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Abstracts of
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Shigeru Watanabe is the professor of psychology at Keio University. He is the president of the Japanese Society for Animal Pschology and associate editor of Animal Cognition.

Dr. Watanabe has published a lot of literatures in the field of comparative cognitive science. He has studied the diversity of cognition in animals with various animal subjects from fish to apes. One of his worldwide well-known researches is that crows can distinguish between the paintings of vanGogh and Chagall, and between the paintings of Picasso and those of Monet (Pigeon's Discrimination of Paintings by Monet and Picassco. Journal of the Experimental Analysis of Behavior, vol. 63,1995, pp. 165-174.). Even though the paintings are abstracted with mosaic, pigeons are able to perform the task. This study was awarded with the Ig Novel Prize: psychology, in 1995.
He is also interested in animal welfare, and has related papers published in the field.

(By Dr. Yoshikazu Ueno)

Animal cognition and animal welfare

Shigeru Watanabe

Department of Psychology, Keio University
*Correspondence:

1) What do animals want?

Animals appear to behave to avoid unpleasant state and to maintain a pleasant state. Spencer claimed that pleasant state is adaptive in an evolutionary sense, thus it is adaptive for an animal to alter its behavior to maximize a pleasant state. This is a speculative theory of pleasure based on the correlation between pleasure and adaptation. Soon after, Thorndike formulated his "law of effect" as follows. "Of several responses made to the same situation, those which are accompanied with or closely followed by satisfaction to the animal, will often other things being equal, be more firmly connected with the situation", where satisfaction is defined as the state in which "the animal does nothing to avoid, often doing such things as attain and preserve it". This empirical definition of pleasure evolved to a more sophisticated definition of reinforcement by B.F. Skinner the founder of operant conditioning. According to Skinner "We observe the frequency of a selected response, then make an event contingent upon it and observe any change in frequency. If there is a change we classify the event as reinforcing to the organism under the existing conditions" (Skinner, 1953).

Simple sensory stimulation, such as a light turning on also has some reinforcing effect for animals. Here, I report the reinforcing effect of music in songbirds. Java sparrows remained longer on a perch where they could hear music by Bach than a perch where they could hear music by Schoenberg (Watanabe & Nemoto, 1998). Thus, they preferred Bach to Schoenberg. Interestingly, pigeons, rats or goldfish do not demonstrate a musical preference although they can discriminate between different types of music.

Some psychoactive drugs have strong reinforcing effects that cause addiction in humans. Dopamine has a crucial role in the reinforcing properties of these drugs as well as in reinforcement in general. Dopamine agonists have reinforcing properties and dopamine antagonists reduce reinforcing properties. We examined the reinforcing properties of methamphetamine, a stimulant, in mice, goldfish, and planaria. Even planaria prefer methamphetamine (Kusayama and Watanabe, 2000). Thus, the origin of dopamine agonist-induced positive reinforcement can be traced back to invertebrates.

2) What do animals recognize?

To understand animal behavior, it is essential to know their sensory world, Umwelt. Several methods are used to examine the sensory world of animals. Innate behavior can be used to measure sensory threshold. Classical conditioning provides another tool for measuring the sensory world.

From the viewpoint of psychophysics, operant conditioning provides the most reliable measurement. For example, the visual acuity of Japanese jungle crows measured vy operant conditioning is better than that of pigeons, but worse than predators such as falcon (Yamamoto et al., 2001) .

Animals can discriminate complex stimuli such as music as demonstrated previously. Even carp and goldfish can discriminate between two different types of music. I trained Java sparrows to discriminate between English from Chinese. After the training, the birds were tested with novel text spoken by a novel speaker. The birds maintained their discrimination in the tests. These results clearly demonstrated that the Java sparrows could discriminate between two different languages. Thus, songbirds have auditory discrimination abilities comparable to humans. They have, however, a different auditory system than humans. First, they do not have a laminated cortical structure. Auditory input goes to the telencephalon, then to the diencephalon before returning to the telencephalon .

Birds can also discriminate complex visual stimuli such as paintings. Pigeons were trained to discriminate between watercolor and pastel paintings. The birds also demonstrated generalization to new paintings, indicating that they could discriminate painting media. Pigeons could also discriminate between painters . Pigeons trained to respond to Van Gogh but not to Chagall responded to paintings of Van Gogh to which they had been exposed during the training (Watanabe, 2001). These observations suggest that birds have visual cognition similar to humans. Their visual discrimination however, is not exactly the same as humans. Pigeons maintained their discrimination for scrambled paintings made of small parts of the paintings. Such discrimination is impossible for humans. Their brain mechanisms are also different from humans. In pigeon, the visual pathway through the optic tectum is the main visual system, whereas in human the principal visual pathway does not involve the tectum (colliculus superior).

3) Animal cognition and animal welfare

The concept of animal welfare is somewhat anthropomorphic, hence there is species discrimination. For example, primates, particularly great apes, must be treated more carefully than rodents. What is the origin of this type of species discrimination? Biological relatedness with humans? Or a scala naturale? Recent studies of animal cognition demonstrated that cognitive ability evolves independently in different species. An increase in brain size occurs in different animal groups independently ~~,~~ for example, primates in mammals and corvids in birds. If cognitive ability is an important factor in animal welfare, we must carefully evaluate the cognitive ability of species that are distant from humans.

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“ENVIRONMENTAL ENRICHMENT” BASED ON WILDNESS, REQUIREMENTS AND WELFARE OF ANIMALS

P. Koene

Ethology Group, Department of Animal Sciences, Wageningen University, P.O. Box 338, 6700 AH Wageningen, The Netherlands

*Correspondence: paul.koene@wur.nl

This paper reviews current theory and practice of environmental enrichment. In addition, the concept of potential wildness, indicating the ability to show wild-type behaviour and to survive in the wild, is introduced to weigh species-specific behaviour, environmental requirements and animal welfare, ranging between natural and captive conditions. The working hypothesis is that the potential wildness of an animal determines its environmental requirements and the care humans should give.

When designing environments for wild and captive animals, two approaches are possible, the bottom-up and the top-down approach. In the case of farm animals, the bottom-up approach is usually taken, i.e. the animals are kept under circumstances that are as simple as possible. If animals in such environments show behaviour indicative of suffering, modification of the environment is necessary to decrease animal suffering. The second, top-down, approach starts from an environment that fulfills all natural needs of the wild or captive animal, and reduces complexity until an environment remains in which at least the basic needs of the animal are fulfilled. This second approach is not often taken, but is recognizable in some designs of naturalistic zoo enclosures.

Last but not least attention is given to the evaluation of the effects of providing environmental requirements and/or enrichment. Evaluation of the animal’s response should only be done in situ, i.e on the farm and in the zoo. Individual animals must be asked the right questions (by using randomization and single case analysis) and answers of different individuals can be combined in overall conclusions (using meta-analysis). In this paper the enriched environment is situated between the environment that provides basic requirements and the natural environment. The requirements of an animal on this scale vary with its potential wildness. Furthermore, for providing environmental enrichment the top-down approach is more efficient in giving animals good welfare, i.e. it provides basic requirements (no suffering) plus enrichment (pleasure).

Keywords: environmental enrichment, top-down approach, wildness, requirements

THE DOPAMINE CONNECTION; IS ANIMAL STEREOTYPY A MODEL FOR HUMAN ADDICTION?

Sebastian McBride

Insitute of Rural Sciences, University of Wales, Aberystwyth, United Kingdom.

*Correspondence: sdm@aber.ac.uk

Hughes and Duncan postulated that stereotypies are derived from the appetitive phase of goal-directed behaviours (Hughes & Duncan, Anim. Behav. 36:1696, 1988). The commonality in neural mechanism (mesoaccumbens dopamine pathway) mediating stereotypy (Cabib & Bonaventura, Phys. Behav. 61:499, 1997) and the appetitive phase of goal-directed behaviours (Berridge, Phys. Behav. 81:179, 2004) lends supports to this hypothesis. Stereotypy is, in fact, considered to be a result of long-term potentiation of the mesoaccumbens dopamine pathway as a result of stress exposure in the context of the animal's genotype (Cabib & Bonaventura, Phys. Behav. 61:499, 1997). This potentiation process places the animal in an enhanced motivational state when exposed to conditioned and unconditioned positive reinforcers e.g. cues that indicate the arrival of food or food itself (McBride & Hemmings, Brit. Soc. Anim. Sci. 32:35, 2004). Restriction of these highly motivated behaviours are the potential basis for stereotypy development (Lawrence & Terlouw, J. Anim. Sci. 71:2815, 1993).

In humans, stress-induced long-term potentiation of the mesoaccumbens dopamine pathway also results in an enhanced motivational state but specifically towards reward-seeking behaviours e.g. eating and psychostimulant administration. These behaviours are also elicited by conditioned and unconditioned positive reinforcers and chronic dysregulation of this system is the considered basis for human addiction (Robinson, & Berridge, Addict. 95:S91, 2000).

This commonality in dysregulated dopaminergic mesoaccumbens physiology that underlies both stereotypy and human addiction potentially suggests that one may be representative of the other. The implications of this on the putative functionality of stereotypic behaviour are discussed.

Keywords: Dopamine, stereotypy, addiction

BIG CATS AND BARKING DOGS – HUMAN : ANIMAL INTERACTIONS AND THEIR EFFECTS ON BEHAVIOUR AND WELFARE

Danica Peck, Alan Lisle, Clive Phillips

Centre for Animal Welfare and Ethics, School of Veterinary Science, University of Queensland, Australia

*Correspondence: c.phillips@uq.edu.au

The behaviour of seven tigers and their seven keepers, who interacted with them all day in a theme park display, was observed for 5 h/d over 25 d. Three dimensions of tiger personality were identified by PCA and rank correlation analysis, using keeper assessments of 27 personality traits: external awareness (active, vigilant, skittish,oblivious), self awareness (focused, intelligent, obedient, careless, aggressive) and youthful (playful, excitable, impulsive, curious). These three dimensions were statistically correlated. Fourteen traits were rejected because of low inter-observer reliability (Friedman's test > 0.001). Tiger personality was not strongly correlated with their observed behaviour, but external awareness was positively correlated with frequency of rolling on their back (Correlation Coefficient 0.82, $P < 0.05$), and self awareness tended to be negatively correlated with playing (CC -0.68) and approaching another tiger or person (CC -0.71)($P < 0.1$). Tiger external awareness score was positively correlated with frequency of approach by keepers (Correlation Coefficient 0.86, $P < 0.05$), and tiger self awareness score was positively correlated with the frequency of keepers intercepting the tiger to prevent fighting (CC 0.78, $P < 0.05$). Keepers had normal self-assessed scores for neuroticism, extraversion, and openness, but below average scores for agreeableness and conscientiousness. Within agreeableness, keepers scored particularly low for trust, and within neuroticism they scored highly for impulsiveness. Within agreeableness, those with low trust scores hit the tigers more (CC – 0.80, $P < 0.05$). Keepers with high neuroticism scores patted the tigers less (CC – 0.79, $P < 0.05$) and those with high extraversion scores tended to hit them less (CC – 0.70, $P < 0.10$). Those with high openness scores invoked more spraying behaviour (CC 0.82, $P < 0.05$). Keepers with high conscientious scores played with tigers less (CC – 0.84, $P < 0.05$). We conclude that keeper personality influences their behaviour towards tigers and tiger behaviour.

Keywords: tiger, personality, keeper

THE NEED FOR LYING TIME IN HIGH PRODUCING DAIRY COWS

Lene Munksgaard[1], Margit Bak Jensen[1], Mette S. Herskin[1], Peter Lovendahl[2]

Dept. Animal Health, Welfare and Nutrition, Dept. Genetics and Biotechnology, Danish Institute of Agricultural Sciences

*Correspondence: lene.munksgaard@agrsci.dk

Dairy cows with high yield require higher energy intake. If this is obtained by spending more time eating, then less time is available for lying and other activities. We discuss whether high yielding cows have enough time to both eat and lie, and how time constraints affect cows. In a loose housing system with one cubicle and one eating-place per cow, we found a negative correlation between lying and eating time, and lying time was negatively correlated with yield while eating time was positively correlated with yield in first lactation Holstein cows. Their average lying time was 10.3± 1.9 hours/day. Results from experiments estimating demand functions suggest that heifers of about 400 kg have an inelastic demand for lying at about 12-13 hours per day. Furthermore, previous studies have shown that restriction of lying time to 10 hours a day induces both behavioural and physiological stress responses. In another study, decreasing the time available for eating, lying and social contact made the cows spend an increasing proportion of time lying, while the proportion of time spent eating and in social contact was constant. For these cows, there was a reduction in feed intake and milk yield under time constraints, suggesting that under time constraints cows give up some feed intake in order to maintain a certain level of lying time.

In conclusion, a lying time of less than 10 hours per day may have adverse effects on welfare and production. The exact need for lying time is not known, but this may well be higher than 10 hours.

Furthermore, under commercial conditions some high producing cows may not be able to fulfil their needs for eating and lying time. This may lead to a reduction in the welfare of the animals as well as increase the risk of production diseases.

Keywords: cows, lying time, high yield

MAXIMUM JOURNEY TIMES FOR FARM ANIMALS DESTINED FOR SLAUGHTER

Michael Cockram

Division of Animal Health & Welfare, Royal (Dick) School of Veterinary Studies, University of Edinburgh, UK.

*Correspondence: M.S.Cockram@ed.ac.uk

There is consensus that it is appropriate to slaughter animals close to their source of production rather than to transport them over long distances. However, more evidence is required on the effects of long distance transport on the welfare of farmed animals in order to provide a basis for specifying maximum journey times. A rationale for restricting journey time could be made on the basis that:

1. aspects of welfare are adversely affected after a specific journey duration and thus stopping a journey before this occurs would help to minimise any adverse effects of transport;
2. transportation is a continuous, aversive experience for animals and restricting journey time would minimise the duration of this experience;
3. there are many risk factors associated with transportation that have the potential to affect aspects of welfare and the longer the journey, the greater the risk; and
4. the spread of infectious diseases would be reduced.

There is an alternative argument that too much emphasis has been placed on journey times and that greater focus should be placed on the quality of the journey. If environmental conditions (including driving style, road conditions, vehicle design and operation, space allowance, thermal conditions and ventilation), the fitness of the animals and the pre- and post handling of the animals are optimal, it may be possible to transport animals over long distances without major welfare problems. However, if there is widespread non-compliance with regulations and inadequate enforcement to provide optimal conditions, the argument for limiting journey times is strengthened. The evidence to support these approaches will be discussed by reviewing factors affecting the welfare of farmed animals during road transport, and the behavioural and physiological responses of farm animals to journey length and duration of feed and water restriction.

Keywords: transport, animal welfare, legislation, farm animals

ABSTRACTS OF ORAL PRESENTATIONS

SPOKEN PRESENTATIONS

INFLUENCE OF OVERSTOCKING ON BEHAVIOUR AND CLAW HAEMORRHAGES IN DAIRY COWS

S. Dippel[1*], C. Winckler[1], D. M. Weary[2], C. B. Tucker[3]

[1] Department of Sustainable Agricultural Systems/Livestock Sciences, BOKU - University of Natural Resources and Applied Life Sciences Vienna, Austria

[2] Animal Welfare Program, University of British Columbia, Vancouver, Canada

*Correspondence: sabine.dippel@boku.ac.at

Overstocking of cubicle housed dairy cows has been shown to affect behaviour as well as claw health, but the nature of this relationship is unclear.

We monitored the behaviour and claw health of 48 Canadian HF-cows in four groups during the first three months after calving. Groups were housed in identical free-stall pens with solid concrete flooring and sand bedding, with either one (control) or 0.75 stalls per cow (overstocked). Lying, feeding and standing behaviour was recorded on two consecutive days per week using scan sampling at 10-min intervals from video. Data were pooled for weeks 1-3, 5-8 and 9-12 after calving, respectively. Claws were scored directly after calving (T1), and after four (T2), eight (T3) and 12 weeks (T4).

