestic Fowl Roost on Angled Perches?

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Red Jungle Fowl roost in trees to reduce the risk of predation. Because roosting increases survival in their wild relatives, we expected domestic fowl to choose to roost on perches. We predicted that birds would use angled perches more than horizontal ones since an angled roost would be similar to structures found in the wild. We assigned 768 male broilers to 16 pens in a 4x4 randomized complete block design. Each block contained a control pen with no perches and three treatment pens with either: (1) three 0° perches; (2) three 20° perches; or (3) one each of 0°, 10° and 20° perches (mixed angle treatment). Perch use was measured every 15 minutes for 3 consecutive hrs, 4 days/wk from day 1 to 42 using instantaneous scan sampling.

Overall perch use was highest in the 0° treatment and lowest in the 20° treatment. The same pattern of perch use occurred within the mixed angle treatment. Perching generally increased with age, but a decline in perching occurred during wk 6, likely due to high ambient temperatures and high body weight. Use of the 0° and 20° perches during weeks 3 through 6 was higher in the mixed angle treatment than in the 0° and 20° treatments, respectively, possibly resulting from the birds having access to a variety of angled perches in the mixed angle treatment early on. Use of the 10° and 20° perches in the mixed angle treatment were higher, but not significantly so, than 0° perch use during week 1. Our predictions were partially met since angled perches were used more initially than horizontal perches. We determined that perching increased with age of bird, was greater for lower angled perches, and followed a crepuscular pattern.

The behaviour of male growing pigs housed in a deep-litter and conventional housing system.

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Housing pigs in large sheds using a floor base of deep litter has been developed as an alternative housing system for pigs. These systems are cheaper to establish and are perceived as being more «welfare-friendly» for pigs, compared to conventional intensive systems. Recent industry records have shown that pigs grown out in deep-litter systems are ten percent less efficient in converting feed to live weight gain and are 15-20 percent fatter.

In an initial experiment we developed an ethogram of behaviour for growing pigs in a deep-litter and conventional housing system. The aim of the present experiment was to measure the social and feeding behaviour of male growing pigs housed in a deep-litter group housing system and conventional housing system. Eight hundred and eighty crossbred (Large White x Landrace) entire male pigs were used in the experiment. The pigs were eighteen weeks old at the start of observations. There were 200 pigs/pen (17 pigs/feeder) in the deep-litter system. Initially there were 20 pigs/pen (20 pigs/feeder) in the conventional pen. Two weeks prior to slaughter group size in conventional pens was reduced to 15 pigs/pen (15 pigs/feeder). The deep litter pens were 10m x 20m and the conventional pens were 2.7m x 3.6m. The feeding system was the same in both treatments (double spaced, wet-dry feeders). Four replicates were used, with ten animals per replicate selected as focal animals. Social behaviour of these focal pigs was measured by direct observation four weeks prior to slaughter and feeding behaviour was observed using time-lapse video two weeks prior to slaughter. Analyses of variance for behaviour data analyses were applied to pen means (not individual pigs).

Results from the social behaviour component of the trial showed that pigs housed in a deep-litter system were more active and had more social interactions (aggressive, exploratory and sexual behaviour) away from the feeding area compared to conventionally housed pigs ($P<0.05$).

Feeding behaviour results indicated that pigs housed in conventional systems spent more time in the feeding area, had more feeding events and had a shorter duration of feeding compared to pigs on deep-litter ($P<0.05$). Conventionally housed pigs had a higher total feeding time over the observation period, although this was not significant. Conventionally housed pigs had a higher level of social interactions ($P<0.05$) around the feeder, which may cause interruptions during feeding bouts compared to deep-litter systems.

From these results we hypothesise that pigs grown out in conventional housing systems have more social interactions around the feeder that limit feeder access. This may result in a restriction to potential feed intake. When pigs are put into an unrestricted feed situation where there is increased accessibility to the feeder (deep-litter system), feed intake may increase, resulting in excess fat deposition and possibly feed wastage.

The rôle of UV_A light in mating and mate choice of the domestic fowl

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The functional significance of UV_A perception by domestic fowl and other birds has yet to be determined fully; one potential rôle is mediation of social signals including mating signals. The implications for domestic fowl of being able to perceive, but unable to utilise UV_A light due to its absence in intensive housing, may be a welfare concern.

Our first study investigated the rôle of UV_A light on behaviour and production parameters in two flocks of 41 Ross 508 broiler breeders (4 cockerels, 37 hens per flock). Each flock experienced a UV_A-enriched light environment and a conventionally lit environment for five, two-day periods in a cross-over experiment. Birds exposed to UV_A attempted to mate more often (1.27 vs. 0.99 matings/male.hour; s.e.m.=0.09 and 0.08 respectively; P=0.019) and increased their locomotory activity (5.31 vs. 3.74 minutes/bird.hour; s.e.d.=0.4; P=0.011). There were no significant changes in production parameters, other than an increase in cracked eggs in UV_A (0.05 vs.0.01 eggs/bird.day, as a proportion of the total number of eggs; s.e.m.=0.01 and 0.01; P=0.019).

The second study investigated the rôle of UV_A light in mediating sexual cues using a four-armed maze to assess mate choice. One cockerel was placed in each arm and exposed to one of four levels of UV_A-supplemented light per day (1.6%, 14.6%, 43.5%, 57.5% of the total spectral power output of the luminaires). Over four days, each cockerel experienced each light treatment in a different arm. Each day, ten hens were given the opportunity to choose a mate, quantified by the length of time spent associated with each cockerel. This schedule was repeated for two other groups of cockerels. When given the opportunity to inspect the cockerels for 5 minutes at a distance of 60cm or more away through mesh doors, hens spent most time with cockerels lit by 1.6% and 14.6% UV_A (1.33 vs. 1.37 vs. 1.22 vs. 1.16 log seconds/hen.choice respectively for increasing UV_A; s.e.d.=0.08; P=0.042). During a second inspection of 15 minutes, at a distance of less than 60cm, hens spent significantly more time with cockerels lit under 14.6% UV_A (1.62 vs. 1.88 vs. 1.69 vs. 1.51 log seconds/hen.choice respectively for increasing UV_A; s.e.d.=0.12; P=0.038). A control trial using the same ten hens was performed with no cockerels present. Hens had no preference during near inspection, but during remote control inspection had an inherent preference for 14.6% and 57.5% UV_A (1.28 vs.1.38 vs. 1.26 vs. 1.51 log seconds/hen.choice respectively for increasing UV_A levels; s.e.d.=0.06; P<0.001).

We conclude that UV_A light is implicated in the mediation of sexual cues, possibly through the reflective properties of secondary sexual characteristics. An enhancement of signalling between the cockerel and the hen may thus explain the increase in attempted copulations seen in study 1.

In the context of milking robot failure, does the cow care if she is not milked?

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Failures in the attachment of the milking robot happen in the range from few to up 10% of milking visits. They mostly involve the same cows, whose udder conformation is less convenient for robot attachment. In general, after milking failure cows try to revisit the milking robot voluntarily if they are not sent to the separate area. Since it is difficult to estimate the effect of milking failure on the cow and her welfare in conditions of robotic milking, a 16-day trial was conducted on 12 cows. The cows were milked in a milking parlour with 6 milking stalls. During each evening milking 3 randomly chosen cows were not milked. After milking (or not milking), all cows were closely observed in the cubicle house for 1 hour; thereafter, 3 unmilked cows were milked. In total, each cow was observed 12 times after milking and 4 times after omitted milking. The following behavioural traits were registered: time budget for 1 hour, occurrence and time until eating, drinking, lying, urination and defecation, as well as aggressive interactions. Milking order was defined on the basis of whether the cow came to the milking parlour within the first group of six cows or within the second group of six cows. Moreover, the data related to the milk yield and the use of the automatic feeding installation with the complete diet were analysed. After omitted milking, cows that came to the milking parlour in the first group stood longer in cubicles (14.2% of 1 hour) and lay less (5.4% of 1 hour) than milked cows (respectively: 7.0% and 16.3% for standing and lying in cubicles) ($P<0.05$). After omitted milking cows urinated earlier and more frequently (64.5%) than cows after milking (36.3%) ($P<0.05$). After omitted milking cows ate faster than cows after milking (238 v. 206 g/min) ($P<0.05$); however, differences in eating time and in feed intake were not statistically significant. Milk yield per cow averaged 24.9 kg during days with omitted (delayed by 1 hour) milking and 25.3 kg during the days without omitted milking ($P<0.01$). It was concluded that cows show some signs of inconvenience after omitted milking, this seemed to be greater in cows that were more motivated to be milked i.e. coming earlier to the milking parlour. However, interest in feeding was not affected by omitted milking. It is suggested that a trial with simulated robot failures for different cows should be conducted in the light of our findings, paying particular attention to the effect of robot failure on highly productive cows.

Poster presentations

arranged by theme

Effect of manipulating feathers of laying hens on the incidence of feather pecking and cannibalism

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Feather pecking is a problem in commercial laying hens, particularly in loose-housing systems where many hens can be affected by few feather peckers. In addition, feather pecking can become an even larger problem if it spreads throughout the flock.

There are several possible ways that feather pecking may spread from initial feather peckers to other hens. The simplest way is that one hen may damage the feathers of a hen, and another hen may find the damaged feathers an attractive pecking target.

The aim of this experiment was to determine if damaged feathers were feather pecked more than undamaged feathers on the same body area, and to determine whether some types of feather-body area manipulations were preferred over others as a pecking stimulus.

Manipulations involved damaging the feathers on the rump, tail or belly of different hens, with two or three levels of severity of manipulation at each body area. Sixteen groups of 11 Lohmann Brown hens between 26 and 28 weeks were observed with the recipient, the feather pecker and the body area that was pecked all being recorded. The feather pecks were classified separately as either gentle or severe.

Damaged feathers did receive significantly more (ten fold) severe feather pecks than undamaged feathers ($p=0.026$). There were also more gentle feather pecks to damaged feathers (four fold), although this did not reach statistical significance. Certain feather-body area manipulations were more preferred as targets of severe feather pecking, specifically the tail feathers when cut very short, the rump feathers when they were ruffled, and the rump when feathers were removed.

These results add support to the suggestion that feather pecking does indeed spread through flocks by damaged feathers becoming an attractive target for feather pecking behaviour.

An unexpected result of performing the feather manipulations was an outbreak of cannibalism in half of the experimental groups. Even though there was no visible damage to the skin of the hens after having the feathers manipulated, 13 of the 16 hens (83%) who were attacked were wounded on the part of the body where the feathers had been damaged in some way. Therefore it appears that by changing the appearance of these hens by manipulating their feathers, we somehow made them into victims of cannibalism.

Stone chewing in indoor housed pigs

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Free-range pigs spend much time foraging and exploring their surroundings. In outdoor pigs sniffing, grazing, rooting and chewing behaviour can be observed. The animals chew food items as well as non-food items, such as stones and earth. Pigs spend about the same amount of time stone chewing as they spend rooting, when they have access to a pasture (Braund et al., 1998, Appl. Anim. Beh. Sci. 56: 173-186). Indoor pigs direct their foraging and exploring behaviour to the floor, the walls and the straw. This experiment focused on the effect of offering stones to indoor pigs and the relation between stone chewing and foraging related behaviours. It was hypothesised that supplying indoor pigs with stones can be regarded as an environmental enrichment.

Two groups of 8 gilts (Yorkshire x British Landrace) were used in the experiment. The animals were housed indoors in pens on straw. For a period of 9 days distributed over 2 weeks the gilts received 8 small stones (± 4 cm in diameter) every other day using an alternating schedule. Observations were done using individual scan sampling. Every 3 minutes the behaviour of each individual was recorded. The ethogram included resting, straw chewing, sniffing the floor and stone chewing. Both groups were observed for 3 hours on all experimental days, for 1.5 hours in the morning and for 1.5 hours in the afternoon. Observations started immediately upon the offering of stones. The gilts had access to the stones for the rest of the day. On control days only the gesture of offering stones was made. Just before the afternoon session started all stones that the pigs had removed from the pen were returned.

On the days the animals were provided with stones, the animals spent about 45% of their time chewing stones. They rested much less (21% of their time versus 55%; $P < 0.01$) and chewed less on straw (4.5% of their time versus 19%; $P < 0.01$). Sniffing behaviour was not affected by the offering of stones. Repeated measurement analysis showed a strong effect of condition (stones or no stones) and no effect of time on both resting and straw chewing behaviour. In conclusion, the behaviour of the gilts was strongly influenced by the supply of stones. The animals were activated by the stones and used them intensively for chewing and manipulating purposes. Supplying indoor-housed pigs with stones can be considered an enrichment of the environment of the animals. The function of stone chewing and its relation with other oral behaviours however remains unclear.

Effect of milk flow rate and presence of a floating nipple on abnormal sucking between dairy calves

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The aim of this study was to investigate if access to an artificial teat compared to an open bucket would decrease abnormal sucking in calves held in pairs, and if the calves would perform less abnormal sucking if they spent longer time drinking/sucking the milk. Abnormal sucking is defined as a calf sucking on a body part of another calf.

In total 16 calves in 8 pairs were included in the study. They were fed twice a day with 2.5 l of whole milk from a bucket that was connected to another bucket with a rubber pipe. This arrangement was done to regulate the milk flow in the bucket where the calves drank. Each group had 4 different treatments during 4 weeks in a random order. The treatments were 1. Bucket with fast flow 2. Bucket with slow flow 3. Floating nipple with fast flow and 4. Floating nipple with slow flow. The milk ran from one bucket to another in approximately 40 s during fast flow and approximately 10 min during slow flow. All groups had one treatment for 6 days before behavioural observations were performed. They were done as instantaneous recordings at 20 s intervals during 30 min starting when the calves received their milk. The behaviours recorded were categorised into 5 groups and tested by an analysis of variance, the General Linear Model.

The treatment ”bucket with slow flow” and the two treatments with a floating nipple resulted in a significant decrease in abnormal sucking, compared to “bucket with fast flow” ($p<0.001$). During the experiment 13 of 16 calves sucked at least one time on another calf, but there were big individual differences between calves. Of all the abnormal sucking performed 64% was directed under the belly of the other calf. Sucking on other objects was significantly higher in the treatment ”floating nipple with fast flow” ($p<0.001$), because the calves continued to suck on the empty nipple after the milk was finished. During this treatment 95 % of the objects they sucked was the empty nipple. They continued sucking for up to 15 min on the nipple. Those calves that had no access to a nipple did not suck on other objects to the same extent as the ones with a nipple. The calves licked and bit on objects more when the milk flow was fast than when it was slow ($p<0.001$), independent of if there were a nipple in the bucket or not. All calves had finished ingesting the milk after 3-4 min with fast flow and 14-16 min with slow flow.

The conclusion of this study is that both the performance of sucking and the time taken to ingest milk are important in order to decrease abnormal sucking between calves. This implies that dairy calves should be allowed to suck the milk and that milk flow should be so low that the motivation to suck has vanished.

Stereotyped behaviour in juvenile foxes

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Stereotyped behaviour occurs frequently in captive farm and zoo animals. In the present study, possible stereotyped behaviours were identified for juvenile silver foxes (*Vulpes vulpes*) and blue foxes (*Alopex lagopus*) housed in traditional wire mesh cages.

The behaviour of 12 blue and 12 silver foxes of both sexes was video-recorded for two 24-h periods at the ages of 3-5 months. Their behaviour was analysed with continuous recording. A behavioural pattern was regarded to be a stereotype one if the pattern had invariant sequence of movements without any obvious goal and function, and if it was repeated without changes more than 15 seconds. The time spent on activity or rest during a 24-h day was derived using instantaneous sampling with 10 min intervals. The foxes were fed twice a day during working hours (0800-1600 hours).

Four main categories of possible stereotypies were found. S1, Locomotory stereotypies alone: repeated pacing, including pacing and jumping along a cage wall or around in the cage with or without a twirl of the head. S2, Locomotory stereotypies with neighbour: repeated pacing and jumping along a cage wall with a neighbouring fox. S3, Manipulative stereotypies: including scratching, digging, licking and biting the cage. S4, Tail-chase: repeated chasing and biting of own tail. Blue foxes performed these four types of behaviours 2.7±7.5 (median = 0), 0.6±1.5 (0), 21.6±12.1 (19.5) and 0.8±1.2 (0) min/24 h, respectively. The figures for silver foxes were 4.5±6.6 (0.7), 2.9±2.4 (2.1), 18.6±8.7 (17.8) and 2.2±3.1 (0.9) min/24 h, respectively. Silver foxes performed more S2 than blue foxes ($P < 0.001$, Mann-Whitney U-test). No other differences were observed either between species or between sexes ($P > 0.05$). In both species, S3 occurred more often during evening (1600-2400 hours) than during night and working hours ($P < 0.05$, Friedman Two-way ANOVA). S1 was observed more often during working hours than during other times of day in blue foxes ($P < 0.05$).

Spearman Rank Correlations between 24h activity and stereotypies S1, S2, S3 and S4 in blue foxes were 0.17 (NS), 0.38 (NS), 0.86 ($P < 0.01$) and 0.36 (NS), respectively. Corresponding correlations in silver foxes were 0.27 (NS), 0.11 (NS), 0.56 ($P < 0.05$) and -0.59 ($P < 0.01$), respectively.

The most performed stereotyped behaviour S3, and perhaps S2, do not necessarily fulfil all the criteria of a true stereotype; they may have an obvious function. Juvenile foxes are replacing their teeth at around this age, and this might partially explain the large category of manipulative stereotypies (S3): the foxes may have a need to gnaw on something. Locomotory stereotypies with neighbour (S2) is also questionable, because it may be contact seeking behaviour. The conclusion is that true stereotypies seem to be rather rare in juvenile farmed foxes.

New possibilities for measuring stress responses using Infra Red Thermography

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Animals exposed to stressors show various physiological responses, among them changes in body temperature. A well-known short-term temperature response is an immediate increase in core body temperature. On long term fluctuation in the circadian temperature rhythm may be affected. The two main methods for measuring body temperature are by rectal probes and by telemetry devices. Drawbacks of both methods are (1) that the area in which the animal can be studied is small, as the distance to the receiving apparatus is limited, and (2) that the animal has to be disturbed for the insertion or implantation of the measuring devices. Furthermore, changes in body temperature need to be corrected for changes in activity pattern of the animal.

A new measuring device for automated recording of body temperature is being developed at the AWC Utrecht, in co-operation with Noldus-Wageningen. By combining an infrared video camera with the automated behaviour-recording software Ethovision®, we now have an integrated tool for tracking changes in both behaviour and skin-temperature continuously. The advantage of this method is that animals can be tracked without disturbing them, in various environments, even in dark. A new feature is the possibility for measuring temperature at different parts of the body (e.g. head and tail) simultaneously.

At the conference we present results of integrated behaviour/temperature measurement of rats exposed to different stress regimes. Long- and short-term variations in temperature of body and tail surface, measured with present method are compared with known variations in core-body temperature. Implications of present method for welfare research, its specific limitations and possibilities are discussed. We conclude that present method is a useful, additional tool for behavioural, physical and welfare research.

Flight distance as an indicator of temperament in Holstein cows

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The objective of the study was to determine whether flight distance, how close a human can approach a stationary cow before she moves away, could be an indicator of temperament. In experiment 1, sixty-two daughters of eight sires were selected to measure flight distance in six commercial dairy farms. Flight distance was measured four times for each cow once a week or once a month. Measuring was conducted in free stall barns, outdoor paddocks, or pastures. Flight distance was analyzed by variance analyses using a model that included sire, farm, repeated number of measuring, parity, and lactation period. Tukey's studentized range test was performed on all these factors. Farmers' daily operations for cows in lactating and dry periods were observed. Observations were conducted six days for each farm at an interval of one week or one month. The operations were classified into four categories by the probability of touching cows: [A] operations where farmers certainly touch cows, [B] operations where farmers perform them near cows and occasionally touch the cows, [C] operations where farmers never touch cows, [D] operations by machinery and vehicle. Spearman rank correlation coefficients were calculated between operation time of each category, total operation time and flight distance for the six farms. In experiment 2, fifteen cows were observed to measure flight distance and temperament score in the Hokkaido National Agricultural Experiment Station. Flight distance was measured three times for each cow once a month. On the same days as measuring flight distance, the temperament score of each cow was determined according to the activities when body size was measured. Numerical scores from one (very quiet) to four (nervous) were assigned. Spearman rank correlation coefficients were calculated between flight distance, temperament score, body weight, and body weight/height ratio. In experiment 1, farm and repeated number of measurings were significant effects on flight distance. Flight distance was different among farms and gradually shortened as measurings were repeated. Sire, parity, and lactation period had no significant effect on flight distance. Flight distance was positively correlated with operation time of category [A] in lactating cows and total operation time in dry cows. Cows in farms where farmers touched their animals longer had shorter flight distances. In experiment 2, flight distance was negatively correlated with body weight, body weight/height ratio, and temperament score. More massive and nervous cows had shorter flight distances. It was unexpected that more nervous cows tended to have shorter flight distances. This may be explained by the result that the temperament score was positively correlated with the body weight and body weight/height ratio. Handlers tended to score cows by body size because they could feel some difficulty in holding massive cows. These findings indicate that flight distance can be interpreted as an indicator of temperament in a broad sense, but it can be strongly influenced by daily operation time that farmers handle their cows.

Feather Pecking and Coping Styles

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The way animals respond physiologically and behaviourally to threatening situations is defined as coping. The existence of different "coping styles" have been described. This generally refers to active coping (fight/flight) or passive coping, in which the animal tries to remain undetected by becoming immobile. The active coping style of mammals is characterized by a strong sympathetic response, but low corticosteroid response, whereas their passive coping style is characterized by a strong cardiac parasympathetic response and strong hypothalamic- pituitary-adrenocortical response. Little is known about the coping styles of birds, in particular laying hens. The purpose of this investigation was to determine whether there is a difference in coping style in chicks from a high (HFP) and low feather pecking (HFP) line of laying hens. We studied heart rate and stress hormone levels during baseline conditions and during manual restraint in HFP and LFP hens. During manual restraint (restraining the bird on its side by hand for 8 min) HFP birds had somewhat faster heart rate and significantly higher plasma noradrenaline levels than LFP chickens. LFP hens had both significantly higher plasma corticosterone levels and a higher parasympathetic activity than HFP hens. The results showed that in terms of coping style, LFP chickens are passive, whereas HFP birds are active.

Can piglets' behaviour help to predict their growth?

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Piglet personality traits have been widely studied in the last decade. However, none of the studies attempted to link these traits with weight gain during the first month post-weaning. This experiment was therefore conducted to compare the weight gain of 252 piglets raised on a commercial farm and subjected to different behavioural tests after weaning. Piglets were early-weaned at 17±1 days old. Between 20 and 25 days old, open-field and reaction to human tests were conducted on each piglet. For this purpose, piglets were isolated and their behaviour was noted every 20 sec for 4 min in the open-field test. Then an unknown human entered the test pen and the approach behaviour of the piglet was noted for 3 min. At 23±1 days old, we evaluated the social status of each piglet in its home pen. Dominant piglets were the first ones able to eat for 30 sec in the single-space feeder of the pen. Weight was measured individually on the arrival of the piglets at the post-weaning building and weekly for the following month. Weight gain was calculated for each week. Principal component analysis and varimax rotation were used to analyze the contribution of each variable measured in the behavioural tests before performing a Spearman rank-order test on the behavioural traits obtained and weight gain.

The principal component analysis yielded five factors with Eigenvalue higher than 0,90 that accounted for 81% of the total variation between individuals. The five factors correspond to sociability, active response to stress, passive response to stress, ingestion and hierarchy. Sociability (27%) was best defined by measures related to favorable reaction to the presence of humans (long time spent in an area around a human and high number of contacts with this person). Active response to stress (21%) was best described by variables involving a high level of activity such as walking or running and high number of vocalizations. Passive response to stress (14%) was best defined by variables involving low level of activity such as standing, urinating and defecating. Exploration of the surroundings was the variable with the lowest loading for these two factors. The factor ingestion (10%) was strongly associated with feeding and drinking. Finally, hierarchy (9%) was best defined by social status of the piglet in its home pen. A significant correlation was found between hierarchy and weight gain of piglets after weaning ($r \geq -0,15$, $p \leq 0,10$).

These data demonstrate that personality traits of piglets may not be a strong tool to predict their growth but still have some impact. Furthermore, the factors defined in this study explain over 80% of the inter-piglet variation in response to behavioural tests and are similar to previously published results.

Individual differences in temperamental traits of horses

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Temperament generally refers to relatively stable individual characteristics that show some consistency over time and across situations. The interest in behavioural research on temperamental traits in animals has grown since we know that they are relevant to the science of animal welfare. It places a particular emphasis on the way in which individuals react to environmental change and challenge. With a behavioural test one can objectively assess the individual response to an environmental change or challenge. These tests, such as a novel environment test or a novel object test have been executed to a great extent with cows, pigs and rodents, but to a lesser extent with horses. In most of the horse studies, animals were either not from the same age, and/or were privately owned. In the latter case rearing conditions differed between horses. The goal of this project is to develop and execute behavioural tests to assess individual characteristics in horses at an early age.

In this study 41 Dutch warm-blood horses were used. These horses were born in the spring of 1998 and are housed in groups of 8 or 9. Between the age of 5 months and 3 years all horses will go through several behavioural tests to assess individual differences. To test consistency, these tests will be repeated twice a year with a four weeks interval. Behavioural tests that are executed between 5 months and 13 months include an arena test, a novel object test and a handling test. During these tests behaviour is recorded with real time video camera. Behaviour is analysed with the Observer system (Noldes Information Technology). During the tests heart rate is measured with Polar Horse Trainer transmitters. Before and after the tests saliva is collected to analyse cortisol levels.

The first test, the arena test, is performed to assess individual difference in behaviour while in isolation. This test is first performed at an age of 5 months; foals have not been isolated before. Foals are first made acquainted with the testing environment, which is an ordinary inside arena, used for horse riding, in groups of eight. During the tests foals are one by one left alone in that same arena for 10 minutes, isolated from the group, other horses and people. The second test is executed to observe the responses of horses to a novel object. In this novel object test an umbrella is lowered into the arena. Latency times to contact the umbrella as well as total time spent close to the umbrella will be used to differentiate between horses. In the third test, the handling test, the performance of the horse, i.e. willingness to co-operate, while being with a human will be measured. In this test the human leads the horse to make it cross a concrete 'bridge'. Behavioural data will be linked to physiological data. Responses in different tests will be compared between and within horses.

Responses of young bulls to repeated deprivation of lying down

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The effect of repeated stress (deprivation of lying down) on behaviour, performance, and hormonal responses in sixteen tethered Danish Friesian bulls (age 7 month) were studied. The animals were assigned to either control treatment or deprivation of lying down (DLD) from 7.00 to 14.00 and again from 15.00 to 22.00 hour every day during 10 weeks. Feed intake was recorded daily. The behaviour of individual animals was recorded for 48 hours both in weeks 3 and 8. Blood samples used for analysis of plasma hormone and metabolite concentration were collected weekly. ACTH and cortisol responses to iv. injection of CRF and saline, and GH responses to iv. injection of GRF were measured on the following days before and during the treatment period: –32, 3, 22, 49 for CRF; –36, 60 for saline and 7, 55 for GRF. Blood samples were taken by vein puncture immediately before injection and after 15 and 30 min. Bulls subjected to DLD had a shorter lying time (571 versus 970 min/ day, $P < .0001$), spend more than 3 hours sitting and had an increased frequency of transitions between behaviours (726 versus 543 no./day, $P < .001$). The behavioural changes were consistent, suggesting that the bulls did not adapt to the repeated deprivation of lying down. The blood sampling itself had no effect on ACTH and cortisol concentration, as there was no response to saline injection. In lying deprived bulls the ACTH response to CRF injection was initially (day 3) reduced ($P < .05$) but returned gradually to the same level as in control animals (day 22 and 49). There were no treatment differences or treatment x day interactions on the cortisol response to injection of CRF. However, the cortisol response to CRF injection 3 days after initiating DLD was reduced compared with before treatment in the animals subjected to deprivation of lying (35.3 versus 67.0 nmol/L, $P < .01$). Bulls deprived of lying down tended to have lower circulating levels of IGF-I (355 g/ml control, 328 g/ml lying deprived, $P = .10$), while no effect was observed on the GH response to injection of GRF. Numerically the deprived bulls had a 10% higher feed conversion ratio (6.65 ± 0.43: versus 5.98 ± 0.19 feed units/kg gain, $P = .23$) and a 12 % lower daily gain compared to control (1115 ± 75 versus 1246 ± 55 g/day, $P = .19$), but the difference were not statistically significant. However, between animal variation was increased in lying deprived bulls. In conclusion, deprivation of lying down in young bulls caused consistent behavioural changes, whereas the responses in the pituitary-adrenocortical axis changed as the treatment progressed.

Correlations between feeding test behaviour, adrenal cortex function and body size in silver foxes (*Vulpes vulpes*)

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Recently, the feeding test has been validated as a practical tool for measuring farmed silver foxes' fear towards man. In the test, a fox is offered its normal feed, and it is recorded whether the fox starts or does not start to eat within 30 s while man stands near its cage. Earlier it has been shown that animals eating in the test (performed once in October) have less active adrenal cortex function than animals not eating. In the present study, the relationship of behaviour in a repeated feeding test was assessed not only to adrenal cortex function, but also to adrenal mass, body mass and brain mass.

The feeding test was performed for 24 male and 24 female juvenile silver foxes once a month from August to December. The behaviour was scored from zero (not eating in any of the tests) to five (eating in all tests). Cortisol:creatinine ratio was analysed from a 24-h urine sample collected in October. All other measurements were carried out in early January.