Overstocking had no effect on time spent at the feed bunk or total time standing without feeding. However, overstocked cows spent less time lying and more time standing in alleys, particularly during weeks 9-12 ($p<0.05$).

Sole haemorrhages were of minor to medium severity, and overstocked cows had more haemorrhages at T2 ($p<0.05$) and T3 ($p<0.001$). Time spent at feed bunk during weeks 1-3 was negatively related to haemorrhage counts at T2 (all cows: $r=-0.44$, control: $r=-0.63$; $p<0.01$). Total time standing without feeding and time standing in the alley were positively correlated with haemorrhage counts at T2 in control cows only ($r=0.52$, $p=0.01$ and $r=0.55$, $p<0.01$, respectively). However, the latter relationship was negative for overstocked cows in both T2 ($r=-0.77$, $p<0.001$) and T3 ($r=-0.69$, $p=0.001$). In summary, overstocked cows spend more time standing and are more likely to have haemorrhages, particularly several months after calving. These results indicate there is a relationship between behaviour and the development of claw lesions, but this relationship changes with stocking density, perhaps due to competitive interactions.

Keywords: stocking density, dairy cows, behaviour, claw haemorrhages

AFFILIATIVE GROUP SIZE AND WITHIN-GROUP SOCIAL BONDS IN LACTATING COWS

Ken-ichi Takeda, Yumi Ichikawa, Tomoko Koshino, Yoko Fuiioka. Kanii Matsui
Faculty of Agriculture, Shinshu University, Japan

*Correspondence: ktakeda@shinshu-u.ac.jp

Previously, we found individual differences in the time spent on allogrooming. The size of affiliative groups that formed varied and the productivity of the animals differed with group size. We estimated the upper limit of the size of an affiliative group and compared social bonds and animal productivity with affiliative group size.

Behavioural observations were conducted with 55 lactating Jersey cows in a free-stall barn. The cows were milked twice a day and fed after each milking. Forty-seven cows were studied as focal animals; they were observed continuously for 3 h after each feeding, for a total of 80 h, using all-animal sampling. The frequency of and time spent on allogrooming were recorded as typical affiliative behaviour and the performers and receivers of allogrooming were identified.

There were remarkable individual differences in the frequency of allogrooming (127.9±107.2 times/animal/80h, chi-squared test; $P<0.001$). The time spent allogrooming also varied greatly among the focal cows (2493.4±2196.0 sec/animal/80h). There was a positive correlation between the frequency and time spent allogrooming (Spearman's rho=0.96, $P<0.001$). The frequency of performing allogrooming per grooming partner increased with the number of grooming partners (Spearman's rho=0.81, $P<0.001$). There were from 0 to 11 affiliate cows per group (mean: 5.8 cows, binominal test, $P<0.05$). Therefore, the maximum affiliative group size was 12. The frequency of performing allogrooming per grooming partner also increased with affiliative group size (Spearman's rho=0.91, $P<0.01$). Milk yield (305 days) tended to increase with affiliative group size (Spearman's rho=0.30, $P<0.05$). From this study, it is clear that the social bonds among affiliate cows were strong and that milk yield increased with group size. Moreover, finding a way to make cows form affiliative relationships with many cows would improve animal welfare within a herd.

Keywords: allogrooming, milk yield, social behaviour, welfare

EFFECTS OF DAILY TIME AWAY FROM PASTURE ON THE BEHAVIOUR AND MILK YIELD OF DAIRY COWS

Naomi Botheras[1,2*], Paul Hemsworth[1,2], Sarah Chaplin[1], Jeff Rushen[3]

[1]Institute of Land and Food Resources, University of Melbourne, Australia

[2]Animal Welfare Science Centre, Department of Primary Industries, Victoria, Australia

[3]Agriculture and Agri-Food Canada, British Columbia, Canada

*Correspondence: Naomi.Botheras@dpi.vic.gov.au

In Australia, most dairy cows graze outdoors all year round. At milking time, the herd is brought from pasture to the milking facility, where some cows may have to wait considerable time to be milked. The amount of time cows spend off pasture may affect the time available to perform important behaviours and in turn impact on their welfare and productivity. This study investigated the effects of time spent off pasture for milking on the behaviour and milk yield of dairy cows.

Fifty Friesian cows (parity 2 - 9, 7 - 11 wk post-calving) were managed as one herd and taken together to be milked twice daily. Once the cows arrived at the holding yard, half were milked immediately and returned to pasture (Short treatment) while the others were held for 2 h in the yard before being milked (Long treatment). The treatments were imposed for 6 weeks. Time budgets of behaviour were described by observing cows once every 15 min during six 4-h observation sessions conducted over 4 days during week 6 of treatments.

There was no difference between Short and Long treatments in the time cows spent grazing or ruminating. However, there was a trend for Short treatment cows to spend less time standing ($P = 0.06$) over 24 h than Long treatment cows. Milk yield was lower ($P < 0.001$) in the Long treatment.

While increased time off pasture did not affect time spent grazing, milk yield was reduced. The mechanism(s) responsible for this depression in milk yield is not clear, however this result has obvious implications for herd management in situations in which time off pasture varies markedly within the herd.

Keywords: dairy cows, behaviour, time budget, welfare, milking

COMPARISON OF ORAL BEHAVIORS OF YOUNG CATTLE IN PEN AND PASTURE ENVIRONMENTS

Toshie Ishiwata[1*], Katsuji Uetake[1], Robert J Kilgour[2], Yusuke Eguchi[1], Toshio Tanaka[1]

1 Graduate School of Veterinary Medicine, Azabu University, Japan

2 Agricultural Research Centre, NSW Agriculture, Australia

*Correspondence: ishiwatato@aol.com

Oral behaviors such as tongue rolling and bar-biting are related to stereotypic behavior in cattle. So focusing on oral behaviors, behavioral characteristics of young cattle in pen and pasture conditions were compared.

Behavioral observations of 122 steers in eight pens and 1136 steers at six pastures were performed using instantaneous recording during daylight over three days at each farm. The pens had Japanese Black X Holstein (Farm F1) and Japanese Black (Farm JB), the pastures had Angus, Murray Grey, Shorthorn, Hereford, Santa Gertrudis and their crosses (Farm A, B, C03, C04, D and E) aged 5-15 months. The pastures varied in vegetation from native pasture to improved pasture. The proportion of steers performing all behavioral categories was compared between rearing conditions by MANOVA and one-way ANOVA followed by the Tukey's post-hoc test. The proportion of steers performing all oral behaviors (eating, drinking, self-grooming, allogrooming, licking objects and tongue rolling) on Farm F1 (42.5%) was not different from that at pasture (Farm A: 63.1%; B: 62.6%; C03: 52.9%; C04: 55.2%; D: 49.9%; E: 44.8%). Comparing behavioral category separately, the proportion of steers eating was less in the pens (Farm F1: 32.9%; JB: 22.3%) than on Farms A (60.7%) and B (61.5%), which had sparse native pasture ($P<0.05$). The proportion of steers performing other oral behaviors than eating (self-grooming, allogrooming, licking objects and tongue rolling) was greater on Farm F1 than in the other farms ($P<0.05$). The proportion of steers performing allogrooming was greater in Farm JB (1.3%) than at pasture (Farm A: 0.6%; B: 0.3%; C03: 0.3%; C04: 0.4%; D: 0.2%; E: 0.3%) ($P<0.05$). In the pen conditions, high proportions of steers eating followed the feedings twice a day. The other oral behaviors increased after eating and approximately 1.5-2.5 h after dawn.

Although the proportion of oral behaviors was affected by pasture conditions, cattle in pens performed more oral behaviors to compensate for their lower proportion of eating.

Keywords: animal welfare, beef cattle, oral behavior

CATTLE AT PASTURE USE INANIMATE OBJECTS TO GROOM SPECIFIC PARTS OF THE BODY

Robert Kilgour[1*], Katsuji Uetake[2], Toshie Ishiwata[2]

1 Agricultural Research Centre, Trangie NSW 1823, Australia

2 School of Veterinary Medicine, Azabu University, Japan

*Correspondence: bob.kilgour@agric.nsw.gov.au

Under intensive management conditions such as feedlots, grooming by domestic cattle against inanimate objects is prevented due to the damage that large animals cause to fittings. This prevention may result in lowered welfare due to frustration through animals being unable to satisfy a need. As a first step in the resolution of this question, we aimed to determine patterns of grooming in cattle as a basis for assessing the likely degree of deprivation when grooming is prevented. Beef cattle were observed on open pasture on three commercial farms during three morning and three afternoon observations. All self grooming bouts that were observed were described as they occurred, giving a total of 150 grooming bouts. The bodily parts used were the tongue and hind hoofs. The inanimate objects included living trees, dead fallen trees and fence posts. Self grooming using bodily parts was directed mainly to the hip (23%), shoulder (21%) and flanks (19%) and these were rarely the areas groomed using inanimate objects ($\chi^2_{2df} = 29.6$, $P<0.001$). Self grooming using inanimate objects was mainly directed to the neck (43%), forehead (13%) and cheek (13%). These areas were never seen to be groomed using the tongue or hind hoofs ($\chi^2_{2df} = 39.0$, $P<0.001$). It therefore appears that cattle use objects to groom specific parts of their bodies, those being difficult or impossible to reach with their tongue or hind hoofs. Given that these areas are difficult or impossible to reach without the use of inanimate objects, prevention of grooming using such objects is likely to result in lowered welfare.

Keywords: animal welfare, grooming

HOW EARLY SUCKING EXPERIENCE AFFECTS CALVES' LEARNING TO USE THE AUTOMATIC MILK FEEDER?

Laura Hänninen[1], Helena Hepola[2], Satu Raussi[3], Sanni Heinonen[2], Juha Sariola[4], Hannele Khalili[4], Hannu Saloniemi[1]

1Research Centre for Animal Welfare, Department of Clinical Veterinary Science, University of Helsinki, Finland,

2Research Centre for Animal Welfare, Department of Animal Science, University of Helsinki, Finland,

3Research Centre for Animal Welfare, MTT Agrifood Research Finland, Agricultural Engineering Research. Finland.

*Correspondence:laura.hanninen@helsinki.fi

Optimum rearing system prior to the automatic milk feeder (AMF) is not known. Dam-reared calves would learn to suck nurse cows better, but they could be also less adapted to humans than individually housed calves.

Forty-one calves were blocked by birth date and randomly allotted within blocks to the experimental treatments. Calves were either housed for four days with their dam (DAM) or individually with colostrum feeding either from a teat-bucket (TEAT) or from an open bucket (BUCKET). Then one calf from each treatment was introduced to an AMF pen (Day 1) of six experienced calves (age 21±2 days). If the calves had not drunk successfully during the first 5 or 10 hours, they were guided to the feeder and the procedure was repeated on the following day. The mean daily AMF visit duration and milk-consumption during the first two days were scored. Furthermore, the number of calves that needed assistance for these two days and their mean daily duration spent by the door of the occupied or empty AMF (relative to total time spent by the door) were counted. The three oldest calves were removed from the pen 5±2 days prior the test was repeated with next three calves. The differences between treatments were analyzed with mixed models.

On Day 1, TEAT calves were more at the AMF door, occupied by the caretaker, compared to DAM or BUCKET (16±7% vs. 1±0.5 or 5±3%, $p=0.009$ or $p=0.05$, respectively). During Day 2 more DAM calves needed assistance than TEAT or BUCKET (77% vs. 36% or 43%, $p=0.07$) but BUCKET calves had longer visits/liter milk than TEAT or DAM (433±35s vs. 397±54s or 322±39s, $p<0.0001$).

Calves that have been used to teat-bucket for their first four days of life used an AMF more rapidly than dam-reared or calves fed from an open-bucket. Also they may experience humans more positively than open-bucket fed calves. Prior dam-rearing may delay calves' learning to use AMF.

Keywords: calf, automatic milk feeder, teat bucket, open bucket, learning

THE EFFECT OF GENDER AND TIME SPENT WITH DAM ON BEHAVIOURAL DEVELOPMENT IN INFANT DAIRY CALVES

Mariko Lauber[1,2*], Paul Hemsworth[2,3], John Barnett[3]

1 CRC for Innovative Dairy Products, Australia

2 Animal Welfare Science Centre, University of Melbourne, Australia

3 Animal Welfare Science Centre, Department of Primary Industries (Victoria), Australia

*Correspondence: mariko.lauber@dpi.vic.gov.au

Behavioural development has obvious implications for animal productivity and welfare. Factors, including gender and rearing experiences, may affect behavioural development in dairy calves. In this study the effects of gender and time spent with dam (TWD) on behavioural development were examined in 47 dairy calves (24 males and 23 females). Calves were removed from their dam either within 12 hours of birth or between 12-24 hours of birth. At 2 and 6 weeks of age (WOA), each calf was exposed to an Open Field, a Novel Object (beach ball) and a Startle (opening umbrella whilst feeding) test. Each calf also completed a Learning task, requiring the location of a single, marked, teat on a three-teat feeder that provided milk. 3-way ANOVA with repeated measures on age were used to examine gender and TWD.

Calves that spent 12-24 h with their dams had increased heart rate and greater avoidance responses in the Startle test at 2 WOA ($P<0.05$). Male calves showed greater avoidance responses at this age in this test ($P<0.01$). There was no TWD effect on the animals' responses in all tests at 6 WOA; however, female calves learnt quicker than male calves at 6 WOA ($P<0.05$).

Relative to 2 WOA, vocalisation and latency to sniff/lick the walls/floor of the arena decreased and time spent interacting with the object increased in the Novel Object test at 6 WOA ($P<0.01$). For the Open Field test, vocalisation and urination decreased ($P<0.01$) and distance travelled ($P<0.05$) increased at 6 WOA. Learning rate improved at 6 WOA ($P<0.01$). There were no differences between responses at 2 and 6 WOA in the Startle test ($P>0.05$).

Correlation analyses showed that individual differences were relatively stable between 2 and 6 WOA for many of the variables recorded in the 3 behavioural tests. Overall, time with dam influenced the behavioural and physiological responses to the startle test at 2 WOA, and gender influenced learning at 6 WOA. Based on findings from a previous study where experience did not effect responses of 6 WOA calves, it is concluded that age influenced the behavioural responses in the Novel Object and Open Field tests and the Learning task.

Keywords: cattle, behavioural development, gender, time with dam

PREVIOUS EXPERIENCE AFFECTS CATTLE WATER SOURCE PREFERENCE

Gabriela S. Bica* , L. C. Pinheiro Machado Fº, Dayane L.Teixeira, Helder Gusso

Lab of Applied Ethology, Department of Zootechny & Rural Dev., Federal University of Santa Catarina, Florianópolis/SC, Brazil. leta@cca.ufsc.br

*Correspondence: gabrielasb@yahoo.com.br

Water source may affect water consumption, as previous experience may affect the animals' preference. However, there is little research on the later. The aim of this trial was to determine if previous experience would affect the animal's preference of two different sources: pond or trough. The experiment was held in the South of Brazil, during November 2004. We used 48 Nelore and Hereford crossbred steers, all familiar with ponds from birth, from which 24 had 3 months of previous experience with troughs. The animals were paired according to weight, age and experience, and randomly allocated, six with and six without previous experience with troughs, to 4 paddocks of 4ha each, having natural pasture and mineral salt "ad libitum". In each paddock the 12 steers could choose to drink from a pond or a trough. The trough was located close to the side of the pond where the animals usually enter to water, in order to allow them to choose where to drink. Observations started the next day of the entrance of the animals in the paddocks, and were made simultaneously for 12h during four days, from dawn to dusk, totalizing 48h of evaluation per paddock. Data were analyzed by Chi-square procedure. Previous experience affected the number of visits to each water source ($P<0.01$): of a total of 98 visits to the water sources by the naive animals, 73 drinking events occurred at the pond and 25 at the trough. Of 128 drinking events within the group of experienced steers, 69 were performed at the pond and 59 at the trough. We conclude that the preference of the animals was affected by previous experience. Naive steers preferred the familiar source of water, but no preference was expressed by the experienced animals.