No correlations were observed between urine cortisol:creatinine ratio, base level of plasma cortisol and plasma cortisol response to ACTH administration. There were no correlations between the feeding test behaviour and adrenal cortex function. Adrenal mass was correlated only with body mass (both sexes: $r = 0.48$, $P < 0.01$; males: $r = 0.43$, $P < 0.05$; females: $r = 0.30$, $P = 0.16$). Thus, adrenal mass reflected general body size rather than adrenal cortex function. The more frequently the foxes ate in the feeding tests, the heavier they were ($r = 0.36$, $P < 0.05$). This same trend was observed in both sexes (males: $r = 0.37$, $P = 0.076$; females: $r = 0.36$, $P = 0.087$). The correlation between the feeding test behaviour and, body mass, and the lack of correlation between the feeding test behaviour and adrenal cortex function indicate that the repeated feeding test, used in the present study, may be measuring more motivation to eat than fear. A possible explanation to this is that the foxes habituated to the test situation with the repetition of the test, and therefore hunger overcame fear.

Males ($r = 0.42$, $P < 0.05$), but not females ($r = 0.086$, $P = 0.69$), with heavier brain ate more frequently in the feeding test. On the other hand, brain mass did not correlate with body mass in males ($r = 0.16$, $P = 0.45$) or females ($r = 0.062$, $P = 0.77$). The cortisol:creatinine ratio in urine was negatively correlated with brain mass in the females ($r = -0.45$, $P < 0.05$), but not in the males ($r = -0.12$, $P = 0.57$). These results may point to the direction that bigger brain enhances coping, but the sex differences in the correlations remain unexplained.

Effects of reproductive stage, diurnal rhythms and feeding on heart rate and arterial blood pressure in unrestrained goats

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Heart rate and arterial blood pressure are sensitive circulation criteria that can be used to monitor the physical as well as psychological condition of animals. These variables have therefore been recommended as valuable tools for investigations into behavioural physiology in animals and as a complement to measurements of hormones. However, using physiological variables when evaluating animal well-being requires knowledge of the normal variations in these parameters. The aim of the present study on dairy goats (*Capra hircus*) was to evaluate changes in arterial blood pressure and heart rate that occur during the course of an entire day, in response to changes in feeding routines, and from one reproductive stage to the next. The same four Swedish domestic goats were used in the experiment, so that each animal served as its own control. The goats were 4-5 years old, multiparous, and kept individually in boxes where they could move freely. The animals were fed hay and a mixture of oats and concentrates at 07.00 and 15.00 h in the boxes, except during lactation when oats/concentrates were given in connection with milking. Registrations were made by radiotelemetry (Data Sciences Inc., St. Paul, Minnesota, USA) during pregnancy, lactation and the non-pregnant, non-lactating (dry) period. Each telemetry device consists of a sealed transmitter body and a fluid-filled catheter. Under anaesthesia, the transmitter body was placed subcutaneously on the lateral side of the neck, and the catheter (40 cm) was tunnelled subcutaneously to the superficial temporal artery and further into the carotid artery. During the registrations, the heart rate and blood pressure signals were transmitted to a receiver, placed centrally above each box, and the signals were digitised. Registrations were made every 30 min, where each value is a mean calculated over a period of 10 s in each animal. Heart rate rose around the morning and afternoon feedings ($P \leq 0.05$), whereas blood pressure did not show any diurnal rhythm. Comparison between reproductive periods revealed that heart rate was higher during the 5^{th} month of pregnancy ($P \leq 0.05$) than during lactation and the dry period, whereas for blood pressure no such difference between periods was found. Withholding three consecutive meals from lactating goats resulted in a continuous slowdown of the heart rate, whereas blood pressure fluctuated. Refeeding temporarily increased the heart rate ($P \leq 0.05$), but had no effect on blood pressure, which continued to fluctuate. The results show that with this telemetry device it is possible to measure both heart rate and blood pressure day and night in the same unrestrained animals over a length of time long enough to include all reproductive periods. Our results emphasise that when planning experiments it is important that the exact stage in each reproductive period, the act of eating, and the amount of food given all be taken into account.

Effects of omitting three milking occasions in dairy goats

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It is unavoidable that situations occur when animals feel discomfort or pain, but efforts should be made to avoid such situations as far as possible. However, a mother may loose her off-spring or the power supply may fail, which means that milk accumulates in the udder and this is known to be painful. The aim of this study was to investigate if it is possible to objectively evaluate if dairy goats experience discomfort due to omitted milking occasions.

The study was performed in a change-over design, during two separate weeks. Seven dairy goats *(Capra hircus),* in the 22^{nd} – 26^{th} week of lactation, were milked and fed concentrates in a milking stand at 07.00 and 15.00 h. Hay was given in their boxes before milking. During the first two days of each week the goats were milked as usual. On the morning and evening of the third day and on the morning of the fourth day, the goats were taken to the milking stand, but not milked. Immediately after the last omitted milking, the goats returned to the milking stand and were milked. Thereafter the milking was performed as usual the remaining days.

During the period when the milkings were omitted, and the corresponding control period, behavioural observations were made. S*tanding* (=standing without eating) and *laying* (=laying without eating) were registered. Each observation period lasted for 20 min and registrations were made once every minute. During the day (9.30 – 16.30 h) there were no differences between treatments but during the night (17.30 – 05.30 h) the goats were standing more when they were not milked ($p \leq 0.05$). When the goats were not milked it was no difference in time spent standing between day and night, but when they were milked they were standing more during the day ($p \leq 0.01$). Thus, the animals were behaviourally affected by the omitted milkings, probably due to the distended udders. Blood samples were withdrawn from an intrajugular catheter during the same period as the behavioural observations took place. The results showed that plasma cortisol and oxytocin concentrations did not differ between treatments. However, the vasopressin concentration decreased when milkings were omitted ($p \leq 0.01$), and increased to control levels when the milking started again ($p \leq 0.01$). Since vasopressin has been reported to be implied in the pain response this result is difficult to explain. Telemetric registrations of heart rate and blood pressure registrations were made (Data Sciences Inc., St Paul, Minnesota, USA) every 10 min during the whole study. These parameters did not differ between treatments. The small physiological changes could be due to the fact that the goats were in late lactation and that the milkings were not omitted for long. The behavioural results indicated that the animals experienced discomfort, but this was not substantiated by the physiological parameters. This emphasises that behaviour was a more sensitive criterion of discomfort in the present experiment.

Frustration-induced aggression: the effects of thwarting access to food and water in the domestic hen.

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Frustration can be defined as the reaction to a situation in which a behavioural response is not rewarded when the animal has learnt to expect one. It is usually induced experimentally by thwarting access to food by physically preventing access while still allowing visual contact with the resource. The behavioural response may include increased activity, behaviour directed at the barrier, displacement behaviours or aggression. In group- housing systems for poultry, access to resources such as food, water or nest boxes in large group-housing systems may be thwarted by physical barriers or other individuals, which may lead to increased aggression and reduced welfare. The aim of the present experiment was to extend past work by investigating the effect of thwarting access to food and water, examining in detail the type of aggression expressed and also the effect of repeated experience of the frustrating event. Thirty-four hens were housed in small groups and home pen observations of aggression were used to assign birds to dominant:subdominant pairings. Nine pairs were tested under food deprivation and eight under water deprivation. We used a small test arena (1.2 x 0.9 m) with a 2.0 m runway leading to it, with one ten minute test trial for each pair per day. The subdominant bird was fed/watered before each trial and then secured in the arena by a small leash. The dominant bird was given seven training non-thwarted trials with free access to food/water from a small dish in the arena. This was followed by thwarting trials on test days 8, 12, 16 and 20 with three non- thwarting trial days following each thwarting trial day. In thwarting trials a clear plastic cover was placed over the food/water dish.. Behaviours recorded included aggressive pecks, non-aggressive pecks, running attacks, standing, preening and pacing. The data were adjusted for time spent eating/drinking and analysed using REML. Higher rates were shown in thwarted trials compared to non-thwarted trials for aggressive behaviours (1.20 vs 0.74 per min), non-aggressive pecks (0.65 vs 0.36) and running attacks (0.20 vs 0.10, all $P<0.001$). No effect of repeated experience of thwarting was found ($P>0.05$). A higher proportion of time was spent walking (0.15 vs 0.10, $P<0.001$), pacing (0.006 vs 0.0003, $P<0.00$ 1), and out of the arena in the runway (0.14 vs 0.07, $P<0.00$ 1) in thwarted vs non- thwarted trials, but no difference was shown for time spent preening (0.02 vs 0.03, $P>0.05$). The results show that the behavioural response to thwarting in this situation was to increase activity, and aggressive and non-aggressive interactions with the subdominant bird. Similar results were shown by Duncan and Wood-Gush (1971). Running attacks, in which the subdominant had no chance to show submissive behaviour and avoid attack, may destabilise the hierarchy. The aggressive response to thwarting of access to both food and water was indistinguishable and did not decline with repeated experience, at least on the schedule used here. Thwarting access to resources appears to cause an increase in aggression and may therefore lead to reduced welfare in group-housed birds.

Duncan and Wood-Gush, 1971. Anim. Behav., l9, 500-504.

Salivary cortisol as a non-invasive indicator of stress in rhesus monkeys (*Macaca mulatta*): Methodological considerations

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Plasma cortisol levels have frequently been used as an indicator of stress in humans and animals. However, the sampling procedure can often produce a rapid cortisol rise, limiting the use of this measure to isolated animals that are quickly restrained, or have a canulated blood vessel for sampling. As an alternative, the measurement of salivary cortisol is becoming increasingly popular. This method is non-invasive and samples can be collected more frequently and easily. It has been used in pigs, humans, goats, horses and lately in some species of primates like squirrel monkeys and rhesus macaques. However, in the latter case, there are no published data about important aspects of the validation of this technique: *i.e*. how closely salivary cortisol reflects plasma concentrations and to what extent results are not affected by the sampling procedure (*e.g*. interval between stressful event and sample). This work was carried out to look for correlations between total cortisol levels in plasma (C_{pl}) and cortisol in saliva (C_s); and to establish if there is a rise in salivary cortisol shortly after handling.

First, parallel samples of blood and saliva were collected from 21 adult rhesus macaques tranquillised and blood-sampled for routine husbandry purposes. Plasma and saliva samples were frozen at -20°C and were later analysed for cortisol using radioimmunoassay. The average for C_{pl} was 53 µg/dL ± 1.2 SE, while C_s was 4.5 µg/dL ± 0.4 SE. Percentages of cortisol found in saliva were 8.4% of plasma levels (range: 1.9-14.4%), similar to what the literature reports for pigs and humans. The correlation between C_{pl} and C_s was 0.41 ($p=0.003$). This is close to what some studies have reported for pigs, but overall lower than studies in other species. Possible reasons for this will be discussed.

In the second stage of this study, we investigated the effect of time on C_s after a stressful event. It is known from previous work that there is a rise in C_{pl} after handling and tranquillisation. We wanted to find out how long does it take for C_s to rise after a stressful event, in order to determine a reasonable time interval to sample a conscious animal without the procedure affecting the indicator. We collected saliva from 8 adult monkeys at 5-minute intervals after capture and tranquillisation. Including the time since entering an animal room and injecting subjects with the tranquilliser, samples were effectively taken at 5-10 (t_1), 11-15 (t_2), 16-20 (t_3) and 21-25 (t_4) minutes after the procedure started. The shape of the curve obtained indicated a steep rise from t_1 to t_2 with C_s increasing significantly from 1.98 µg/dL ± 0.24 SE to 4.23 µg/dL ± 1.35 SE (Wilcoxon signed rank test: $Z= -2.02$; $p=0.04$), up to 218% the initial levels. In conclusion, saliva samples taken from adult rhesus macaques should be collected during the first 10 minutes of initiating a procedure. This is especially important when sampling groups since this interval might be difficult to achieve with the last animals. More research with habituated non-tranquillised animals is necessary to further clarify this methodological issue.

Heart Rate Variability: a novel non-invasive means of assessing fear responses in animals?

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Fear is one of the principal negative emotional states experienced by farmed animals but despite much investigation, assessment of emotional states remains problematic. Changes in cardiac activity (CA) during exposure to fearful stimuli have been used increasingly as indirect measures of intensity of fear. Traditionally these shifts in CA have been expressed using mean heart rate parameters. More recently, however, researchers have begun to investigate a more intricate component of cardiac function known as heart rate variability (HRV). Heart rate (HR) is principally under the control of the parasympathetic and sympathetic branches of the autonomic nervous system (ANS). In healthy animals, HR at any one time represents the net effect of both branches. Under resting conditions, parasympathetic activity (PA) is dominant and functions to slow HR. Sympathetic activity (SA) increases during times of psychological stress with a concomitant increase in HR. However, on a beat to beat basis, HR does not remain constant. It fluctuates around the mean, reflected in rhythmic oscillations on an electrocardiogram (ECG) of different R-R interval duration, and is known as HRV. Although HRV has been used extensively in clinical medicine for over 25 years, it has only recently gained attention as a measure of the psychophysiological status of humans and, potentially, animals. Variations in HR and HRV are most frequently analysed using time domain analysis (TDA) and frequency domain analysis (FDA). Several variables derived from TDA may be used as measures of PA.

Table 1. Time Domain Measures of HRV

Measure	Description	Significance
SDNN	SD^1 of RR intervals	Represents all components contributing to variability
SDANN	SD of the averages of RR intervals in all 5-minute segments of the entire recording	Measures variability due to cycles shorter than 5 min
RMSSD	Square root of the mean of the sum of squares of difference between adjacent RR intervals	HF variance, parasympathetic nervous modulation
NN50	# of pairs of adjacent intervals differing > 50 ms	HR variance, parasympathetic nervous modulation
pNN50	NN50 divided by the total # of intervals	HR variance, parasympathetic nervous modulation

FDA, using Fast Fourier Transform to mathematically transform HRV data into power spectral density (PSD), reveals hidden physiological rhythms not expressed using TDA. The principal spectral components of PSD are located in 3 frequency bands: Very Low Frequency (VLF), 0.003-0.04 Hz; Low Frequency (LF), 0.04-0.15 Hz; High Frequency (HF), 0.15-0.4 Hz. PA is the principal cause of HF but controversy exists with respect to the LF component. Several studies suggest that SA is responsible for the power in the LF band whereas others advocate input from both branches of the ANS. The LF:HF ratio is accepted to reflect the sympathetic modulation. Fearful situations result in changes in the ANS control of HR almost instantaneously, usually in the direction of sympthetic dominance. The duration and intensity of SA excitation depends on the individual and the nature of the situation. After short exposure, sympatho-vagal balance often returns to pre-exposure levels within minutes. If a situation persists, such as long-term social stress, SA can remain aroused even after HR has returned to baseline levels. With technological advances, interbeat intervals can now be recorded non-invasively on farmed animals over periods of several minutes to several days. Analysis of this data using TDA and FDA techniques may reveal HRV to be a potential tool for the assessment of autonomic function and therefore a useful indicator of emotional state in farmed animals.

Relationship between rearing conditions, behavioural strategies and immune reactivity in pigs

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The behavioural strategy of pigs, as measured by the degree of resistance displayed in the backtest, may be related to their immune reactivity. Recent research shows that, when challenged immunologically, low-resisting pigs (LR) show a higher humoral immune reactivity (antibody response), whereas high-resisting (HR) pigs tend to have a higher cell mediated immune response (T-cell proliferation). However, it is unknown if and how different rearing conditions influence these differences in immune responses. The aim of the present study was to examine the relationships between behavioural strategies, rearing conditions and (cellular and humoral) immune responses of pigs. Pigs were reared either in an enriched environment (straw bedding, 'rich') or under impoverished conditions (bare concrete floor, 'poor'). At 10 and 17 days of age pigs were subjected to the backtest to determine their behavioural strategy (Hessing et al., 1993, Appl. Anim. Behav. Sci. 37:285-295). Ten LR (5 reared 'poor' and 5 'rich') and 19 HR (10 'poor' and 9 'rich') were used. Pigs were immunised with DNP-KLH (1 mg) at 8-9 weeks of age. Blood samples were drawn prior to immunisation (day 0) and at day 7, 14, 21, 28 and 35 post immunisation. In vitro KLH-specific cellular immunity (T-cell proliferation) was measured as well as humoral immune responses (antibody titers including the isotypes IgG, IgM and total Ig).

HR pigs showed a higher KLH-specific T-cell proliferation than LR pigs ($p < 0.05$) throughout the whole post immunisation period, but the kinetics of the cellular immune response did not differ between LR and HR pigs. Furthermore, T-cell proliferation tended to be affected by behavioural strategy and rearing condition interactions at day 14 and 28 ($P < 0.10$). 'Poor' LR pigs tended to show a higher cell mediated immune response to KLH than 'rich' LR pigs. For HR pigs, opposite effects of rearing conditions were found. Pigs reared under poor conditions showed higher total Ig antibody titers than 'rich' pigs ($P < 0.05$), and a different time course of the response ($P < 0.01$). IgG titers were affected by a behavioural strategy x rearing condition interaction ($P < 0.05$); for total Ig titers this interaction changed with time ($P < 0.01$). The IgG and total Ig responses to KLH appeared similar for both 'poor' and 'rich' HR pigs; differently reared LR pigs, however, tended to vary in both magnitude (IgG antibody titers 'poor' LR > 'rich' LR) and time course of the humoral immune response. In conclusion, immune reactions of pigs appear to be linked to both individual characteristics and rearing conditions. Moreover, these two factors interact, indicating complex relationships between rearing conditions and behavioural strategies. The present study confirms the relationships between behavioural strategy (HR vs LR) and humoral and cellular immune responses found in previous studies; however, they only hold for 'poor' rearing conditions. Both the magnitude and the kinetics of the humoral immune response of LR pigs may be more influenced by environmental conditions than those of HR pigs.

Effects of intracerebroventricular infusion of Arginine-Vasopressin on plasma cortisol level and behaviour in sheep

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Arginine-Vasopressin (AVP) as well as Corticotrophin-releasing factor (CRF) have been known as important mediator of stress responses in rodents. In sheep, it has been reported that AVP is a more potent releaser of adrenocorticotrophic hormone than CRF in anterior pituitary cells. Neither its effect in vivo other than systemic infusion nor central effects on behaviour, however, is fully elucidated in a whole animal model. We elucidated corticotrophic potential of AVP in vivo using intracerebroventricular infusion technique and determined the effects of AVP on behavioural function in sheep.

Five sheep were assigned to each of 4 treatments. Sheep were infused intracerebroventricularly with 0.5 ml of artificial cerebrospinal fluid (aCSF) or 0.12, 1.2 or 12 μg AVP dissolved in 0.5 ml aCSF into third ventricle over 30 min. Serial blood samples for cortisol measurement were collected via indwelling jugular catheters every 10 min. Behaviour was successively recorded via time-lapse video recorder. Occurrence of bleating and duration of sham chewing, bar biting, i.e. biting their cage and water cup, and rubbing were analyzed. All these observations were conducted for 120 min after the onset of infusion.

One point two and 12 μg of AVP elicited a dose-related increase in plasma cortisol values. Two sheep bleated once or 72 times after 1.2 μg infusion of AVP, and three bleated once, 7 or 8 times after 12 μg infusion. Sham chewing was observed in one sheep after 0.12 μg infusion, in one sheep after 1.2 μg infusion, and in all sheep after 12 μg infusion. The mean latency to start sham chewing was 2518.2 ± 421.0 sec after the onset of 12 μg infusion and the mean of total duration was 1031.8 ± 259.0 sec which was significantly longer than other treatment. Bar biting was observed in all sheep only after 12 μg infusion. The mean latency to start bar biting was 3053.8 ± 580.7 sec after the onset of infusion and the mean of total duration was 568.2 ± 330.3 sec. Rubbing was observed in four sheep only after 12 μg infusion. The mean latency to start rubbing was 3157.81 ± 770.9 sec after the onset of infusion and the mean of total duration was 42.2 ± 62.7 sec.

These results indicate, together with our findings reported at the 31st ISAE congress, that AVP has the same corticotrophic potential as CRF infused intracerebroventricularly in equal molar concentration. Though the oral stereotypical behaviours, i.e. sham chewing and bar biting, were not dose-dependent in this study, which suggest those responses were pharmacological, we speculate that AVP might relate with oral stereotypies in sheep. Further study is needed to assess the role of AVP in stress responses of sheep, considering various stressful contexts and using selective AVP receptor antagonists.

Repeatability and Inter-rater Agreement of Behaviour Tests on Piglets on Commercial Farms

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The level of fear relates to the animal's ability to cope with the environment and thus constitutes a probable indicator of animal welfare, also for piglets. Piglets represent a problematic target for behavioural tests, as their behaviour repertoire changes rapidly. Furthermore, group housing complicates the behavioural testing of individual animals in their home environment. The aim of this study was to examine the repeatability and reproducibility of two different fear tests.

The study included two commercial pig farms, where the piglets at weaning (approx. 4 weeks old) were transported to a farm unit at another location. Two suckling piglets (3 weeks old) from each of 42 litter were tested individually in a test arena (1 x 1.5 m^2). Following a 2-min period alone in the arena the piglets were tested towards either an unfamiliar person or a red plastic football. The latency in seconds to approach and touch the person or object was registered within a 2-min testing period. The tests were repeated on other piglets from the same litters two days later. Either one or three weeks after weaning (w.a.w.) 44 groups of 30-45 piglets were tested in their home group and environment, towards both an unfamiliar person standing outside the pen, and a red plastic football introduced to the pen. The tests were repeated two days later. The latency in seconds, of the first piglet to approach within one metre from the person, or to touch the ball, was registered.

We found a high inter-rater agreement of two observers measuring the response of the suckling piglets (mean (person): 90.1 vs. 89.7; mean (object): 45.4 vs. 45.3) as well as weaned piglets (mean (person): 26.3 vs. 26.4; mean (object): 29.1 vs. 26.7). The latency to approach the person or object varied from 2 sec. to > 120 sec., 40 % of the suckling piglets did not approach the test person.
The response of the suckling piglets was categorised into: Fast (<30 sec); moderate (31-120 sec) and slow response (>120 sec). Tests on littermates showed a low level of repeatability (χ^2=2.882, P=0.610 (person); χ^2=4.837, P=0.328 (object)).
Weaned piglets did not respond differently to the person between days (median: 34 vs. 17; z(Wilcoxon test)=1.327, P=0.185 (1 w.a.w.); median: 18.0 vs. 17.5; z=1.269, P=0.204 (3 w.a.w.)). The response to the object differed between days for the younger piglets (median: 35.5 vs. 26.0; z=2.419, P < 0.05), no correlation were discovered (r_s=0.158; P=0.483) as well as the older piglets (median: 21.5 vs. 8.0; z=4.318, P<0.0001) showing no correlation (r_s=0.221; P=0.323).

These fear tests have potential in an operational welfare assessment system, as they show a high level of inter-rater agreement. Repeatability on the individual level is difficult to assess due to learning interference, and results from the individual fear tests of the suckling piglets showed no repeatability on litter level. A plausible explanation could be the variation in fear response between littermates. Test of repeatability on farm level demands further studies. The person tests on groups of weaned piglets seemed to be repeatable on group level. Learning is assumed to have influenced the results of the object test, as the response tended to be faster and less varying in the second test, especially for the older piglets.

Fear Testing in Loose Housing Systems for Pregnant Sows

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Fear reactions shown by animals towards humans, reflect the quality and quantity of human contact. Animals may be unpleasantly affected by the recurring contact between animal and man, depending on handling and management conditions. Therefore, fear reaction towards humans is a relevant welfare indicator for use on commercial farms. In loose housing systems it is often difficult to carry out fear tests on individual sows, due to a high animal density. An operational fear test might be carried out in relation to management routines where sows are individually handled.

The aim of this study was to measure repeatability and reproducibility of an on-farm fear test and further to investigate the effect of familiarity of test person and phase of pregnancy.

A sample of 208 sows (140 sows in mid pregnancy – tested either of two days; 68 sows in late pregnancy) from four farms with loose housing systems, were tested towards either a familiar or unfamiliar person. At a passage – 10 metres long and about 1 metre wide (used as a test arena) the sows had to pass a human. Fearful animals were presumed to hesitate approaching the test person compared to the speed of moving away, and to show less explorative behaviour during the test than less fearful animals. In order to measure the fear reaction the time required to approach the person (Time A) and the time to move away from the person (Time B) were compared: The degree of hesitation (Time A / Time B).

Two observers registered the behaviour of all the sows to analyse the reproducibility of the fear test. We found a high inter-rater agreement regarding the degree of hesitation (mean: 1.83 vs. 1.86; Wilcoxon test: $z=-0.721$, $P=0.471$). The fear test was repeated on two groups of 70 mid-pregnant sows not showing a significant difference (mean: 2.05 vs. 1.86; $F=0.227$, $P=0.634$). Familiarity of the test person was shown to have an effect on the degree of hesitation (mean: 1.42 vs. 2.23; $F=8.085$, $P<0.005$). The phase of pregnancy was tested comparing 68 sows one week prior to parturition with 70 sows in mid pregnancy. This did not seem to affect the degree of hesitation (mean: 1.58 vs. 1.91; $F=1.459$, $P=0.229$).

Reproducibility and repeatability for the fear test seems to be high. The phase of pregnancy did not affect the result of the fear test. The test might thus be successfully applied in an operational welfare assessment system and carried out when sows are routinely moved from the gestation to the farrowing section. The choice of test person should be considered as the response to an unfamiliar person tends to differ from the response to the stock person. A possible correlation between the fear of a familiar and an unfamiliar person might be elucidated through further studies.

Methods for evaluating HPA-axis function in dairy cows

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In the last three decades, milk production level in Dutch dairy cows has almost doubled. Genetic correlations between milk yield and health traits of dairy cows indicate that selection for high milk yield may lead to a deterioration in health. However, cows with similar milk production levels show, for example, a great variety in occurrence and severeness of mastitis. Obviously, some individuals seem to better adapt to the demanding milk production level than others. These differences in adaptation may be a result of differences in immune system and the Hypothalamus-Pituitary-Adrenal (HPA)-axis of individual cows. The HPA-axis is of vital importance for the ability of a cow to adapt to environmental change and plays an important role in balancing the immune response. From a welfare point of view, it is therefore interesting to study HPA-axis reactivity of dairy cows in relation with their milk yield.

To study HPA-axis function in dairy cows two challenge-tests were developed in two experiments. In Experiment 1, pituitary-adrenocortical responses to exogenous stimulation with different doses of bovine corticotropin-releasing hormone (bCRH) were measured to assess a dose of CRH which effectively discriminates between individual cows (CRH-challenge-test). In Experiment 2, a dexamethasone/corticotropin-releasing-hormone-test (DEX/CRH-test) was adjusted for use in dairy cows by determining the dose of DEX and CRH. The DEX/CRH-test has proven to be valuable for studying altered feedback resistance of the HPA-axis in humans.

In both experiments, the day prior to testing multiparous Holstein cows were supplied with a jugular vein catheter to facilitate frequent blood sampling. In Experiment 1, 35 multiparous pregnant cows in mid-lactation received one of the following doses of CRH: 0 (control, n=7), 0.003 (n=7), 0.01 (n=7), 0.03 (n=7) or 0.1 (n=7) µg/kg BW. In Experiment 2, the doses DEX administrered to 17 multiparous non-pregnant cows were: 0 (control, n=4), 0.01 (n=3), 0.1 (n=3), 1.0 (n=3) and 10.0 (n=4) µg/kg BW in combination with 0.1 µg/kg BW CRH four hours later. Serial blood samples were taken to analyse ACTH and cortisol in plasma. Results of Experiment 1 suggest that a dose of 0.1 µg/kg BW CRH gives a pituitary-adrenocortical response which effectively discriminates between HPA-axis reactivity of individual dairy cows. In Experiment 2, a dose of 1.0 µg/kg BW DEX suppresses CRH-stimulated endogenous cortisol release in dairy cows to such an extent that the negative feedback function of the HPA-axis in dairy cows can be studied. In future experiments, these tests will be carried out in cows differing in milk production and energy-status.

Effects of softer flooring on the behaviour, health and productivity of dairy cows in tie stall housing

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To test the advantages of providing softer flooring for dairy cows, we compared the behaviour, health and productivity of lactating Holsteins housed in tie stalls with either soft rubber mats (n=12) or concrete flooring (n=12). Cows were paired on the basis of 305-d milk yield in their previous lactation and body weight. Data was collected for 16 weeks beginning on day 14 of lactation (± 4 d). General activity of cows was observed continuously during one 24-h period during weeks 1, 3, 7, 11 and 15. Time spent eating was estimated by a scan sampling one complete 24-h period every two weeks (8, 24-h periods). By sampling, each cow was observed for a 3-min period at 12-min intervals.

Cows on rubber mats spent significantly more time lying compared to cows on concrete flooring (9.52 ± 0.63 vs. 7.86 ± 0.38 h/d). However, individual lying bouts was longer in duration for cows on concrete (1.71 ± 0.36 h vs. 1.09 ± 0.08 h) and they changed position less frequently (lay down = 6.14 ± 0.08 vs. 9.34 ± 0.10 times/d). Cows on concrete flooring spent more time standing idle, however both groups spent the same amount of time eating. Overall there were no significant differences between the two groups in feed consumed or average milk yield. However, there was a tendency for feed conversion ratio to improve over time with cows on the soft rubber mats. Weekly milk samples were tested for somatic cell count, fat, protein and lactose, none of which differed between the two flooring treatments. We also scored cow cleanliness, leg lesions and other injuries weekly throughout the study. There was a significantly higher (almost doubled) incidence of swelling of the carpus joint for cows housed on concrete. Our results show that cows housed on soft rubber flooring were less hesitant to change positionfrom standing to lying (and vice versa) and as a result changed position more frequently. On rubber mats cows spent more total time lying and less time standing idle than cows on concrete flooring. The decreased incidence of swelling of the carpus joint for cows on soft rubber mats may have important long term effects in preventing a variety of leg problems. The increased resting time and reduced leg injuries show the advantages of providing soft flooring in tie stalls for the welfare of dairy cows.

The effects of feeding space allowance for cows on eating behavior characteristics in free-stall housing

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For a compact design of free-stall housing, the reduction of feeding space per cow is one of the choices. The objective of this experiment is to examine the effect of feeding space allowance for cows on eating behavior in free-stall housing.