Keywords: previous experience, steers, pond, trough, drinking behaviour

BEHAVIOURAL INDICATORS OF FRUSTRATION AND PLEASURE IN STABLED HORSES

Shigeru Ninomiya*[1], Shusuke Sato[2], Ryo Kusunose[3], Takeshi Mitumasu[4], Yoshiaki Obara[5]

1 United Graduate School of Agricultural Science, Tokyo University of Agriculture and Technology, Japan
2 Department of Grazing Animal Production, National Institute of Livestock and Grassland Science, Japan
3 Equine Research Institute, Japan Racing Association, Japan
4 Faculty of Agricultural Science, Utsunomiya University, Japan
5 Department of Veterinary and Medicine Science, Tokyo University of Agriculture and Technology, Japan

*Correspondence: nomiya@cc.tuat.ac.jp

Horses perform eating behaviour more than half a day in grazing situation, but are often restricted from doing so in the stable. It is important for the welfare and management of stabled horses to understand frustration and satisfaction of eating motivation. To find indicators of frustration and satisfaction (pleasure), we observed eating behaviour of stabled horses.

(1) We observed behaviour of stabled horses (n=71) for 8 hours at 2 minute intervals and analyzed the time budget of each behaviour by a least-squares analysis of variance. Bedding investigation increased after eating and the time budget of it tended to be negatively correlated to the speed of consuming feed (minutes/kg) ($r=-0.52$, $P=0.09$).

(2) We investigated the effect of delaying feeding time for 1 hour which can cause frustration in horses. Behaviour was recorded for 2 hours after the usual feeding time at 1 minute intervals, and compared with that of the horses when they had been fed at the usual time (n=5). Bedding investigation was increased by this treatment. (12.8%, 6.0% $P<0.01$, paired T-test)

It is suggested that bedding investigation is the indicator of frustration.

(3) 6 horses were operantly conditioned to press the button for the reward (timothy cut hay, 3g). The experiment lasted 4 days. The number of the presses for the reward was fixed on 3 or 12 (FR3, FR12) on each day. The effect of fixation was analyzed by paired T-test. Behaviour and ear position of horses in their own box after 1 hour operant treatment in the experimental operant box were recorded for 2 hours at 30 seconds intervals. The number of rewards obtained in FR3 was higher than in FR12 (408, 249, $P<0.05$). After FR3, horses investigated bedding less (5.2%, 9.4%, $P<0.01$), and spent more time standing-resting with ears rotating laterally and the position of the neck low which indicates sleep than after FR12 (15.8%, 6.8%, $P=0.01$). It is suggested that horses were less frustrated in FR3 than in FR12 and sleeping is the indicator of satisfaction (pleasure).

Keywords: frustration, satisfaction, pleasure, welfare, stabled horse

EFFECT OF DIET ON THE CRIBBING RATE OF HORSE

Katherine Houpt, Lindsay Whisher, Johanthen Olsen

College of Veterinary Medicine, Cornell University, Ithaca, NY 14853-6401

*Correspondence: kah3@cornell.edu

Our hypothesis was that high concentrate sweetened grain ($\geq$ 3.3 Mcal/kg) promotes cribbing. The specific aims of the study were 1) to test if increasing the sweet flavour of the diet would increase the rate of cribbing, 2) to determine if replacing carbohydrate calories of concentrates with fat calories will reduce the rate of cribbing; 3) to determine if adding antacids to sweet feed would reduce the cribbing rate. To test this hypothesis, 6 chronically cribbing horses received each of nine diets for two weeks. Free choice hay was fed with and without a grain supplement. The diets (with % time cribbing in parenthesis) were hay only (21%), plain oats -low calorie feed- (16%), oats + sugar -increased calorie content and sweetness- (15%), oats + corn oil- isocaloric control for sugar- (17%), sweet feed - a mixture of corn, oats, soybeans and twenty percent molasses- (22%) and sweet feed + rice bran - isocaloric control which reduces sweetness and carbohydrate content of sweet feed-(26%), and sweet feed supplemented with one of three antacids: Neighlox (21.3%),;Settlex (19.4%); and Prelief (22.5%).

All diets were fed twice a day. During each diet, the horses were videotaped 24 hours per day using a time lapse recorder for at least 47 hrs. The horses' behaviour was recorded every minute on the minute by an observer viewing the videotape. For each diet, we calculated an average cribbing rate for each horse while consuming each diet. There was a significant difference (Friedman's AOV) in cribbing rates among the hay, oat, and sweet feed diets. Therefore, a component of the sweet feed probably stimulated cribbing frequency. There was no significant difference between the hay and the oat diet; both produced a relatively low cribbing frequency. There was no significant change in cribbing rate among the 4 oat-based diets or among the sweet feed diet and the sweet feed plus bran or antacid diets.

Keywords: horse cribbing feeding diet stereotypy

LATERALITY, SUCKLING BEHAVIOUR AND FACIAL HAIR WHORL PATTERNS IN THE NEONATAL FOAL

Jack Murphy[1]*, Sean Arkins[2]

1 Department of Life Sciences, Foundation Building, University of Limerick, Ireland

2 Department of Life Sciences, Schrődinger Building, University of Limerick, Ireland

*Correspondence: jack.murphy@ul.ie

Recognising lateralised behavioural patterns in the young horse is important with regard to athletic performance. During the normal birthing process, one of the foal's forelegs is presented first to facilitate ease of passage of the foal's shoulders through the birth canal. The muzzle is directly involved in tactile association including one of the first critical behaviours (suckling). The objective of this study was to investigate if neonatal foals exhibited lateralised patterns during and immediately post the birthing process that were correlated with the orientation of their facial hair whorl patterns.

Observations of newborn foals were conducted at equine stud farms (n = 22). Foaling personnel recorded the leg (L or R) initially presented by the foals during delivery. Subsequent observations determined the side the foals first or preferentially suckled from. The foal's facial hair whorl patterns were assessed as radial (R), clockwise (C) or counter clockwise (CC) depending on the hair flow from the locus of the hair whorl. Complete data were available for 212 foals with single facial hair whorls (colts = 101, fillies = 111). Statistical analysis using Pearson Correlation Coefficient and Chi-square were conducted in SPSS.

There was a significant association between the sex of the foal and the choice of foreleg presented initially at birth ($r = .228$, $df = 210$, $p < 0.01$). Significantly more colt foals led with the left foreleg ($\chi^2 = 7.2$, $p < 0.01$) and significantly more filly foals led with the right foreleg ($\chi^2 = 3.9$, $p < 0.05$) than expected purely by chance. There were no differences in the side of the mare that foals suckled from in either colt or filly foals. There was a significant association between the sex of the foal and the orientation of the facial hair whorls ($r = .508$, $df = 210$, $p < 0.01$) where colts had significantly more CC whorls and fillies more C whorls ($p < 0.05$). There was also a significant association between the orientations of the facial hair whorls and the choice of leg presented during delivery ($r = .705$, $df = 210$, $p < 0.01$).

Knowing which leg was initially presented by the neo-natal foal during the birthing process may be a useful indicator of future lateralised motor behavioural patterns in the performance horse. The findings suggest that laterality in the horse is determined in utero. This type of information may be beneficial when designing individual training plans to maximise performance in competition horses.

Keywords: Neonatal foals, laterality, hair whorls

ACOUSTIC FEATURES IN VOCALIZATION OF KOREAN NATIVE COWS(Bos Taurus *Coreanea)* IN ESTRUS

Seong C. Yeon [1*], Ji H. Han [1], Katherine A. Houpt [2], Hong H. Chang [1]

[1] College of Veterinary Medicine, Gyeongsang National University,Jinju 660-701, Republic of Korea

[2] Animal Behavior Clinic, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853-6401,USA

* Correspondence: scyeon@nongae.gsnu.ac.kr

The purpose of this study was to analyze the acoustic feature of vocalization of Korean native cows (*Bos taurus coreanea*) and to look at differences between the two reproductive conditions, estrus and non-estrus.

The animals used in this experiment were twenty six cows of Koran native cows. Eight cows were in estrus and 18 cows were not in estrus. The vocalization of cow in estrus were recorded from 2001 to 2003 in early morning and the vocalization of non-estrous cows were recorded in the situation in which the cows waited for feed using 6mm Camcorder. Duration of a single non-estrous call was 1.85 ±0.79(sec) in and of an estrous call was 1.86±0.44(sec) ($p=0.701$). Intensity of a single non-estrous call was 71.4±6.2(dB) in and of an estrous call was 68.8±4.2(sec) ($p<0.001$). The estrus call was a harsh and noisy call and first formant of estrus call(832±150Hz) was higher than that of non-estrous calls(784±127Hz)($p=0.001$). However the second formant(1570±127Hz) of the estrous call were lower than that of the non-estrous call(1710±166Hz)($p<0.001$). Also the third and fourth formant of the estrous call were lower than that of the non-estrous call($p<0.001$).

The results of this study may indicate that analysis of vocalization could be an indicator on conditions of cows between of different physiological conditions in cows.

Keywords: Korean native cow(Bos taurus coreanea); cow; estrus; vocalization

EFFECTS OF CAGE SIZE AND SPACE ALLOWANCE ON AGGRESSION AND FAECAL CORTICOSTERONE IN LABORATORY MICE

Kerry Westwood[1], Oliver Burman[1], Christine Nicol[1], Diane Owen[2], Chris Sherwin[1], Mike Mendl[1]

[1]Centre for Behavioural Biology, Dept of Clinical Veterinary Science, University of Bristol, UK

[2] Central Science Laboratory, York, UK

*Correspondence: kerry.westwood@bristol.ac.uk

Laboratory housing conditions can affect animal welfare and result in physiological and behavioural changes affecting research data quality. This study uses a multidisciplinary approach to investigate the effects of industry relevant home cage sizes and space allowances on indicators of welfare in laboratory mice. The long term aim is to contribute towards optimum housing specifications for this widely used research animal. Mice from inbred (C57Blk-6J) and outbred (ICR-CD1) strains were housed in single strain groups in different cage sizes (330 or 960 cm^2) at different space allowances (60cm^2 (inbreds) 100 or 167 cm^2 per mouse (inbreds and outbreds)) in a factorial design, with 6 replicates of each treatment. Behavioural, neuroendocrinological, immunological, physiological and histopathological measures were collected either on a bi-weekly basis from week 6 to week 11 of life, or post-mortem. Here we present analyses of aggression (aggressive interactions/20mins) and faecal corticosterone levels (ng/g).

Aggression increased more in outbred mice than inbred mice with increasing age (Week1: inbred (0.40±0.09), outbred (1.90±0.49); Week3: inbred (0.81±0.16), outbred (4.09±1.05); Week5: inbred (0.3±0.09), outbred (4.35±0.82), $F_{2,86}$=11.49,$p<0.001$), after cage-cleaning (Settled: inbred (0.68±0.12), outbred (3.06±0.55); After-cleaning: inbred (0.33±0.07), outbred (3.79±0.78), $F_{1,43}$=5.034,$p=0.03$), and in larger cages (Small: inbred (0.49±0.11), outbred (1.46±0.36); Large: inbred (0.52±0.09); outbred (5.28±0.8), $F_{1,43}$=17.798,$p<0.001$). Faecal corticosterone decreased with increasing space allowance in inbred relative to outbred mice (60cm^2: inbred (234.70±37.84); 100cm^2: inbred (234.49±25.26), outbred (150.05±14.84); 167cm^2: inbred (191.42±20.74), outbred (151.69±8.25), $F_{1,34}$=10.982,$p=0.002$).

These results suggest that for the outbred strain, aggression tends to be higher in larger cages, following cage-cleaning and as the animals get older. For the inbred strain, increasing the space allowance appears to decrease levels of stress. Strain differences in the ability to recognise congenic animals, and hence in territorial behaviour, may underlie some of these findings. The findings also indicate that housing and husbandry recommendations may vary according to strain.

Keywords: Welfare, aggression, corticosterone, space, group.

INFLUENCE OF TAIL BIOPSY AND INK TATTOO ON BEHAVIOUR, FLUCTUATING ASYMMETRY AND TAIL HISTOPATHOLOGY IN C57BL/6JBOMTAC MICE

Dorte Bratbo Sørensen*[1], Charlotte Stub[1, 2], Henrik Elvang Jensen[1], Merel Ritskes-Hoitinga[2], Peter Hjorth[3], Jan Lund Ottesen[4], Axel Kornerup Hansen

1: Laboratory Animal Science, Department of Veterinary Pathobiology, Royal Veterinary and Agricultural University, 3 Ridebanevej, DK-1870 Frederiksberg C, Denmark,
2:Biomedical Laboratory, University of Southern Denmark,23 Winsloewparken, DK-5000 Odense C, Denmark,
3:University of Århus, Denmark,
*Correspondence::dobj@kvl.dk

Genetic material for e.g. PCR on transgenic mice is normally obtained by tail biopsy. Additionally, tail tattoo may be used for permanent identification. The aim of this study was to evaluate the influence of tail cutting and ink tattooing on welfare in C57BL/6J mice.

In one group, mice were marked by tattooing the tail at 4, 12 or 20 days of age. In another group, 2.5 mm of the tail was biopsied at 12 or 20 days of age. In both groups, body weight and FA were followed until 8½ weeks of age, where the level of fear/anxiety was assessed using a light-dark test box. Furthermore, climbing behaviour was observed and a beam walking balance test was performed in mice that had been tail biopsied. A histopathological evaluation of the level of restitution in the remaining part of the tail was performed on a third group of mice at 7 weeks after tail-cutting on day 12 or day 20. In all three groups control mice were not treated.

FA was increased by tattooing at 4 and at 20 days of age, but the effect was not observed until 38 days of age (Friedman non-parametric test; $p<0.05$). Climbing behaviour was reduced just after tail biopsy at 20 days of age (Friedman non-parametric test; $p<0.05$), but this difference disappeared later on. No signs of neuromas were found in the biopsied tails, but seven weeks after amputation a significant number of mice did not have fully regenerated glandular tissue and hair follicles in the tail (Fischers exact test; $p<0.001$). Moreover, most of the mice subjected to tail tattooing showed traces of ink in their feces several days after tattooing.

It is concluded that tattooing may have long term negative effects on welfare, while tail biopsies do not seem to have a dramatic effects on welfare.

Keywords: tail, biopsy, tattoo, welfare, neuroma

FEAR IN RAINBOW TROUT EXAMINED BY CONDITIONED SUPPRESSION OF OPERANT FEEDING

Stephanie Yue *, Ian J.H. Duncan, Richard D. Moccia

Department of Animal and Poultry Science, University of Guelph, Canada

*Correspondence: syue@uoguelph.ca

Conditioned suppression has been used traditionally to assess levels of anxiety or fear in animals. Measurements are made on the effects of the supposed anxiety or fear on behavioural responses that are non-reflexive and conscious in nature. This paradigm was chosen to help investigate the capacity for fear in rainbow trout, as there is currently a lack of consensus as to whether or not fish have the capacity for subjective experiences.

Trout learned an artificial operant task of pendulum pressing for a food reward in a mean of 4.3 1-h sessions. In a separate training procedure, they also learned, through classical conditioning, to associate a neutral light cue with an aversive stimulus (plunging dip net) within 30 of such pairings. After negative conditioning, when again allowed to pendulum press for food reward, their mean pressing rate dropped from 3.6 responses/min. to 2.9 responses/min. ($P<0.05$). Most importantly, when the light cue was illuminated for a 3-min. interval and superimposed on a steady bout of pendulum pressing, trout ceased to press and did not resume activity until termination of the light stimulus (mean number of responses during 3 min. interval immediately prior to light cue = 14.3 vs. during the 3 min. light stimulus = 0.1). If fish had no ability for subjective experiences, the light would have had little effect on operant responding. Trout in the current study showed similar results to various species of birds and mammals subjected to similar tests. These results challenge the view of fish as unconscious, non-sentient animals.