The observation of eating behavior was conducted in three commercial dairy farms that had free-stall housing. Total feeding space was 28.4 m, 32.4 m and 27.1 m in Farms A, B and C, respectively. Thirty-two cows were kept in housing of Farm A, 58 cows were kept in Farm B and 79 cows were in Farm C. The feeding space per rearing cow was 0.89 m in Farm A, 0.56 m in Farm B and 0.34 m in Farm C. Twenty-four hour observation of eating behavior began at the morning milking. The identification of eating cows and the identification of the feeding place of their access were made every 10 minutes, directly. The minimum length of pre-meal intervals was used 20 minutes in this study.

There was no difference in the daily eating time between Farm B and C. Although Farm B and Farm C had about the same daily eating time, the number of meals and average meal lengths differed. The number of meals in Farm C was significantly larger than that in other farms. There was no difference in the number of meals between Farm A and B. The average meal length was shortened by increasing the density of rearing cows or the reduction of feeding space. In Farm B and C, there were high rate in 150-200 and 250-300 minutes range of eating time. In Farm A, there was high rate in 250-300 and 300-350 minutes range of eating time. Frequency distribution of individual eating time became longer by the reduction of the density in the change from Farm A level to B level. However, the density change from Farm B to C level did not affect the distribution of individual eating time. Frequency distribution of meal length significantly differed in Farm C with that in other farms. In Farm C, about 50 % of meals were stopped within 10 minutes, on the other hand, in Farms A and B, less than 20 % of meals were stopped within 10 minutes. The percentage of meals that lasted equal to or longer than 60 minutes was 20.9 % in Farm A, 8.0 % in Farm B, and 3.2 % in Farm C. The percentage of the quiet short meal (less than 10 minutes) increased by the change of density from Farm B to C level, and longer meals decreased by the change of the density from Farm A to B. It was concluded that cows in Farm C adapted to the high-density situation by shortening their meal lengths and increasing the number of meals to sustain their daily intake. Cows had to exert more effort to live in a situation like the one in Farm C than they did in situations like those in Farms A and B.

The effects of the density of cows in free-stall housing on stall utilization and lying behavior

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For increasing housing efficiency, it is important to know how many cows can be housed in free-stall housing. When the number of rearing cows is larger than the number of stalls, resting behavior might be disturbed by the competition between cows. The objective of this study was to examine stall utilization and lying behavior of cows in free-stall housing with different density levels.

The observations were made in three commercial farms that had free-stall housing. Density (ratio of number of rearing cows to number of stalls, number of cows/number of stalls) was 0.53 in A housing, 0.77 in B housing and 1.20 in C housing. Three rows of stalls were placed in each farm's housing. Observations were carried out from July 29 to August 2, 1996. The cows were observed throughout 24-hour period. The position of the cows (trough, stall and alley) and behavioral types (standing, lying and eating) were observed every 10 minutes. From recorded data, daily lying time, the mean of utilization time of the stall at the end of a row and the duration of the lying period were compared for every housing.

Daily lying time was 789 minutes/day/cow in A housing, 613 minutes/day/cow in B housing and 545 minutes/day/cow in C housing. Daily lying time was shortened according to the increase in density. Number of lying period was 9 periods/day/cow in A and B housings, and 11 periods/day/cow in C housing, which the density was highest of the three housings. Utilization time of the stall at the end of a row was significantly shorter than that of other stalls in every housings ($P<0.05$). In addition, the mean of utilization time of the stall at the end of a row was 395 minutes/stall in A housing, 373 minutes/stall in B housing and 625 minutes/stall in C housing. The utilization time of the stall at the end of a row in A housing was almost equal to B housing, and the time in C housing was longer than that in other two housings. The duration of the lying period was 86 minutes/number, 68 minutes/number and 49 minutes/number, respectively, and was significantly shortened according to the increase in density ($P<0.05$). In housings A and B, the duration of the lying period immediately after the milking was longest, and it was shortened according to time after the milking. In C housing, in which the density was the highest of the three housings, the duration of the lying period was influenced by the amount of time after the milking. Although the duration of the lying period was that difference was large immediately after the milking between housings, and after that it became small. Therefore, it was found that in high-density housing utilization of the stall at the end of a row, which in utilization was little low-density housing, was lengthened so that competition for stalls increased. Further, it was found that the duration of the lying period immediately after the milking was especially shortened according to the increase in density.

Eating and Resting Behaviour of Market Weight Pigs in a Nürtingen Housing System.

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The Nürtingen housing system for pigs includes a thermally controlled resting area (kennel) and allows the resting pigs to keep their noses outside the kennel through plastic curtain strips. This housing system provides free access areas designated for social interactions, eating, drinking, elimination, and showering during hot weather. The objective of this study was to assess the use of the kennels by the pigs and to compare resting, eating and other behaviours of pigs reared in the Nürtingen (N) and conventional (C) housing systems. Behavioural data were collected using time-lapse video recording summarized at hourly intervals during the day. In order to assess seasonal effects, the observations for N were extended over summer and winter periods. External temperatures ranged from 18 ^{O}C to 33 ^{O}C in the summer and -5 ^{O}C to 3 ^{O}C in the winter. The internal temperatures were close to ambient in the summer and 1 ^{O}C to 3 ^{O}C in the winter. Inside of the kennels temperatures ranged from 20 ^{O}C to 33 ^{O}C. Market weight pigs, between 90 and 105 kg, were used for the observations and penned at 1.06m^2 and 1.02m^2 per pig for the C and N housing systems respectively. The differences between housing systems for the proportion of pigs observed resting (N 91.3; C 89.9%) and eating (N 7.2; C 6.7%) were non significant. Pigs in the N system were observed resting more ($P<0.01$) in the summer (91.3%) than in the winter (87.1 %), but pigs rested outside of the kennels less ($P < 0.01$) in the Winter (4.7%) than the Summer (16.7%). The pigs in the kennels rested predominantly (86%) with their noses protruding through the plastic curtain. Over the period of a day, eating behaviour was observed to occur more frequently around the time of placing feed in the feeder. The eating activity peaked in the afternoon (13.9%) for N pigs and in the morning (16.4%) for the C pigs. Pigs in the N system effectively utilized all available activity areas of the pen. Higher environmental complexity of the N system provides, broader variety of spacial choices and more occupational opportunities for the pigs. These results indicate that the N system may enhance the well being of pigs.

Behaviour and performance of sows and piglets in crates and a group-house deep-straw Thorstensson system

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A comparison was made of the performance and behaviour of sows and piglets housed in crates and a group-house deep-straw Thorstensson system (balanced for parity and time of year). Two batches of seven were farrowed in the Thorstensson system of which five in each batch were selected for analysis. Thus a total of ten sows were analysed from the group-system (mean parity: 1.90 ± 0.40; 6 gilts) and compared with eight sows from crates (mean parity 1.62 ± 0.26; 4 gilts). 24 h time-lapse video recordings were made and a farrowing day was established for each sow by noting the 24 h period during which she gave birth (09.00h to 09.00h).

Each sow and litter was then analysed from 12.00h to 20.00h during the 24h immediately following this day. The following analyses were conducted: (1) The number of each lying and related event was noted (lie sternal, lie lateral, lie sternal move to lateral, lie lateral move to sternal, roll over, sit to lie); (2) The number of piglets within 0.3 m of the sow was noted, expressed as a proportion of the litter size and two indices were calculated for each sow based on either the mean for 10-minute scans or all lying events. Production parameters were collected throughout; weaning occurred on day 24 (± 3).

The total number of sow lying and related events was significantly greater in the Thorstensson system (mean for crate: 6.50 ± 1.26; Thorstensson: 12.80 ± 1.38; $U = 9.50$; $p < 0.01$) due to an increased incidence of sternal to lateral movements (crate: 3.62 ± 0.73; Thorstensson: 6.10 ± 0.78; $U = 17.50$; $p < 0.05$) and rollover events (crate: 0.37 ± 0.18; Thorstensson: 2.20 ± 0.55; $U = 14.0$; $p < 0.05$). Piglets aggregated closer to the sow in the Thorstensson system at lying events (crate: 0.30 ± 0.07; Thorstensson: 0.54 ± 0.05; $U = 15$; $p < 0.05$).

At birth mean litter size was 10.88 (± 0.72) in the crate and 11.90 (±0.56) in the Thorstensson system. At weaning mean litter size was 10.25 (± 0.49) in the crate and 9.80 (± 0.55) in the Thorstensson. Overall piglet mortality was significantly higher in the Thorstensson system (crate: 0.63 ± 0.32; Thorstensson: 2.10 ± 0.48; $p < 0.05$) due to an increased incidence of crushing (crate: 0.25 ± 0.16; Thorstensson: 1.90 ± 0.48; $p < 0.01$). One day after farrowing the increased risk of mortality due to crushing in the Thorstensson system appeared due to an increased tendency of piglets to aggregate near the sow during lying events and increased frequency of roll over and sit to lie behaviours.

The effect of housing system during gestation on behaviour and skin lesion scores of gilts in the farrowing house

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For the foreseeable future it is likely that sows will continue to farrow in crates irrespective of how they are housed during gestation. Loose housed sows experience more frustration around parturition when confined in crates (Marchant and Broom, 1996). The purpose of this study was to evaluate the effect of housing system during gestation on the welfare of gilts on initial introduction to the farrowing crate, at parturition and throughout lactation.

Fifty-two gilts were allocated to three gestation housing treatments: stalls (ST); loose bedded* (LB) and loose unbedded* (LU) (*Group size = 4). Five days before expected farrowing date gilts were moved into conventional farrowing crates with fully slatted metal floors. Behaviour was recorded directly for 60 seconds every 5 minutes during the first hour in the crate and on video for 24 hours on days 1 and 8. Prior to and during housing in the farrowing crate 34 locations on the body were inspected for lesions which were scored according to a method adapted from de Koning (PhD Thesis, Utrecht, The Netherlands, 1985). Lesions were scored from 0 to 6 according to severity; addition of scores yielded a total score per gilt. Kruskal-Wallis tests and Repeated Measures MANOVA were performed on the data. During the first hour in the farrowing crate LB gilts attempted to turn (median, min.-max.; 0.4(0-2.3) *vs* 0(0-0.7)) and paced more (1.8(0-6.5) *vs* 0.7(0-1.6)) than ST gilts ($P<0.01$). ST gilts grunted more than LB gilts (6.7(1.6-20.9) *vs* 3.3(0.1-11.3); $P<0.02$). There were no significant differences between the treatments in the number of posture changes made by gilts on Day 1 but LU gilts made significantly more posture changes than ST gilts on Day 8 (99(74-162) *vs* 58(37-131); $P<0.001$). Furthermore, while the number of posture changes made by ST gilts decreased significantly from Day 1 to Day 8 ($P<0.0001$) no reduction in the number of posture changes made by animals coming from both loose treatments was observed ($P>0.05$). Prior to entering the farrowing crate both LB and LU gilts had significantly lower lesion scores than ST gilts (12(4-16) and 18(10-22) *vs* 22(12-34); $P<0.05$). After farrowing there were no differences between the treatments ($P>0.05$), however, the LB gilts had significantly lower lesion scores than LU and ST gilts at weaning (19(12-29) *vs* 27(15-31) and 29(21-46); $P<0.05$). The initial restlessness of gilts in all 3 treatments was reflected by an increase in the skin lesion score ($P<0.05$) after 24 hours in the farrowing crate. There were further significant increases ($P<0.05$) for the LB and LU gilts after farrowing suggesting that they were more frustrated at farrowing than ST gilts.

Irrespective of housing system during gestation gilts appear to experience distress during the first 24 hours in a farrowing crate, however, ST housed gilts appear to adapt more readily. Parturition is more stressful for gilts that are housed loose during pregnancy, but, providing bedding to loose housed gilts has a beneficial effect on skin health in the farrowing house which persists until weaning.

Influence of housing conditions on responses of pigs to preslaughter treatment and consequences for meat quality

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Several studies have shown that welfare of slaughter pigs is improved by providing straw in the home pen. In this experiment, the effects of housing conditions on behavioural and cortisol responses during preslaughter treatment, as well as the consequences for meat quality, were studied in 48 crossbred slaughter pigs (Great Yorkshire x (Great Yorkshire x Dutch Landrace). Six groups of four pigs were raised in intensive housing conditions ("Standard" treatment: standard farrowing crates (4.2 m^2) followed by standard rearing pens (0.5 m^2/pig) and fattening pens (0.8 m^2/pig), and six groups of four pigs were raised in extensive conditions ("Enriched" treatment: larger farrowing pens (7.2 m^2) followed by larger rearing and fattening pens (both 1.2 m^2/pig), all provided with straw). At several times during the fattening period pigs were taken out of their pen, subjected to behavioural tests (social isolation, fixation in a nose-sling) and returned to their home pen. At 26 weeks of age, pigs were transported to a commercial slaughterhouse. Behaviour before, during and after transport, salivary cortisol levels and meat quality was assessed. Group means were analysed with an analysis of variance model.

No differences in behaviour during transport or in any of the meat quality variables were found. However, during preslaughter treatment stockmen needed significantly less time to load pigs from Standard housing conditions (Standard: 56.8 ± 11.9 sec; Enriched: 93.7 ± 12.5 sec; $P<0.01$). The behavioural tests during the fattening period may have resulted in a higher motivation in Standard pigs to leave their pen in order to explore another environment. Intensive housing systems mostly lack the substrates necessary to evoke inquisitive exploration (Lawrence 1987). Results from a previous study (Geverink et al. 1998) showed that pigs housed in standard conditions, were easier to load at slaughter if they had been allowed regularly to exit their pens, even when this was followed each time by fixation in a box and transport. It is likely that pigs from enriched pens will be more willing to leave their pen at slaughter, if they have been allowed regularly to exit their pen without being subsequently subjected to a test.

Rise in salivary cortisol levels due to transport (Enriched: 3.63±0.58 ng/ml; Standard: 6.68±0.80 ng/ml; $P<0.001$) was difficult to interpret as omission of straw after cleaning of the pens at the day of slaughter apparently led to high baseline cortisol levels in Enriched pigs (Enriched: 8.63±1.27 ng/ml; Poor: 2.60 ±0.37 ng/ml; $P<0.001$).

The extensive housing system should be preferred as it is known to have positive effects on pig welfare during rearing and fattening, and does not lead to impaired meat quality.

Effect of cold housing on immune status, serum cortisol and growth rate of dairy calves

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It is widely accepted that in farm animal production the negative economic impact of disease is augmented in stressed animals. The decrease of disease resistance is believed to be due to stress-induced immunosupression. Furhermore, diverse types of environmental stressors alter the resistance of animals to infectious diseases. The aim of the present study was to identify housing conditions that do not overtax their physiological capacity to cope.

A total of 44 bull calves entered the 63 test days at age of 12±2 days in winters 1996-1997, experiment 1 and 1997-1998, experiment 2. They were evenly allocated in three experimental groups living in different climatic conditions; one group was housed in a warm room (+10-+16 ^{o}C), the second one in a cool room (0-+5 ^{o}C) and the third group in an uninsulated room where the temperature fluctuated (+6--22 ^{o}C) according to climate outside. The calves were reared in group pens with a concrete floor covered with a 40 cm deep straw bed. Hay, concentrated feed and warm water were offered *ad libitum*. Serum cortisol and total IgG were measured from blood samples collected weekly and the calves were weighed four times during the experiment.

In experiment 1, there were no a significant difference in daily growth rate between the groups. In experiment 2, the calves grew in cold as well as did the calves in cool, but slightly better ($p<0.05$, MANOVA) compared with the calves in warm. The mean concentration of serum cortisol ranged from 14,5 to 21,1 nmol/l between groups. The calves housed in warm had lower serum cortisol values (14,5±3,9 nmol/l) compared with the calves in cool (18,4±4,8 nmol/l, $p<0.05$, MANOVA) or in cold (21,1±5,5 nmol/l, $p<0.01$, MANOVA). There was no a significant difference in serum IgG-values between the groups. Nor was there any correlation between serum cortisol and total IgG values ($r=0.14$, $p=0.39$, Pearson's 2-tailed). The weekly means of serum IgG ranged from 1,0 to 5,5 mg/ml during 9 test weeks. The elevated cortisol level indicates that calves may experience cold and cool environments as stressful compared with the warm room. However, the unchanged or even better weight gain and unchanged IgG level in cold exposed calves indicate that the intensity of the cold stress was not excessive.

Preferences of dairy cows kept in cold loose house for different kind of cubicle flooring

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High producing dairy cows need to optimize their resting time. The type of flooring in the stall can affect time spent lying down. Our aim was to study cows' preferences for three kinds of flooring materials in an uninsulated loose house in summer and winter. We examined three types of stall flooring : concrete with large amount of straw, soft rubber mats with a small amount of straw, and sand with no extra bedding. Lactating cows housed in groups of 5 or 6 were allowed to choose between each pair of materials. In winter four groups of six cows were videofilmed seven or eight days during each four week test period, and in summer four groups of five cows were videofilmed for seven days during each three week period. Observations were made every 9 minutes to record which cows were lying in which stalls. The number of times a cow was seen lying on each material was used as an indicator of preference. To give the cows some experience of all materials before their choices were recorded, only cubicles with one material were available for three days and cubicles with the other material were open for the next three days. The cows' choices were then recorded after these six days. Total lying time on each material were used to get more information about the cows' perception of the materials.

Cows preferred concrete with a lot of straw to sand ($p<0.01$ in all four groups in winter and in summer). In winter three groups preferred concrete with a lot of straw to a soft rubber mat with a little bit of straw (group A $p<0.001$, group C $p<0.05$, group D $p<0.01$). In summer no preference was found between these materials. Cows strongly preferred lying on a soft rubber mat with a small quantity of straw to lying on sand ($p<0.001$ in all four groups in winter and $p<0.05$ in three groups in summer).

The cows did not appear to like lying on sand. This is perhaps due to the type of sand or it's unfamiliarity to them. Since we found the same choice in both summer and winter, this suggests that the thermal properties of sand may not be the major factor. The use of rubber mats may allow the farmers to reduce the use of straw bedding.

The effect of increasing broiler behaviour possibilities by giving extra furniture and a slimmer body: the effects of perches and feed restriction.

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Leg weakness is the most pronounced physical welfare problem in broilers. Leg weakness is partly caused by genetic factors, which cause at least a predisposition for leg problems (Kestin et al., 1992). Such leg problems may be diminished by exercise and feed restriction.

An experiment was done in which the effects of two factors on broiler locomotor behaviour were tested. The factor *FED* compared the development of ad lib fed broilers versus restricted fed ones. Restriction was given by a skip-a-day schedule in which animals could eat successively for a full 24-hr and were deprived of food from the next 24 hr and so on. The other factor *PERCH* concerned the availability of perches as a means for exercise. In the control condition 2 perches of 0.75 m length were placed at floor level, in the experimental condition 2 of those perches were at 0.20 m above floor level. Both factors were crossed and replicated 2 times (8 pens). In each of 8 pens, measuring 1 m * 0.8 m, 12 subjects of Euribrid hybro G strain (6 males and 6 females) were kept. The light-dark schedule was 6 hour dark and 18 hour light. In situ behaviour recordings were made and analyzed with an ANOVA. Ex situ, the gait score was measured and analyzed with the Mann-Whitney U test.

In week 6 the mean weight of the ad lib *FED* group broilers was significantly higher ($P<0.001$) than restricted *FED* broilers, and higher in males than in females ($P<0.001$). The percentage of time spent in locomotor activity decreased to almost zero in all groups, although the restricted *FED* high *PERCH* broilers have a significantly higher locomotor activity (2% of the total time) than all other groups ($P<0.001$). The ad lib *FED* high *PERCH* group used the perch less ($P<0.001$) than the ad lib *FED* and low *PERCH* group and the restricted *FED* high *PERCH* group which both used the perch significantly less ($P<0.001$) than the restricted *FED* low *PERCH* group (>30% of the total time). The gait score showed a sex difference (females have lower gaits scores; $P=0.036$), a *FED* difference (restricted *FED* groups have lower gaits scores; $P=0.001$), but no *PERCH* effect was found ($P=0.202$). Physical examination at 7 weeks of age revealed significantly more leg problems (Fisher's exact test: $P=0.032$) in the ad lib *FED* group (31 of the 48 broilers) than in restricted *FED* group (20 of the 46).

The conclusion is that weight contributes significantly to the gait score and leg problems. However, in the restrictedly fed groups there is still a high number animals showing physical leg problems. This could be due to a lack of physical training due to space limitations but, most probably, it has a genetic origin. Perches are used by broilers. In this experiment no effect of this use and exercise on gait score and leg problems is found.

The effect of temperature and grouping on behaviour and growth of dairy calves

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The lower critical temperature of dairy calves from 3 to 56 days of age has been around 8-10 ^{o}C. In many experiments calves housed in low temperatures have had similar daily gains but higher feed intake than calves reared in warm environments. Our aim was to compare the performance of young calves in indoor and outdoor group housing systems in a variable Nordic climate. In addition, as cross-sucking is considered to be a problem in group housing, we compared calves housed individually and in groups.

The calves were reared outdoors in a group pen, where they had either heated (Treatment 1) or unheated shelter (Treatment 2) and inside the barn either in a group pen (Treatment 3) or in individual boxes (Treatment 4). Both heated and unheated shelters were 12 m^2 and bedded with straw. The size of a yard beside the shelters was 20 m^2 and it was covered with bark. The same kind of construction was built inside the barn. The individual boxes (1.2 m^2) had a wooden slatted floor. There were four male calves in each group. The calves came to the 12 week (individual boxes 7 week) experiment at the age of 10 days on average. During the first 7 weeks the calves were given 2 litres of whole milk three times per day using teat-buckets. The calves were tied up at the teat-buckets during and 20 minutes after milk feeding. Hay, concentrates and water were offered *ad libitum.* After the milk feeding period the calves received concentrates maximum 2.5 kg/day/animal. Direct observations of feeding and oral behaviour were carried out during the weeks 1, 3, 5, 7, 10 and 12, with 2 minutes intervals 11 hours/week. Observation times (6-9, 13-16, 19-22, 22-24 o´clock) were randomly allocated into 4 days during each observation week.

So far the data for 6 outside groups, 4 inside groups and 3 groups of calves in individual boxes has been collected and analyzed. According to this data the growth of the calves during milk feeding period (806, 834, 917, 756 g/day in treatments 1,2,3 and 4) did not differ significantly, although the calves in the inside groups tended to grow better. Total dry matter intake, hay or concentrate intake did not differ significantly between the treatments. For the total 12 week period the growth of calves was 880, 912, 1021 g/day for the group reared calves (treatments 1,2 and 3). During the weeks 1-7 all calves ate concentrates and hay only for 1.6 and 3.7 % of the total observation time on average, but after the milk feeding had stopped the time spent eating solid feeds increased (7.3 and 17.1 % during weeks 10-12 on average). A great part of the calf's time was spent ruminating; at the age of 8 weeks 22.6, 23.1, 18.8 and 17.8 % of the observation time in treatments 1 to 4. Sucking other calves was seldom observed (0.19, 0.34, 0.49 and 0.36 % of the observation time during weeks 1-7 in treatments 1 to 4).

In conclusion, the calves managed very well both inside and outside the barn, and the growth of the calves was good. Cross-sucking was not a problem in this experiment.

Effects of a two-sided slope floor versus slatted floor on the behaviour of dairy cattle

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The TOP™ floor has recently been developed for the aim of reduction of ammonia emissions from dairy production units. It is characterized by concrete elements with a two-sided slope. Spaces between the elements allow rapid flow of urine whereas feces are removed by an automatic scraper. With regard to animal welfare, this study focused on preference, time budgets, ethological indicators of floor slip resistance and locomotion behaviour on the TOP floor in comparison to a slatted floor (10/3.5 cm width).

80 Holstein-Friesian dairy cows were studied in a cubicle house which had been equipped with one floor type in each barn half one year before the investigations started using direct observations and video recordings. The cows were randomly assigned to both barn areas (i.e., TOP or slatted floor), and feeding, standing, walking and lying was recorded by scan-sampling for 3 hours on 11 days within a 3 week period. Licking caudal to the costal arc, mounting, and slipping was simultaneously recorded by continuous recording. Time-lapse video recordings which were taken when all cows had free access to both barn areas allowed analysis of preference for one floor type.
In a second experiment, walking speed and position of the head while walking over a fixed distance on both floors was repeatedly measured in 12 early gestating heifers.

Floor type had no effect on the percentage of animals standing/walking on the feeding alley, standing with the head through the feeding gate and lying or standing in the cubicle. 3-hours time budgets of 12 focal animal cows differed individually between floor types but were not uniformly influenced by the flooring system. Given free access to both barn areas, time spent feeding or standing did not differ between floor types. Licking frequency tended to be higher on the TOP™ floor (37.7 ± 4.6 vs. 28.6 ± 2.0 events/40 cows*$3h^{-1}$; mean ± SE, n=10 days). Mounting activity of animals in heat was also higher on TOP™ floor (17.3 ± 8.2/cow*$3h^{-1}$, n=6) compared with slatted floor (6.8 ± 2.4/cow*$3h^{-1}$, n=4). However, independent of mounting activity, slipping was significantly reduced on the slats ($p<0.05$; Mann-Whitney-U). Slipping while licking was not observed.
Heifers on slatted floor were more frequently observed with upright head position ($p<0.01$; n=12, Wilcoxon). However, walking speed of heifers on slatted floor was slightly lower than on TOP floor (7.4 ± 0.3 vs. 7.0 ± 0.2 s/9m; n=12, p=0.058, Wilcoxon).

In conclusion, locomotion patterns of heifers seemed to be positively influenced by the slatted floor. Dairy cows on TOP floor showed more frequently behavioural elements which require increased floor slip resistance while standing. However, the increased slipping rate on this floor suggests an enhanced risk for injuries.

The effect of flooring type and social grouping on the growth and activity of dairy calves

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Cows on softer floors have previously been shown to rest longer and get up and lay down more often than cows on harder floors. The importance of flooring type for resting behavior of calves is less well known, and it has been postulated that social grouping might disturb resting behavior. We studied the effect of softness of flooring and social grouping on the activity and growth of dairy calves.

One week old male dairy calves were randomly assigned to one of three treatments for a three-month test conducted during the summer; 12 calves were individually housed in pens (1.05 x 1.8 m^2) with concrete floors (IC), 12 calves were individually housed in same size pens with a soft rubber mattresses (IRM), and 24 calves were housed in pairs (PAIR) in concrete-floor double pens (2.1 x 1.8 m^2). All the pens were bedded with a small quantity of wood shavings.

The calves were on a milk diet for the first 5 weeks and got hay and concentrate thereafter. They were filmed continuously six times for 24 hour periods during the weeks 1 to 12. Activity was scored as standing, resting on brisket and resting on side and we measured total daily duration, bout frequency and mean bout duration. Calves were weighed at two week intervals. The feed consumption was measured daily.

There were no significant differences between housing treatments in mean bout durations of standing (IC = 31 ± 14 min, PAIR = 23 ± 10 min, IRM = 33 ± 1), resting on brisket (IC = 59 ± 16 min, PAIR = 54 ± 26 min, IRM= 58 ± 16 min) or resting on side (IC = 4 ± 7 min, PAIR = 7 ± 37 min, IRM= 5 ± 8 min) nor were there any differences in mean bout frequencies for standing (IC = 9 ± 4, PAIR = 9 ± 4, IRM = 9 ± 3), resting on brisket (IC = 10 ± 4, PAIR = 10 ± 5, IRM = 10 ± 4) or resting on side (IC, PAIR and RI 1 ± 2). The housing treatments did not differ in the mean total daily durations of standing (IC = 179 ± 67 min, PAIR = 188 ± 63 min, IRM= 178 ± 58 min), resting on brisket (IC = 501 ± 98 min, PAIR = 485 ± 101 min, IRM= 500 ± 93 min) or resting on side (IC = 8 ± 16 min, PAIR = 15 ± 41 min, IRM= 10 ± 17 min). Average growth rates did not differ significantly between treatments (IC = 1,04 ± 0.04 kg/d, PAIR = 1.04 ± 0.09 kg/d, IRM = 1.00 ± 0.04 kg/d).

The aging effect was studied from the pooled data. The longest mean bouts of standing and resting were at the age of 2 weeks (29 ± 14 min and 79 ± 26 min, respectively), decreasing thereafter. The maximum total mean frequencies for standing and resting on brisket were at the ages of 3 (9 ± 4 and 11 ± 5) and 6 (9 ± 5 and 11 ± 6) weeks.

We found no effect of individual or group housing or softness of flooring on growth or activity patterns, although there were changes in activity as the calves aged. Softness of flooring appears to be less important for young calves than for adult cattle.

Preference testing of resting areas by sows in group housed systems

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The imminent legislation banning sow stalls (Welfare of Pigs Legislations, 1991) provides a difficult choice of alternative housing in areas where high rainfall excludes outdoor systems and where high quality straw is scarce and expensive. A suitable alternative may be voluntary cubicle pens containing an exercise area and stalls without rear gates. These pens usually have partially-slatted floors without bedding and house small static groups of sows. The objective of this study was to determine whether sows prefer this system over a system offering greater protection from pen mates, with the added option of straw bedding or bare concrete in both systems. Thirty two sows in eight groups of four were introduced successively into an experimental pen for two week periods. The sows had access to three different resting areas all available with and without straw. These areas included ungated individual stalls, individual stalls with sow-operated gates and a communal lying area. Sows were fed outside the experimental pen so that the choice of sleeping area was not influenced by the location of feeding. The sows were allowed five days at the start of each week to develop their behaviour patterns and were then continuously observed for the remaining 48 hours by time lapse video cameras.

There were significant ($P<0.001$) effects both of type of rest area and of straw bedding, with an interaction ($P<0.05$) between these two factors and weeks (Table 1). Sows chose to spend more time in communal areas than in individual stalls, particularly when the communal area was bedded with straw. However, the effect of straw in the communal area was only observed in week 1 and not in week 2. The provision of straw did not increase the use of individual stalls and there was no preference between ungated stalls and those with sow-operated gates. The time spent in stalls was 28% of the total time in rest areas.

Table 1 Effects of type of resting area, straw bedding and week on total time spent by sows in these areas (minutes/sow/hour)

Bedding	Week	Type of resting area			SEM	Sig
		Ungated cubicle	Gated cubicle	Communal		
Straw	1	4.65[a]	3.96[a]	24.37[d]		
No Straw	1	3.11[a]	3.45[a]	15.24[b]	1.208	P<0.05
Straw	2	3.06[a]	4.51[a]	20.01[c]		
No Straw	2	3.62[a]	3.83[a]	19.69[c]		

Means with a common superscript do not differ significantly

The system preferred by sows is a combination of mainly communal rest areas with some areas for individuals to rest in isolation. No preference was shown for cubicles with sow-operated gates over cubicles with no rear gate. The preference shown for straw in week 1 but not week 2 suggests that straw may not be important to sows, alternatively sows may show a stronger preference for a different substrate. These findings suggest that the level of welfare provided by the unbedded voluntary cubicle system is less than optimum in relation to sow preference.

A laser-based method for measuring the pain sensitivity of cattle

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We have developed a method for measuring the pain sensitivity of cattle using a CO_2 laser aimed at the caudal aspect of the metatarsi. Infra-red thermography showed that calves responded by lifting their legs when skin temperatures reached 45 - 55 °C. In experiment 1, the validity of the method was tested by comparing the response latencies of 14 calves to two power settings (2.25 W vs. 4.5 W) with each setting being applied 6 times. We found that both leg lift latencies and tail flick latencies were lower at the higher power setting, and the calves were more likely to respond by kicking than by simply moving the leg. The standard deviations between and within-calves were smaller at the higher power setting, and the large within calf variation means that at least three tests were required to obtain reliable measures that could differentiate between calves. In experiment 2, application of the laser at a range of power settings (2.0, 3.0, 4.0, 4.5, 5.0 and 5.5 W) on 16 calves showed that response latencies decreased as power increased up to 4.5 W, after which no further change occurred. In experiment 3, the repeatability of the method was evaluated on 9 measures with the high power setting (4.5 W). The coefficient of variation associated with repetition of the measures was 36 %. In general, we found little change in response latencies with repeated use of the laser, except that responses on the second test tended to be shorter. Experiment 4 showed that ambient temperatures between 16 °C and 27 °C did not affect response latencies, but these were longer at temperatures of 6 °C. We suggest that the method is a useful way of measuring cattle's sensitivity to pain as the animals need not be restrained and the distance to the animal need not be closely controlled. However, to obtain accurate, valid and reliable measures it is necessary to use a high power setting (4.5 W) and take at least three consecutive measures of the response latency.

How regrouping of young stock can be expressed as a welfare indicator in a dairy herd.

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Loosed housed young stock in a dairy herd are frequently regrouped. This may lead to aggression and fear and consequently affect the welfare of the young stock. The purpose of this contribution is to define two expressions for regrouping as a welfare indicator and to discuss their feasibility in a welfare assessment system at herd level.

Regrouping of loose housed animals can be defined as any changes in the inter-animal relations from the time t_i to t_{i+1}. Consequently, several types of regrouping exist; one or more animals may join an existing group with or without other animals leaving it and similarly, animal(s) can leave a existing group, with and without others joining it. Therefore "a group" can be defined in terms of inter-animal relations within a certain physical enclosure. These enclosures - the pens - are not static in a practical farm environment. New pens are constructed, others are removed and existing pens can either be divided or joined.

The effects of regrouping found in the literature vary from no changes at all to prolonged effects lasting more than two weeks. A part of the explanation for this variation is factors like the prior social contact between the animals, pen familiarity, the number of animals mixed, animal density and housing design. However, experimental situations differ from farm situations in that they typically involve only a single mixing and rarely consider the experience of the animals prior to mixing. Young stock at commercial farms may be regrouped repeatedly and they may be familiar with some of the «guests». Therefore, there is a need for a dynamic evaluation of the dimension of regrouping at farm level.

Two approaches are described and evaluated on detailed data for placement and housing of young stock in 10 Danish dairy herds during 18 months. First, to select a group of representative animals and calculate the frequency and magnitude of the changes in their inter-animal relations over the recording period. Secondly, to use the duration of inter-animal relations as a measure for the stability of the groups. Starting when grazing animals are housed, all existing pairs of inter-animal relations are mapped and then followed until the first recording they are no longer found. The results using the first approach showed that the animals experienced changes in the group composition at intervals from less than a month to two months, depending on herds. When changes occurred, 43-72% of the individuals in the established groups where "unknown" to the representative animals. The second approach demonstrated that the average length of the observed inter-animal relations ranged from 1,2 to 3,8 months on the 10 farms.

It is concluded that the difference found between the herds in the study is mostly due to management strategies of the farmers as opposed to housing system. A feasible method for assessing the dimension of regrouping is survival analysis of the duration of inter-animal relations. It is recommended that this parameter should be used as a welfare indicator for group housed young stock.

The effects of the introduction of a new housing system on the welfare of American mink (*Mustela vison*)

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In 1994 Wiepkema published a report with an inventory on the welfare situation of farmed mink. His conclusion was that the farming of mink was only acceptable if the welfare situation on farms would be improved. According to his recommendations an Action Plan was designed to improve the welfare of mink focusing on the following topics: no food restriction or only limited, weaning at 11 weeks (6/7 weeks is traditional), selection, enrichment of the cage by a tube and/or platform, cage size 30x45x85 centimetres (2550 cm^2), nest box available filled with straw, group-housing of females with their pups during summer in coupled cages.

The consequences of the implementation on negative and positive signs of welfare were studied in 1998. Six farms differing with respect to the degree of implementation of the Action Plan were selected. On these six farms 360 female minks were observed in winter (February- before mating time); 300 female minks and their pups were observed in summer (June/July- pups 6-12 weeks old) and the behaviour of the latter animals was observed again in autumn (end of October- before pelting time) to control for the occurrence of stereotypic behaviour. Apart from stereotypic behaviour also tail-biting behaviour was scored in each observation period by describing the length of the barren tail tip in centimetres. Especially in summer the observations were also focusing on the presence of positive indicators of welfare, such as variability in behaviour, positive social contact, play and object manipulation.

The occurrence of stereotypic behaviour in the winter of one "classical" farm without any implementation (farm A) is compared with the results of one farm with almost complete implementation (farm B). More stereotypic behaviour was observed on farm A than on farm B (MWU, U= 584.0 P<0001 N= 120). Four other farms which had implemented the proposed measures to some degree had also significantly less stereotypic behaviour than farm A. On one farm the occurrence of stereotypic behaviour was comparable with that of farm A (probably because of the food restriction regime). Similar differences were seen during the summer, although stereotypic behaviour occurred less then.
There seems to be a clear inverse relation between the occurrence of stereotyped behaviour and the degree of implementation of the measures. In addition social contact, behavioural variability, object manipulation were enhanced in those farms which made progress with environmental enrichment, no food restriction and prolonged weaning. In five farms tail-biting occurred less in winter than in summer. In autumn also pups of 6 months old had started tail-biting irrespective of their housing situation (alone with another pup or with their mother).

It is concluded that the proposed implementations can improve the welfare of mink on the long term. The effects of tail-biting as observed on the six farms cannot be explained yet.

Modelling of pig-expert reasoning to assess overall welfare of pregnant sows

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In order to explore a procedure to quantify the welfare status fo farm animals we asked pig-welfare scientists (n = 11) to assess the welfare status of pregnant sows on a scale from 0, worst, to 10, best. The housing systems assessed by these experts were tethering (T); individual housing in stalls (S); yard, ie group housing with stalls (Y); trickle feeding or biofix (B); electronic sow feeding (E); and outdoor housing with huts (H). The family pen system (F) was added as a (positive) reference system.

Differences were found between individual systems (T and S) and indoor group-housing systems (Y, B and E), and also between these and the more extensive systems (O and F).
In addition, the arguments given by the experts to justify their subjective scores were recorded. These include aspects of space, substrate and social parameters such as group size and group stability. From these arguments three different models were constructed to calculate welfare scores. All models are additive, and possible weighting factors and interactions were ignored. Model A is a within-expert model, for each expert based on his/her own arguments. Model B is an integrated across-expert model which is based on the arguments from all experts. Model C incorporates only the main arguments from model B. The figure below shows an example of scores obtained for an individual expert (x). It indicates similarity between the subjective scores given by this expert and the calculated model-scores.

These results, which were obtained in the process of developing a decision support system to assess welfare, suggest that pig experts are able to perform overall welfare assessment in a rational way; that there seems to be a substantial degree of consensus underlying this reasoning; and that the reasoning processes allows itself to be modelled using simple additive models.

Keywords: Animal welfare, pigs, decision support system, weighting.

Animal welfare in a metabolic unit - a new approach

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Measurement of nutrients bioavailability in the dog is obviously more desirable than tests performed solely in the laboratory, but direct measures with dogs are both time consuming and expensive.

From a veterinary ethological point of view, traditional metabolic cages were found an unacceptable environment for dog nutrition trials. The following aspects raised concern:- stainless steel reflects bright light, makes a high pitch noise when the crate is handled or if the animal jumps against the side of the crate. The floors are usually constructed of round bars or expanded metal which is uncomfortable for the pads. The floors are also uncomfortable to sleep on. Movement is limited and frustration may cause abnormal excretory behaviour, e.g. by defecating against the side panels. Contrary to dogs' natural behaviour, the dogs are forced to live on their toilets. Furthermore, most metabolic cages do not allow normal social behaviour due to their construction, i.e. the dog is exposed to five solid panels. The problem is that stress from such an artificial environment may seriously affect the welfare and metabolism of the dog.

The aim of this presentation is to show how the welfare of the dog was catered for by installing a collection unit in the kennels without compromising the efficiency of a metabolic cage. The method to fulfil dogs' basic needs in a metabolic facility took a number of principles into account.

During the adaptation phase the following principles were applied: - availability of proper shelter with heating pads, long runs for exercise, socialisation and exposure to a more natural environment as well as human contact, i.e. regular walking and grooming of the dogs.

During the collection (faeces and urine) phase a specially designed collection apparatus (false floor) made of polyvinyl chloride was used. The apparatus has a number of positive features. The smooth surface enables easy collection and cleaning. The apparatus has a non-reflective grey colour, is less susceptible to environmental temperature changes, durable, replaceable and movable. The sleeping and eating quarters are separate from the elimination area, based on normal dog behaviour. The faeces and urine are separated during the collection process. Apart from being shorter in length, the cages resemble the long-run kennels with shelters and exposure to natural conditions.

This system provides the dog with a comfortable environment with daily grooming, feeding and cleaning by their usual handlers as well as separate sleeping, feeding and voiding (collection) areas. This system provides the researcher with reliable data, easy observation and accurate collection of faeces and urine with minimum contamination. In addition the system improves the dogs' welfare and well being to a great extent.

Individual differences in behavioural response to a single injection of apomorphine in chicks – a test to predict dopaminergic sensitivity?

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Feather pecking represents one of the most serious behavioural problems in laying hens, occurring both in caged birds and birds kept in floor systems. Although feather pecking is a specific case of pecking, motor patterns of this behaviour are similar to stereotyped pecking, induced in birds by the dopamine receptor agonist apomorphine (Nistico and Stephenson, 1979). This implies possible dopaminergic control of feather pecking. Surmann and Havemannn-Reinecke (1995) proposed differences in behavioural responses to a single injection of apomorphine as a test to predict individual dopaminergic sensitivity in rats. The aim of the experiment presented here was to examine the individual differences in behavioural responses to a single injection of apomorphine in chicks shortly after hatching and to consider its possible use as a test of individual dopaminergic sensitivity. Our ultimate aim was to investigate whether behavioural response to apomorphine injection («dopaminergic sensitivity») can be used for prediction of susceptibility to feather pecking. In the experiment 160 Hisex brown chickens were tested at the age of 2 to 6 days. Apomorphine (0.5 mg/kg) was injected intramuscularly into the breast muscle. Behavioural tests were performed in a 30x40 cm testing box in the presence of the second, untreated chick (opponent). During the 30 min test period, starting immediately after the injection, locomotion and all pecking related activities were recorded. Results were analysed using factor and cluster analyses. Apomorphine treatment caused increased motor and pecking activities with large individual variation. Results of factor and cluster analyses suggested that chicks can be divided into three groups, according to behaviours prevailing in their response: group 1 - pecking and pulling of own and opponent's toes, backward pacing; group 2 - pecking on head and body of the opponent; group 3 - object pecking, forward pacing, head shaking. In the next part of the experiment, behaviour of young chicks after the apomorphine challenge was related to feather pecking behaviour in adult birds. For each chick a factor score was calculated. From each group, the 14 chicks with the highest and the 14 with the lowest factor scores (84 chicks in total) were selected and reared in pairs in cages until the age of 40 weeks. Direct observations focused on feather pecking behaviour and were carried out on 5 occasions, giving 60 min of observation per bird. Observation data were correlated with data obtained from the apomorphine test, however, no relation between behavioural response to apomorphine injection of young chicks and feather pecking in adult birds was found.

Nistico G., Stephenson J.D., Pharmacol. Res. Commun., 11:555-570; 1979
Surmann A., Havemann-Reinecke U., J. Neur. Transm. Suppl. 45:143-155; 1995.

Assessment of animal welfare on farm level - application of the „TierGerechtheitsIndex“ TGI 35 L resp. TGI 200 in alternative housing systems for laying hens as an example

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There is an increasing need to assess housing conditions in relation to animal welfare on farm level. Scientific investigations using classical indicators for animal welfare are not adequate because of varying conditions in the field, limited time and financial resources. Therefore, the „**T**ier**G**erechtheits**I**ndex“ has been developed first in Austria (TGI 35 L) and than modified in Germany (TGI 200) as a scoring system. Predominantly the housing environment is judged which means that the preconditions for good welfare are classified. However, to a lesser degree criteria concerning the animal (i.e. cleanliness) and management (i.e. herd records) are included, too. Quantitative and qualitative criteria are rated with points and summed up. Poorer conditions in one criterion can be compensated by better conditions in another one.
51 houses for laying hens with alternative housing systems were judged with the TGI 200 (200 maximum points). Additionally, the TGI 35 L was used in 10 hen houses. All hen houses were located on organic farms.

Deep litter systems achieved fewest TGI 200 points (86.6, n = 5), followed by free range systems (113.1, n = 18), deep litter with an covered outside yard (116.5, n = 8), aviaries (118.0, n = 4) and free range systems with an additional covered yard (133.8, n = 16). The mean was 118.7 points (n = 47, without aviaries). The standard deviation was higher on free range systems because of a great variability of pasture conditions. Mean values of other criteria did not differ very much between the systems. But within a single criterion, great differences could be found between farms. Comparing both TGIs the results were for aviaries 59,0 % of TGI 200 points and 46.1 % of TGI 35 points (n = 4), for one deep litter system with a covered yard 61.5 resp. 53.3 %, for free range systems 62.8 resp. 50.6 % (n = 2), and for free range systems with an additional covered yard 66.3 resp. 52.9 % (n = 3). Some criteria could achieve more points in the TGI 200 system than in the TGI 35 system.

Concerning the TGI 200, nest stocking rate, pasture structuring, and mucking out frequency achieved between 20 and 40 % of the maximum points, presence of cocks, raised perches, drinker stocking rate, nest litter material, amount of floor eggs, size of covered run, duration of pasture access, pasture size, pasture quality, plumage condition, quality of the scratching area, and presence of herd records achieved between 40 and 60 %, herd size, perch length per hen, perches distance, perch material, feeder stocking rate, nest brightness, frequency of access to outside runs, feeding area brightness, air quality, roughage supply, drinker and feeder cleanliness, occurrence of ectoparasites, functionability of stable equipment, and occurrence of beak trimming achieved between 60 and 80 %, animal density in the stable resp. the covered run, duration of darkness period, and feeding frequency achieved between 80 and 100 %.
The results show that both index systems offer the possibility to detect weaknesses within the housing conditions. A validation of the assessment of the housing conditions with more animal related criteria would be useful.

Councils on Animal Ethics in Norway and Denmark

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Denmark and Norway have similar councils on animal ethics. They are appointed by the ministries that are in charge of the animal welfare act, which is the Ministry of Justice in Denmark and the Ministry of Agriculture in Norway. The Norwegian Council has 7 members, and the Danish 11. Part of the members are appointed on suggestion from farmers and consumers (Denmark only) organisations and Animal Protection Organisations, and part of the members are independent. Members include both laymen and persons with expert knowledge. The chairpersons are a theologian (Norway) and a philosopher (Denmark).

Both councils are independent and advisory only. The councils shall follow new development in husbandry and husbandry systems, breeding and biotechnology and give advice to their ministries concerning any need of change in legislation or administrative practices. In contrast to the FAWC in England, the Norwegian and Danish councils are not dealing with farm animals only, but will discuss matters concerning pets and sport animals, laboratory animals, fish and wildlife. Reports are made on request from the ministry or at the council's own initiative. The councils also receive requests from organisations and private persons.

Although the two councils are very similar, they also differ in some respects. In Denmark there are other advisory boards working with animal welfare issues, and the Danish Council is therefore concentrating on larger and more general issues, whereas the Norwegian Council is dealing also with less extensive and more specific questions. The recommendations and conclusions of the two councils also vary to some degree. Both councils consider principles of what is right or wrong to do to animals and attempt to weigh the interests of both humans and animals. The Norwegian Council, however, tends to put relatively more weight on the interests of the animals, whereas the Danish Council can be said to seek compromises which are realistically possible to achieve. This may in part be explained by tradition, and by differences in agricultural practices of the two countries.

The Danish Council has since 1992 made 13 reports or statements; e.g. on animal experimentation, pig production, broiler production, biotechnology, pest control, ritual slaughter, keeping of horses, ovum pick up technique in cattle, and breeds that are prone to birth difficulties. Several of the reports have served as basis for new legislation in Denmark.

The Norwegian Council has since 1993 made 28 reports or statements; e.g. on fur animals, laying hens, ostriches, training of dogs, feral cats, catch and release in sport fishing, starvation as a mean of production regulation in fish farming, and breeding.

The experience so far is that ethical councils of this kind play an important role in initiating public debate on animal welfare issues and ethical questions concerning the use of animals in a modern society. Our opinion is that public awareness and interest in this matter is necessary to secure that animal welfare is given preference in production systems and that people have knowledge to give their pets adequate and acceptable conditions. Furthermore, the statements can precede new legislation.

Management stressors in 3- and 14-day old lambs

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Male and female lambs are subjected to stressful and painful management practices (e.g., tail-docking and/or castrating). The notion that performing stressful procedures without administration of analgesics, tranquilizers or anesthetics "sooner versus later" is commonly accepted. Further, minimizing distress enhances welfare of the animal. This investigation examined the hypothesis that docking female lambs was less stressful at 3 days versus 14 days of age. Likewise, we evaluated the hypothesis that docking and castrating male lambs was less stressful when performed at 3 versus 14 days of age.

Twenty-five Dorset lambs (10 males and 15 females) were treated on either 3 (5 males and 8 females) or 14 days of age (5 males and 7 females). On the day of treatment, males were docked and castrated by elastrator bands: females were docked by elastrator band. After treatment, behaviors of all lambs were videotaped for 1 hr and ethograms were analyzed. Differences due to treatment day were assessed by ANOVA. Significant differences were defined as having a probability less than 0.05.

The frequency of display of normal behaviors in treated male lambs was similar at 3 and 14 days of age. Behaviors associated with locomotion and positioning (e.g., walking, changing positions, lying in ventral recumbency, standing and kneeling), care soliciting (e.g., vocalizations) or ingestion (e.g., suckling) were not modified by day of treatment. The responses of female lambs were similar to that of males with the exception that 14-day old lambs stood more frequently than 3-day old lambs. Alternatively, the frequency with which both male and female lambs wagged their tails was greater in 3-versus 14-day old lambs.

Display of abnormal behaviors was highly variable in both age groups of males and females. The frequency of abnormal locomotor activity (e.g., ataxia, rolling, thrashing, crawling, kicking and bucking) and displacement behavior (e.g., apathy) was similar between 3- and 14-day old males and 3- and 14-day old females. The frequency with which the male and female lambs were observed in lateral recumbency, dorsal recumbency and "dog-sitting" was also similar between 3 and 14 days of age.

This data does not support the hypothesis that castrating and docking males or docking females is more beneficial if done at a younger versus older age.

Daily movements, and denning ecology of female brown bears (*Ursus arctos*) in central Sweden

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In 1984 the "Scandinavian Brown Bear Research Project" was started to investigate the ecology of brown bears (*Ursus arctos*) in Sweden and Norway. The main areas of study are population dynamics, dispersal, genetics, nutrition and predation, use of area and habitat use. This paper reports on an intensive study of nine radiomarked female brown bears in Dalarna, Sweden (3 with cubs of the year (COY), 3 solitary not pregnant and 3 solitary and pregnant) From mid-May until late November 1998, when all bears had denned, we determined their location daily from a car, airplane or skis and calculated the distance of their daily movements.In order to obtain more precise information on the denning behaviour prior to hibernation, we located the bears twice a day during October.

Movement patterns of the bears was probably influenced by external parameters like food availability, population density, climatic conditions, hunting season, and vicinity to human settlements. However, there seemed to be some general patterns. Juvenile bears (1-4 years old) moved over longer distances than older ones (5 years and older), although their home ranges are reported to increase with age. Rest time decreased dramatically in early fall as the bears had to forage intensively to gain adipose tissue prior to denning. In addition the daily distance moved was gradually reduced. After the main location for the den was chosen, the bears stayed close to the den, but left it several times.According to several observations, den excavating the burrow does not take more than an hour, but it took several days until the bears finally started denning. Possibly they tested the quality of the den and improved the nesting material.

In 1998 the three pregnant females started to den on 5th, 14th and 16th October, which was before the first snowfall (19th October). However, females with COY and solitary non pregnant females denned after the snowfall. Two of the nine females were disturbed by moose hunters and abandoned their dens. New denning sites were usually established at a distance of 4-6 km, although one bear dug a third den only 100 m from the second one.

Since 1986, the time of den entrance and emergence has been documented 125 times for 30 female brown bears in Dalarna. The time of den entry varied for individual bears. Pregnant females (n= 50) entered the den eight days earlier (23th October) than females with COY. In addition denning lasted 20 % longer for pregnant (194 days) than for single non pregnant bears (166 days, n = 40) and bears with COY (165 days, n=22). Duration of denning increased with age in all three groups.

Chrono-ethology in ungulates - Research and application

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Amidst the daily zoo routine one can hardly estimate the health condition of an animal .
In worse cases an animal gets sick or infertile before its (bad) physiological conditions are discovered by zoo staff. Time patterns of behaviour as a result of chrono-ethological studies, however, have been recognized as early and sensitive indicators of the animals' well-being. For that purpose continuous 24h observations during several days with automatic and telemetric data acquisition sets are necessary. Careful monitoring of all environmental changes, a critical selection of the recorded behavioural parameters and adequate chronobiological data analysis enable us to estimate the well-being of an animal. Chrono-ethological studies of three ungulate species (in the Zoos of Frankfurt, Kronberg, Antwerpen, and Köln) confirm the value of this relatively new field of research and application.

One of our first investigations in ungulates were the chronobiological studies on giraffes (*Giraffa camelopardalis reticulata*). It is known that adult giraffes undergo very short "deep sleep" phases, when the neck is bent backwards and laid down (each episode lasting 1-2 min, altogether 10-15 min/night). In new-born giraffes slightly longer and more often deep sleep episodes occur (up to 6 min each, for about 0.5 h/night). Changes of this rigid sleep pattern always are indicative of physical exhaustion, possibly caused by malnutrition or infections. In two cases giraffe-offsprings developed increasingly longer "deep sleep" episodes up to several hours per night, though during day the babies seemed healthy and strong. One died at the age of 7 days, the other one which developed the same behavioural changes could be rescued by artificial feeding in time, because online-data analysis showed the alarming increase of sleeping duration early enough. Few days afterwards the sleep pattern turned to normal.

Until today successful keeping and especially breeding of Okapis (*Okapia johnstoni*) in Zoos is an exceptional event. In pregnant Okapis we detected that the chrono-ethogram signals the date of birth at least three days ahead by characteristic irregularities of locomotor activity of the dam. The continuous video-recording of birth and the following days of offspring and parents reveals information about their fitness and well-being especially related to social stress by conspecifics.

Very recently we started a project on Grevy's Zebras (*Equus grevyi*). In contrast to their well-known social behaviour data on their rest/activity pattern are missing. Our chronobiological data will deliver a set of norm-chrono-ethograms as basis for further research. The study clearly demonstrate the influence of different maintenance conditions (e.g., access to indoor, resp. outdoor pens under various climatic conditions) and ageing on the animals' activity and sleep pattern.

The chronobiological studies, so far, have shown that the time pattern of behaviour of an animal is typically influenced by its age, physiological condition, social environment and maintenance. 'Normal' chrono-ethograms of zoo-animals in well-defined conditions would offer an important tool to detect physiological or social irritations and accordingly start veterinarian and nursing interventions in due time.

Jet-lag phenomena of the Kiwi (*Apteryx mantelli*)

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It is one particular aim of a zoo to display its animals in an active state to the visitors rather than at rest hidden in a box. In case of crepuscular or strictly nocturnal animals, this might even be impossible because of the mismatch between the visiting hours and the animals' behaviour. Therefore nocturnal houses with a 12h time-shifted light/dark (LD) program were built in a number of zoos. The idea of such nocturnal houses is principally based on the assumption that the internal clock controlling the sleep/activity cycle can be time-shifted. However, this clock-shifting is a process not as simple as just switching light on and off, as chronobiological studies have shown.

Kiwi birds are rarely shown in Zoos and even more seldom they mate and breed. In Frankfurt Zoo several North Island Kiwis (Apteryx mantelli), strictly night-active birds from the forests of New Zealand, are kept in outside enclosures with local day/night cycles and within the nocturnal house with inverse light/dark programs for the public. But the birds in the nocturnal house showed no normal activity pattern and were mostly not visible to the visitors.

With time-lapse infrared video control and automatic data acquisition systems with passive infrared detectors we observed the bird and recognized that the kiwi could not follow the time-shift. It suffered from »jet-lag», i.e. disrupted sleep and activity periods. Even after 7 months in the nocturnal house it has not accepted the inverse LD-program. Based on the assumption that all prior observation can best be explained by a rigid internal clock, we tried a very slow transfer with a special light program adapted from the natural LD-cycle. Only after about 4 weeks the LD-cycle finally matched the inverse programme regularly presented in the nocturnal house. Now the bird revealed its natural time pattern of behaviour in the nocturnal house, too.
Our data show the extremely high light sensitivity of the kiwi`s circadian system. Disturbances in the activity pattern during the time shift experiment correlate to even dim lights on/off and an inadequate «twilight simulation machine» of the nocturnal house. According to natural twilight conditions we designed a more realistic device for dawn/dusk simulation, which helped the bird to better follow the time shift. Additionally our experiments show that seasonal changes of day-length are essential for a normal rest/activity pattern.

Like in chronobiological studies reported for ungulates (see Rumbuchner et al.) physiological changes altered the chrono-ethogram of the kiwi, too. For example, we observed changes prior to egg-laying, too.

From our chronobiological studies of the kiwi, we conclude that in general, simulations of the natural light conditions, concerning intensity, amount and dynamics of the light/dark conditions have major impact on the internal and external synchronisation of the circadian clock system and thus the animals' well-being in an artificial surrounding.

Diurnal and ultradian rhythms of behaviour in red deer (*Cervus elaphus*) and Przewalski horse (*Equus ferus przewalskii*), measured through one year under nature-like conditions

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This study was conducted with the view to preparing methods and concepts for biorhythmic status diagnosis for the purpose of widest possible unbiased assessment of the living conditions of free-ranging wildlife. Moreover this study was intended to provide species-specific standard values and, therefore, was conducted under more or less troublefree and naturelike conditions in all seasons of the year.

General locomotive activity and feeding of four Przewalski mares under semireserve conditions (about 44 ha) and of four enclosure-kept red deer were recorded by the ETHOSYS(R) system. Data collected on 1,498 days were recorded from horses from June 1995 through July 1996. Additionally climate parameters and body mass of the horses were regularly recorded. Data collected on 952 days were recorded from two red deer each between April 1995 and January 1996 (40 ha-enclosure) as well as between July 1997 and May 1998 (2 ha-enclosure). Daily and monthly mean values, power spectra and DFCs (as a measure of harmony between internal rhythms and external 24-hour period) for activity and feeding were calculated. The results present a typical year in red deer and horse under seminatural conditions and describe the adaptation of individuals to a natural environment.

The two species had in common for the whole year a polyphasic daily pattern of activity and feeding closely related to sunrise and sunset. Changing relations between daytime and nocturnal activities are shown. The level of activity of horses was lowest in winter; whereas feeding was lowest in summer. Feeding of horses accounted for 40% of total activity in summer and 62% in spring (all-year average being 52%). Activity and feeding of deer drop to their minimum in winter and were highest in summer. Feeding of deer accounted for 36% of total activity in summer and 44% in autumn (all-year average being 41%).
In Przewalski horse, some of the seasonal variations in time pattern occured in a leapwise manner. In red deer all seasonal variations in time pattern took a course of gradual transition.

Time patterns of activity and feeding in either species were characterised by 24-hour rhythmicity and by ultradian components of 4.8 to 12 hours (horses) and of 4 to 12 hours (red deer) in period length. Species-specific season-related variations in nutrition, depending on nutritional conditions, led to species-specific variations in the ultradian structure of activity and feeding. Various stress conditions of either species were recordable and could be evaluated by biorhythmic analysis of behaviour data that had been acuired in gapless condition over extended periods of time. Several observations show decreased DFC associated with strong changes in activity levels is indicative of disturbances. This form of analysis is also convenient to follow up individual adaptational processes, such as introduction into a new herd.