Keywords: trout, fear, avoidance behaviour, learning, sentience

EFFECTS OF BILL-TRIMMING ON THE WELFARE OF DUCKS

Leslie Gustafson[1], Heng-Wei Cheng[2], Joseph P. Garner[3], Edmond A. Pajor[3], Joy A. Mench[1]

1 Department of Animal Science, University of California, Davis, USA

2 Livestock Behavior Research Unit, USDA-ARS, USA

3 Department of Animal Science, Purdue University, USA

*Correspondence: jamench@ucdavis.edu

Ducks on commercial farms are routinely bill-trimmed to prevent feather pecking and cannibalism. We evaluated the effects of bill-trimming on the welfare of Muscovy (MUS) and Pekin (PEK) ducks. In conformance with commercial practice, MUS (N = 48) were trimmed at 3 wk of age by cutting without cautery, while PEK (N = 128) were trimmed at hatch either by cutting with cautery or by tip-searing. Time budgets were assessed using focal and scan samples taken from the day after trimming until processing age. Data were analyzed using GLM. In the first week post-trim, untrimmed (NOTRIM) MUS (N = 48) and PEK (N = 64) spent an average of 33% and 26%, respectively, of their time performing bill-related behaviors. Trimmed MUS and PEK performed these behaviors significantly ($p < 0.001$) less often (5% and 11% of time for MUS and PEK, respectively), and also rested significantly more (MUS = 91%, PEK = 88%) than NOTRIM ducks (MUS = 60%, PEK = 74%). By 2 weeks post-trim there were no longer behavioral differences between treatments. Trimmed MUS gained significantly ($F_{1,141} = 30.73$, $p<0.0001$) less weight (4% less) than NOTRIM during the week following trimming, although this difference disappeared by wk 2. There was no treatment effect on body weights of PEK. At processing age, there were more ducks with moderate-severe feather damage or tissue injury in NOTRIM (PEK = 58%; MUS = 28%) than trimmed pens (PEK = 9%, MUS = 5%). Morphological analysis of the bills revealed evidence of scarring at the site of trimming. The particularly thick scar tissue in MUS had apparently impeded nerve and blood vessel re-growth into the bill. However, there was no evidence of neuroma formation in any trimmed group. These results are consistent with bill-trimming causing acute, but not chronic, pain in ducks.

Keywords: duck, bill-trimming, pain, feather pecking

WELFARE INDICATORS FOR SHEEP AND CATTLE EXPORTED BY SHIP

Mathew Pines, Carol Petherick, John Gaughan, Clive Phillips

Centre for Animal Welfare and Ethics, The University of Queensland, Gatton, Qld 4343, Australia

*Correspondence:m.pines@uq.edu.au

Mortality is the principal welfare indicator which has been used for Australian live export, but as this only measures extreme events, there is a need for additional indicators. We conducted an adaptive conjoint analysis to evaluate stakeholders' opinion of welfare indicators for ship-transported sheep and cattle, including pre-embarkation depots. Eighteen indicators were initially identified in consultations with two nominees of each identified stakeholder group (government officials, animal welfare representatives, animal scientists, stockmen, producers/assembly depot operators, exporters/ship owners and veterinarians). A total of 135 stakeholders completed the disk-based questionnaire, 48% of the total number of stakeholders invited to partake. The order of their declining preference for indicators (and importance values), was mortality (8.6%), clinical disease incidence (8.2%), respiration rate (6.8%), space allowance (6.2%), ammonia (6.1%), weight change (6.0%), wet bulb temperature (6.0%), time in assembly depot (5.4%), % animals in hospital pen (5.4%), fodder intake (5.2%), stress-related metabolites (5.0%), % feeding trough utilised (5.0%), injuries (4.8%), % animals able to access trough at any one time (4.8%), % animals lying down (4.7%), cortisol (4.5%), noise (3.9%), photoperiod (3.4%). Cluster analysis revealed common responses to 4 groups of indicators: (1) clinical disease incidence, (2) intake and metabolism (fodder intake, cortisol and other stress-related metabolites), (3) animal condition (mortality and body condition) and (4) environmental factors (photoperiod and ammonia). Stakeholder groups differed in their preferences for these clusters ($P = 0.01$). Government officials, animal welfare representatives and some animal scientists showed a greater preference for (1) than other stakeholder groups. Stockmen considered (2) to be more useful indicators than other stakeholder groups, while producers/assembly depot operators, exporters/ship owners, veterinarians and some animal scientists preferred (3). No one stakeholder group was strongly represented in (4). The results identify potential new welfare indicators for exported livestock and can be used to direct research efforts effectively.

Keywords: welfare indicators, adaptive conjoint analysis, livestock exporting, sheep, cattle

TIME DEVELOPMENT IN SOWS' CHOICE OF RESTING SITE AROUND PARTURITION IN PENS WITH PARTLY HEATED FLOOR

Lene Juul Pedersen[1], Jens Malmkvist[1], Erik Jorgensen[2]

Danish Institute of Agricultural Sciences, Research Centre Foulum, [1]Dept. of Animal Health, Welfare, and Nutrition and [2]Dept. of Animal Genetics and Biotechnology.
*Correspondence: lene.juulpedersen@agrsci.dk

Early piglet mortality is to a great extent caused by crushing but cold stress immediately after birth may be the underlying cause. Provision of a heated floor may assure a better thermal environment. For loose-housed sows, this requires that the sow does not avoid the heated floor during parturition. Their choice of resting site was therefore investigated in the present study.

Twenty-six sows housed in "central nest pens" were observed from 5 days prior to 5 days after parturition. Pens were divided into a nest area with concrete floor and an activity area with drained floor. In half of the pens the nest area was heated to 34 C (H) whereas the other half was kept neutral (C). The sows' choice of resting area was observed continuously and scan sampling every hour of the piglets' resting site was done.

Fifty-one % of the sows chose to farrow in the nest area whereas 49 % farrowed in the activity area with no significant difference between treatments. Throughout the following 48 h the sows spent on average 83 % of their resting time at their farrowing site. However, after 48 h the H sows that have chosen to farrow in the activity area, spent 83 % of their resting time on the heated floor away from their farrowing site whereas all other sows spent most of their resting time (79 %) at their farrowing site. H piglets born in the activity area, gradually spent more time resting alone on the heated floor, which was not the case for C piglets. In conclusions, sows choice of farrowing site were not influenced by access to a heated floor. However, around 2 days after parturition, piglets actively sought the heated floor, resulting in a preference also for the sows to rest here.

Keywords: Sus scrufa, thermoregulation, preference

THE EFFECT OF HOUSE ARRANGEMENT ON THE BEHAVIOR OF SOW

Ruey Chee Weng[1], Liang Chou Hsia[2*]

[1]Department of Biotechnology, Mei-Ho Institute of Technology, Taiwan

[2]Department of Animal Science, National Pingtung University of Science and Technology, Taiwan

*Correspondence: lchsia@mail.npust.edu.tw

The purpose of the experiment is to compare the behaviour, stress and welfare implications of 3 different housing systems for sows. A total of 64 first litter LY Landrace ♀× Yorkshire ♂ sows used in the present experiment. There were 16 sows in stalls, 16 sows in groups (4 in each group), and 32 sows in electronic sow feeding (ESF) during gestation. There were four treatments during lactation stage. They were (1) 16 sows in stall moved to farrowing crate; (2) 16 sows in group pen moved to farrowing crate; (3) 16 sows in ESF moved to farrowing crate, (4) but another 16 sows in ESF moved to group farrowing pen. Behavior observation were conducted for 24 hours during the following time: first day in each sow housing treatment, day of service, 80 days after service, 109 days after service, day after farrowing, 14 days after farrowing, 27 days after farrowing, post weaning day. The results during pregnancy period showed that the sows kept in stall had significantly more standing ($p<0.001$), eating ($p<0.05$), drinking ($p<0.001$), dog-sitting ($p<0.001$) behavior and had significantly less moving ($p<0.001$), and lying ($p<0.001$) behavior. The results during lactation stage showed that the sows kept in small groups had significantly more standing ($p<0.001$), rooting ($p<0.001$), moving ($p<0.001$), but significantly less eating ($p<0.01$), dog-sitting ($p<0.01$), lateral lying ($p<0.001$), and nursing frequency ($p<0.001$). The present results also showed that the behavior was significantly different ($p<0.001$) among different physiology stages. The above results showed that the stall had a negative effect on the sow during pregnancy stage, although dog-sitting behavior had significantly more for sows raised in farrowing crates than group farrowing house.

Keywords: Stall, group pen, ESF, sow

EFFECT OF FEEDING EXPERIENCE DURING GESTATION ON FEEDING PATTERNS AND REPRODUCTIVE PERFORMANCE IN LACTATING SOWS

Rozenn Guillemet, Alice Hamard, Hélène Quesnel, Marie-Christine Meunier-Salaün
INRA-UMR SENAH 35590 Saint-Gilles, FRANCE

*Correspondence::rozenn.guillemet@rennes.inra.fr

Voluntary feed intake of hyperprolific sows can be insufficient to cover the requirements for milk production and maintaining body condition. A bulky diet during gestation may reduce feeding frustration in restrictedly-fed sows and may prepare animals to *ad libitum* feed supply after farrowing. The objective of this study was to evaluate feeding patterns during lactation and reproductive performance according to previous feeding experience.

Thirty-four nulliparous sows (Large-White x Landrace) were offered during gestation either a control (C, 3.3% Crude Fiber, 2.4 kg/day) or a high-fibre diet (HF, 12% CF, 2.8 kg/day) at isoenergetic levels. All sows were offered *ad libitum* the same lactation diet from the first day postpartum (D1) until weaning (26.6 ± 0.3 days). Litters were homogenized at 48 h postpartum (11.2 ± 0.1 piglets). Feeding patterns of 16 sows were recorded as daily food intake (DFI), meal frequency and meal size. Additional measurements included birth and weaning weight of piglets and weight and backfat thickness (at D1 and weaning) of sows. Treatment effects were evaluated by variance analysis.

During lactation, DFI was numerically higher for HF than for C (6.7 ± 0.1 *vs* 6.3 ± 0.1 kg/d, $P>0.1$). Compared to C, sows fed diet HF consumed their diet in more (9.8 ± 0.3 *vs* 7.1 ± 0.2 meals/d, $P<0.001$) but smaller meals (751.9 ± 21.9 *vs* 1011.2 ± 33.7 g, $P<0.001$). Treatment did not have an effect on sow weight, loss of backfat thickness, litter size, number of live-born and birth weight of piglets. Piglet weaning weight was on average 500 g higher for diet HF than for C ($P=0.07$). Average daily gain during the first week postpartum was greater in HF litters (2.1 ± 0.08 *vs* 1.9 ± 0.08 kg, $P<0.05$).

In conclusion, feeding a fibrous diet during gestation modulates feeding patterns during lactation and improves piglets' growth.

Keywords: feeding behavior, reproductive sow, fiber, performance

BEHAVIOURAL EFFECTS OF EARLY PIGLET CROSS-FOSTERING

Anna Valros[12*], Maija Karhapää[3], Sanna Jyrävä[1], Katja Niemi[1], Hilkka Siliander-Rasi[3]

[1]University of Helsinki, Dept of Clinical Veterinary Science, Research Centre for Animal Welfare

[2]University of Helsinki, Institute for Rural Research & Training, Mikkeli

[3]MTT Agrifood Research Finland, Swine Research

*Correspondence: anna.valros@helsinki.fi

Cross-fostering (CF) is commonly used to enhance survival of piglets in large litters. However, CF might cause problems e.g. by disturbing nursing behaviour or by decreasing teat stability.

The study included 62 sows with litters. In the CF group (30 sows) litters included 3 CF piglets (CF 1-2 days after parturition). In the control group (C: 32 sows) 3 piglets were selected as focal animals. In both groups 10 sows were videotaped for 24 hours on the day of CF (d1) and 10 days thereafter (d10). Nursing behaviour was recorded continuously. Groups were compared using Mann-Whitney U-tests.

CF sows had a higher frequency of nutritive nursings on d1 than C sows (median: 27.0 vs 23.5, $p < 0.05$). The duration of nutritive nursings tended to be longer in CF sows and there was a tendency for lower teat order stability in the CF sows on the day of cross-fostering ($p < 0.1$ for both). On d10, the CF piglets used the middle third of the udder to a higher extent than the C piglets (66.7% vs 45.8%, $p < 0.05$) and the front third of the udder less (4.3% vs. 33.9%, $p < 0.05$). There was no difference in the use of the back third of the udder ($p > 0.1$). Mortality rates were higher in CF litters, but the difference was not significant (3.1 vs 10.8, $p > 0.05$). Two piglets were killed by the sow in the CF litters, none in the C litters.

The results indicate that CF increases the nursing stimulus, possibly due to an increased restlessness at the udder. Growth rate did not differ between CF and C piglets (results not presented here). CF piglets could usually not acquire front teats, however, they mainly occupied teats on the middle parts of the udder. CF at an early age did not appear to disrupt the long-term nursing behaviour or teat order stability.

Keywords: Cross-fostering, behaviour, piglets, nursing

EFFECTS OF THERMAL ENVIRONMENT ON EARLY PIGLET VITALITY IN A LOOSE HOUSE SYSTEM

Jens Malmkvist[1], Lene J. Pedersen[1], Birthe M. Damgaard[1], Karen Thodberg[1], Erik Jørgensen[2]

Danish Institute of Agricultural Sciences, 1. Dept. Animal Health, Welfare and Nutrition, 2. Dept. Genetics and Biotechnology

*Correspondence: jens.malmkvist@agrsci.dk

Causes of early piglet mortality include reduced vitality due to hypoxia during parturition and low birth weight combined with heat loss and late/no energy intake in the first critical period after birth. Besides, low vitality piglets may run a larger risk of being crushed by the sow. We investigated whether floor heating affected thermoregulation and indicators of early vitality in piglets in a loose house system.

Twenty-two Landrace X Yorkshire sows of 2nd parity were housed individually in 7.5m^2 pens in a climate controlled facility. Eleven sows were exposed to pen floor heating (33.5°C) from 12h after onset of nest building and until 48h after birth of 1st piglet ('HEAT'), and eleven sows received no floor heating ('CONT', floor temperature: 21.1° C). The groups had similar litter sizes at birth (CONT: 16.4±0.8, HEAT: 16.0±0.8; p=0.76), duration of parturition (CONT: 251±17 min, HEAT: 287±43 min; p=0.45), and standard variation inter-birth interval (CONT: 20±2.3 min, HEAT: 22±3.4, p=0.63).

The concentration of lactate in umbilical cord blood – an indicator of hypoxia – increased with the length of parturition ($p<0.001$) and with declining piglet weight ($p<0.001$). The thermal environment had no effect on the blood lactate immediately after birth ($p>0.05$).

Floor heating resulted in an earlier recovery of piglet rectal temperatures ($p<0.001$), i.e. the risk for experiencing hypothermia after birth was reduced. Moreover, fewer piglets per litter died during the first week with floor heating (HEAT 1.4±0.48 vs. CONT 2.6±0.93, p=0.003). Preliminary analysis indicate that live born HEAT piglets may touch the udder (49±4.3 vs. CONT 53±5.2 min) earlier than CONT piglets. However, there was no difference in piglet activity from birth to first suckling between treatment (HEAT 49.8±1.76% vs. CONT 49.2±2.01%, $p>0.05$).

Floor heating around parturition had favourable effects on thermoregulation, vitality and survival of piglets.

Keywords: Sus scrofa, piglet viability, thermoregulation

INFLUENCE OF FIVE DIFFERENT HOUSING AND FEEDING STRATEGIES ON AGGRESSION AND ACTIVITY OF ORGANIC SLAUGHTER PIGS

***Merete Studnitz**

Danish Institute of Agricultural Sciences, Department of Animal Health, Welfare and Nutrition

*Correspondence: merete.studnitz@agrsci.dk

Production of organic slaughter pigs implies a trade-off between several considerations: consumer opinion, leaching, economy, and finally the pigs´ welfare. In this study, systems in which the slaughter pigs are kept outdoors for various periods of time were compared. The objective of the project was to find the strategy yielding the best production results while at the same time taking welfare and environment into account.