Studies on the Visual Acuity of Dogs Using Shape Discrimination Learning

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It is important to understand the function of sense organs in farm and companion animals, and thereby improve management from the viewpoint of animal welfare. In recent years, some reports dealing with the application of the sensory and learning ability of animals to their management have been published. For the visual sense, for example, Manda et al. (1989) investigated the response of cattle to variously colored electric fences in order to apply sensory capability to the management of grazing animals. Visual acuity of ruminants was also studied and reported that the score for Japanese Black cattle and Holstein cows was between 0.04-0.08 (Entsu et al., 1992; Manda et al., 1993). We studied the color vision of sheep (1989), pigs (1991) and wild boars (1997), as well as their visual acuity. The results showed that the scores of sheep (1995) and pigs (1998) were 0.085-0.19 and 0.017-0.07, respectively. On the other hand, studies on the visual sense of dogs are very few. It is known that the dog retina contains two classes of cone photopigment, but the color vision of dogs has not been investigated in detail. Rosengren (1969) reported that three female cocker spaniels were well capable of discriminating red, blue, green and yellow in different degrees of brightness, but some other reports showed different results. In our previous research, it was clarified that dogs also are able to discriminate among the three primary colors (1996), but the visual acuity of dogs has not been studied yet. The objective of this study was to determine the visual acuity of dogs. Two female Shiba breed dogs were used. The dogs were trained to discriminate between a Landolt ring and an ordinary ring of equal size associated with feed. The left and right positions of the two targets were shifted according to the Gellermann series. The dogs were subjected daily to one or two sessions which consisted of 30 trials each. The criterion of successful discrimination was three consecutive sessions with more than 21 correct choices ($P<0.05$, Chi-square test). At first, the dogs were trained to learn the relationship between a positive target (ordinary ring) and a reward. During this training, it took eight and 12 sessions for the two dogs to reach the learning criterion, respectively. In the following training, the dogs were trained to discriminate between both rings at a distance of 1.8 m, which corresponds to a visual acuity score of 0.01. During this training, it took 10 and 11 sessions for them to reach the learning criterion. After the dogs were fully trained, their visual acuity was determined by changing the size of the rings or the distance from the target. The visual acuity score was calculated based on the procedure provided by Oyama (1989), and was expressed as a decimal (Schober, 1972). The best scores of visual acuity for the two female dogs were 0.24 and 0.33, respectively. The score is slightly better than the results of some other farm animals.

Studies on Numerical Cognition in Dogs

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Numerical cognition has mainly been studied in laboratory animals such as primates, rodents and birds. There are few studies on farm and companion animals. We recently reported that the criterion for numerical cognition of pigs would be "three" or "four" at maximum (1995). On the other hand, very few studies have been reported on dogs, even including other visual abilities. We studied and reported the color vision and visual acuity of dogs (1997, 1999). This study was conducted to investigate the numerical cognition of dogs for their visual sense. Four female Shiba dogs, a Japanese native breed, were used. Before training, two dogs were habituated to the experimental apparatus for 10 days. The habituation process was not applied to the other two dogs because they had prior experience in the apparatus. After the habituation process, the dogs were trained using an operant conditioning technique to discriminate between a positive and a negative panel associated with feed. On the positive panel, one or three black dots were printed. On the negative panel, there was no printed dot. The left and right positions of the two panels were shifted according to the Gellermann series. The dogs were subjected daily to one or two sessions which consisted of 30 trials each. The criterion of successful discrimination was three consecutive sessions with more than 21 correct choices in each session ($P<0.05$, Chi-square test). All sessions were videotaped for behavioural observations. In the following training, the dogs were tested for discrimination between two panels selected from 30 patterns of panels. The panels were different in the size of each dot and the distance between the dots. The positive panel was changed from a three to an eight dot-panel one after another. The positive panel was used in succession and the negative panels were changed in turn: 3 vs. 1 dot, 3 vs. 5 dots, 3 vs. 2 dots and 3 vs. 4 dots. After the discrimination test of the three dot-panel, other positive panels were tested in the same way. The results of this study are summarized as follows: (1) dogs can recognize up to "seven", (2) dogs tend to perform grooming as a displacement behavior after responding incorrectly, and (3) dogs recognize the number intuitively as Davis and Perusse (1988) called the numerical cognition process "subitizing". More studies are needed to investigate the numerical cognition of dogs for auditory and olfactory senses as well as under several different conditions.

Dogs in Czech households

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It could be assumed that our knowledge about the dog, the most ancient companion of man, modified into many different breeds, is profound. However, this is not the case; we do not even know how many dogs there are around the globe. According to estimates, there are some 500 millions pet animals kept globally, and dogs constitute an important proportion in this number.

The exact numbers of dogs living in the Czech Republic are not available. The estimates are between 1 and 1,8 millions. Furthermore, there is no reliable information about the coexistence of man and dog in this country. We therefore approached dog owners using a questionnaire (Askew 1997, Podberscek and Serpell 1997).

We analyzed 305 questionnaires containing almost 50 000 data. The group can be characterized as follows: dogs live in households with varying numbers of members; the smallest proportion of dogs (4.9 %) lives in one-person households, about one-fifth lives in 2-person-home, and about three quarters of all dogs live in homes with 3 and more persons. More than a half of the dogs live in a family house with yard (53. 4 %). However, many of the responding owners share their homes with another dog or dogs (48.6 %), cats (26.9 %), guinea pigs (14.1 %), birds (8.2 %) and others (25.6 %). The dog breed assortment is rather rich: there are dogs of 80 acknowledged breeds and more than 30 mongrels. Fractions larger than five per cent of the sample are only for German shepherd, dachshund and poodle. The distribution of gender in the sample is nearly equal.

The dogs are almost exclusively perceived as companions. Such response was obtained from 97. 5 % of respondents; of this number, 24.0 % perceive their animal as working dog as well, and only 2.4 % owners consider their dogs as working only. Nearly all (97.7 %) consider dogs as family members. They have the dog´s photographs (97.1 %) and celebrate its birthdays (70.8 %). All respondents talk to their dogs daily (97.4 %), and many of them even communicate important issues to their dogs (82.9 %), i.e. there is a permanent auditory communication. Moreover, the respondents declare to perceive moods of their dogs (95.4 %), and vice versa, that their dogs perceive their own feelings (96.1 %). Thus they admit other than auditory interspecies communication.

The results of our survey indicate that there is a multitude of contacts between man and his dog (similar to the situation in other countries), and that their coexistence as viewed by dog owners, is intensive.

Detection and classification of canine aggression in rescue centres

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Many of the dogs in rescue shelters have behaviour problems, either as a cause of, or as a result of, their abandonment. These include inappropriate aggression which is a multifactorial concept and is therefore not straightforward to classify. We have designed a multistimulus test to detect several types of aggressive behaviour in kennelled dogs. Such a test would be of use to rescue shelters, as often it is necessary to admit dogs with no prior, or an unreliable character history. A standardised test could assist the re-homing of dogs to suitable owners and/or direct the correct treatment of aggressive temperaments.

A random sample of dogs (n=106) was tested while in their kennels at two rescue centres. The test was divided into five sections: Squatting outside the kennel without making eye contact with the dog; standing outside the kennel making eye contact with the dog; attempting to remove a toy from the kennel; opening and closing a multicoloured umbrella aimed toward the dog, and lastly walking a standard unfamiliar dog past the kennel. Sections 1-4 examined a dog's response to environmental and human stimuli while section 5 examined the effect of another dog in close proximity. Each dog was tested twice: Pearson's correlations were used to analyse the validity of the results and 47 reliable measures were found ($r>0.4$).

Average scores for each of the reliable measures were calculated for each dog, and Principal Factor Analysis was used to simplify the data. Six interpretable factors were found and these were used to construct the composite variables: Position, Threat, Tail Flag, Whimper, Dog Confidence and Dog Threat, the values for which were either between 0 and 1 or -1 and 1, with values closer to 1 indicating an increased probability of the dog showing that particular type of behaviour. This method was adopted so that the aggressive temperament of an unknown dog could be examined by comparison with this reference sample. Further analysis showed tail flagging was more common in males than in females (Mann Whitney U-test, $U=-2.94$, $P<0.001$), and the dogs' position in the kennel differed between the two shelters ($U=2.55$, $P<0.01$), as did the amount of whimpering ($U=6.367$, $P<0.001$). Differences between shelters could be interpreted in terms of differences in the husbandry regimes.

On the basis of the behavioural outcome of this test canine aggression can be subdivided into fear, dog-dog and possessive aggression. Dominance and predatory aggression, which are not likely to be seen in a kennel situation, were not detected.

Does therapeutic riding affect horses behaviour?

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Studies on human-animal relationships have been increasing both on pets and farm animals in the past few years. Little research has been carried out on horses despite their long and close relationship to man. This ancient and deep relationship has been enriched by new aspects which consider the horse as a therapeutic aid. Many studies show the effects of this kind of therapy on patients. However, little information is available on the reactivity and behaviour of horses used for therapeutic riding.

The aim of this research was to assess if the routine and management of the therapeutic riding work affects the behaviour and welfare of the horses used for this purpose.

A preliminary study was carried out in a therapeutic riding centre near Milan. Three adult geldings, similar in age and size, were observed. They were housed in single boxes and fed straw and concentrate twice a day. All the horses were trained by the same person. 55 therapeutic riding lessons, lasting 20 minutes each, were video-recorded, throughout a whole month. The videorecordings were made during fixed days of 4 weeks (at the beginning, in the middle and at the end of the week). Observed patterns were: obedience to patient physical commands, keeping steady pace, staying on the trail, neck yanking, biting the bit, and body postures of the horses (ears, head, neck and tail). All the recorded behavioural patterns were scored on the basis of their display variability and graduality and analysed by univariate (Spearman correlation) and multivariate analysis (PCA: Principal Components Analysis).

The three horses showed an individual variability in the observed patterns so it was not possible to analyse all the subjects together with the multivariate analysis. However the results of the PCA made for each horse, identified three main components in all the animals. The first component was made by the variables neck yanking and biting the bit which showed a strong positive correlation ($P<0.001$). A second one was related to the obedience and to the capability to stay on the trail, while body movements of the horses weighed mainly on the third component. The multivariate analysis showed no evident effect of day or week on the considered behaviours. A higher reactivity of the horses seemed to be related to the beginning of the lesson, to the period of the day and the kind of exercise. It could be supposed that the routine of therapeutic riding did not cause evident behavioural changes on the considered horses.

The social bond between man and cat

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During the last two decades research has provided evidence that pets can have beneficial effects on the physical and psychological health of humans, both profylactically and therapeutically. Gradually one has become more aware of the pets' role as a social partner for humans. The aim of this study was to analyze the relations between cats and their owners and elucidate the significance of the cat to the humans in different situations, which needs a cat can fulfill as compared with the spouse and children, and which negative traits the cat can have.

A questionnaire was sent to 800 randomly chosen members of Norwegian Association of Pedigree Cat Clubs, with a response percentage of about 50. The questions were grouped into three. In the first part, the owner was asked to give different kinds of information about the cat. The second dealt with facts about the owner, and why and how the cat got into the household, while the last part treated the relationship between man and cat. The owner was asked to state their degree of attachment to the pet on a scale from 1 to 10 (strongest). A mean self-rated attachment score of 8.74 was obtained (N=398). There was no difference in attachment scores between single-respondents and respondents with a partner/spouse. Women were more attached to the cat than men, and owners without children were more attached to cats than owners with at least two children.

The cat's most negative qualities were their tendency to scratch and destroy furniture, aggression, and other annoying behaviour. The greatest disadvantage with keeping cats was the feeling of being bound in connection with holidays and journeys. The most frequently stated reasons for having cat as a pet were their independence and love. The owners were also asked to give their opinion on whether a cat in the household had any effects on children. Overall, 98.2 % of the assumed effects were stated as positive. Some of these were that the child would be more self-confident, more extroverted, more capable of showing care and more responsible later in life.

Differences in relationships with feline companions, partner and child were compared. Unconditional love was the primary benefit of the human-cat relationship and verbal communication and human companionship were the primary benefits of the human-human relationship. Twelve statements for each of the three attachment figures were listed in the survey, for which the respondents were asked to state if they agreed based on a scale from 1 (strongly disagree) to 4 (strongly agree). The cat got the best score in the statements concerning both company (my cat/partner/child provides me with companionship) and relaxation (I enjoy watching and relaxing with my cat/partner/child). In general, however, the child got the highest scores.

To conclude, the cat can be an important attachment-figure for humans. Although never a complete replacement for human contact, feline companions can satisfy some of man's needs, some needs even being better satisfied by the cat than by the partner/spouse.

Original research in the area of animal welfare of dog and cat in Greece

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Having identified a gap both in the relevant Greek and European bibliography, it was decided by our team to undertake a survey on Companion Animals' Welfare in Greece within the framework of my doctorate thesis. Based on the collected data and following appropriate advanced statistical analysis (x^2 and Odds ratio analysis), this survey produced results indicative of the status of protection of companion animals in Greece. In this context, two different questionnaires were drafted and addressed to pet owners and vets. The 'pet owner' questionnaire includes questions of demographic nature as well as specific questions aiming at decoding the human-animal inter-relationship and the level of the owners' responsibility towards their pets. This paper presents some results coming out of the pet owner's questionnaire. The 'vet' questionnaire includes questions examining veterinarian's position towards animal welfare issues such as stray dogs, euthanasia, castration and routine practices performed by them.

Full results of the statistical analysis will be published in the course of 1999.

293 (44,8%) of the pet owner's sample were University graduates and 87,5% of the total is living in the two largest Greek urban centres, i.e. Athens and Thessaloniki. 382 (59,4%) of this sample were living in an apartment. 290 (46,7%) got their pet by a friend or a family relative and 289 (45,3%) got it for companionship purposes. 73% of them keep their pet inside home and 42,1% feed their pets with commercial pet food. When their pet suffers from a lethal disease, 61,6% of the owners choose to support treatment against 38,4% who choose euthanasia. 88,3% of those who choose euthanasia do it due to emotional motives. 51,6% suggest that castration is the best solution for stray dogs. 79,1% is against mutations. In case of absence, 64,1% leave their pet with a friend and only 9,5% put it in a kennel. 46,2 of the total of owners' sample was aware of the European Convention for the Protection of Companion Animals.

It was found that sex, living area and presence of children when tested against the source of pet provision are proved to be statistically dependent parameters. The same parameters when tested against the motivation for getting a pet are proved to be statistically dependent parameters, too. It was found that women leave their pet less frequently alone at home. It was found that women prefer to continue with treatment when their pet suffers from a lethal disease and that High School graduates also prefer this way.

Barking as a means of communication in domestic dogs

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Barking in domestic dogs still remains a topic of controversial discussions. While some authors assess dog-barking an acoustic means of expression becoming more and more sophisticated during domestication, others name this sound type "non-communicative". Vocal repertoires as works on individual sound types are rare, however, and there has been almost no work done on low-intensity, close-range vocalizations, yet such types of vocalization are especially important with the more social canids, hence, with the human-dog-communication and understanding of dogs. Most of the investigations published so far are based on auditive sound impressions and lack objectivity.

The principal method used in this study was sonagraphic. This facilitates the identification of sounds and reveales, whether subjective classification can be verified by objectively measured parameters. Finally, meanings, functions and emotions were examined for all the major sounds described and are discussed in terms of relationships between sound structure and signal function, signal emission and social context as behavioural response, and overlapping channels of communication.

Ontogeny of acoustic communication in 11 European wolves has been compared to various dog breeds (8 Standard Poodles, 8 Toy Poodles, 15 Kleine Münsterländer, 11 Weimaraner Hunting Dogs, 16 Tervueren, 12 American Staffordshire Terriers, and 13 German Shepherds) from birth up to 8 (12) weeks resp. 4 (12) months of age. Noisy and harmonic sound groups were analysed separately as overriding units. Following parameters were used: fmax=maximum of spectrographic pictured sounds (Hz), xfo=mean of the lowest frequency band of harmonic sounds (Hz), xfd=mean of the frequency of strongest amplitude of noisy sounds (Hz), delta f=frequency range of sounds (Hz), duration of sounds (ms). Statistical analysis was run on "Statistica", Release 4,0. The spectrographic analysis reveales from 6 to 9 sound units which seem to be breed-specific ($p<0,05$).

Within the sound type barking 2 to 8 subunits were classified in the different breeds, according to their context-specific spectrographic design, and behavioural responses. Categories of function/emotion include f.e. social play, play soliticing, exploration, caregiving, social contact and "greeting", loneliness, and agonistic behaviours. "Interaction" was the most common category of social context for masted barkings (56'Yo of occurences). Especially close-range vocalizations, concerning the major sound type of most domestic dogs, the bark, evolved highly variable. However, the ecological niche of domestic dogs is highly variable, just as the individual differences in the dogs are, which seem to be breed-typical to a great extent. Thus, complexity within the dog's vocal repertoire, and therefore enhancement of its communicative value, is achieved by many subunits of bark, some standing for specific motivations, informations and expressions. Complexity within the dogs' vocal repertoire is extended by the use of mixed sounds in the barking context. Transitions and gradations to a great extend occur via bark sounds: harmonic, intermediate and noisy subunits.

Behaviour problems in dogs - a survey to estimate frequencies and other parameters.

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Behaviour problems in companion animals are an important and fast growing field, although there is a lack of research and scientifically-based methods in diagnostics and treatment. It is often both an ethical question and a question of animal welfare when an animal has developed a problem behaviour. Many animals, especially dogs and cats, are euthanized because of problems with their behaviour. Furthermore, there are likely many more living as problem animals, a situation of poor welfare for the animal, and sometimes leading to considerable inconvenience and stress for the owner. Generally, people tend to blame behaviour problems on the owner's lack of knowledge or experience, but this is an oversimplification. The reasons underlying behaviour problems are numerous, and interact with each other in complex ways.

The project has several long-term aims: to increase knowledge and understanding of behaviour problems in dogs, and to decrease their prevalence by prevention, and by developing reliable diagnostic methods. In the first step, the aims will be as follows:

1. To estimate the frequency of dogs with behaviour problems in Sweden; the number of owners looking for help, and the number of dogs euthanized because of behaviour problems.
2. To collect information about, and estimate the frequency of, different kind of behaviour problem, and the breed, sex and age of the animals affected.
3. To work out specific questions for the continuing project, preferably dealing with aspects of early experience connected to the later development of behaviour problem.

The main method will involve collecting information by questionnaires, handed out to different groups. A questionnaire has already been sent to a sample of approximately 2000 dog owners, and from this part there will be results at the time of the conference. Another questionnaire will be sent to animal hospitals and practicing veterinarians. They will be asked to fill in a form when they get questions about behaviour problems in dogs. From this form it should be possible to estimate the frequency of inquiries and visits to the veterinarians because of behaviour problems in dogs, as well as gathering data about the dog and what happens to it. There will also be an attempt to collect information from dog trainers and different groups of people that regularly examine dogs with behaviour problems.

Foraging behaviour in domestic fowl and crossings between domestic and jungle fowl

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In this study we compared the foraging behaviour in domestic fowl and jungle fowl crosses. The aim of our study was to investigate whether domestic fowl still possess abilities to behave in an adaptive fashion in a foraging situation and to investigate whether foraging behaviour have been modified through domestication. The experimental animals were 30 birds, 17 cockerels and 13 hens. Half of the animals were bred from a Swedish bantam father (*Gallus gallus f. domesticus*) and a Swedish bantam mother ("domestic", n=14). The other half were bred from similar mothers, but with a jungle fowl cockerel (*Gallus gallus*) as ("wild-type", n=16). All birds were subjected to two different foraging situations to study how well the birds were able to assess costs and benefits and adapt to a changing environment when moving between patches of feed. The first situation (short) consisted of two food patches with a travel distance of about 260 cm in between, the second situation (long) consisted of the same two food patches but the distance between them was now increased by 43 %. To simulate depleting patches the feed was mixed with wood shavings. Wild-type birds had more total patch visits than the domestic birds ($p<0.05$). The wild-type birds also had more patch visits when the distance was short compared to the long distance runs ($p<0.05$). The average patch visit time was significantly shorter for the wild-type birds than for the domestic birds for short distance runs ($p<0.05$), and the same tendency was found when patches were further apart ($p=0.064$). Wild-type birds stayed longer in each patch when the distance between patches was long compared to when it was ($p<0.001$). Both breeds behaved in accordance to some qualitative predictions based on the optimal foraging theory, i.e. moved between patches, left patches before these were empty and stayed shorter time on successive visits to the same patch. However, domestic birds responded less than the wild-type birds to the increased cost of travelling when patches were further apart. The fact that the domestic animals did not show any significant response to an increase in travel costs might be an indication that they were not as capable to adapting to the changing environment as the wild-type animals were. This might be because domestic birds do not perceive the situation in the same way as the wild-type birds does. In the domestic environment there is less need for animals to remember patch distribution and estimate travel costs. If such behaviour carries some costs to the performer it may have been passively selected against and therefore domestic birds may be poorer in assessing these things. The wild-type birds adopted what seemed to be a more costly foraging strategy, moving more between patches than the domestic birds without ingesting more feed.

Comparison of behaviour of commercial hens and Gifu native fowl

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During domestication, behavioural characteristics of fowls may have changed. We reported that commercial hens could adjust their behaviour to a change in rearing condition in a relatively short period compared with Gifu native fowl (ISAE 98). The Gifu native fowl is one of the oldest and the most famous native chickens in Japan. The objective of this experiment was to compare behavioural patterns of domestic hens and Gifu native fowl in outdoor aviary and cage conditions.

Experiment 1 : Two aviaries (9.4 x 4.7m each) were used. Ten Gifu native fowls and the same number of commercial hens were reared in adjacent areas. These birds were moved from conventional cages to these areas one year before this experiment. The birds had ad libitum access to feed and water. The behaviour of both breeds was recorded at 1-min intervals from 06:00 to 16:00 for five days. Statistical analysis was performed using the Willcoxson signed rank test. The five days of observations were dealt with as replications. The proportions of hens feeding, sitting and showing feather pecking behaviour were significantly greater in the commercial hens than in the Gifu native fowl ($P<0.05$). On the other hand, the proportions of hens that showed ground pecking and preening were significantly greater in the Gifu native fowl than in the commercial hens ($P<0.05$). The Gifu native fowl showed a greater proportion of ground pecking than feeding. During the daytime, the proportion of birds feeding in the Gifu native fowl had two peaks in the early morning and afternoon. On the other hand, the proportion of birds feeding in the commercial hens was increasing by around noon. The total proportion of birds (that showed) feeding and ground pecking was almost the same in both the breeds.

Experiment 2 : In the cage condition, 10 hens of each breed were reared individually (948 cm2 / hen). Behavioural observation were carried out from 06:00 to 16:00 using the 1 min interval scan sampling method. Feed and water was provided ad libitum. Statistical analysis was performed using the Mann-Whitney U-test. The proportions of feeding and sitting in the commercial hens were significantly higher than those in the Gifu native fowl ($P<0.05$). On the other hand, the proportions of walking and preening in the Gifu native fowl were significantly higher than those in the commercial hens ($P<0.05$). Ground pecking was hardly observed in both the breeds in the cage condition. During the daytime, the proportion of feeding in both the breeds gradually increased, and the highest proportion of feeding in the Gifu native fowl was observed just after the feeding operation.

These results indicate that commercial hens and the Gifu native fowl have different behavioural patterns. The Gifu native fowl spent more time in vigilant and investigative behaviour than the commercial hens. A similar difference between the two breeds in behavioural patterns was observed in both cage and free range conditions.

How do miniature pigs discriminate between people? :Discrimination between people wearing coveralls of the same color

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Previous studies suggested that miniature pigs can discriminate between people wearing different coloured clothing. The aims of these experiments were to examine: I) whether the pigs can discriminate between people wearing the same coloured clothing; 2) what cues they rely on if they could discriminate.

Four 3- to 4-month-old miniature pigs were used for the experiments. For 2 weeks in a Y-maze they were conditioned to receive raisins from the rewarder wearing dark blue coveralls. Then, they were exposed to Experiments I through 7. In these experiments, the pig was given the opportunity to choose the rewarder or non-rewarder, who occupied randomly assigned positions in the maze in each trial. They were alternatively called by the rewarder and non-rewarder within each trial except for some sessions of Experiment 3 and all sessions of Experiment 4 through 7. The pigs were rewarded with raisins if they chose the rewarder. One session consisted of 20 trials. Successful discrimination occurred when the pig chose the rewarder at least 15 times in 20 trials ($P<0.05$). Each pig was subjected either daily or twice a day to a session of 20 trials. The rewarder and non-rewarder were the same persons throughout the experiments. In Experiment 1, both rewarder and non-rewarder wore dark blue coveralls. By 20 sessions, all pigs successfully identified the rewarder. In Experiment 2, (1) both wore coveralls of the same new colours or (2) one of them wore coveralls of new colours. They significantly preferred the rewarder even though the rewarder and/or non-rewarder wore coveralls of new colours. I n Experiment 3, both wore dark blue coveralls but olfactory cues were obscured and auditory cues were not given. The pigs were able to identify the rewarder successfully irrespective of changing auditory and olfactory cues. In Experiment 4, both wore dark blue coveralls but covered part of their face and body in different ways. The correct response rate went down when a part of the face and whole body of the rewarder and non- rewarder were covered. In Experiment 5, both wore dark blue coveralls and changed their apparent body size by shifting sitting position. The correct response rate went up as the difference of body size between the experimenters increased. In Experiment 6, the distance between the experimenters and the pig was increased in 30 cm increments. The correct response rate of each pig decreased as the experimenters receded from the pig, but performance varied among the pigs. In Experiment 7, the light intensity of the experimental room was reduced from 550 lux to 80 lux and then to 20 lux. The correct response rate of each pig decreased with the reduction in light intensity, but all pigs discriminated the rewarder significantly even at 20 lux.

In conclusion, the pigs were able to discriminate between people wearing coveralls of the same colour after sufficient reinforcement. These results indicate that pigs are dependent mainly on visual cues to discriminate between people. Reducing visual information made discrimination more difficult for the pigs.

The effect of test arena location on behaviour and heart rate of sows during a human approach test.

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The 'standard' human approach test has long been used to assess a pig's fear of humans. However, there are concerns about whether the test is assessing fearfulness or exploratory motivation and over the methodology, with a standard 2-minute acclimatisation period shown to be too short (Forde et al., 1998). The aim of this experiment was to determine whether test pen location influenced approach test parameters, after a 10-minute acclimatisation period. Human approach tests were carried out on 24 Large White x Landrace sows in three different environments; home pen (HP); novel pen in home building (NPH); novel pen in novel building (NPN). Each batch of 8 sows was exposed to each environment once, in a different order, and no sow was tested more than once in any 7-day period. At testing each sow was fitted with a heart rate monitor and moved individually to the test pen. After acclimatisation, a novel human entered the pen and stood against one wall for 3 minutes. After this, the novel person approached and touched the sow. Behaviour and heart rate were continuously recorded. Two sows were omitted due to incomplete data sets. During acclimatisation, locomotor behaviour (sections crossed) was highest in NPN (72.3), lowest in HP (36.3) and intermediate in the NPH (51.0, χ_r^2=20.7, $p<0.001$), although sows in the NPN also spent longer standing alert and motionless ("freezing", 101.1s vs 51.6s (NPH) and 65.4s (HP), χ_r^2=8.4, $p<0.05$). Sows tended to root more in the NPH ($p<0.06$). Sows did not differ in standard approach test parameters. Fourteen sows interacted and two did not interact, in all environments. However, six sows were inconsistent in their interactions. Mean heart rate was highest in the NPH (97.8 bpm vs 92.3 bpm (HP) and 95.3 bpm (NPN), χ_r^2=8.4, $p<0.05$). Heart rate tended to increase more in the NPN treatment when the human entered the pen (+12.0 bpm vs +7.0 bpm (NPH) and +5.5 bpm (HP), χ_r^2=5.5, $p<0.07$). Long term heart rate variability was highest in the NPN when the human was present ($p<0.001$). Short-term variability was lowest in the NPH ($p<0.01$). The results suggests that, when using standard parameters, location is relatively unimportant providing sows are given sufficient time to acclimatise. However, in the NPN environment, the sows had the most variable behaviour pattern with bouts of locomotor activity interspersed with bouts of freezing. The inconsistency in approach behaviour of six sows suggests that they were influenced to some extent by the test environment. Similarly, there were differences in physiological responses within the different environments, which suggest that when sows are exposed to a little novelty in an otherwise familiar environment, their psychological response may be greater than when they are exposed to a totally novel environment. In order for the approach test to be a reliable indicator of a pig's behavioural and physiological response to a human, it is recommended that testing be carried out within a familiar arena and only after an adequate post-handling acclimatisation period.

Reference

Forde, R.M., Marchant, J.N. and Spoolder, H.A.M. (1998) The approach test acclimatisation period: how long is long enough for sows? In. *Proceedings of the 32nd International Congress of the ISAE*, (Eds. I. Veissier & A. Boissy), p220, INRA, France.

Recognition of people by dairy calves

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We examined whether very young dairy calves are able to recognize a familiar person, and whether they use the colour of clothing or other indices to do so. This study comprised two phases: a phase of familiarization and a test phase. During the familiarization phase, one person, who always wore the same colour clothes, gave milk and interacted positively (spoke gently and patted) with the calves in their stalls for 6 d each week. During the test phase, the calf had to make a choice in a Y maze placed in front of the gate of its stall. When the calves chose the familiar person, they received 200 ml of milk as reinforcement. When they made the incorrect choice, they received nothing and were returned to their stalls. During each test day, the calves made 8 choices. The criterion of success was that the calf made at least 6 correct choices for 2 test days.

The first test was carried out with 14 one-week-old male and female holstein calves. The familiar person, who had fed and handled the calves, and who was wearing the same clothes as during the period of familiarization, was in one arm of the Y-maze. The other arm was empty and the position of the person in the maze was randomized. After only 3 tests, 11 of the 14 calves reached the criterion for success, in that they approached the person rather than the empty arm of the maze.

The second test, carried out with 5 two-week-old calves, examined whether the calves can differentiate the familiar person (wearing the same clothing as during the period of familiarization) from an unfamiliar person wearing clothes of a different colour. The criterion of success was reached by all 5 calves.

The third test was carried out with another 7, 2-week-old calves. It examined whether the calves can differentiate the familiar person and the unfamiliar person, when the two people are wearing clothes of the same colour (i.e. the same colour worn by the familiar person during the phase of familiarization). None of the calves were able to reach at the criterion of success, often adopting a strategy leading them to always choose the same arm of the maze.

The fourth test was carried out on 6 calves. It was similar to test 3 with the difference that the familiar and unfamiliar person both wore the same colour clothes, but which were not the same as worn during the phase of familiarization. This was done to see whether by removing the most salient indicator, we could encourage the calves to use other indicators. Only one calf managed to differentiate the familiar and unfamiliar people according to the criterion of success.

This study shows that even very young calves are capable of discriminating between a familiar and an unfamiliar person, when these people wear different colour clothing. However, it seems possible that some calves can use other indicators than the colour of clothing to recognize people. The method is an effective way of examining calves' abilities to recognize people.

Early contact with peers or a stockperson influences later emotivity and social behaviour of dairy calves

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Intensive dairy production usually leads to disruption of the relationship of the calf with its dam at birth and is replaced by interactions with other calves and stockpeople. The present experiment investigated the effects of regular interactions with a peer or with a human at early age on later emotivity and social response to other peers and humans of dairy calves reared in isolation.

From birth, 26 dairy female calves were isolated and artificially reared in individual hutches (1.9 x 1.2 x 1.4 m). At 15 days of age, they were randomly allocated to three treatments : Nine calves were allowed to enter in a small adjacent pen built at the front of their hutch (G0). Nine calves entered in similar adjacent pens but a calf, always the same for a treated calf, was present in the pens (G1). Eight calves also entered in an adjacent pens where always the same human gently stroked them (G2). Treatment sessions were performed, 10 min once a day, three days a week for 5 months.

Emotivity and social reactivity were tested from 5 months of age. The reactions towards a new object (plastic red and white traffic cone) placed in the adjacent pen were observed for 4 min. The reactions towards a peer and a human behind a grid were observed in the adjacent pen for 4 min and in a new pen for 3 min. Choice tests between two peers (C1 : familiar vs. unfamiliar), one unfamiliar peer vs. one unfamiliar human (C2), and two humans (C3 : familiar vs. unfamiliar) were successively performed in a new pen for 4 min. At 7 months of age, calves were gathered, according to their weight, in 9 groups of three with one animal per treatment and social interactions during the first 2 hours of gathering were recorded.

When with a new object, G0 calves approached it less (63.5 vs. 131.7 vs. 117.4 s, SD=57.8, $P<0.05$) and were observed more with their necks stretched than G1 and G2 ones (15.8 vs. 8.3 vs. 9.1, S.D.=6.5, $P<0.05$). G0 calves also interacted less with the peer and the human in the familiar environment, than G1 and G2 ones in the first min of the test (8.0 vs. 19.3 vs. 15.9 s, SD=7.2, $P<0.10$). In addition, G1 and G2 calves showed more gambols with their familiar peer or human than with the other one ($P<0.01$). No difference was observed in an unfamiliar environment. Moreover no treatment difference was observed during the choice test except for C3 test where G2 calves showed more approached to the humans during the first min of the test than the G0 and G1 ones (50.5 vs. 23.0 vs. 22.3s, SD=16.1, $P<0.01$). Finally, G0 calves expressed more non-agonistic interactions (46,5±10.7%, $P<0.01$) than G1 (24.8±8.8%) and G2 ones (28.7±6.2%) following the gathering. No difference was observed in agonistic behaviours.

In conclusion, both regular interactions with peers or human in young age could play a role on the emotional and social development of dairy calves.

The effect of different milkers on behaviour, milking speed, milk production, heart rate and health of tied dairy cows

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The aim of this study was to investigate the effect of different milkers on the behaviour of tied dairy cows. The study was carried out in a large dairy farm in Tartu, Estonia, where each milker had a permanent group of 57 cows to milk every morning and afternoon. A total of 24 dairy cows of the Black Estonian and Red Estonian breeds were observed. Four permanent female milkers and six of their cows, as well as four relief female milkers, were videotaped continuously during four months. The videotapes from three days in the beginning of the first month and three days from the beginning of the last month were analysed. Recordings were made of the interactions of milker (31 different behaviours) and cows (38 different behaviours). The milking speed was measured in 14 and the heart rate in 7 of the videotaped cows with both ordinary and relief milker. Disease incidence and milk production were recorded from all cows belonging to the four milking groups. The personality of all ordinary and two relief milkers were measured by NEO-PI personality inventory, the Interpersonal Reactivity Index subscales, the Aggression Questionnaire subscales, Rosenberg Global Self-esteem scale and an Animal Attitudes scale. The data was analysed by Analysis of Variance (GLM, SAS 6.12).

On the personality test the milkers rated themselves low on «Agreeable» (4 milkers), «Extraversion» (3), and «Open» (3), and rated themselves high on «Selfesteem» (4), «Verbal aggression» (4) and «Hostility» (3). The ordinary milker in group 3 and 4 rated high on aggression, whereas the other two rated medium on that test. The behavioural recordings showed that the milkers most often just walked up between the cows (68%) or changed from one cow to another, and only rarely stopped behind the cows before walking up to them. The cow´s first reaction was standing still (35%), turning head towards milker (30%), looking at milker (16%) or stepping away from milker (6%). The milkers only touched the udder and the hind part of the cow, never the front part. The duration of milking from behavioural recordings as well as the milking speed was considerably longer and the amount of milk lower for relief milker compared to ordinary milker. The milk production was lowest in group 4 (mean 15.6 l./day first month) and highest in group 1 (18.8 l./day) and group 2 (19.8 l./day). Heart rate of the cows tended to decrease with one relief milker compared to the ordinary milker, increased with another and both increased and decreased with a third (74.7 vs. 71.4 beats/min. for ordinary and relief milker respectively during milking). All focal cows were healthy during videotaping.

It is concluded that this pilot study has shown the importance of learning more about the complex interaction between individual milkers and cows and which effects it may have on health and production.

Segregated early weaning affects behavior and adrenal responses in piglets

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The North American swine industry is adopting segregated early weaning (SEW) system rapidly with little information about its potential effects on pig welfare. The development of abnormal behavior, the occurrence of agonistic interactions after mixing, and the concentration of cortisol, a stress hormone, were monitored in pigs weaned at different ages. In experiment 1, 47 pigs from six litters were crossfostered at 3 days of age. Three litters were weaned between 9 and 13 d of age (SEW1, n=23), the other three litters were kept with the sows (control, n=24). Behavior observation was carried out at the weaning day (day 0), and at days 1, 2 and 3 post-weaning (PW). Urine samples were collected one day before weaning and at days 1, 3 and 5 PW. In experiment 2, another group of 47 pigs from six litters was studied. Littermates were weaned between 9 and 12 d of age (SEW2, n=24) or between 20 and 23 d of age (CW, n=23). Pigs were videoed weekly up to 8 weeks of age. Behavior data were collected for 5 min every 30 min from 900 to 1800 h. At 10 weeks of age, pigs were mixed and transported for 20 min. Basal and post-transportation saliva samples were collected. The outcome and duration of agonistic interactions were recorded for three days after the regrouping. The data were analyzed using mixed model and contingency table (SAS® software). The results are expressed as mean (lsm) ± s.e.m.

SEW1 pigs showed higher levels of vocalizations than control pigs on day 0 and 1 PW (frequency/min, 1.83±0.58 vs. 0±0.57, 7.44±0.58 vs. 0±0.57, respectively, $p<0.0001$). They spent less time lying on day 1 in the morning (AM), but more time on day 3 AM PW than control pigs (% of observation time, 20.46±5.50 vs. 53.96±5.38, 73.58±5.50 vs. 50.87±5.38, respectively, $p<0.01$). Belly-nosing started on day 1 PW in SEW1 pigs and no occurrence of this behavior was recorded in control animals. Urinary cortisol/creatinine ratio was also higher on days 1 and 3 PW in SEW1 pigs (nmol/mmol, 219.99±31.48 vs. 66.61±10.99, $p<0.001$ and 94.91±13.63 vs. 65.56±8.79, $p<0.04$). SEW2 pigs showed a higher frequency of belly-nosing than CW pigs in both weeks 5 and 7 of age (frequency/hour, 2.37±0.23 vs.1.56±0.24, 1.91±0.23 vs. 1.23±0.24, respectively, $p<0.04$). Transportation caused a 7-fold increase in salivary cortisol, but there were no differences between treatments in basal and post-transportation samples. SEW2 pigs showed higher proportion of fights with no clear outcome (n=821, 44.57% vs. 32.18%, $p<0.04$) and tended to fight longer than CW pigs (sec, 34.17±4.98 vs. 22.98±6.44, $p<0.08$).

The increased vocalization rate, performance of belly-nosing, and sustained high levels of urinary cortisol in SEW1 piglets demonstrates that the procedure is stressful. Cortisol response to transportation was similar for both SEW2 and CW pigs, indicating a lack of long-term consequences of weaning age on the control of the stress axis. Our data also indicated that SEW compromise the ability of piglets to establish a stable social hierarchy later in life.

Piglet survival - can it be improved through selection?

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A large problem in modern pig production is the high piglet mortality. In many production systems up to 20 % of potential slaughter pigs die, which accounts for a significant economical loss for the producer. The individual variation between sows in litter survival is large, indicating that there might be a genetic background to this trait. The aim of this study was to estimate genetic and phenotypic parameters relevant for piglet mortality. It is the first part of a study aiming to investigate the genetic variation in maternal behaviour and the study is included in the project ”Maternal behaviour of sows, with a focus on genetics, physiology and social environment”. Data on maternal behaviour is presently being collected from nucleus herds in Sweden.

Data from 18200 piglets, born in a research herd between the years of 1983 and 1996 was used. Litter size was recorded as total born. All piglets were individually weighed at birth and at three weeks of age and all piglets that died within that period were again weighed. Cause of death was recorded by the caretaker staff.

Total mortality during the first three weeks was 18%, including stillborn piglets. Almost 75% of the piglets died within the first week of age and the majority of those within the first couple of days after birth. In litters with more than 10 piglets, the mortality increased with litter size. The most common causes of death were crushing by the sow (28% of total dead) and starvation (11% of total dead). The mean birth weight of piglets which died (1.15 kg, std 0.37) was significantly lower than that for surviving piglets (1.45 kg, std 0.31). However, 21% of all the crushed piglets had a birth weight above 1.45 kg. The variation in birth weight within litter did not seem to affect the mortality in that litter.

For the genetic analysis an animal model was used. The model included batch, parity number and litter size as fixed effects, birth weight as a regression and a genetic effect of animal (the piglet), common litter effect and maternal effect (the sow) as random effects. The heritability for survival was estimated to be 0.08. Even though this heritability is quite low it is still possible to improve survival genetically, if information from all relatives is used in the selection process.

The maternal effect accounted for 6% of total variation. This effect can be separated into heritable traits of the sow affecting piglet survival (i.e. her genetic capacity for milk production and maternal behaviour) and traits of the sow that are not heritable. From the piglets point of view, both these effects will be environmental in nature, but a separation is important in order to know what genetic progress can be reached in the sows ability to successfully raise a large litter. The analysis with a separate maternal genetic effect is now in progress.

Variability in the Expression of Pre-farrowing Behaviour in Gilts: effects of genotype and straw in the farrowing crate

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There are many aspects to maternal investment. Our study focussed on nest-building in the pre-parturient pig. The nest-building phase has been identified as a period where the welfare of pre-parturient pigs housed in farrowing crates is compromised (e.g. Lawrence, 1998). Many different breeds of pig are routinely farrowed in crates, and most probably not all have been subject to the same level of selection pressure to allow adaption to the farrowing crate. In this study we therefore considered: a) does maternal investment at the nest-building stage reflect a given breeds maternal quality?; b) how has artificial selection affected the pre-parturient pigs response to the crate? We compared breeds which varied both in their reported maternal quality, and the extent to which their dam lines had been subject to artificial selection. In addition to the genetic aspects of this study, we also investigated how changes to the farrowing crate, such as the addition of straw, affected pre-farrowing behaviour in these breeds.

The subjects were 44 1st parity sows, of four different breeds: Meishan pure, M (n = 4); Duroc pure, D (n = 7), both with no selection for litter size; 50% Meishan, 50% Landrace, ML (n = 7), 75% Landrace, 25% Duroc, LD (n = 4), both selected for litter size. Sows were introduced to farrowing crates at 4 days prior to expected farrowing date, half of each breed being provided with straw. Posture and behaviour was recorded over 11 x 10 minute periods during the 24hr pre-farrowing period and analysed using ANOVA.

Breed	**M**		**ML**		**LD**		**D**	
Treatment	**Straw**	**No straw**	**Straw**	**No straw**	**Straw**	**No straw**	**Straw**	**No straw**
No. Lie ⇒ sit events	10.8	11.0^{a}	10.4	8.3^{ab}	9.3^{x}	$3.3^{b\,y}$	6.3	5.3^{bc}
No. Sit ⇒ stand events	10.0^{a}	5.4	8.6^{a}	5.4	6.5^{ab}	2.3	4.1^{b}	2.3
Fixture-directed behaviour	0.14^{x}	$0.25^{a\,y}$	0.16	0.16^{b}	0.13	0.16^{ab}	0.12	0.16^{b}
Straw-directed behaviour	0.25^{ab}	0	0.21^{ac}	0	0.30^{b}	0	0.15^{c}	0
Floor-directed behaviour	0.26	0.26	0.17	0.20	0.21	0.30	0.22	0.24

a, b, c - between breeds and within treatments, means with the same suffix do not differ significantly ($p>0.05$)
x, y - between treatments and within breeds, means with the same suffix do not differ significantly ($p>0.05$)

The presence of straw stimulated more substrate (straw, floor and fixtures) -directed behaviour, stepping and posture changes, whilst reducing time spent in fixture-directed behaviour. In the absence of straw, gilts tended to truncate the process of standing up by performing less sit to stand posture changes. Previous work (e.g. Jarvis *et al.*, 1997) has linked certain behaviours in crates (e.g. sitting, fixture-directed behaviour) to increases in physiological 'stress' (e.g. ACTH). An increase in the frequency of standing up and sitting up has also been identified as a response to confinement (e.g. Hansen and Curtis, 1981). The effect of Meishan genes was to increase standing and sitting posture changes and increase time spent in fixture-directed behaviour. This may point to the Meishan pig and its cross-bred being less adapted to the farrowing crate than the other two breeds.

Digging activity and motivation in penned blue foxes

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Farmed foxes are usually housed in bare wire-mesh floor cages. Recently, it has been demanded that foxes should be kept in conditions which enable species-specific behaviour. For instance, the need to dig has been emphasized. The aim of the present study was (1) to clarify the amount of digging activity, and (2) evaluate factors which motivate digging in the case of farmborn blue foxes under penned conditions. Two separate experiments were carried out. In Exp. 1, six juvenile male blue foxes were housed throughout the year from August to next July in an earthen floor enclosure measuring 6 m wide x 10 m long x 2 m high. Exp. 2 was from July to December, included 10 earthen floor enclosures (3 m wide x 5 m long x 2 m high) containing each two juvenile male blue foxes. Originally, number of nestboxes per enclosure in Exps.1 and 2 were 2 and 1, respectively. New nestboxes were later added to test the novel object effect. Behaviour of the test foxes was mainly monitored by 24-h video recordings. Progress of digging in enclosures was also followed by drawing all digging marks, burrows and holes on scale-dimensional paper with an interval of 1-2 times per month. The results showed that already on the first study day clear signs of digging were observed. Digging sites were concentrated below and nearby nestboxes and pen walls. Maximally about 20% of the total enclosure area was affected. Total surface area of digging sites did not increase from late summer onwards because foxes tended to cover part of old sites simultaneously when digging new ones. Digging activity decreased during autumn, and almost totally ceased during winter. In May, foxes resumed digging activity. Digging need and motivation were evaluated by two means: (1) by analyzing digging purpose (Exps. 1 and 2), and (2) by the dammed-up test (Exp.1), i.e. after 10 months exposure to the earthen floor foxes were transferred for 12 days into small wire-mesh cages with no possibility to dig the ground. Thereafter, foxes were transferred back into the earthen floor enclosure. The assumption was that if digging is a crucial need for foxes, and when they have been denied the possibility to dig for an extended period , the need to dig would be dammed up. Accordingly, releasing foxes back into the earthen floor enclosure should trigger pronounced digging activity (rebound effect). Foxes were observed to dig for the following reasons: (1) to make a hole or a resting site, (2) to find an escape route, (3) to cache food , faeces, or sticks (4) in response to a novel object (new nestbox, replacement of nestbox), and (5) displacement without any clear goal. Typically, digging occurred in brief intervals. A fox's digging activity lasted 7 min per day on average. A proper rebound effect for digging activity was not found.

Feeding motivation and metabolism of pregnant sows fed fibrous diets

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The effects of fibrous diets supplied to pregnant sows on their feeding motivation and some physiological parameters were studied. Three diets were formulated, a concentrate low fibre diet enriched in starch (S diet, NDF = 8.8 % of DM) , and two high-fibre diets enriched in either sugar beet-pulp (BP, NDF = 24.7% of DM) or wheat bran (WB, NDF = 21.3% of DM). Twenty four multiparous Large-White sows, housed in stalls, were fed these diets in a 3 × 3 Latin square during three 21-days periods over pregnancy. Eight sows were planned to receive one diet at each period. Daily rations which were determined in order to supply the same daily amount of metabolizable energy (33.4 MJ/d) amounted 2.44, 2.74 and 2.90 kg/d for S, BP and WB diets, respectively. Feed was supplied once daily at 09h30 AM. Behavioural recordings were carried out around the meal. The day 18 of each period, blood samples were taken every 15 min between 1 h before the meal until 2 h after the meal, and after every 1 h and 4 hours until the next meal, the day 19. Fifteen sows were submitted on d16 of each period to two 45-min operant conditioning sessions (progressive ratio 1-1-6-6-11-11 - …., 8 g food reward) 4.5 h and 23 h after the meal.

The occurrence of non-feeding oral activities over the 45 min following the feed distribution were significantly reduced for the fibrous diets, but did not differ among diets when the 45 min following the end of the meal was considered. Prior to feeding, plasma glucose (771 mg/l) and insulin (7.37µIU/ml) were similar for the three diets. The peaks responses of glucose and insulin to the meal were delayed in sows fed the BP diet. Plasma glucose level after feeding showed a higher increase for S than for WB and BP diets, the maximal value being obtained 34 min, 76 mn and 91 mn after the beginning of the meal for S (1052 mg/l), WB (971 mg/l) and BP (931 mg/l) diets, respectively. After feeding, the insulin concentration with S diet showed a faster increase than with the fibrous diets (S: 57 min, 345 µIU/ml; BP: 90 min, 195 µIU/ml; WB: 81 min, 260 µIU/ml). The area under the glucose curve between the two meals were similar between diets ($P>0.10$), whereas the area under the insulin curve was significantly lower for BP than for S and WB diets ($P<0.01$). Whatever the experimental diet, no difference was recorded in the number of rewards received by sows 4.5 h and 23 h after the meal (19.3, 19.5 and 18.8 rewards at 4.5 h, and 20.0, 18.5 and 19.4 rewards at 23h, for S, BP and WB, respectively).

It was concluded that there are only short term effects of high fibre diets on the behaviour and the physiological status of the pregnant sow, and on the long term there is no clear evidence of an effect on their feeding motivation.

The feeding technique affects social behaviour in group housed veal calves

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An appropriate feeding technique for the group housing of veal calves should limit the risk of excessive intersucking, allow for good animal control, and additionally, should be labour efficient. The electronic automated feeder appears to be promising in this regard. It allows for a more natural sucking schedule and assists in health control by registration of individual drinking speed and volume. However, being almost the only food source for veal calves and allowing only one calf at a time to suck, the automated feeder might also have disadvantages through increased food competition.

To examine this question further, we compared the social behaviour of calves fed by automated feeder (one group of 16) with the behaviour of calves fed by teat buckets (one group of 8) or by buckets with floating teat (one group of 8) in two replicates. Different group sizes were used because in practice the different feeding systems are inseparably connected with the keeping of calves in bigger or smaller groups respectively. Altogether 64 male German Holstein calves were observed. They were kept from two to eight weeks of age on perforated floor, fed a commercial diet and 100 g hay per day each. Space allowances were 1,5 m^2 per calf. The frequency of agonistic behaviours (body pushing, boxing), cohesive behaviours (sniffing, head rubbing, licking) and play fighting as well as the site of activity were individually recorded with continuous behaviour sampling over 90 hours per replication, distributed over the 15 hour light day and the six observation weeks.

As the two bucket groups did not differ in social behaviour, they were treated as one group in the further analysis. The automated feeder calves showed more agonistic interactions than bucket calves (medians: 0,20/h vs. 0,07/h, n=32, $p<0,01$, Wilcoxon Two-Sample-Test) and less cohesive interactions (1,22/h vs. 3,00/h, n=32, $p<0,001$). Play fighting also occurred less frequently in automated feeder calves (0,04/h vs. 0,14/h, n=32, $p<0,01$). Most body pushing (89%) in automated feeder calves was performed near the feeder, while there was no preferred site of other activities or in the bucket calves.

We conclude that there is obvious competition for the automated feeder which also adversely affects the socio-positive behaviour of group housed veal calves. It should be investigated whether measures such as ad libitum provision of roughage and equipment of the feeder with a protection device against driving out of sucking calves, can alleviate this effect.

Loose housed, floor fed pregnant sows: Effect of group size and space allowance

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The increasing focus on farm animal welfare in the resent years has lead to more attention on housing methods. In Denmark, consumer pressure and law reforms has caused a change in housing systems for pregnant sows towards more loose housing systems, now accounting for about 75% of all newly build facilities for pregnant sows.

At the Danish Institute for Agricultural Science two experiments were carried out on loose housed, floor fed, pregnant sows kept on partly slatted floor, investigating effects of group size and space allowance respectively on activity, agonistic confrontations (head knocks or bite) and weight gain.

Exp. 1 (group size): Group sizes of 12 and 24 sows (six replicates) were compared. Both groups had 2.2 m^2 per sow. The sows were weighted at insertion in the pen three weeks after service, and again when the sows were removed from the pen about 80 days later. In week 2 after insertion skin damages and leg injuries were assessed. 24h video recordings were made in weeks 2 and 3 during two successive days in order to measure activity and agonistic confrontations. Data were analysed by PROC GLM (SAS, 1995) using treatment, week, day and block as class variables. The groups of 12 sows tended to be more active compared to groups of 24 sows (20.2% vs. 16.8% of sows being active, P=0.06), and there were more agonistic confrontations in the small groups (2.89 vs. 1.69 agonistic confrontations per sow per 24h, P=0.01). In contrast, a bigger proportion of the sows in the 24-sow groups tended had damaged skin (68.9% vs. 52.7%, P=0.08) and to be removed from the pen due to injured legs (2.1% vs. 0%, P=0.07).

Exp. 2 (space allowance): Groups of 12 sows having either 2.2, 3.0 or 4.5 m^2 per sow (six replicates) were compared. Data collection and statistical analysis was made as described for exp. 1. There was no difference in activity between the three groups. However, as the space allowance increased, fewer sows were active on the slatted part of the floor (30.2%, 22.9% and 17.7% respectively, P=0.01). During feeding agonistic confrontations decreased as the space allowance increased (20, 16.9 and 13.3 per h respectively, P=0.04). However, more sows tended to have injured skin in t he groups with 4.5 m^2 per sow, while fewer sows had damaged skin when space allowance was 3.0 m^2 per sow (65.3%, 58.2% and 72.2% of sows respectively, P=0.08)

There were no differences in weight gain between the groups. Giving the sows more space per animal, or increasing the total floor space available by increasing the group size, decreased the level of agonistic confrontations. Generally, the restrictive floor feeding caused high levels of agonistic confrontations in all groups.

Unrestricted contact versus duplicate cage procedure: A methodological evaluation on social influence on foraging behaviour in domestic chicks

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In most studies on social learning of domestic chicks aged a few days, the tutor and the bystanders are separated by a Perspex (duplicate cage procedure). This is done to ensure that the animals learn by pure observation only. In nature contact between chicks is unrestricted and longer lasting and space dimensions are more extended. The aim of this study was to investigate the effects of these differences on foraging behaviour.

16 groups of 4-5 Leghorn White chicks were tested in an arena measuring 4 by 5 metres. The floor was covered with wood chips in which small food hoards (chicken crumbs of two different colours) were hidden. Close to the food hoards, which were separated by 1 metre, were green and red objects matching the colour of the food nearby. Chicks were tested 9 times in the arena between the age of 1 to 5 days. Each trial lasted half an hour. During trial 1 and 2 there was a duplicate cage compartment in addition in the arena. Chicks of treatment '**Re**stricted' could only observe a tutor feeding red food beside a red object in the duplicate cage compartment, whereas the compartment was opened after one minute for chicks of treatment '**Fr**ee' (8 groups per treatment). After 10 minutes the tutors were taken out of the arena and the compartment in treatment Fr was closed. The groups of treatment Fr were released with their tutors also in trial 4, 5, 7 and 8.

All groups which developed a successful foraging behaviour in the arena (13 out of 16) found food without their tutors and at new places within the first 3 trials. No group incorporated green food in the diet. This is a significant difference to naive groups with no tutor at all, tested at an earlier occasion ($p=0.044$). However, in those trials in which all groups were tested without their tutors, it took even the successful groups of treatment Re significantly longer to find food than the groups of treatment Fr ($p<0.05$). This difference remained until the end of the experiment. In relation to this point, groups of treatment Re were similar to groups with no tutors at all. Furthermore, 3 groups of treatment Re did not develop a successful foraging behaviour in the arena. This was only recorded in earlier experiments with a foraging inhibiting tutor. Thus the duplicate cage procedure even prevented some groups to develop a successful foraging behaviour. It is concluded that, testing chicks aged a few days with a duplicate cage procedure, a difference should be made between social influence on particle preferences (e.g. preference of Re and Fr for red food particles in contrast to the preference for green food particles of control animals) and social influence on learning where to find food (some Re groups did not find food at all or it took them significantly longer to find it in successful trials).

Assessing dominance relationships in cattle: How reliable is the paired feeding test in a middle sized dairy herd?

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Dominance relationships are usually assessed by analysis of displacements in undisturbed herds. As this method is time consuming, a competitive test, such as the paired feeding test, has been suggested as an alternative method. Such tests are problematic, because the motivation of the test animals cannot be controlled, interactions may be forced between animals usually avoiding each other and influences of third animals cannot be taken into account. Although it has been found in small groups that results of food competition tests and field observations correspond well, there may be an increase in complex relationships and mutual avoidance with increasing group size.

We therefore investigated the reliability of a paired feeding test in a herd of 39 dairy cows from which dry cows were temporarily separated, so that 32 to 35 animals were in the herd at any one time. From the 741 possible relationships, we observed 620 dyads (83.7 %) interacting in the field during 180 hours (on 60 days in the pen, 54 days on pasture) with a total of 2339 displacements recorded. A cow was regarded as subordinate if she displaced another cow in less than 33 %, and dominant if she displaced in at least 67 % of encounters. Other relationships were interpreted as unclear.

In the feeding test we tested 678 pairs (91.5 %) during 135 hours over 78 days; 479 pairs were tested twice and 199 pairs only once, because of culling of cows. In repeated tests, results differed in 32 pairs (6.7 %). After morning milking, cows were moved pairwise to the holding area of the milking parlour and offered concentrate for 5 minutes from a bucket which only allowed one animal to feed. Interest in the concentrate was in general very high. Each cow was tested once a day. A cow was regarded as subordinate if she was in control of the bucket for less than 25 %, and dominant if she controlled it at least 75 % of time. Other relationships were interpreted as unclear.

Results of both methods were similar in 77.5 % of cases, 17.2 % of assessments were dominant or subordinate with one and unclear with the other method, and 5.3 % of assessments were contradicting. However, when calculating a rank order based on dominance values (number of dominated cows/recorded individual relationships) from the field observations or the food competition test, 92.4 % of cows differed in rank between the two methods; 23.1 % differed by one rank, 20.5 % by two ranks, 18.0 % by three ranks and 30.8 % by four to nine ranks.

Differences between our investigation and those in small groups may have been affected not only by group size, but also by the low but regular change in herd composition during the 8 months needed for investigation. Those changes are rather usual for dairy herds. Under these circumstances results of field observations and paired feeding tests corresponded moderately concerning individual relationships, but correspondence was low with respect to position in a dominance order.

Differences in the size and colour of model comb stimuli appear not to be discriminated by laying hens

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The comb of the domestic hen (*Gallus gallus domesticus*) and specific features of it have been shown, in small flocks, to be highly correlated with social status (Bradshaw 1992; Appl. Anim. Behav. Sci. 34, 359-363. Graves et al. 1985; Behav. Proc. 11, 189-197). It is possible that the comb may also signal social status to hens which are unfamiliar with each other, as early work in this area suggested (Hale 1957; Behaviour 10, 240-254). If this is so, hens might be expected to respond differently towards unfamiliar conspecifics with markedly different combs.

In this experiment, sixteen ISA Brown hens were exposed in a runway to four model combs attached to a stuffed hen. A stuffed hen was used to control for differences in features other than the comb which might have a signal function. Latency to feed next to the stimulus under each of the four treatments was recorded. It was hypothesised that hens would react to the four colour/size combinations in different ways, which would demonstrate two things. One, that the hens were basing their decision to approach the stimulus upon changes to the comb and two, that certain colour/size combinations were more attractive or deterrent than others, in terms of latency to feed.

Results showed that there were no significant differences in latency to feed between treatments. However there were significant differences in latency to feed between individual hens. One explanation for this finding could be that the features of the comb investigated here had no signal function with respect to social status, when presented to unfamiliar hens. It should be noted however, that the results do not necessarily imply that hens were unable to perform the expected discrimination. Other possible explanations for the observed result include the model being perceived as unrealistic and non-threatening by the hens, the use of secondary cues for identification of the stimulus (the same stuffed hen was used throughout) and the possibility that latency to feed may not have been a sensitive enough measure to detect any discrimination taking place. Further work is planned in order to investigate the alternative explanations presented above and to ensure that the result was not due to a methodological problem.