1: indoors after weaning

2: outdoors until 40 kg

3: outdoors until 80 kg

4: outdoors, fed ad lib during the entire experiment.

5: outdoors, fed restrictively during the entire experiment.

When kept outdoors the pigs were fed restrictively with ad lib access to roughage, whereas when kept indoors they were fed ad lib. Five treatments comprising 25 groups of ten pigs were included in the study. The purpose of the behavioural observations was to examine how the five strategies affected the pigs. In a test situation, the level of aggression and activity (lying, standing, walking, running) was measured. During the observations the door into the pigs´ resting area was closed. Aggression and activity were recorded by all occurrence and scan samples every 30 seconds, respectively. Aggression included head knocks and bites, both are common in all groups of pigs and therefore no ethical problems arose from aggression. All treatments were observed in a randomised order the day after weaning, and after being moved at 40 kg and 80 kg. The data were analysed using Kruskal Wallis test. There was no significant difference in activity either across treatments or time of observation. There was significantly more aggression in treatment 2 than in any other treatment when observed at 40 kg, $P<0.02$. Totally, there was more aggression indoors than outdoors, $P<0.001$. Conclusion: the best strategy is for the pigs to stay outdoors during the entire period.

Keywords: organic slaughter pigs, dilemma, behaviour, production, pollution

DO POSTURE CHANGES OF SOWS INFLUENCE EARLY SUCKLING BEHAVIOUR AND WEIGHT GAIN IN DOMESTIC PIGLETS?

Gudrun Illmann, Zuzana Pokorná, Kristýna Bělská, Marek Špinka

Ethology Group, Research Institute of Animal Production, Prague, Czech Republic

*Correspondence: Illmannova@vuzv.cz

Domestic sows are relatively immovable during the period around parturition and this has been interpreted as a good maternal behaviour because it reduces the danger of piglet crushing. However, it remains unknown whether the frequency of posture changes of the sow also affects suckling opportunities and thereby the piglet weight gain. This study had two aims: (i) to document the frequency of posture changes during the course of the first day. (ii) to assess its influence on suckling duration and piglet weight gain within the first day. Thirteen sows were video taped for 24 h after birth. Three phases were distinguished: Birth (start to end of parturition), P1 (end of Birth to 12 h post partum.), P2 (12h to 24h post partum). Posture changes between standing, sitting, lying on the belly and udder access were counted, suckling activity was recorded and piglets were weighed at the start of P1, 12 h post partum and 24 h post partum. The first analysis showed: (i) Sows were changing posture more frequently during Birth than during P1 and P2 (Birth: 11.2 posture changes/h; P1:3.2 posture changes/h; P2: 3.9 posture changes/h (GLMM, $F_{2,24}$=7.25, $p<0.01$). The duration of suckling activity was not influenced by the frequency of posture changes in any phases after birth (GLMM, $F_{2, 24}$=1.75, NS). The weight gain of piglets during P1 (6.0 g/h) and P2 (3.9 g/h) was not influenced either by the suckling activity (GLMM, $F_{1,11}$=0.01, NS) or from the frequency of posture changes (GLMM, $F_{1,11}$ =0.56, NS). In conclusion, posture changes occur most frequently during parturition; the frequency of posture changes does not influence either the suckling duration or the weight gain.

Keywords: pig, maternal behaviour, parturition, activity,

THE EFFECTS OF ALBUTEROL ON BEHAVIOR AND PHYSIOLOGY OF FINISHING PIGS

Jeremy Marchant-Forde[1]*, Don Lay Jr. [1], Kim McMunn[1], Brian Richert[2], Ruth Marchant-Forde[1]

1USDA-ARS, Livestock Behavior Research Unit, Purdue University, West Lafayette, IN 47907, USA

2 Department of Animal Sciences, Purdue University, West Lafayette, IN 47907, USA

*Correspondence: marchant@purdue.edu

Ractopamine, a β-agonist used by some swine industries positively affects productivity but negatively affects behavioral and physiological responses to handling. Pure R-albuterol may deliver similar production effects without the negative effects. This experiment looked at the effects of albuterol on behavior and physiology over a 5-week period.

192 pigs (88.8±0.9 kg) housed in groups of six in 32 pens (1.4m x 4.1m) were assigned to one of four treatments: 1) Control – standard finishing diet, 2) ALB-2 – diet with 2 ppm of albuterol R-enantiomer, 3) ALB-4 – diet with 4 ppm R-albuterol, or 4) ALB-RS8 – diet with 8 ppm mixture of R- and S-forms. All diets were offered ad libitum for 4 wks.

Blood was collected four times: Wk 0 - before treatment, during Wk 2, during Wk 4 and at slaughter at the end of Wk 4. Blood was analyzed for stress hormones. Behavioral responses to weighing were recorded at Wk 0 and weekly during Wk1-Wk4. Behavioral and heart rate (HR) responses to human presence in the home pen were measured during Wk 0, Wk1 and Wk3. HR responses to a 36-min transport process were recorded. Data were analyzed using Proc GLM of SAS, with pen as the experimental unit.

Treatment did not affect cortisol, epinephrine or norepinephrine concentrations during the experimental period ($P>0.1$). Treatment did not affect handling measures ($P>0.1$) or behavioral responses to human presence. However, during the human presence test in Wk1 and Wk3, control pigs had heart rates around 10 bpm lower ($P<0.05$) than pigs in the other three treatments. During transport, overall HR were similar across treatments, but at certain 1-min time points, control pigs had higher HR than albuterol-treated pigs ($P<0.05$). The results indicate that albuterol-treated pigs do not show marked differences in behavioral and heart rate responses to handling and transportation from control pigs.

Keywords: Pigs, albuterol, behaviour, heart rate

REGROUPING AND SOCIAL RANK IN LACTATING GOATS: DO THEY MATTER FOR MILK PRODUCTION?

Adrián Fernández[1], Lorenzo Alvarez[1*], Francisco Galindo[2], Luis Zarco[3]

1Centro de Enseñanza Práctica e Investigación en Producción y Salud Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México

2Departamento de Etología y Fauna Silvestre, Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México

3Departemento de Reproducción Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México

*Correspondence: alorenzo@servidor.unam.mx

With the aim of testing the hypothesis that regrouping decreases milk production in French Alpine goats that were lactating, a study was done using two groups (n=8, 7). During their third month after parturition, four goats from each group were exchanged (first regrouping) between pens and left for 2 weeks, then the same two subgroups of four goats were taken back to their original pen for another 2 weeks (second regrouping). In the third regrouping, the two groups were all placed in the one pen. Milk production and social behaviour were measured daily before and after each regrouping. An individual index of success based on the experience in agonistic encounters was calculated, and three ranking groups were created: low-, medium- and high-ranking goats (Alvarez et al., Appl. Anim. Behav. Sci. 84:119-126, 2003). Kruskall-Wallis, Mann-Whitney, t-test, ANOVA, and Duncan's test were used to analyze the data.

All regroupings led to a similar increase in aggressive behaviors that last by one-two days. Mean daily milk production decreased after first (2.82±0.2 vs. 2.53±0.2, kg±se; $P<0.05$) but not after second and third regrouping. Daily milk production (Kg) was higher in medium- (n=7, 2.99±0.26) than in high-ranking goats (n=3, 2.03±0.42; kg±se; $P=0.06$) and similar to low-ranking goats (n=5, 2.31±0.24; $P>0.05$; $F=2.72$, df=2).

It is concluded that (a) aggressive behaviour increases after all regroupings, whereas milk production decreases only after the first regrouping, suggesting an important capacity of adaptation to a novel and stressful managements in the French Alpine goat, and (b) medium-ranking goats produce more milk than high-ranking goats and similar to low-ranking goats, suggesting an effect of social success on the productive performance. The study highlights the importance of considering effects of common practices in herd managements on social behaviour and production.

Keywords: Regrouping, social rank, milk production, goat

THE EFFECT OF PHOTOPERIOD ON BROILER BEHAVIOR AND WELFARE

Richard Blatchford[1], Joy A. Mench[1], Patricia Wakenell[2]

1 Department of Animal Science, University of California, Davis, USA

2 School of Veterinary Medicine, University of California, Davis,USA

*Correspondence: rablatchford@ucdavis.edu

Unnatural lighting regimes for poultry, such as the near-continuous lighting that is common in commercial broiler chicken production, have been identified as welfare concerns. Providing a longer period of darkness (scotophase) could improve broiler health and provide opportunities for increased sleep and more normal activity rhythms. However, there is limited experimental evidence to support a recommendation for any particular scotophase length. We examined the effects of three lighting schedules (23L:1D, 20L:4D, or 16L:8D) on behavior and leg condition in male broilers (N = 290; stocking density = 3kg/m^2). Broilers were reared under these schedules from 2-6 wk of age; illumination levels were 20 lux during the photophase and 1 lux during the scotophase. There were 3 replicate pens per treatment. Behavior was recorded using scan samples during two continuous 24-hour periods per pen each week. At 6 weeks of age, all broilers were gait scored using a 0-5 scoring system, weighed, euthanized, necropsied, and evaluated for tibial dyschondroplasia (TD) using a 0-3 scoring system. There were no significant differences between treatments for final body weight (mean = 3.10±0.38kg; $F_{2,297}$= 1.42, p = 0.242), gait score (mean score = 2.0; χ^2 = 5.881, p>0.25), or TD (mean score = 0.2; χ^2 = 7.135, p>0.25). Time budgets under the different photoperiods were similar, except that resting behavior occupied a greater proportion of the budget in 20L:4D (30%) and 16L:8D (24%) than in 23L:1D (15%). In addition, resting behavior during the photophase typically consisted of wakeful sitting, while lying and sleeping were more typical during the scotophase. These findings suggest that a longer scotophase could increase sleep and improve welfare with little effect on production.

Keywords: broiler, welfare, behavior, lighting, leg problems

GENETIC RELATED DIFFERENCES IN RESPONSE TO CHRONIC STRESS IN LAYING HENS.

Ruth M. Marchant-Forde[1], Laura Jefferson[1,2], Heng-Wei Cheng[1], William M. Muir[2]

[1]Livestock Behavior Research Unit, USDA ARS, Purdue University, Poultry Science Building, 125 S. Russell Street, West Lafayette, IN 47907, USA

[2]Department of Animal Sciences, Purdue University, Lilly Hall, 915 W. State Street, West Lafayette, IN 47907, USA

*Correspondence: rmarcha1@purdue.edu

The objective of this research was to examine genetic differences in behavioural and physiological response to chronic stress (increased group size combined with a higher stocking density) in 3 strains of hens: KGB birds selected for high productivity and survivability; control birds (C) with poorer productivity and survivability; and Dekalb-XL (D) birds, a highly cannibalistic commercial strain. At 17-wks of age, 112 birds per strain were allotted to standard 4 bird (K4, C4, D4, 213cm^2/bird) or 10 bird cages (K10, C10, D10, 170cm^2/bird) and behaviour was recorded weekly for 14 weeks. At 30-wks of age, 2 birds/cage were sedated and blood sampled before being feather scored and euthanized. Total body weight (BW) as well as individual organ weights (heart, liver, spleen and adrenals) were obtained. The total time and number of bouts of postural, consummatory and aggressive behaviours were determined. Blood was assayed to evaluate circulating corticosterone, adrenaline, noradrenaline and dopamine. Overall, K4 and C4 birds were less active than all other strain X group size (SXGS) combinations (p<0.05). D4 and D10 birds were most active (p<0.05) and levels in K10 and C10 was intermediary. Aggressive pecking was affected by genetics (K=0.27±0.05; C=0.33±.08; D=0.73±0.17 p=0.016) but there were no notable effects of SXGS interactions. Other behaviour parameters did not differ significantly between strains or SXGS. Likewise, there were few consistent differences in behaviour across SXGS at the individual week level. D4 & D10 birds exhibited the heaviest BW and spleen weights but the lowest adrenal/BW ratio and poorest feather condition score (all p<0.05). Lastly there were few effects of strain or SXGS on the hormones or neurotransmitters measured. Genetic and stress related differences seen in bird behaviour were not evident in the physiological indices observed in this study. Further work is necessary to elucidate the regulatory interrelationships between these parameters in poultry.

Keywords: Stress, Behaviour , Chicken

BEHAVIOURAL EFFECTS OF LONG TERM SOCIAL STRESS IN TWO STRAINS OF WHITE LEGHORN ROOSTERS

Johanna Väisänen[1*], Inma Estevez[2], Per Jensen[1]

1 Department of Biology, IFM, University of Linköping, SE –581 83 Linköping, Sweden

2 Department of Animal and Avian Sciences, University of Maryland, College Park, MD 20742, USA

*Correspondence: johanna.vaisanen@ifm.liu.se

Large social groups where chickens are unable to form stable hierarchies are common in poultry production. The long term effects of these environments on the birds' behaviour are unclear. To study this, we simulated the social conditions of production by exposing two strains, HGPS and LGPS, of male White Leghorns selected for high vs. low group productivity and survivability, to social stress involving recurrent regroupings with two-day intervals between 6 and 14.5 weeks of age. Agonistic interactions were observed in seven 15-bird groups/strain, of which 4 belonged to social stress and 3 to control treatment, on the 2nd day after each regrouping. The treatment period was divided into three sub-periods of equal length. During the first period, HGPS birds showed both intensive (e.g. attacks) and mild (e.g. threats) agonistic acts more than LGPSs, the effect of line decreasing thereafter. In the second period, intensive agonistic activity was greater in HGPS controls than stressed HGPSs, a treatment effect lacking among LGPSs. In the last period, no strain or treatment effects were present. After the regroupings, 16 birds/treatment and strain were tested after four-day training in a long arena where 4 cages provided with strangers (except during training) were protruding in the corridor with a food source in the end of it. In this test, no strain or treatment effects were found for a latency to reach the food source past the strangers, while in both strains the birds undergone the stress treatment passed by the strangers more frequently than the controls. Our results suggest that in the long term, birds living in unstable social environments may adopt alternative behavioural strategies/styles in order to avoid high energy consuming agonistic behaviour. It also seems possible that the capacity of a bird to adapt to an unstable environment may be influenced by genetic selection.

Keywords: Social stress, Production; Selection; White Leghorn; Agonistic behaviour

EFFECTS OF CHRONIC STRESS ON RESPONSE TO SOCIAL ISOLATION IN THREE GENETIC STRAINS OF LEGHORN HENS

Alan G. Fahey[1,2], Ruth M. Marchant-Forde[2], Heng-Wei Cheng[2]

[1]Purdue University, West Lafayette, Indiana 47906, USA

[2]USDA-ARS West Lafayette, Indiana 47906 USA

*Correspondence: agfahey@purdue.edu

Social stress in laying hens is a common problem affecting welfare. To address this three genetic strains of Leghorn chickens were housed in a low (4 birds/cage, 213cm^2/bird) and high (10 birds/cage, 175cm^2/bird) density cage system at 17 weeks of age to form 6 treatments. These cage densities are within industry guidelines. The three genetic strains included docile (KGB), aggressive (DXL), and control (MBB) strains. Ninety-six birds (8 birds per treatment x 2 test dates) were subjected to social isolation in an opaque walled cage (120cm x 120cm) at 23wks and 27wks of age. Standing, sitting, walking, vigilance, inactivity, escapes, escape attempts, environmental pecking, head orientation, time spent in the cage periphery and time spent in the cage centre were recorded during each 20 minute test period. At 30 wks of age, 12 birds per treatment were sedated and euthanized and body weight, individual organ weight and immune function were assessed. High and low density KGB birds were found to be more vigilant than MBB ($P<0.05$). No other behaviors were notably affected by treatments. High density and Low density DXL had significantly heavier body and liver weights than high and low density MMB ($P<0.05$). High density DXL also had greater heart weights than all other strains and densities ($P<0.05$). Finally, B cells, Gamma Delta cells, CD4 and CD8 cells did not appear to be affected by treatment. In conclusion, chronic social stress was shown to have little affect on ability of the three genotypes in high or low density cages to respond to social isolation or immune function. While, body and organ weights differed across genotype, there was no notable impact of stress on these parameters.