Does the available space influence the behaviour of turkeys kept at different stocking densities?

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Stocking density is an important issue of discussion regarding turkey welfare. One assumption is, that decreased individual space due to increased stocking density interferes with the turkey's ability to perform normal behaviour. It is one aim of our investigation to examine this hypothesis.

In two commercial Louisiana pens, when populated with about 4500 ten week old male turkeys each, 4 groups of 400 birds were fenced into compartments of different dimensions, leading to one low density (2.0 birds/m², LD) and one high density (3.5 birds/m², HD) group in each pen. Another middle density group (2.7 birds/m²) was also set up in each pen, but is not considered here. The turkeys were reared until 19 weeks of age.

To determine the minimum space physically covered by male turkeys, we measured the horizontal outline of standing turkeys by planimetry from 180 photographs. Every two weeks from week 11 to 19, twelve randomly selected birds were weighed, and photographed three times each from directly above. While the average weight increased from 8,91 kg to 19,17 kg, the area covered increased from 1048 cm² to 1742 cm². Accordingly, the LD-group initially covered a minimum pen area of 20,97 % (week 11) and finally 34,84 % (week 19), the HD group 36,69 % and 60,97 %, respectively.

Frequencies of, among others, threatening or pushing, aggressive pecking and standing up after disturbance by a conspecific were recorded at the 2 week-intervals from 24 h-time-lapse videotapes on two days per week during the 14 daylight hours. The random samples of turkeys being under two cameras in each group were observed with continuous behaviour sampling for 10 minutes per camera every second hour. The average number of observed birds was determined by concomitant instantaneous scan sampling at 2 minute-intervals.

According to a first orientating analysis (procedure GLM), frequencies of standing up after disturbance and threatening or pushing were different between stocking densities ($p<0,05$, but $n=2$) not only when differences in available space became high, but from the beginning of observations. However, figures of standing up (LS-means/100 birds*h: LD week 11: 4.57, LD week 19: 10.18 and HD week 11: 10.41, HD week 19: 31.52) corresponded well with the available space. Threatening or pushing/100 birds*h occurred 2.53 and 15.78 times (week 11 and 19) in LD-birds compared to 8.77 and 36.48 times (week 11 and 19) in HD-birds. Age-dependent changes in social behaviour apparently played an additional role, as activities of older LD-birds were higher than the ones of younger HD-birds while proportions of minimum space covered were similar (about 35-37 %). Differences in aggressive pecking could only be found in week 17 and 19 (week 19: LD 2.22/100 birds*h, HD 9.32/100 birds*h), suggesting, that space effects depended on the maturational state of the birds. Our data indicate so far that the performance of certain behaviour is space-dependent, and in the case of social behaviour also age-dependent. The investigations are continued.

Aggressiveness after calving and docility of suckling cows

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Cattle can be difficult to handle in several contexts. In particular, cows after calving have been said to sometime attack humans when they come close to their calves. Cattle can also react differently to constraint during handling. The aim of that study is to quantify the aggressiveness of cows after calving and to analyse the relationship between that behaviour and the easiness of handling or docility. Cows were considered as aggressive after calving when they threatened the handler or attacked him. During the docility test score described by Le Neindre et al.(1995) the handler tries to maintain the animal in a corner of a pen during 30 consecutive seconds. That score can vary from 6.5 (the most aggressive animals) to 17 (the most docile ones).

From 1994 to 1997, 597 cows were observed (300 Salers cows and 297 Limousine cows). Those cows were wintered indoors. On the first week following the calvings the cows were housed in individual pens with their calves. Handlers scored the cow's aggressiveness on three occasions when they came close to the calves, a first time few hours after calving (from 2 to 14 hours) then two and eight days after. Few hours after calving 14% of the cows were aggressive. That percentage decreased sharply on the two other observations periods (4% two days after calving and to 1% 8 days after). No significant difference was observed between the two breeds.

In a second set of observations, 46 Aubrac cows living in free range conditions all year round were studied. For each cow the reaction towards human in the few hours after calving was observed in springs 1997 and 1998 and one docility test was performed in autumn 1998. Just after calving only 16 of those cows were never aggressive and 10 were aggressive on the two consecutive years. The repeatability of the trait between years was not significant. Cows which were never aggressive just after calving had a docility score of 15.1±1.3. That score was 14.7±1.9 for the ones aggressive on at least one of the two years and 14.4±1.6 for the cows aggressive on the two consecutive years.

The probability of aggressiveness just after calving was quite high in the two samples. However that behaviour disappeared for most of the cows within few days and the reproducibility from one year to the other was not significant. Those results confirm the observations from farmers that cows can be dangerous after calving and that such an aggressiveness is rather unpredictable. The large difference observed between the two sets of data cannot be explained due to confounding factors.

Aggressiveness just after calving and docility score are not correlated. Aggressiveness after calving is probably a component of the maternal behaviour (protecting the offspring) but the docility score measures only the reactions of cattle to human constraints.

An approach to objective comparison of calls in poultry chicks

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An as objective as possible evaluation of the behavioural reaction of farm-animals to environmental changes is necessary for the applied ethology. The idea to examine the vocalisation as a part of the behaviour of some farm animals arose. It has to be expected that changes in the emotional status are reflected in the calls. This led to the development of a special numerical sound analysis system for animals. In our first experiments we could establish differences in the distress calls of domestic fowl chicks during different situations. For further development we have tested the method on chicks of other species.

Therefore 20 chicks of each species - domestic fowl, muscovy duck and quail - were kept in commercial rearing boxes (100 cm width and 60 cm depth). The aim of this study was to analyse distress calls of chicks during a step by step reduction of group size. The Step-Isolation-Test with a reduction of group size from 5 to 1 animal was carried out at 6th or 7th day of life with 4 repetitions. Ten calls of every group size during the test were selected and examined respectively by our numeric analysis of sound signals. This method is based on a FFT-Analysis of the acoustic signal (SPECTRQ 3000) with use a bandwidth of 20 kHz with 100 Hz frequency resolution and 2 msec time window sequence and a subsequent numerical processing of the sonagram. The firs step in this processing is the calculation of five spectral parameters for each spectrum. The spectral parameters show a typical course within the call. The call parameters are derived from this curves for the description of single call qualities.

During the isolation of one animal from the group the chicks of each of the three species utter only one call type respectively. We defined this call type as distress call. The distress calls show a decrease in pitch frequency in each species. The structure of the spectra is very similar in the distress calls of the three species. The call parameters also reacted to social stress in all species comparably. As an example see the peak amplitude of distress calls for different group sizes in the table. The single animals had the strongest calls in chicken and quail. In muscovy ducks the longest calls with highest energy were observed for the group with two animals, where the two ducks yell alternately in bouts. They so reach more calls per time unit than the single animal. This leads probably to a higher excitement in both animals.

peak amplitude of distress calls in dB (mean ± SEM)					
species	group size				
	5 animals	4 animals	3 animals	2 animals	1 animal
domestic fowl	98,5±0,6^{a}	95,6±0.4^{b}	100,4±0,5^{c}	101,2±0,6^{cd}	102,2±0,5^{d}
muscovy duck	95,9±0,7^{ab}	94,8±0,9^{a}	97,3±1,1^{b}	108,3±0,8^{c}	101,8±1,3^{d}
quail	87,3±1,0^{a}	90,4±3,5^{b}	88,2±2,1^{ab}	94,5±1,3^{c}	96,0±1,5^{c}

Different letters indicate significant differences of the means in each line ($p<0,05$).

The examples prove that differences in the excitement of the animals get ascertainable by numeric analysis of sounds. The method in general is appropriate for an analysis of all animal's sounds. Therefore it is only necessary to define special parameters for an appropriate description of the features of the selected call type.

The Social Behavior of Pekin Ducks raised in a Production Environment.

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The Pekin duck originated in China and was imported into the United States in 1875. The domestic Pekin duck is believed to be a descendant of the wild mallard duck (Anas platyrhynchos platyrhynchos). There is very limited information available on the behavior of these ducks. Mallards are described as dabbling ducks and surface feeders. The Pekin duck shows similar characteristics. Elevated levels of aggression results in increased feather-pulling which may lead to tissue damage and ultimate mortality. This is an exploratory study looking at the ontogeny of aggressive behavior in Pekin ducks raised in a production environment. Ten pens of ducks, 5 pens of hens and 5 pens of drakes (n=10 ducks/pen), were raised on litter in 2.4m x 2.4m floor pens containing one bell waterer and one tube feeder. Birds were individually marked and behavioral observations were collected using focal animal sampling with all occurrences of aggressive behavior being recorded (5 days per week,15 minutes per pen, for 5 weeks). Dominance hierarchies were calculated and levels of aggression determined. There were no significant differences in levels of total aggression (pecks and threats) between the hens and drakes, (26.3 and 27.5 interactions per bird per pen, respectively). However, there was a significant increase in the level of total aggression from week 1 to week 5 of age ($P<.001$). It was also determined that significantly more aggressive interactions (78%)($p<.01$) occurred in pen areas other than the feeder space (2% of interactions) or the waterer space (22% of interactions). Baseline plasma corticosterone levels were established for Pekin ducks with no significant differences existing between hens and drakes , 5.6 ± 2.13 ng/ml and 6.3 ± 2.13 ng/ml ($P>.05$). In order to evaluate the welfare of production ducks, information on basic behavior patterns and physiology is necessary. This study provides the first evaluation of the development of aggressive behavior and the social organization of Pekin ducks raised for production purposes.

Perimeter spacing behavior of animals modeled by computer simulations

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Animals closely confined in bounded space have been reported to position more frequently near the perimeter of their enclosure than in the center portion. Perimeter spacing behavior was first reported for cattle and later for pigs, chickens, rabbits, and guinea pigs. The possible explanations reported for perimeter spacing include: 1) avoidance of the center of the pen where contact or agonistic encounters are more probable; 2) thigmotaxic or contact seeking behavior such that the animal has contact with the enclosure wall; and 3) a form of anti-predator behavior among chickens. We have employed computer simulation models to investigate factors causing artificially simulated animals (animats) to exhibit perimeter spacing. In this report, all pens are square. A computer program was written to simulate the movement for animats with different spacing strategies relative to group-mates. In the first simulation, animats moved randomly, and no perimeter spacing behavior resulted. In a second set of simulations, each animat moved in sequence, one step each, in a manner that maximized the distance to its first nearest neighbor (NN), nearest two NN, nearest three NN, etc. until the final simulation was based on each animat moving one step in the direction that maximized its mean distance to all group-mates. This series of simulations resulted in increased perimeter spacing behavior as the number of NN group-mates that each animat attempted to avoid increased. These results suggest that perimeter spacing by animals can occur simply by all group members choosing to maximize their distances from their first two or three NN. In more recent simulations we have employed a predator-prey simulation model to determine which portions of enclosures offer the best location for survival of prey. We believe that this model has relevance for confined animals, not necessarily because of any relationship to anti-predatory behavior but rather because these simulations indicate the portions of pens where interference from conspecifics is more and less likely to occur. The portions of pens where "kills" (or disturbances) are more frequent would be expected to correspond to pen space that is of lesser quality for behavior such as resting. Animat-predator and prey movements were random. Matrices of locations of kills and locations of surviving prey were produced as output. The positions of fewest kills were the corners, followed by the other portions around the pen perimeter. These results indicate that a resting animal is least likely to be disturbed when in a corner. Other perimeter locations provide the next best level of protection from disturbance by a moving group-mate. One simple reason that explains all perimeter spacing is not likely, and the reasons probably vary by species, ambient temperature, group size, and numerous other factors. However, our simulations indicate that perimeter spacing behavior can result from rather simple algorithms, which do not include motivation on the part of the animats to seek contact with the perimeter or avoid the pen center.

Cattle can use individual familiar herd members as discriminative stimuli

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The ability of cattle to discriminate between individual familiar herd members was tested in a learning experiment. From a herd of 14 yearling South Devon heifers who had been reared together, four (the «Ds») were chosen to act as discriminative stimuli and six (the «Ss») were chosen to learn discriminations. The Ss learned to choose the correct individual out of a pair of Ds. When they had learned one such discrimination, the experiment was repeated, requiring them to learn a second pair of Ds. A crossover design was used to assign pairs of Ds to the Ss.

A Y-maze was constructed from electric fencing within the home field of the heifers. During all trials, the two Ds to be discriminated stood tethered to the ground, one each inside of the Y-maze side arms, about 8 metres away from the start area of the maze. The arm in which each D was placed varied randomly, allowing for a maximum of three consecutive placements of one D on the same side. During training, a bucket behind the assigned positive stimulus D was filled with about 200 g of barley while a similar bucket behind the other D was left empty. A training trial consisted of an S waiting in the start area for about 45 seconds and then being allowed to choose to go into one of the side arms. If the choice was correct she was able to eat the barley immediately. If the choice was incorrect, she was confined in the incorrect arm for about one minute and then allowed to go to the correct arm and eat the food.

Four training trials per day were carried out with each subject until they reached the learning criterion. The learning criterion was set at four consecutive days without incorrect choices, or alternatively, five consecutive days with a maximum of one incorrect choice. The Ss who had reached learning criterion within 14 days were subsequently subjected to at least five test trials each. During test trials, cues emanating from the experimenter's behaviour or from the presence of food were controlled for (the experimenter was out of sight and both buckets were empty).

Four of the six Ss reached the learning criterion within 14 days for both pairs of Ds. The other two reached the learning criterion within 14 days with one pair of Ds, but not with the other. In each of the cases in which the test trials were conducted the Ss chose the correct D significantly often (Binomial tests, one-tailed, $P<0.05$). The speed of learning was influenced by the pair of Ds to be discriminated (Wilcoxon signed-ranks test, two-tailed, $T=21$, $N=6$, $P<0.05$), but there was no order effect. All subjects retained their ability to make the correct choice after a twelve day break. The results are discussed in the context of the concept of individual recognition.

Influence of environmental enrichment on aggressive behaviour and dominance relationships in growing pigs

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Previous studies suggest that environmental enrichment with substrates reduces aggressive behaviour among pigs indirectly by acting as a diversion. The present study investigated whether environmental enrichment during rearing also has a direct affect on social behaviour by assessing (1) aggressive behaviour in a test box and (2) dominance relationships in the home pen.

In a randomised block design, three hundred and twenty Large White x Landrace pigs were allocated to one of two environmental treatments from birth to 15 weeks of age. Five blocks were used, each containing eight groups of eight pigs. Half the pigs were reared in barren environments with slatted floors and recommended space allowances. The remainder were reared in enriched environments with three times the recommended space allowance, solid floors and access to substrates. Aggressive behaviour, such as headthrusting, biting or fighting, was assessed by placing three (or sometimes two) piglets from one group in a wooden test box (1.6 x 1.6 x 0.78m) together with three (or two) piglets from another group for 30 minutes. Tests were repeated each week from one to four weeks of age and in each test both groups were unfamiliar but came from the same environmental treatment. Behaviour was recorded in real time via camera. Dominance relationships were assessed by depriving each group of pigs of food for 18 hours and than providing food in a single-space feeder. The identity of each pig which displaced a penmate from the feeder was then recorded continuously for 15 minutes. Tests were repeated over three consecutive days at 12 weeks of age and dominance was calculated from the average ability to displace penmates from the feeder (the greater the ability the lower the score). The average number of fights a pig engaged in within 30 seconds of being displaced from the feeder by a penmate was also recorded. Individual body weights were recorded at regular intervals throughout the experiment. Results were analysed by Analysis of Variance.

Piglets from barren environments were more aggressive than their enriched counterparts in the test box and this difference became more evident with age. In the first test piglets from barren environments sniffed other piglets more frequently ($P<0.001$), in the second test they showed more sniffing and headthrusting ($P<0.05$), in the third test they showed more sniffing, headthrusting and biting ($P<0.001$) and in the fourth test they showed more sniffing, headthrusting, biting and fighting ($P<0.001$). The nature of dominance relationships also appeared to differ between barren and enriched environments. In barren environments dominance was associated with aggressive behaviour during the dominance test ($r=-0.27$, $P<0.01$) and also in the test box ($r=-0.23$, $P<0.005$). In enriched environments dominance was associated with body weight ($r=-0.23$, $P<0.05$).

The results suggest that environmental enrichment during rearing facilitates the development of social skills so that body weight and not aggression determines dominance.

Changes in the social and individual behaviour of broiler chickens under enriched conditions in an uncontrolled environment in Mexico

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The aim of this study was to compare four methods of enriching the behavioural repertoire of poultry under an uncontrolled physical environment. Poultry production is the most important way to obtain animal protein in the diet in Mexico. However, producers of 'uncontrolled environment' systems still have to face serious economical problems due to the high incidence of welfare and health problems under these conditions.

Five groups of 44 Ross line broilers each (11 birds/m^2) were observed. Group 1 (G1) was enriched with a perch, group 2 (G2) with a dust bathing box, group 3 (G3) with plastic toys and fresh weeds, group 4 (G4) with a combination of those three manipulations, and group 5 as control group. Behavioural sampling was used to record, during 120 hours of observation, information on the frequencies of social behavioural events (pecking and social contact) as well as on individual behavioural events (pecking objects, use of perch, and use bathing box). A Kruskal Wallis test was used to compare behavioural events between groups.

The frequency of head pecking was lower in the group with the dust bathing box ($p<0.05$). The groups with the highest frequencies of head pecking were both the group with the perch (G1) and the group with the combination of all enriching devices (G4) ($p<0.05$). The frequency of use of the perch was higher in G1 than G4 ($p<0.05$). These results suggest that the use of dust bathing boxes reduce the levels of head pecking in broiler chickens and could be an alternative to reduce welfare problems in birds housed under 'uncontrolled' conditions in the Mexican tropics.

Utilisation of space by chickens tested in different rearing densities

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An heterogeneous utilisation of space exists in broilers inducing high local concentrations of birds which could increase the occurrence of health problems. To assess broilers motivations' for using available space, we compared local densities of broilers reared at 15/m² and 2/m² (very low density). Broilers were reared in 9 x 5 m pens containing 10 feeders and 5 drinkers placed centrally. The number of birds standing and lying in 18 1m² squares was recorded by scan sampling (5x3 scans) at 4, 5 and 6 weeks of age (wk4, wk5, wk6). Areas free of equipment (Free) and with drinkers and feeders (DF) were distinguished. The behaviour and location of sixteen identified individuals were noted (5x2 scans) to assess their choice of place for lying. One group of 2/m² (gr2a) and one of 15/m² (gr15a) were tested in August. The temperature during observations was high (21-31°C). Two other groups (gr2n, gr15n) were tested in November (21-26°C). Animals were also tested at 7 weeks of age (wk7); 86.7% were removed in gr15n to obtain a density of 2/m² in each group to assess the incidence of rearing density on birds' behaviour.

The mean density/m² was significantly higher in DF than in Free ($p < 0.05$, chi² test) in gr2a and gr2n at all ages tested (except at wk5 in gr2n) and in gr15n at wk7 (density = 2/m²). The opposing result was obtained in gr15n, although non-significant at wk4. In gr15a the mean density/m² was also lower in DF than Free but only at wk4. High temperatures seem to induce an homogeneous use of space when limited space is available. In gr2a and gr2n the observed number of chickens identified lying more often in the DF than in the Free area was often higher than the converse (see table), although the differences were non-significant (binomial test) in most cases. In gr15a and gr15n the inverse occurred, except at wk7. The mean percentage of chickens lying was not statistically different in gr2a and gr15a (87.4% vs. 84.4%) and in gr2n and gr15n (82.3% vs. 79.0%).

Number of chickens identified lying more often in DF and Free areas.

	gr2a			gr2n			
	wk4	wk5	wk6	wk4	wk5	wk6	wk7
DF	10	12	8	9	10	12	14
Free	5	3	5	6	4	3	0

	gr15a			gr15n			
	wk4	wk5	wk6	wk4	wk5	wk6	wk7*
DF	4	2	5	2	3	3	13
Free	5	6	7	12	11	10	1

*: 2/m²

When reared at very low density, broilers prefer to stay near feeders and drinkers and have a limited use of the other areas. At a higher density animals prefer to stay in areas where they are less disturbed by conspecifics and temperature of the pens regulates the utilisation of space. In conclusion, broilers use space heterogeneously even if considerable space is allocated to them. They spontaneously limit their physical efforts.

Normal Gait in the domestic fowl: A comparative study of layers, broilers, game birds, and ducks

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The anatomical characteristics of chickens and ducks related to posture and gait have been modified considerably through genetic selection. Abnormal posture and/or gait have been considered to be causes of leg problems in ducks and chickens. Commercial broilers, Indian Games and Pekin Ducks are characterised by a large distance between the legs and a horizontal posture of the body, while layer type chickens, Malay and Indian Runner ducks have a small distance between legs and an upright posture of the body. Comparative gait analysis were carried out in the birds of the above mentioned breeds and species. The gait was recorded by a PC-operated videotracking system. The vertical and horizontal movements of three points of the body, at both legs and the cloacal region, were recorded by a camera in posterior position, while the birds were walking on a treadmill. The movements of the points were recorded simultaneously and plotted against the time axis.

Layer type chickens place their legs directly under the centre of gravity and thus the body moves in a straight line. Broilers and Pekin ducks, in contrast, move the centre of gravity step by step laterally towards the position of the supporting leg. The same pattern was also found in the Indian Game fowls. Malay chickens and the Indian Runner ducks walked like laying hens. The results show that duck-type and chicken-type walking was influenced by the anatomical characteristics rather than by the species or breed of birds. The changes of the anatomical characteristics in ducks and chickens do not necessarily lead to leg problems: both, duck-like walking in chickens and chicken-type walking in Indian Runner ducks do not impair the walking ability as it is known from broiler chickens.

Behaviour and welfare of veal calves in large groups and traditional systems: a comparative analysis under commercial conditions

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Keeping veal calves in a social environment with enough space to move around and feeding them by teat is believed to improve welfare. These aspects were realised in a new housing system called Peter's Farm® (PF). A study was done to compare behaviour and welfare of veal calves kept in PF with that of calves in two traditional housing systems.

Of each housing system six commercial farms with Holstein-Friesian bull calves were selected (n=18). In PF the calves were housed from the start of the fattening period in a group of 80 individuals (1.8 m^2/calf) and were teat fed via computerised, automatic feeding stations. The calves in traditional group housing (GH) were housed individually during the first eight weeks (1.2 m^2/calf), thereafter in groups of 6 calves (1.8 m^2/calf) and were bucket fed. The calves in individual housing (IH) were kept in crates during the whole fattening period (1.4 m^2/calf) and were also bucket fed. All calves were fed with milk replacer and a grain mixture (max. 250 g/calf/day) according to a commercial fattening schedule. The calves in IH and GH were fed twice a day. The calves in PF could get the predetermined amount of milk in the feeding station during three feeding periods. All farms had wooden slats and no substrate on the floor. Behavioural observations were done at week 2, 3, 6, 12 and 24 after arrival of the calves at the farm. In these weeks video recordings were made to observe 24 hours activity by measuring every 20 minutes the percentage of calves standing. The number of recorded calves was in PF 80/farm, in GH 6/farm and in IH 2/farm. At the same weeks 10 (PF) or 20 (GH and IH) randomly selected calves were observed at each farm every three minutes during 1.5 hours between 9:00 and 12:00 am.

The mean activity of calves in PF was constant over the day. This in contrast with the activity of calves in IH and GH, which showed two peaks around feeding time. Over the whole period calves in PF showed significantly ($p<0.001$) less abnormal oral behaviour (15.7% ± 1.6) than calves in IH (23.7% ± 1.9) and GH (24.2% ± 2.1). During the first 6 weeks abnormal oral behaviour in PF consisted mainly of cross sucking, thereafter, like in IH and GH, mainly of tongue playing and manipulating objects. In all three housing systems abnormal oral behaviour increased over time ($p<0.05$). Over the whole period self-grooming was significantly ($p<0.002$) less observed in PF (3.9% ± 0.4) than in IH (7.0% ± 0.4) and GH (6.1% ± 0.4). In PF self-grooming increased over the weeks ($p<0.05$), eventually to the level of the two traditional systems.

Except for the occurrence of cross sucking, the behavioural results suggest that the welfare of the calves in PF compared with that of the calves in IH and GH is improved during the first period. At a later age the results indicate similar welfare status in all three housing systems.

Salivary cortisol and catecholamine in elephants - a pilot study

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In zoos elephants are kept under restrain housing conditions. Consequently, this can result in a stress syndrome. In order to assess the animal's welfare in this artificial environment it is necessary to analyse physiological aspects as well as behavioural patterns. Cortisol and catecholamine measurements in saliva are well established in various domestic species and human beings. However, measurements of these hormones have never been applied in zoo elephants. To record changes in physiological patterns it is necesessary to define baselines also for these animals.

In this study 8 female elephants of two zoos were included. The age of the elephants ranged from an average age of 7 years (Africans) to an average age of 31 years in the Asian elephants. Daily salivary samples for cortisol and catecholamine determination were taken at two hours intervals (8 am - 5 pm) over a time of five days. The samples were collected using cotton buds. Cortisol concentration was analysed by radioimmunoassay and catecholamines (adrenaline, noradrenaline, dopamine) were detected by HPLC. During the sample collecting period behaviour of the elephants was observed daily from 7 am to 5 pm. Feeding behaviour, walking, stereotypic behaviour and social interactions between the animals were monitored.

Elephants in both groups were handled carefully by their keepers. Neither aggressive behaviour nor fights between the elephants could be observed during the experiment. The frequence of physical contacts like touching, sniffing to each other or grooming was low. The elephants spent 41% of the observation time with food intake. There was no major variation of these behavioural patterns related to the single days and to the single individuals, respectively. Novel food like gras, leafs or apples led to an increase of the frequence of food intake. In both zoos animals were chained during the nights. During the time of fixation five of eight elephants showed stereotypic behaviour which was specific for each individual. Weaving, head shaking and chain clashing could be observed. One elephant showed stereotypies more often than the others. It passed nearly 30% of the day time with weaving.

The highest levels of cortisol were found in the early morning with 1.88$\pm$0.81nmol/l (mean $\pm$ sem) and the lowest in the late afternoon (0.95$\pm$0.499 nmol/l). No difference in average cortisol concentration between dominant and subdominant females were found (dominant n=2; 1.32$\pm$0.73 nmol/l; subdominant n=6 1.306$\pm$0.69 nmol/l). The data of catecholamines showed a high variation in concentration which was specific for each animal. It seems that catecholamines also show a diurnal progression like cortisol with minimum values in the morning and in the after-noon and a maximum level at 2 pm for adrenaline (14.59$\pm$4.34 nmol/l) and noradrenaline (15.95$\pm$5.32 nmol/l). The maximum for dopamine was found at 12 o'clock (19.58$\pm$6.72 nmol/l).

Saliva has the capability to become the body fluid of choice to monitor glucocorticoid and catecholamine concentrations in elephants and possibly other species. The sample collection is easy and non-invasive. The keeper is able to collect the samples by himself.

Effect of prenatal exposition to low magnetic field on behaviour of calves

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The aim of this experiment was to prove a hypothesis whether the low magnetic field with a magnetic induction ranging from 15 μT to 42 μT, applied in the last three months of intrauterine development, has a negative influence on the growth and behavior of calves after weaning. We used 24 Holstein calves. The mothers of trial calves were exposed to a low magnetic field (MF) from the 196th to 258th day of gestation, while the mothers of control calves were in an environment with a zero MF. Cows were exposed to a magnetic induction from 42,1 μT(head) to 15,0 μT (hind part). We conducted three observations of maintenance behaviour, at the age of 14, 16 and 19 weeks. At the intervals of 10 minutes the general activity of each of the animals was recorded. The lying time was longer in the trial group during all observations. In both groups, the lying time was significantly ($P<0.05$) prolonged with age. A similar trend was also found in the time of lying with ruminating and in the total time of ruminating. The standing time was significantly ($P<0.05$) decreasing with age. In both groups, the shortest periods of lying with ruminating and total ruminating and the longest periods of standing were at the age of 14 weeks.

The maze learning ability tests were conducted at the age of 15 weeks. The 6 unit maze was constructed in the pen 16.4 x 4.5 m from steel fence 1.5 m high covered with a black plastic sheet. On the first observation day the calves was tested five times, the first test was for training. Time was recorded from entering to exit. In both groups, the shortest time spent at part P1 was recorded in the first run. In the other runs from this first observation day, the duration of stay was slightly prolonged in both groups. The following day, in the fifth run, the calves from the control group behaved similarly as in the fourth run, but the stay in the part P1 was prolonged in the trial group due to exploratory reactions, mostly in males. A significant difference $P<0.05$ between the first and second day (18 s vs. 41 s) was found in the trial group. The frequency of the sniffing of the walls was higher in males. The total time of standing in maze decreased from 48 s in the first run to 28 s in the second run, and this level was maintained until the fourth run. There was a high increase in the fifth run to 70 s, and this time changed only negligibly until the eighth run. The average levels on the first and second days (35 s vs. 69 s) were significantly different. We evaluated the orientation of the calves according to the number of mistakes and returns to the entrance part (P1). Entering part P4 (blind way) was considered a mistake. Animals from the trial and control groups made the same number of mistakes (26). In the trial group, there were more returns on the second day. On both days, there were generally less returns in the control group. Calves from the control group ran across the maze in the first day slightly slower than calves from the trial group (76 s vs. 69 s). Beginning in the fifth run, the time spent in the maze was prolonged in the trial group. Due to the time extension, there was a significant difference between the average times on the first and second days (69 s vs. 113 s) in the trial group.

The results did not show a negative effect of prenatal exposition to the magnetic field on maintenance behaviour, only exploratory behaviour were intensified.

Effects of stage of lactation and parity on the lying behaviour of dairy cows in tie-stalls.

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Lying behaviour is often used as an index of cow comfort. However, there is very little published information about the effects of cow factors such as stage of lactation and parity on lying behaviour. Hence, the behaviour of 58 Danish Friesians in tie-stalls was continuously recorded on video for 21.5 hours, starting between 12:00 and 14:30. The cows were in their first (n=29), second (n=14) or third lactation (n=15). There were 24 dry cows, 16 early lactation cows (<100 days in milk) and 18 late lactation cows (>200 days in milk), divided between the three age groups. Each lying down and rising event was split into four stages and the time of onset of each stage was recorded from the video. The four stages of lying were: L1) characteristic, rhythmic swinging of the head with the muzzle close to the ground, L2) one knee and shoulder lowered towards the ground, L3) weight taken onto both knees, L4) sternal recumbency with the legs and body still. For rising, the four stages were R1) sternum raised from the ground, R2) stretching forwards with the head and neck but flanks still resting on the ground, R3) weight taken onto both knees, back legs straightened, R4) standing balanced with four feet on the ground.

First lactation cows took less time to lie down (L1-L4) compared with older cows (26 sec versus 32 sec, $P = 0.02$), probably due to having a shorter preparatory phase (L1-L2) (18 sec versus 21 sec, $P = 0.06$), whereas stage of lactation had no effect on duration of lying down movement ($P > 0.10$). Time for rising was not affected by either stage of lactation or lactation number ($P > 0.10$). Cows in early lactation spent less time lying in total than cows in late lactation and dry cows (early: 576 min versus late: 820 min and dry: 761 min, $P < 0.0001$) and the maximum bout length was shorter (early: 92, late: 136 and dry: 176 min, $P < 0.0001$). The number of lying bouts decreased from early to late lactation and dry cows had the least number of bouts (14.3 versus 11.7 and 8.6 bouts/21.5h, $P < 0.001$).

In conclusion, parity had minor effects on lying behaviour, whereas stage of lactation strongly affected lying behaviour. Discomfort while lying due to a high tension in the udder in early lactation may reduce the lying time and increase the number of bouts. However, early lactation cows may also spend longer eating which may affect their timebudget including lying behaviour.

Risk factors for intersucking in Swiss dairy heifers: an epidemiological approach

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Intersucking, i.e. cattle sucking the udder of heifers or cows, is a problem often reported in dairy herds and may lead to udder damage, mastitis, milk loss, and finally culling of breeding animals. We conducted an epidemiological study to analyse risk factors for intersucking in dairy heifers in Switzerland. We randomly selected 130 dairy farms with constant housing and management conditions for at least three years. By on-site personal interview, we asked the farmers about a broad spectrum of environmental factors possibly associated with intersucking, such as housing conditions, the management, and feeding of calves and heifers. The number of heifers that had performed or were currently performing intersucking was recorded on each farm. In total, 2768 heifers (Swiss Brown Cattle, Simmental and Holstein Friesian) were included in this study. Intersucking has been observed in 303 of them.

We analysed data at the farm level using path analysis (Pedhazur, E.J., 1982. Path analysis. In: E.J. Pedhazur and J. Elazar (Ed.), Multiple regression in behavioural research. CBS College Publishing, New York, 577-635). Two outcome variables were considered, i.e. the occurrence of intersucking on the farm and the proportion of intersucking heifers above the cut-off of 7.2 %. We used multivariable stepwise backward logistic and linear regression analyses to build final models with significant paths ($p<0.05$). Breed factors were treated as confounders to control their influence on environmental factors.

Housing conditions of calves before weaning were significantly associated with the occurrence of intersucking. In particular, calves which had no access to barnyard or pasture ($p<0.05$) and were reared in pens in enclosed buildings ($p<0.01$) were most likely to become intersucking heifers. In addition, factors of the feeding management of heifers after weaning were associated with intersucking. Heifers had an increased risk of intersucking if, for instance, they were not fixed while feeding ($p<0.05$), received less than 0.5 kg concentrate per day ($p<0.01$) and 40 % or more maize silage (dry matter ratio) ($p<0.05$) after weaning.

Our results suggest that (a) a stimulating environment especially in early life and (b) undisturbed access to an appropriate diet (that meets the nutritional and behavioural demands and enables the development of the rumen) during the weaning period reduces the risk of intersucking. We are currently testing these hypotheses by direct observation under particular farming conditions.

Milk cortisol content, heart-rate and behaviour of cows milked in an automatic milking system

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The objective of the present study was to examine the effects of milking cows in an automatic milking system on milk cortisol content, heart-rate and behaviour.

Investigations were carried out on 39 experimental cows milked in an automatic milking system (Lely "Astronaut") and 15 control cows milked twice-daily in a double-sided milking parlor. The two groups were kept under the same husbandry conditions. The experimental cows had free access to the automatic milking system.

Cortisol content, heart-rate and behaviour were measured simultaneously. Samples were taken either in the morning (5-8 a.m.) or in the afternoon (3-6 p.m.). Milk samples were analysed by radioimmunoassay; heart-rate was measured using a commercial heart-rate monitor (POLAR ® horse-tester); step and kick responses during milking were observed with continuous recording. For statistical analysis SPSS for windows was used. Differences of means were analysed using both independent and paired t-tests.

In the morning the milk cortisol concentration of cows milked in the automatic milking system was significantly higher ($p<0.05$) (2.66±1.52 nmol/l; n=15) than that of cows milked in the milking parlor (1.31±0.44 nmol/l; n=7). In the afternoon the results for the automatic milking system (1.92±1.26 nmol/l; n=20) also tended to be higher ($p<0.053$) than for the milking parlor (1.15±0.4 nmol/l; n=8).

Cows milked in the automatic milking system had a significantly higher heart-rate ($p<0.001$) while standing in the milking stall (88±8 beats/minute; n=30) than before entering (84±9 beats/minute; n=23) or after leaving it (81±8 beats/minute; n=19).

Step responses during milking occurred more often ($p<0.01$) in the automatic milking system (2.4±1.8 steps/milking; n=26) than in the milking parlor (0.5±0.3 steps/milking; n=15). Kick responses were rare in both systems.

The three parameters examined are indicators of stress. Therefore, the results suggest that cows experience greater stress in the automatic milking system than in the double-sided milking parlor. Possible causes for this elevated stress include more rank related conflict associated with entering and leaving the automatic milking stall, lack of habituation, and insufficient management of cows.

It is proposed that both optimizing cow traffic and more attention to individual cows could improve the situation.

The restraint test for cattle: females are more difficult to restrain than males

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The restraint test was developed by Boivin et al (1994; Appl Anim Behav Sci 39: 115-122) as a means of assessing the docility of beef cattle. They showed that the test was capable of detecting differences between cattle reared under different conditions in that cattle that were reared in close contact with humans were more docile in tests carried out when they were 4 and 8 months of age and were never aggressive towards humans. Later, Le Neindre et al (1995; J Anim Sci 73: 2249-2253) confirmed these results and also calculated a heritability of approximately 0.2. In the study reported here, I used the restraint test to determine whether heifers and bulls differ in docility and also whether docility is related to feed conversion efficiency (NFCE), feed intake and growth rate. Angus heifers (n=96) and bulls (n=87) born and reared at the Agricultural Research Centre, Trangie were subjected to a single restraint test at a mean age of 8 months (range 7 to 9 months). This involved placing each animal on its own in a pen measuring 6m x 6m for 30s after which time a human entered the pen and stood quietly in a corner for a further 30s. At the end of this period, the human interacted with the animal and tried to restrain it in a 2m x 2m square in one corner of the pen. This was done as calmly as possible using only the body movements of the human or gentle touches with a light cane. In all of the tests, this human was the same person. Immediately following the restraint tests, the cattle were then placed in two large pens, heifers in one, bulls in the other, for 20 weeks where they were allowed access to 10 automatic feeders. Each animal was fitted with a transponder which meant that, when the animal went to feed, the amount eaten was automatically recorded. The animals were weighed weekly and NFCE was assessed by the relationship between liveweight gain and feed intake. Nineteen heifers (19.8%) and 12 bulls (13.8%) did not accept restraint and this sex difference was not significant ($\chi^2 = 1.17$). Heifers, however, took longer to restrain than bulls (25.1 vs 38.5 sec, $P< 0.05$) and attempted to escape more (0.63 vs 0.14 attempts to escape per test, $P< 0.01$). There was no relationship between docility and NFCE, intake or growth rate.

Influence of stocking density and environmental enrichment on behaviour and productivity by male, domestic turkeys

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Intensive turkey husbandry systems are normally not equipped with internal structures or outdoor areas. The enrichment of environment is one way to give the animals the opportunity to exercise most normal patterns of behaviour and in this way can improve the welfare of animals. Within the present limits of scientific knowledge it is not possible to determine the optimal stocking rate related to productivity and welfare in any simple manner.
The purpose of this study was to evaluate the effects on behaviour and productivity of turkeys by provision of elevated levels, straw bales and outside areas in dependence on two stocking densities.

In total, 540 day-old male turkeys of line BUT Big6 were placed in 12 compartments in environmentally controlled, light-proof rooms measuring 4.5 x 3.9m. Each of the 4 compartments was equipped either with elevated levels, ramps and straw bales or outside areas and straw bales or only with litter. The behaviour was video-recorded 23 h per day twice per week from 2 weeks of age up to 21 weeks. Behavioural observations were analysed using time sampling in ten-minutes-intervals. In addition, body weight, food consumption and mortality were recorded. Data were analysed by using GLM-Procedure of the Statistical Analysis System (SAS Institute).

The usage of elevated levels depended upon age of birds, stocking density and light period. The outdoor areas were frequented decreasingly with rising age and body weight and in dependence on weather conditions. The usage of straw bales as sitting space as well as foraging material began during the second week of age until the end of the experiment.
Body weight was only significantly higher in the compartment with elevated level and lower stocking density at the end of the experiment. Environmental enrichment and low stocking density reduced mortality. The mean feed consumption per bird was greater in groups with low stocking density, but differences were no significant.

In conclusion, commercial turkeys accepted and used the offered structures depending on age and stocking density. Environmental enrichment improved walking ability and health of birds. However, according to our observations the animals have problems to use the structures with rising body weights. With respect to animal welfare, a solution of these problems seems only possible by enriching the environment and by selecting appropriate breeds and strains of turkeys.

Avoidance of vibration and thermal stress by broiler chickens in a choice chamber

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We investigated the common currency potential of a choice technique for evaluating transport stressors; vertical vibration and thermal stress. Experiment 1: 12 female broiler chickens, aged 42±3 days were studied individually in two choice chambers; each comprising four compartments connected through a central zone. Coloured compartment wall panels, allocated at random, assisted identification. Birds were fasted overnight. After training, four treatments were applied, one to each compartment; Thermal (T - Air temperature: 40°C, 18%RH), Vibration (V- Frequency: 2 Hz, Acceleration: 1 ms^{-2}), Concurrent Thermal and Vibration (VT - details as previously) and Control (C - No stressors). On each of four experimental days, birds were randomly allocated to a chamber. For each choice, the bird was placed in the central zone, confined for 10 min inspection, then released. A choice was defined as entering a compartment and feeding (5 g pellets), whereupon the bird was confined for 60 min. This procedure was repeated five times on each day. Treatment choices were totalled over all birds and analysed using a Generalised Log Linear Model. The model predicted mean [SE] number of choices for each treatment; C: 17.2 [1.4], T: 16.1 [1.3], V: 13.8 [1.2] & VT: 12.9 [1.2]. There was a main avoidance effect of vibration (T&C - 16.6 [1.1] vs. V&VT - 13.4 [1.0], $p<0.05$) but no main effect of the thermal stressor or interaction. The overall response to vibration supported previous findings on short-term exposure, however the lack of differentiation between treatments was disappointing. The experiment was repeated with the following modifications to increase sensitivity: (i) extending the colour cues to the door frames outside the compartments, (ii) withdrawal of all equipment controls and the holding cage from the vicinity of the choice chambers to minimise operator interference, (iii) allocation of birds to a single chamber for the duration of the experiment. The predicted mean [SE] number of choices in this experiment were more disparate than before; C: 15.5 [2.4], T: 20.8 [2.7], V: 12.3 [2.1] & VT: 9.0 [1.8], but not significantly. Vibration was avoided (T&C - 18.1 [1.9] vs. V&VT - 10.6 [1.5], $p<0.01$) and there was still no main effect of the thermal treatment or significant interaction. Substantial differences between individuals were observed in both experiments. The extreme motivation to feed may have suppressed the requirement to recognise or choose between treatments. Unexpectedly, the thermal treatment was not avoided. Perhaps the conditions were initially pleasant and/or the birds were unable to associate the delayed ‘unpleasant’ effect of the heat with the compartment. Alternatively, the conditions were simply not perceived as aversive. Further work is required to establish which of these factors influenced bird choice and in what manner, before results can be meaningfully interpreted and useful improvements in the technique can be made.

Comparison of two crossbreeds of meat-type chickens: genetic effect on locomotor behaviour

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Increased activity levels are believed to reduce leg abnormalities in commercial flocks of meat-type chickens. Locomotor activity is different in fast-growing and slow-growing crossbreeds during the finishing period but it has not been established whether these differences are induced by genetic factors or by differences in body weight. The aim of the present study was to focus on activity during the starting period, when body weights are very close in crossbreeds with different growth rates and thus to define the influence of the genetic origin of birds on their locomotor activity when young.

We compared two meat-type chicken crossbreeds: broilers (B) which grow fast and are often lame, and "label" chickens (L) which grow slowly and are rarely lame. The time budget (lying, standing inactive, drinking, eating and walking) was measured by scan sampling (SS) in 6 repetitions of 5 chicks (density = 2.5 birds/m^2) at 1, 8, 15 and 17 days of age. Standing bouts were analysed by focal sampling (FS) at 2-3, 6-7, 13-14 and 20-21 days of age.

Time budgets established by SS did not differ significantly in either line up to 2 weeks of age. The number of standing inactive birds was significantly lower in B chicks than in L chicks from 15 d of age (B = 13 ± 2%, L = 24 ± 1%) and the number of lying birds was higher in B birds at 17 days of age.

Significant early differences were found in feeding bouts (FS): the early activity of B chicks was half of that of L chicks at 2 and 3 days old (walking duration by bout: 19 ± 4 s for B; 45 ± 4 s for L, $p < 0.05$), although their body weights were similar at this age (at hatching: B = 36 ± 0,3 g, L = 43 ± 0.5 g). Duration of litter exploration was particularly reduced in B chicks.

The more active chicks during the non-feeding bouts at 2-3 days of age were the same at 3 weeks of age in B stocks but not in L (total duration of bout: $R = 0.412$, $P < 0.05$, $n = 27$; time spent standing by bout: $R = 0.409$, $P < 0.05$, $n = 27$).

In conclusion, the B and L crossbreeds have the same overall activity during the first three days of life (S) but they exhibit different organisation and composition of standing bouts (FS). Genetic factors are probably involved in the expression of locomotor behaviour in very young chicks. Correlations between the level of activity at early and later ages suggest that selection of young mobile B chicks might increase activity at a later age, which could therefore reduce the occurrence of leg disorders.

The influence of male weight, de-clawing and spur removal and female plumage condition on the fertility of broiler breeders.

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A well-known problem in the broiler breeder husbandry is the decrease in fertility in the second half of the laying period. Mainly two factors are held responsible: a lower libido due to, in this period higher, male weight and damage at the, in this period often bare, female skin (caused by loss of equilibrium during copulation by these heavier males). For this reason male weight is kept low and males are de-clawed. Sometimes spurs are removed too. Earlier research suggested that male weight higher than recommended by the breeder did not have a negative effect on fertility. The influence of male weight, spur and/or claw removal and female plumage condition is investigated in a series of tests.

In each test one male and one female, aging between 35 and 39 weeks, were housed at both sides of a fence in a visually isolated room. After three days the fence was raised from outside the room, enabling interaction for 30 minutes. This confrontation was repeated on four successive days, each confrontation being videotaped. All females were raised with males till 21 weeks of age, but had never had any contact with a male afterwards (two compartments with 25 females each). In half of the females plumage on the back was artificially removed before testing.

Males originated from four compartments (16 males and 80 females per compartment). In two compartments the last part of both back and inner toes were amputated in the males. In all compartments spurs were removed in half of the males. In one de-clawed flock and in one flock with intact claws males were allowed to become heavier. All 16 possible combinations were tested once. Results are tested by analysis of variance.

In 75% of the tests sexual behaviour occurred. Heavier males (mean weight: 5,1 kg) were sexually more active than the less heavy males (mean weight: 4,7 kg). They performed significantly ($p = .041$) more unsuccessful attempts and had a tendency to perform more successful copulations. Probably the heavier males were more vital.

In the first part of the laying period spurs are rather small. As expected presence or absence of spurs had no significant influence on the number of successful or unsuccessful matings. Significantly more successful ($p = .013$) and more unsuccesful ($p = .007$) matings occurred between hens with intact plumage and de-clawed males than in the three other possible combinations. Perhaps males were afraid to mate with artificially bare hens. No female damage was found, making female avoidance less likely. These results suggested that a higher male weight did not need to have a negative effect on fertility and that de-clawing could have a positive effect.

The effect of water restriction on the appearance of the faeces and behaviour of heifers

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Water is essential for life. An insufficient supply may lead to a chronic restriction that most often is not perceived by the stock person, but may have considerable consequences on the animal's well being and production. The objectives of this work were to study the effect of water restriction on the behaviour of bovine heifers and to develop a method of diagnosing water consumption deficiency through the visual appearance of the faeces. This experiment was carried out during the spring of the subtropical climate of Florianópolis (27º S), Brazil. The experimental design was a Latin Square with five heifers (lines) and five periods (columns), where the following treatments were randomly assigned: 130%, 100%, 77%, 59% and 45% of the daily requirement of water (NRC, 1989). Each period had 6 days plus one day interval, when all animals had water *ad libitum*. On the sixth day of each period the heifers were continuously observed from 6:30 to 18:30 h. The frequency of drinking, defecation, and urination was registered. Every five minutes a scan of the group was made, and the following behaviours were recorded: eating, ruminating, lying, standing, self-grooming and inspecting pail. At each defecation a sample for dry matter (DM) analysis was collected and a visual evaluation of the faeces, which received a score from 0 (driest) to 4 (wettest), was made. Data were analysed using SAS analysis of variance and a residual correlation analysis between visual score and DM content of the faeces was made. Water restriction had no effect on any behaviour ($P>0.20$), except for inspecting pail ($P<0.02$), which was longer at maximum restriction. There was a significant effect of treatment on the DM of faeces, which increased ($P<0.006$) with water restriction. Water restriction, as expected, reduced the frequency of drinking ($P<0.006$), of defecation ($P<0.03$) and of urination ($P<0.0001$). There was a -0.41 correlation ($P<0.0001$) between the visual score and the DM rate of the faeces. We conclude that the reduction in water availability altered the frequency of defecation and urination of the heifers. Additionally, not only was water restriction correlated with changes in the DM of the faeces, but we were also successful in developing a method of assessing the latter through the visual appearance of the faeces.

The flexibility of feeding patterns in individually housed pigs.

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When pigs are group housed, individuals may be denied access to the feeder at preferred times by other group members. Indeed, when compared to individually housed pigs, group housed pigs eat less frequent, but larger meals. This suggests that individuals have to alter their feeding behaviour due to constraints imposed by group living. Therefore, it would be advantageous for pigs to have flexible feeding patterns in order to decrease the impact of group housing. The aim of this study was to assess the flexibility of feeding patterns by restricting the time of access to food of previously ad libitum fed pigs and then returning them to 24 hr access.

32 Large White X Landrace pigs were used in an experiment of 2 blocks (16 pigs per block) each comprising 3, 2 week periods. In each block; during Period 1, all pigs were allowed 24 hr access to food after which, in Period 2, 8 of the pigs had restricted access to the feeder between 11.00 and 13.00h of each day. The remaining 8 pigs continued on 24 hr access to food and acted as controls. In Period 3, all pigs were returned to 24 hr access to food. Daily feeding pattern and food intake were recorded throughout. Behavioural observations in the form of scan samples were made and pigs were weighed twice a week.

In Period 2 the restricted pigs had fewer visits to the feeder per day, 34.0 vs 70.1 ($P<0.001$); of a longer duration, 98.3s vs 64.5s ($P<0.01$); with a higher food intake per visit, 64.9g vs 33.3g ($P<0.001$) than the control pigs. Daily food intake and live weight gain were lower ($P<0.001$) for the restricted pigs in Period 2 than for the control pigs. Restricted pigs spent more time rooting ($P<0.05$), and less time sleeping ($P<0.05$) and feeding ($P<0.05$) than the control pigs in Period 2. There was a large variation between pigs in terms of how they altered their behaviour. An indication of flexibility was gained by comparing feeding behaviour and time budgets between Periods 1 and 3. The pigs that experienced a period of restricted feeding either resumed their previous behaviour or showed the same trend as the controls.

It was concluded that feeding behaviour was flexible and time budgets were resilient across periods. The individual differences in changes in feeding behaviour and time budgets between pigs could be indicative of different ways of coping with a change in time of access to food. This may have implications when pigs are mixed in that some pigs may be able to adapt more easily than others.

Pig reproductive behaviour in a dynamic service system for gilts

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The dynamic service system is a recently developed variant of group mating. In such a system a team of boars is placed with the females, forming a group in which copulation takes place with minimal supervision. The female population of each group is changed on a regular basis, while the team of boars remains unchanged. Detailed assessment of the mating efficiency achieved by the sexual partners grouped in such a system has not been reported.

The behaviour of 80 gilts and 14 boars was observed over a 54 day period in a dynamic service system with pens of 20 gilts and 4-5 boars. The female population of each pen was changed weekly, four new gilts were introduced into the service pen while four of the oldest were removed. The newly introduced gilts were planned to be mated at their second oestrus since they were injected with PG600 15-17 days prior to their entry (mean age 207.94 days, SD= 11.85 and mean weight 108.91 Kg, SD= 3.71). Altogether 933 mating attempts (MA) were recorded. Behavioural details of each observed MA were taken and the mating quality was defined by using quantitative behavioural criteria. The hierarchy of the boars in each team was determined in a pair feeding test and gilt lesion scores were regularly recorded.

MAs were not evenly distributed across the day with a peak shortly after feeding time (9 am). The mean first boar mount latency (FML) was 2.27±0.08 min and the mean MA duration was 7.51±0.16 min. Moreover, a significant correlation ($r= +0.58$, $p<0.01$) was identified between FML and duration of MA. Only 9.3 and 18.3% of the observed MA were classified as 'very good' and 'good' while 34.7, 24.1 and 13.5% were 'unsuccessful', 'poor' and 'fair' respectively. The mating quality differed significantly between teams of boars (all $p<0.001$) and individual boars within each team (all $p<0.05$). The most notable reason for the mating termination was interruption from another competitor boar (29.2%) while only 1.5% of the observed MAs were interrupted by another gilt. The MA quality was strongly related to the reason of its termination ($\chi^2=119.41$, $p<0.01$). There was no effect of the male social rank on the mating success achieved. 84% of the 80 gilts in the study had a positive pregnancy diagnosis test. Those gilts received more total MAs and total 'good' + 'very good' MAs ($T= 2.33$, $p<0.05$ and $T= 2.25$, $p<0.05$ respectively), and were significantly heavier at the time of the selection ($T= 2.80$, $p< 0.01$) than the negative ones. However, positive and negative animals did not differ significantly in their age ($T=0.95$, $p=0.34$) or their mean lesion score ($T= 0.51$, $p= 0.33$). Gilt lesion scores reached a maximum three days after entry and subsequently declined over time ($r=-0.75$, $p<0.05$). Provided that a good knowledge of the factors influencing the activity of the sexual partners kept in such a system is obtained, the dynamic service system could be a valuable alternative in future pig production.

Talking about cattle behaviour to beef farmers, herdsmen and lorry drivers: A strategy to improve cattle welfare and meat quality in São Paulo State, Brazil

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Two years ago the Fundepec (a beef farmers' foundation from São Paulo State, Brazil), proposed a programme to improve the quality of meat produced by its members. After a market survey and an agreement among beef farmers, abattoirs and supermarkets the programme was implemented in February 1997. At present there are 152 beef farmers, 2 abattoirs and 12 supermarkets engaged on it and, until now 26,923 animals from associated members have been slaughtered already. The main objective of this programme is to offer a new system for meat production and commercialisation. In order to achieve it there are series of actions being carried out; including a project to train farmers, herdsmen and lorry drivers on cattle behaviour and handling. The approach of this specific project was due to carcass bruising occurrences. In a specific case, when we observed 79 animals under usual pre-slaughter management, 98% of the carcass presented bruising, resulting from aggressive management (mainly during loading procedures), bad conditions during transport and high reactive cattle ("bad temperament"). In this case the farmer net income dropped 25%. In order to promote improvements in cattle management the Fundepec set up 6 field days, 4 of them were specifically for farmers and herdsmen, they were placed in farms and there were 373 people present; the other 2 were placed in abattoirs and 117 lorry drivers attended them. After a discussion about the main problems in their work daily routine, we presented a brief explanation about cattle sensorial word, social behaviour, learning processes and reactivity, after that we discussed carefully the relationships among these characteristics and aggressive management, human-cattle interactions and meat quality. We stimulated the discussion by talking in accessible language and exploring their reported experience as examples. We intend to promote these field days continuously and, will offer practical training sessions for people from specific farms and abattoirs, after diagnoses of a high level of bruising in carcass.

A preliminary investigation into the range of biological odours used in chemocommunication in the horse

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Introduction: It has been shown that horses are interested in the odours produced by conspecifics (Crowell-Davis and Houpt 1985). Theoretically, significant odours can be produced from any elimination from the animal, and in this study behavioural responses of horses to five substances from mares and geldings following different levels of physical exertion were evaluated. These were fresh and previously frozen faeces, fresh urine, nasal secretions and saliva. This investigation aimed to evaluate the behavioural responses of horses to different types of biological odours and establish if there is a wider range of media used in chemical signalling than that already documented.

Materials and Methods: Ten thoroughbred horses (five geldings and five anoestrus mares), all in good health, were used to form the panel of testers. Two different individuals (one gelding and one mare) provided the samples. Four samples (fresh faeces, urine, and swabs from inside the nares and inside the lateral buccal mucosa) were collected on two occasions from each donor horse, once after exercise and once in the morning after overnight rest. The faecal samples were divided, with half frozen overnight and then allowed to equilibrate to ambient conditions before use in the experiment. Each trial occurred while the panel horses were at rest in their own loose box. Each subject was presented samples at a height of 1.2m in a muslin covered stainless steel bowl according to a Latin square balanced cross over design. Each trial lasted ten minutes and the response recorded on videotape using a Panasonic NV-M40 video recorder. Measures analysed were latency to approach the sample, total time spent investigating the sample and the number of bouts of investigation of the sample.

Results: Only a subset of horses actually sniffed one or more samples, with sniffing occurring in 95 out of the 180 trials. A generalised linear model with gamma errors was used on the tendency to sniff the samples or not. These indicate that there are significant differences between the horses and the effect of their sex, with mares more likely to sniff the samples than geldings ($p = 0.036$). There is also a suggestion of a difference between exercised and non exercised samples ($p = 0.073$), with exercised samples being more readily investigated.

Conclusion: These results suggest that the media and sources of biological odour used by horses for chemical communication may be more extensive than previously reported.

Crowell-Davis,S. and Houpt ,K.A. (1985) The ontogeny of flehmen in horses. *Animal Behaviour* **33**, 739 - 745.

The behavioural and physiological responses of young calves to transport: effects of space allowance and lairage duration

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The effects of space allowance and lairage during transport on the behavioural and physiological responses of unweaned 10-day-old male Holstein-Friesian calves were investigated. Within each of four batches, 24 calves were randomly allocated to one of four treatment groups: transported for two 9-h journeys at a space allowance of either 0.375 or 0.475 m^2 per calf and non-transported controls which were either offered or not offered milk replacer and water during transport periods. Between journey 1 and journey 2, transported calves were returned to their pens and offered milk replacer during a lairage period of either 1 h (first and third batches) or 12 h (second and fourth batches). During both journeys, transported calves spent significantly less time lying down than control calves (mean proportion of observations = 0.44 vs. 0.75; $P<0.001$). There was no significant effect of space allowance on time spent lying down during each 9-h journey. Although the 12-h lairage period provided additional time for calves to lie down and rest compared with the 1-h lairage period (mean proportion of observations = 0.85 vs. 0.38; $P<0.001$), there was no significant effect of lairage duration on lying behaviour either during journey 2 or post-treatment. Lying behaviour was greater in transported calves during journey 2 than in journey 1 (mean proportion of observations = 0.55 vs. 0.33; $P<0.001$). During journey 1, there was no significant effect of space allowance on the median frequencies of loss of balance, physical trauma (falls and/or collisions), trampling and changes in posture. During journey 1, plasma cortisol concentration was significantly greater in transported calves than in control calves (25 vs. 15 nmol/l; $P<0.001$), with the peak plasma cortisol response 1.75 h after loading. There were no significant effects of a 9-h period without feed and water on biochemical measurements of dehydration. Raised plasma free fatty acid concentration during transport was mainly associated with the time since the last feed of milk replacer. The results suggest that for young calves (mean live-weight of 49 kg), a space allowance during a 9-h journey of between 0.375 and 0.475 m^2/calf can provide sufficient space for them to lie down and adjust their posture. Within this range, space allowance had little effect on loss of stability in response to vehicle movements. On the basis of the interval between feeds required to prevent the mobilisation of free fatty acids in response to an energy deficit, the maximum journey time in the EU for unweaned calves of 8 h appears to be appropriate. If, however, unweaned calves are transported for the maximum journey time of 9 h (in vehicles that provide additional facilities), they should be provided with a source of nutrient energy before a subsequent journey. The mid-journey lairage duration was not an important factor, as although a longer lairage period provided greater opportunity for rest, a shorter lairage duration of 1 h (sufficient for the calves to receive milk replacer, but with little opportunity for rest) had no discernible detrimental effects on the welfare of the calves.

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