Keywords: Chronic stress, isolation stress, genetic

LAYING HEN BEHAVIOUR, HEALTH AND PERFORMANCE IN A FREE-RANGE SYSTEM WITH A MODERN MOBILE HOUSE

Christiane Keppler[1*], Aaron Fürmetz[2], Jürgen Heß[2], Friedel Deerberg[3], Ute Knierim [1]

1 Department of Farm Animal Behaviour and Husbandry, Faculty of Organic Agricultural Sciences, University of Kassel, Germany

2 Department of Organic Farming and Cropping systems, Faculty of Organic Agricultural Sciences, University of Kassel, Germany

*Correspondence: ckeppler@wiz.uni-kassel.de

Free-range systems for laying hens potentially provide great behavioural freedom, but outdoor use may be low and hygienic or environmental problems may occur. We investigated whether a modern mobile housing system for up to 1000 hens may provide solutions to the problems, and assessed outdoor use by the hens, performance and health, as well as sward condition and nitrogen loads of the soil during two years of practical use of one hen-house at an organic farm.

Numbers of birds outside were recorded with scan sampling every 15 minutes on 11 observation days. Plumage condition and injuries were examined three times during the laying period by individual scoring of 50 hens. Endoparasite burden (dissections, faecal examination), mortality rate and egg production were monitored. Health and performance data from the first year were excluded from analysis because of an infectious disease outbreak unconnected to the housing system. Only descriptive analyses were used.

The free-range was intensively used, with on average 35 % of birds (23–44 %, means per day); the maximum was 99 %. 75 % of the hens outside (60–95 %) stayed within 20 m of the house, but sward deterioration was limited through frequent moving of the house. Plumage conditions were nearly perfect at the end of the laying period and egg yield was about 82.4 % per average hen and year. Endoparasite burden was low, but existent (62 % of faecal samples). A mortality rate of 10 % from predators or accidents and 11 % from other causes was unsatisfactorily high, and should be improved. Nitrogen input was much lower than reported from investigations of stationary houses.

We conclude that it is possible with a mobile housing system to provide hens with a high quality environment the whole year round that stimulates outdoor use and avoids environmental problems. Especially the problem of losses due to predators needs further attention.

Keywords: hens, free-range, mobile housing

OUTDOOR USE AND FEAR REACTIONS IN RELATION TO GENOTYPE AND FEATHER CONDITION IN FREE RANGE LAYING HENS

Eberhard von Borell[1*], Hamada D.H. Mahboub[2]

1 Institute of Animal Breeding and Husbandry with Veterinary Clinic, University of Halle, Germany

2 Department of Hygiene, Husbandry and Zoonoses, Menofyia University, Egypt

*Correspondence: eberhard.vonborell@landw.uni-halle.de

Movement frequencies between inside and outside housing areas, the time spent in each area and tonic immobility (TI) were studied in relation to feather condition in free range laying hens of two genotypes (Lohmann Selected Leghorn, LSL, and Lohmann Traditional, LT). From 18 wks of age, LSL and LT were kept in four groups of 50 birds in a poultry house with passages to a roofed scratching room and a grassland area. All birds were equipped with transponders to record the frequency of movements of each hen between inside and outside areas and the time spent in each area during 24 hrs. Feather and body scoring were carried out at 20, 25, 30, 35, 40 and 48 weeks. At 44 weeks of age, TI reactions of 40 randomly selected hens across treatments were quantified. LSL hens moved more frequently to outdoor areas than LT hens (44.66 ± 4.56 vs. 28.78 ± 4.36 means / day, $P < 0.05$) but the proportion of time spent on grassland was greater in LT hens than in LSL hens ($P < 0.01$). Total body feather score was poorer and skin injuries of the rump, tail, belly and comb more frequently seen in LSL than in LT hens ($P < 0.01$). The percentage of time hens spent on grassland and feather damage was inversely correlated ($r = -0.6$, $P < 0.01$) and a positive relationship was found between TI and footpads' inflammation ($r = 0.5$, $P < 0.05$). The negative correlation between feather damage and the time spent on grassland in both genotypes suggest that the risk to suffer from the consequences of being pecked inside the building seemed to be greater in fearful hens that spent less time in outside areas.

Keywords: outdoor use, fear, feather condition, hen

SELF-SELECTION OF FEATHERS BY LAYING HENS AND THEIR EFFECT ON FEED PASSAGE TIME

Alexandra Harlander-Matauschek[a], **Hans-Peter Piepho**[b], **Werner Bessei**[a]

[a] Department of Farm Animal Ethology and Poultry Science, University of Hohenheim, 470c, 70599 Stuttgart, Germany

[b] Bioinformatics Unit, Institute for Crop Production and Grassland Research, University of Hohenheim, Fruwirthstrasse 23, 70599 Stuttgart, Germany

*Correspondence: harland@uni-hohenheim.de

The role of physiological processes is often overlooked in the search of the causes of abnormal behaviour. Due to the fact that previous work showed a relationship between feather pecking and feather eating in laying hens, we hypothesised that feather pecking birds may have a high requirement for structural food components and that feathers may meet this requirement. It is known that components such as fibre modify feed passage in the digestive tract. The objective of the present study was to evaluate the effect of feathers on feed passage.

We examined the response of individually caged laying hens to the presentation of feathers. 24 high feather-pecking birds (H) and 24 low feather-pecking birds (L), selected for pecking at a feather bundle, were divided into four groups: group HF= 12 H birds with access to feathers; group H= 12 H birds without access to feathers; group LF= 12 L birds with access to feathers; group L= 12 L birds without access to feathers. The number of feathers eaten from those presented in a plastic lid (15 feathers per day) was counted daily over a period of 6 weeks. Thereafter five birds from each group were used for determining feed passage time with titanium dioxide as a marker in the bird's digesta samples over a period of 48 hours.

The number of feathers eaten was significantly higher in HF birds than in LF birds before (14.4 resp. 5.2; $p<0.001$), and during 48 hours of marker excretion (9.3 resp. 4.5; $p<0.02$).

The time at which 50% of the titanium dioxide was excreted differed significantly among all groups, with the shortest time in the HF group ($p<0.05$).

In conclusion, further research is needed to discuss possible implications of feather consumption on bird welfare.

Keywords: feather eating, feather pecking, feed passage time

EFFECT OF BROODY HENS ON CHICKS' PECKING AND PERCHING BEHAVIOUR

A.B. Jensen*[1], B. Forkman[1], A. Wichman[2]

1 Department of Large Animal Sciences, Royal Veterinary and Agricultural University, Grønnegaardsvej 8, 1870 Frederiksberg C, Denmark

2 Department of Animal Environment and Health, Swedish University of Agricultural Sciences,

*Correspondence: abrj@kvl.dk

The tendency to feather-peck in domestic fowl is influenced by experiences early in life; it was therefore hypothesised that broody hens have a positive influence on chicks' development of feather-pecking by pointing them to other activities such as ground-pecking and perching.

Twelve groups of 10 Lohmann Tradition chicks were reared in pens (2.55 m^2) with perches at 20 and 40 cm height; six pens were provided with a broody hen and six with heating-lamps. The hens and the heating-lamps were removed when the chicks were 5 weeks old.
The number of ground-pecks performed during 2 min was recorded for all individuals, when they were 1, 8 and 20 weeks old. The position of each chick (floor, low-perch or high-perch) was recorded using scan-sampling 12 times a day on day 5 to 40. Each occurrence of severe feather-pecks was recorded continuously for 30 min in all groups every fourth week. Data were analysed using repeated measures ANOVA.

The brooded chicks ground-pecked 4 times as much in week 1 and 8 than the non-brooded chicks, whereas in week 20 there was no difference. The number of ground-pecks decreased with age for the brooded chicks, whereas it remained constant for the non-brooded chicks. The effect of the interaction between treatment and age was significant ($P = 0.0231$). The brooded chicks were on average 9.6 days old when first observed perching during daytime and the non-brooded were 13.2 days old ($P < 0.0001$). No difference was found between the two treatments in onset of night-perching ($P = 0.2945$). Severe feather pecking was almost non-existing in both treatments throughout the experiment ($P = 0.2505$).

In conclusion, the provision of broody hens resulted in chicks having a higher ground-pecking activity and an earlier day-use of perches. No conclusion could be made about the effect on feather-pecking.

Keywords: broody hens, feather-pecking, ground-pecking, laying hens, perching

FACTORS AFFECTING HEN WELFARE AT DEPOPULATION

Victoria Sandilands*[1], Nick Sparks[1], Ian Nevison[2], Sandra Wilson [3]

[1]SAC, Ayr, UK

[2]BioSS, Edinburgh, UK

[3]Roslin Institute, Roslin, UK

*Correspondence: vicky.sandilands@sac.ac.uk

After a production cycle hens are removed from their housing system (depopulation) and transported for slaughter. The process may cause fear and increased risk of bone fractures, which are welfare concerns. This study investigated birds during depopulation under various conditions, in order to identify key areas for improvement.

Seventeen farms, 8 free range (FR), 2 barn (B), 1 enriched cage (EC), 6 conventional cage (CC), were observed during depopulation. Data relating to the system design (e.g. obstacles, cage opening size, floor area/bird) and depopulation methods (number of, and how, birds caught/carried, distance carried, etc.) were recorded. Fifteen birds/farm were examined for fear levels, using tonic immobility (TI). 97 (mean) birds/farm were killed by overdose with barbiturate after catching and examined by radiography for new and old bone fractures. Birds were examined prior to being loaded into transport modules.

Birds were caught and carried by the legs, and handled by 2-4 people. TI scores did not differ ($P=0.947$, one-way ANOVA), but were correlated with mean time to depopulate/bird ($r=0.555$, $P=0.49$). Old keel fractures were low in CC (9%) compared to EC (29%), FR (32%) and B birds (41%) ($P<0.05$, Chi^2). Old wing fractures were greater in CC and EC birds (6-8%) than with other systems (both 0%) ($P<0.05$, Chi^2). Total old fractures were correlated to perch space/bird ($r=0.973$, $P<0.001$). CC birds had significantly higher proportions of new wing fractures (14%) than all other birds (0-2%) ($P<0.001$, Chi^2), which was correlated with cage opening size ($r=–0.909$, $P=0.012$). Total new fractures were negatively correlated to floor area/bird ($r=–0.801$, $P=0.000$). (Preliminary analyses.)

Fear during depopulation may be decreased by reducing the time to depopulate. Most bone fractures observed were related to the housing system, and not to the depopulation process itself. Wing fractures might be reduced in cage systems by larger cage opening sizes.

Keywords: hens, depopulation, welfare

BEHAVIOUR AND STRESS RESPONSES OF *RED JUNGLE FOWL* AND COMMERCIAL BROILERS WHEN KEPT TOGETHER

Iman Rahayu, HS[1], I. Zulkifli[2], AR. Alimon[2]

[1]Faculty of Animal Science, Bogor Agricultural University, Jl. Agatis-Darmaga, Bogor, INDONESIA

[2]Department of Animal Science, Faculty of Agriculture, University Putra Malaysia, Serdang 43400 Selangor, MALAYSIA

*Correspondence: rahayu21@hotmail.com

The red jungle fowl (RJF) is generally considered to be the single ancestral form of the domestic fowl, and domesticated in Southeast Asia in prehistoric times. Comparing between RJF and commercial broilers (CB) is very appropriate, because the latter has resulted considerable genetic divergence between them. The research was carried out to evaluate performance, behaviour and stress responses when kept together.

At hatch, 40 day-old chick from each genotype were assigned to 10 battery cages in groups of eight in completely randomised design. The commercial broiler starter (21% CP; 2900 KcalME/kg) and finisher diet (20% CP; 3100 KcalME/kg) were provided ad libitum from Day 0 to 20 and Day 21 to 58. Parameters observed were gain, feed intake, FCR, behaviour activities and H/L ratio. The data collected was analized by GLM of SAS software.

They are social interaction between RJF and CB in term of feeding behaviour. The RJF could improve the performance/ growth through learned feeding and social activities of CB, while relatively more active and agile. Under captivity, the RJF more stress than CB. It showed the heterophil/ lymphocyte ratio of RJF and CB on Days 28, 42 and 58 were 0.23; 0.25 and 0.48 versus 0.19; 0.25 and 0.40, respectively.

It is conclude that positive responses of RJF when kept together with CB.

Key words: behaviour, stress responses, red jungle fowl, commercial broiler, captivity

EFFECT OF LIGHT RHYTHM AND LIGHT SOURCE ON THE DIURNAL BEHAVIOUR OF CHICKS

Matti Heikkilä[1*], Stefan Gunnarsson[2], Anna Valros[1]

[1] Research Centre for Animal Welfare, Faculty of Veterinary Medicine, P.O.Box 57, 00014 University of Helsinki, Finland

[2] Department of Animal Environment and Health, Swedish University of Agricultural Sciences (SLU), P.O.Box 234, SE-532 23 Skara, Sweden

*Correspondence: matti.heikkila@helsinki.fi

One reason for variable night-time perch use in commercial layer hens might be the short light-period during the rearing period. Growing chicks may prefer to rest on the floor during the night-time, if they do not have enough time to feed during the day-time. In organic egg production, natural light is compulsory during the laying period. However, there is little knowledge about the effect of different light sources on behavioural development. The aim of the experiment was to study the effect of different light rhythms and light sources on the diurnal time budget of the layer chicks.

126 LSL-chicks were divided into 3 treatments (in total 18 pens): [1)] A8: 8 hours artificial light + 16 hours dark, [2)] A16: 16 hours artificial light + 8 hours dark and [3)] N8: 8 hours natural daylight + 16 hours dark. Chicks were video recorded between 6 and 12 weeks of life. Perching and feeding data were scored using scan sampling (5 min interval) and Mann-Whitney U-test was used for statistical analysis.

Chicks in A8 fed during 2.4 % of the night-time observations, whereas A16 chicks fed only occasionally at night ($p < 0.01$). During day-time, both treatments spent a similar amount of observations feeding, even though the available time was double for the A16 group. Night-time roosting was more frequent early (between 7 and 9 weeks of life) in N8 compared to A8 ($p < 0.05$).

These results suggest that chicks may change their diurnal rhythm depending on day length, but that 8 hours of light may not be enough for daily feeding. The total amount of time used for feeding appeared to be unaffected by the time available for feeding. Natural daylight was found to precipitate the start of night-time roosting.

Keywords: perching, chicks, diurnal rhythm, light

DO SHEEP SELECTED FOR DIFFERENT TEMPERAMENTS EXHIBIT DIFFERENT PHYSIOLOGICAL RESPONSES TO STIMULI IN AN ARENA TEST?

Ngaio J. Beausoleil[1*], Dominique Blache[2], Kevin J. Stafford[1], David J. Mellor[1], Steven Haslett[3]

1 Animal Welfare Science and Bioethics Centre, Massey University

2 School of Animal Biology, University of Western Australia

3 Insitute of Information Science and Technology, Massey University

*Correspondence: N.J.Beausoleil@massey.ac.nz

Selection of sheep for different behavioural responses to a human and to social isolation has resulted in the creation of two behaviourally distinct temperament lines: Calm and Nervous. We hypothesized that Calm sheep would exhibit lower physiological responses to stressful events than unselected sheep, and Nervous sheep higher responses.

30 female hoggets from each temperament line, and 30 unselected animals (Random) were subjected to three arena tests, one per week (stimuli: box, human, dog). Blood samples were taken at 0, 10 (end of test), 20, 40 and 60 minutes, to determine plasma cortisol levels. Baseline cortisol levels, raw concentration responses and changes from baseline were compared between flocks using a split-plot model on log transformed data.

There were no significant differences between the flocks in baseline cortisol levels ($p=0.888$), raw concentration responses or changes from baseline (all stimuli combined: raw $p=0.821$, change $p=0.743$). However, in Week 1 ($n=10$ per flock per stimulus) cortisol change from baseline differed between the flocks (flock x week effect $p=0.0013$). When the box or dog was presented in Week 1, Calm (C) sheep had higher cortisol responses above baseline than Random (R) sheep (Box: C vs R $p<0.0001$, Dog: C vs R $p=0.0007$).

These results do not support our hypothesis as Calm sheep had higher cortisol responses and Nervous sheep lower responses than expected. These relative differences were especially clear in the first week when animals were first exposed to the testing procedure. Thus, Calm and Nervous sheep might be using different strategies to cope with these specific stressors. Calm sheep may be compensating for their low behavioural activity with higher cortisol responses (passive coping). Lower cortisol responses in Nervous sheep may be related to their more overt behavioural responses (active coping). The physiological differences between these groups may have implications for the welfare of animals selected for calm behaviour.

Keywords: Sheep, temperament, plasma cortisol, coping strategies

SELECTION FOR LOW EMOTIONAL REACTIVITY TO IMPROVE WELFARE AND PRODUCTIVITY OF FARMED SHEEP

Dominique Blache[1*], Alain Boissy[2], Drewe Ferguson[3]

[1] Animal Biology, FNAS, University of Western Australia, Crawley, WA 6009, Australia.

[2] URH Equipe Adaptation et Comportements Sociaux, INRA Theix, 63122, France

[3] Livestock Welfare, CSIRO Livestock Industries, Armidale, NSW 2350, Australia.
*Correspondence: dbla@animals.uwa.edu.au

The welfare of farmed animals can be enhanced through improvements in animal environment/management procedures, stock person attitudes and/or adaptability of animals to their production environments. In theory, selection for low emotional reactivity (ER) increases the adaptability of animals to farming systems because these animals display reduced stress responses to novelty and challenging stimuli. Here, we describe a simple system to measure emotional reactivity in sheep. We present data showing that emotional reactivity is heritable and that selection for low ER can potentially improve productivity and the welfare of sheep.

Assessment of the level of reactivity of sheep to novel and stressful stimuli can be achieved using a simple behavioural test, practical enough for inclusion within on-farm selection programs. The test involves isolating a sheep in a 1.5 m^3 box (1.5 x 0.7 x 1.5 m) and objectively measuring the degree of agitation over 1 minute. The repeatability of the test is moderately high (0.6 - 0.76). The heritability has been estimated on 5000 ewe and ram progeny from 4 breeds (Merino, Border Leicester, Poll Dorset and White Suffolk; 9 to11 month old) and ranged from 0.3–0.5.

As indicators of adaptability to farming systems, feeding behaviour and learning capacity was assessed in sheep from two 10-year selection lines, one selected for low emotional reactivity (LER) and the other for high emotional reactivity (HER) based on their responses to the above test and an arena test. Time spent eating and capacity to learn did not vary between the 2 lines in the absence of a stressor but when a stressor was present, the response was greater in the LER line.

It is possible to reliably and practically select for low ER in sheep and there is evidence to support the view that low ER confers enhanced on-farm adaptability.

Keywords: sheep, welfare, emotional reactivity

GROUP SIZE AND FEEDING MANAGEMENT ON THE DOGS BEHAVIOR IN SHELTER - A WELFARE CONCERN

Liang Chou Hsia*, Yu Chun Chen

Department of Animal Science, National Pingtung University of Science and Technology, Taiwan

*Correspondence: lchsia@mail.npust.edu.tw

The purpose of the experiment is to study whether individual and group raising cause problems for dogs. There are 24 dogs, 4 physiology stages: 6 male and 6 female adult, 6 male and 6 female juvenile involved in the experiment. There are five feeding management treatments. Treatment 1. One dog per pen. Treatment 2. Two dogs per pen. Treatment 3. Three dogs per pen. Treatment 4. Six dogs per big pen in daytime (06:30-18:30), one dog per pen in nighttime (18:30-06:30). Treatment 5. Six dogs per big pen for whole 24 hours. The six animals in each physiology stage went through five feeding management treatments. There are six pens for dogs in treatment 1, three pens for dogs in treatment 2, two pens for dogs in treatment 3, and one big pen for dogs in daytime and six pens for dogs in nighttime in treatment 4, a big pen for six dogs in treatment 5. The behavioral observation was done by 6 trained persons. The observer sat in front of pen or pens and recorded behavior every one minute for three days for each physiology stage treatment. The behavioral observation was based on individual dogs, consequence, there were 12 replicates for each treatment. The statistical model is $Y_{ijkl} = \mu + \alpha_i + \beta_j + \gamma_k + \theta_l + \tau_{ij} + \delta_{ik} + \phi_{jk} + e_{ijkl}$ (α=feeding treatment, β=physiology stage, γ=day, θ=replicate). Displacement and low eating activities were considered as an indicator of stressor in the present experiment. The dogs stayed in each feeding management treatment for 3 days. The results showed that the dogs had significantly more drinking ($p<0.01$), moving ($p<0.05$), dog sitting ($p<0.05$), barking ($p<0.05$), and significantly less lying circle behavior during the first day when compared with the second and third days. One dog per pen had significantly more eating ($p<0.001$), defecation ($p<0.05$), urination ($p<0.01$), and significantly less standing ($p<0.01$), dog sitting ($p<0.01$), lying circle ($p<0.001$). The results also notice that dogs in whole day group housed in a big pen showed significantly less eating time ($p<0.01$), barking ($p<0.001$), lying bend ($p<0.001$), moving ($p<0.01$), but had significantly more drinking duration ($p<0.05$), defecation ($p<0.01$), standing ($p<0.05$), lying circle compared to dogs housed in treatment 4. The results of present experiment may indicate that dogs spent more time eating and less drinking and defecation time in the half day group housed dogs (treatment 4). This result suggested that we may keep dogs individually in nighttime and keep them group in daytime.

Keywords: Stray dog, individual and group pen, shelter, behaviour

MATING STRATEGY IN FREE-RANGING DOGS (Canis*familiaris*)

Sunil Kumar Pal

Katwa Bharati Bhaban

*Correspondence: drsunilkpal@rediffmail.com

Mating strategy in free-ranging dogs (*Canis familiaris*) was studied collected over two years in the town of Katwa, West Bengal, India. Ten bitches, which were traceable throughout the study period, and whose home ranges as well as sexual experience were known, were selected for this study. Focal animal sampling yielded data on the mating behaviour of the dogs. The ten focal bitches were followed for the first 6 days of the oestrus (or until the end of oestrus); and a total of 480 h was devoted for collecting data on the mating strategy in free-ranging dogs. All the matings occurred between August and December with a peak in late monsoon months (September to November) ($\chi 2$ = 28.40, df = 3, $P<0.05$). During a single oestrus period the number of males courting a particular female ranged from 9 to 24 (mean ± S.D. = 15.60 ± 4.34), whereas during a single association it ranged from one to nine. During the two-oestrus periods, a total of 312 males were attracted by the ten focal bitches, of which 94% were willing to mount and copulate. Among the focal bitches (N=10), eight individuals allowed 51% of the willing males (N=239) to mount and copulate showing a clear selectivity for mating (t = 13.38, df = 7, $P<0.05$). Interestingly, two oestrous females showing a 'polyandrous' behaviour allowed indiscriminately all the willing males to mount and copulate. The focal bitches enjoyed 4.1 ± 0.6 (mean ± S.D.) successful copulations during a single oestrus; and there was a negative correlation between the number of males present in an association and the number of successful copulations (r = -0.878, $P<0.05$). Of all successful copulations (N=82), 85% copulations were performed by the preferred males after being present a considerable amount of time following the same female, and it may be defined as 'preferential mating'. In nine cases, the opportunist non-courting males copulated successfully after being present only a short time when the courting males were engaged in aggressive encounters, and it may be termed as 'opportunist mating'. Moreover, 5 dominant and powerful males copulated forcibly four bitches, which may be described as 'rape'. Two individuals out of 10 focal bitches mated with the same males in the consecutive years showing the 'monogamy' in free-ranging dogs.

Keywords: Dogs, Polyandrous behaviour, Preferential mating Opportunist mating, Rape, Monogamy.

ASSESSMENT OF ANIMAL WELFARE IN A VETERINARY CONTEXT - A CALL FOR ETHOLOGISTS

Stine B. Christiansen[1]*, Björn Forkman[2]

1 Centre for Bioethics and Risk Assessment, The Royal Veterinary and Agricultural University, Denmark

2 Division of Ethology, The Royal Veterinary and Agricultural University, Denmark

*Correspondence: sbc@kvl.dk

Follow-up studies are an important source of information for veterinarians concerning the potential outcome of a treatment. Few of such studies include an assessment of the welfare of the animal patient involved. With the increasingly advanced treatments offered, the need to evaluate not only the treatment itself but also the implications of the treatment for the welfare of the animal and its owner has become more apparent.

A qualitative analysis was done on 21 follow-up studies, including assessment of animal welfare (AW). The analysis shows that AW and related concepts are rarely defined, and that the parameters used to assess AW are primarily related to health and other clinical aspects, while behavioural parameters - if used at all - are often crude. The assessments are made by animal owners, and sometimes also by veterinarians.

These results have severe implications for the validity and sensitivity of such studies. Seen from an ethological point of view, most studies are lacking sufficient broadness and detail in the parameters used to provide a basis for AW assessments beyond a clinical and functional evaluation. Veterinarians and animal owners do not necessarily have the required ethological knowledge to assess AW in a broader sense. And both groups may be personally involved and thus introduce a bias in the assessment.

The development and validation of parameters for AW assessment in the veterinary clinic could clearly benefit from the expertise and experiences held in the field of ethology and the more impartial position of an ethologist. Such parameters would be useful in both prospective and retrospective follow-up studies, and could support the assessments done on a daily basis by the practicing vet. As an inspiration for ethologists to get involved, examples of potential contributions from ethology to AW assessment in a veterinary context will be presented.

Keywords: animal welfare assessment, follow-up studies, validity

LAME DAIRY COWS HAVE SHORTER AVOIDANCE DISTANCES

Marek Špinka, Ibrahima Dembele, José Panamá, Ilona Stěhulová

Ethology Group, Research Institute of Animal Production, Prague, Czechia

*Correspondence:spinka@vuzv.cz

Avoidance distance (AD) is being used as a measure of fear of humans in dairy cattle. The assumption has been that animals with short AD are less fearful and therefore have better welfare. However, the opposite may sometimes be true. Pain or bad condition may decrease the willingness to move and thereby reduce AD.

Using a sample of 793 randomly selected dairy cows on 24 Czech farms, we examined the influence of lameness on AD. While leaving the milking parlour, cows were categorized as lame (putting weight off one leg) or non-lame. AD was tested by approaching the standing cow frontally from the distance of 2 m, stopping at 0.5 m and touching her muzzle. The influence of lameness on AD was examined on the level of individual cows (using repeated measures mixed and generalized linear models) and on the farm level (using backward stepwise multiple regression).

On the individual level, the proportion of cows with zero AD (allowing touching) was higher in lame (43%) than in non-lame cows (29%; $p = 0.0004$). Among the cows not allowing contact, AD was not significantly different ($p=0.17$) between lame (lsmean 0.62 m) and non-lame cows (0.70 m). At the farm level, herd size and breed (Holstein vs. Simmental) had no influence on AD, but lameness did. The proportion of lame cows was positively related to the proportion of cows allowing contact ($p=0.05$) and negatively to the average AD in the cows that did not allow contact ($p=0.05$).

Short avoidance distances in dairy cows may indicate welfare problems, since they are associated with lameness and possibly other states of low physical fitness.

Keywords: dairy cows, lameness, avoidance distance

TRANSFER OF NERVOUSNESS FROM THE RIDER TO THE HORSE

Uta U. von Borstel*[1] [2], Linda J. Keeling[2], Ian J.H. Duncan[1]

[1] Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario N1G 2W1, Canada

[2] Swedish University of Agricultural Sciences, Department of Animal Envrionment and Health, 53223

*Correspondence: uvonbors@uoguelph.ca

Nervous riders might be more prone to accidents because they can affect the horse so that it becomes more nervous and thus more easily frightened. The present study was undertaken to quantify the effects of nervousness in riders elicited in anticipation of a frightening event, conditioned fear in horses, and the interaction of both on heart rate (HR) parameters in horses.

Twelve horses were subjected to classical conditioning which involved an auditory cue functioning as the conditioned stimulus (CS) to frightening visual or auditory events, as well as neutral stimuli (NS) as controls. The horses were then each ridden by three of twelve riders and HRs were recorded while being ridden on a course that involved playing the CS, the NS, and situations during which both horse and rider (BN), or the rider only (RN) were made nervous by telling them that the CS or, falsely, the NS would scare the horse. In no test was the frightening stimulus actually given, so any increase in HR represented an anticipation response. The mean HR for the horses during 5 sec, starting 5 sec following each tone was calculated, and a mixed model was used to analyse the horses' HR responses in the different situations.

Compared to the NS, horses' mean HR responses were significantly higher ($p < 0.05$) after the CS ($df = 12$), RN ($df = 11$), and BN ($df = 7$). The results demonstrate that horses had successfully learnt the CS and that the riders' nervousness increased the horses' HRs in the RN situation in a similar way as did the CS. Mean increase in HR was highest after the BN; however, there was great variation, indicating that the synergistic effect of BN is specific to certain horse-rider pairs and so can be particularly dangerous.

Keywords: horse-riding, animal-human interactions, heart rate, nervousness, classical conditioning

ABILITY OF PONIES TO DISCRIMINATE BETWEEN PHOTOGRAPHS OF TWO SIMILARLY DRESSED PEOPLE

Hajime Tanida[1]*, Yuki Koba[1], Naoko Horikawa[2], Tatsuo Nagai[2]

1 Graduate School of Biosphere Science, Hiroshima University, Japan

2 Hiroshima Prefectural Saijyo Agricultural High School, Japan

*Correspondence: htanida@hiroshima-u.ac.jp

This study examined whether ponies that were able to discriminate between similarly dressed people in a Y-maze also were able to discriminate between two- dimensional photographs of those same people under similar experimental conditions. Two Shetland ponies were conditioned to receive a reward from an experimenter sitting at one end of the maze while the other end was unoccupied. The rewarder, a female, was paired with a male or a female non-rewarder in subsequent trials to establish that the ponies could discriminate between them. The rewarder and both non-rewarders had engaged in daily management of the ponies. In any one trial, both people in the maze wore the same colour clothing and the same au de Cologne. Each session consisted on 20 trials in which rewarder and non-rewarder were assigned to branches of the maze according to a Gellermann series. The success criterion was that the ponies chose the rewarder in at least 15 of 20 trials ($P<0.05$ by Chi square test) in two consecutive sessions. Both ponies successfully discriminated the rewarder from the male non-rewarder, and one pony could discriminate the rewarder from the female non-rewarder as well. Using the same success criterion, both ponies were then tested (without prior exposure to the photographs) to determine whether, within two sessions, they could discriminate a two-dimensional photograph of the rewarder from those of the non-rewarders. Photographs were taken with a digital camera, enlarged to life-size and printed on super fine paper. As before, both ponies successfully discriminated the photograph of the rewarder from that of the male non-rewarder. Again, one pony could discriminate the photograph of the rewarder from that of the female non-rewarder but the other could not. Results suggest that ponies can transfer knowledge of a three-dimensional world to discrimination of two-dimensional photographic images.

Keywords: ponies, discrimination, Y-maze, two dimensional photographic images

AFFINITY OF LAMBS TO THEIR STOCKPERSON DOES NOT DEPEND ONLY ON FOOD CONDITIONING

C. Tallet*, I. Veissier, X. Boivin

INRA centre de Clermont-Ferrand/Theix, Unité de Recherche sur les Herbivores, Equipe Adaptation et Comportements Sociaux, France

*Correspondence: ctallet@clermont.inra.fr

The affinity (motivation to approach) of farm animals to their stockperson is usually described as resulting from food conditioning.

We assessed whether it is solely based on food conditioning and if it depends on the motivation of the animals to eat.

Fifty six lambs were reared by three and artificially suckled from a multiple-nipple bucket. Each group was assigned to one of four treatments (14 lambs in five groups per treatment): the stockperson was present motionless just before the food distribution (BEFORE, conditioning paradigm); while the lambs were suckling (WHILE); 15 minutes after food distribution (AFTER); or was totally absent (CONTROL). The treatments were performed three times a day over seven days then two days a week.

At 3.5 weeks of age, each lamb was tested in a 6x1.5m arena during three successive 2-minute phases: 1.alone, 2.with the familiar stockperson, 3.alone. Lambs were tested after 5 hours of starvation *versus* after free access to food (cross-over design).

BEFORE lambs (44±9 s) approached the stockperson for a longer time than WHILE (11±4 s; Mann-Whitney, $P<0.01$) and CONTROL lambs (7±4 s, $P<0.001$). AFTER lambs (27±7 s) approached longer than CONTROLS ($P<0.01$) and were intermediate between BEFORE and WHILE lambs. WHILE lambs tended to approach longer than CONTROL lambs ($P=0.06$). Food deprivation only increased the affinity of AFTER lambs (Wilcoxon, $P<0.01$). Vocalisations increased when the stockperson left only for BEFORE and AFTER lambs (ANOVA, $P=0.02$).

The approach to the stockperson consecutive to conditioning or presence after food was higher than the approach of controls. Conditioning was more efficient but not affected by motivation to eat. Both situations induced a distress following the separation from the stockperson. Hence, conditioning partly explains the affinity of artificially suckled lambs to their stockperson and other mechanisms are implied (attachment, amount of attention to human …).

Keywords: sheep, human-animal relationship, affinity, development, conditioning

DISCRIMINATION OF HUMAN URINE BY DOGS TO DETECT PROSTATE CANCER

Donald M. Broom[1], Kevin R Elliker[1], Barbara A Sommerville[1], David E Neal[2], HywelWilliams[3], Sarah Armstrong[3]

[1] Department of Veterinary Medicine, University of Cambridge

[2] Department of Oncology, University of Cambridge

[3] Queen's Medical Centre, University of Nottingham

Correspondence: dmb16@cam.ac.uk

Some dogs have a good enough relationship with humans to allow their impressive olfactory discriminatory ability to be used for human benefit. In addition to tracking, and identifying people, they can be trained to find substances such as explosives or drugs. Can dogs recognise and indicate human urine samples which come from people with malignant prostatic adenocarcinoma (CaP)?

Four dogs have been trained using kindly words from the trainer and small pieces of food as positive reinforcement. Initially the dogs had to locate a single CaP sample in one of four holes in a floor-mounted array, the other holes being empty. Dogs indicated the sample, which they could sniff but not contact, by pointing with the nose, sitting, or touching the hole with the paw. With random alteration of the position of the CaP sample, the dogs were then trained to indicate it when control samples of urine from men of a similar age but without malignant prostate cancer were put into the other holes. Further trials in which the trainer did not know the location of the CaP sample were then carried out. The dogs made the discrimination. Finally, test trials were carried out with an independent observer present, unknown CaP and control samples used, and samples blind to all those present at the trial. (We cannot give the figures because the medical journal publishing the results will not allow it. These will be presented at the conference.)

It may be that use of dogs in this way will allow earlier diagnosis of malignant cancer than is possible by established methods. The screening methods could also be used for large numbers of people. The key issue is to distinguish the dangerous malignant condition, which requires treatment, from the very common benign form which is not dangerous.

Keywords: olfaction, learning, dog, prostate cancer, discrimination

DOGS CAN YAWN ON CUE: PSYCHOLOGICAL PREPAREDNESS NEEDS REVISION

Jacqueline Perkins

GOOD DOG Behaviour Clinics

*Correspondence: gooddog@dodo.com.au

The hypothesis tested was that dogs can not be easily trained to yawn on command. This hypothesis was presented by Martin Seligman in 1970 (On The Generality of the Laws of Learning: 1970 Psychological Review vol 77, pp. 406-418) as a prime example of a psychological canine learning limitation. Learning limitations were hypothesised to occur because the dog's brain was said to be contra-prepared to easily learn certain psychological tasks. The theory of psychological preparedness formed to explain this "phenomena". This theory has been accepted for many years and appears in most major texts. In total, my group trained four dogs to yawn on command. They are each part of a close multi-dog family household receiving a very large amount of human contact. Breed and age varies. Dogs 1,2 and 4 are a part of my own household, and represent every dog in my household. Dog 3 is a part of a co-workers household, which has three dogs in total. The time taken to train each dog varied from minutes to days. Each dog was easily trained to yawn on command using a combination of traditional gentle training methods including yawning at the dog to solicit a yawn, and marking the naturally occurring yawns.

All four dogs use the yawn in spontaneous attempts to solicit human food and attention. It has become a tool for communication. The co-worker and owner of dog3 noticed an improvement in inter-dog relationships within the household since yawn training. Dogs may have greater cognitive abilities than previously believed. A close rapport with humans may be required for humans to measure their true cognitive abilities. Home video footage will accompany the talk.

Keywords: Yawning, dog, preparedness

THE RELATIONSHIP BETWEEN MORPHOLOGY AND SIGNALLING DURING THE EARLY DEVELOPMENT OF THE DOMESTIC DOG (*CANIS FAMILIARIS*).

Keven John Kerswell[1,3*], Paul Hemsworth[1,3], Pauleen Bennett[2,3], Kym Butler[4]

1 Institute of Land and Food Resources, University of Melbourne, Australia.

2 School of Psychology, Psychiatry and Psychological Medicine, Monash University, Australia.

3 Animal Welfare Science Centre, Department of Primary Industries, Australia.

4 Primary Industries Research Victoria, Australia.

*Correspondence: keven.kerswell@med.monash.edu.au

The morphology of a species constrains its signal repertoire by limiting the structures available for transmission and reception of signals. Little work has investigated the effect on signalling of a rapid morphological shift, as has occurred in the dog. It is likely that under these circumstances either new signals will develop or the frequency of remaining signals will change to compensate for information loss due to signalling structure loss. We used the domestic dog (*Canis familiaris*) to investigate the above idea.

Forty domestic dog litters (comprising 32 breeds) that differed in morphology were recorded for half an hour at weekly from the age of 5 weeks to 7 weeks (for a total of 3 observations per litter) using the scanning method of direct observation. The breeds differed in coat length, ear height, tail length, overall size, lip structure, snout length and degree of eye coverage. A "morphology score" was created that measured the degree to which each signalling structure contrasted with the background, which is necessary for signal detection. An overall score for each breed was calculated by summing over the unweighted scores for each characteristic. The frequency of pawing, biting, licking, gross body movements (barging etc.) and vocalisation between littermates were compared to the score for each individual characteristic and the overall morphology score using simple linear regression after appropriate transformation of the data. It was found that licking increased with decreasing ability to signal ($p = 0.017$). This suggests that licking may be compensating for information loss due to loss of signalling structures.

Injury from aggressive conflict may be the only cost paid for communication failure in the dog, because reproduction and survival is largely controlled by humans. Thus increasing the use of a signal that serves to de-escalate encounters and does not escalate encounters by being misunderstood, such as licking, is the most logical compensation.

Keywords: Dog, Communication, Signalling, Morphology.

URBANIZATION AND LIFE OF CATS IN CZECH HOUSEHOLDS

E. Baranyiová, A. Holub, M. Tyrlík, M. Volfová,A. Ličková,

T. Samková

University of Veterinary and Pharmaceutical Sciences, Faculty of Arts, Institute of Psychology,

Masaryk University, Brno, Czech Republic

*Correspondence: E. Baranyiová, actavet@vfu.cz

In many countries the number of cats, raised as pets, has been increasing. This applies as well to the Czech Republic that has also gone through unusual urbanization in the last decades. Therefore we studied the relationships of these new phenomena to one another. We analyzed the data from questionnaires distributed to cat owners. The results from rural (R) and city (U) groups were compared and evaluated by χ^2 test. The cats in the R group (n = 54) lived in family houses with yards, whereas the U cats (n = l44) mostly lived in city apartment buildings.

Even though physical and social contacts between people and cats in the U group were very intensive as a results of living in small niches of rented city apartments (Czech housing complexes although comfortable are smaller than many other European countries), we found significant differences from R cats in only 3l (5l.7%) of the 60 questions. However, only 38 of these questions referred to the behaviour of cats and of those, only l6 (42.l%) differed significantly between R and U cats. Of the other 22 parameters studied l5 (68.2%) had differences mostly concerning the number and relationship of people in the home. These demographic changes were almost a third (62.0%) greater in number than the behavioural changes of U cats in comparison to R cats. In conclusion, even though the traits of people and cats co-existing in the same environment have different biological importance, it is evident that in the U environment their relationship increased in intensity, their mutual contacts were closer, and family members showed relatively greater changes in behaviour than their cats. Cats are considered even in an urbanized society as suitable, desirable companions, and, are able to effectively adapt to great changes in their living environment.

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Key words: rural, urban, behaviour, human-animal bond

RESPONSES OF LABORATORY RATS TO PAIRING OF REPEATED INTRA-PERITONEAL INJECTIONS WITH FOOD TREATS, PETTING AND TICKLING

Sylvie Cloutier, Ruth C. Newberry

Washington State University, Department of Veterinary and Comparative Anatomy, Pharmacology and Physiology, Center for the Study of Animal Well-being, Pullman WA, USA, 99164-6520

*Correspondence: scloutie@vetmed.wsu.edu

We hypothesised that using a conditioning technique to pair a stressful procedure such as intra-peritoneal injection with a rewarding experience would decrease the stress associated with repeated exposure to the procedure in rats.

Three different reward types (Food (F), Petting (P) and Tickling (T)) were compared to two control conditions (Handling (CH) and Injected (CI)) (N=8 rats/treatment). Rats were handled and/or injected daily for 10 days. Immediately following injection, rats were rewarded or left undisturbed (control) for 60-sec. Ultrasonic vocalisations were recorded at injection. Chromodacryorrhea (stress indicator) was recorded daily during treatment. Behaviour, assessed using the Anticipatory Reaction to Handling (ARH), Human Approach (HA) and Elevated Plus Maze (EPM) tests, was measured before and after treatment.

Rats from all treatments emitted 20-kHz ("stress") vocalisations (Fisher's Exact test, P=0.5). P rats produced more chromodacryorrhea than rats in other treatments (Mixed model on ranked data, F=3.3, DF=4,35, P=0.02). Rats in all treatments were faster to approach a human hand in their home cage after than before treatment (ARH, F=66.7, DF=1,55, P<0.0001). However, CH and P rats made fewer visits to a human hand in a Y maze after than before treatment (HA, F=5.31, DF=4,35, P=0.002). Treatment did not affect behaviour in the EPM (P>0.05). Our attempt to condition rats to associate injection with a positive experience was not successful under the conditions used. Nevertheless, by refining the methods, Food, Petting or Tickling could possibly be used to alleviate the stress of laboratory procedures and improve the relationship between researchers and their animals.

Keywords: Stress; Laboratory rat; Classical conditioning; Injection

ASSESSING THE SUITABILITY OF MARMOSETS TO ENTER A POSITIVE REINFORCEMENT TRAINING (PRT) PROGRAMME

Verity A. Bowell, Hannah M. Buchanan-Smith

Department of Psychology, University of Stirling, Stirling, FK9 4LA, Scotland, U.K.

*Correspondence: v.a.bowell@stir.ac.uk

Positive Reinforcement Training (PRT) can improve animal welfare and is increasingly being used with primates in laboratories to refine husbandry and experimental procedures. Factors such as age, sex and temperament which may influence the success or speed of training have however not been studied in detail Thirty pair-housed common marmosets (*Callithrix jacchus*) were temperament tested with three tests - response to a stressful event (cage changing), novel object interaction and hand feed test - and then trained using PRT to hold a target and enter a transport box on request. All 30 marmosets were trained successfully, with the median of seven 8-minute sessions required to reliably perform the task. Analysis showed that age and sex did not affect the number of sessions required to train the marmosets. Response to the stressor was also not a good predictor of the number of sessions required to train individuals. Marmosets who were considered 'fast' to touch the novel object (> 1 s.d. below the mean) took significantly fewer sessions to train than those considered 'slow' (> 1 s.d. above mean, t test, $p < .05$), and marmosets willing to take food from a person (hand feeding) prior to the commencement of the training programme ($n = 19$, median = 7) required significantly fewer sessions than those who were not hand feeding ($n = 11$, median = 10, Mann-Whitney, $p < .05$). These results suggest that bolder or better adapted marmosets may be easier to train than more timid temperament types. These simple, easy to administer tests may therefore be useful in predicting which marmosets have temperament types which facilitate the need for fewer training sessions. Using these basic tests should facilitate effective time management and assist with choice of individuals for experimental protocols.

Keywords: Positive reinforcement training, temperament, marmoset

THE PERCEPTION OF THE HUMAN-ANIMAL RELATIONSHIP DIFFERS ACCORDING TO THE HIGHER EDUCATION ORIENTATION

Claire Diederich*, Melanie Mathot, Jean-Marie Giffroy

Laboratory of Anatomy and Ethology of the Domestic Animals, Department of Veterinary Medicine, University of Namur, Belgium

*Correspondence:claire.diederich@fundp.ac.be

A survey was conducted to compare the perception of the pet's function and status, and of the human-animal bond (attachment, cruelty, animal nuisance and animal experimentation) between veterinary (n=87VET) and literature students (n=72LIT). Results were analysed with Chi-square test ($p<0,01$).

More VET own at least one pet (Chi-sq=13,1). VET state that pets supply affection (Chi-sq=6,72, $p<0,05$) and are a way for nature entering into cities (Chi-sq=21,7). VET find pet-food and accessories stores useful if coupled with veterinary advice, resulting from economical strategies and answering to an anthropomorphic need whereas LIT find them shocking in front of human famine (Chi-sq=23,29). VET sustain the development of animal science and techniques while LIT would support the human one's (Chi-sq=22,27). VET do not support legislation against aggressive breeds neither the excessive media coverage of bite accidents, the owner is responsible for his dog (Chi-sq=24,7). LIT would relinquish a dog that has bitten, lock it up in kennel or euthanize it (Chi-sq=14).

VET and LIT qualify dogs as loyal and cats as independent. Cat predatory behaviour is considered as innate although rather disgusting. Puppies are to be educated even if some LIT suggest to be patient. A pet is a friend with positive influence on child development, to whom the owner is attached. Its death is grievous, part of the life's cycle. Pet cemeteries are touching opportunity for keeping the emotional bond. Veterinary fees would be discussed before an expensive surgery. Fifty percent of the respondents are against the aesthetic ear surgery. Animal experiments are needful but most respondents would change their perfume if tested on animals.

In conclusion, LIT appreciate the company of animals but favour however the people development and well-being. VET show a great animals interest, where they find their professional motivation. Their education (ethology, philosophy, human sciences, ethics) influences their argumentation.

Keywords: human-animal relationship, survey, pet, education

ASSESSMENT OF THE TRADITIONAL PRODUCTION OF THE HYBRIDS OF INDIAN WILD ASSES (*Equus hemionus Khur*) AND FEMALE DONKEYS (*Equus asinus*) IN GUJARAT, INDIA

R.Kimura[1*], J.Sheth[2], F.Sheth[2], M.Masuda[3]

1 Equine Museum of Japan, Equine Cultural Affairs Foundation, Japan

2 FRIGE, Genetics Centre, India

3 Japan Bird Research Co.,Ltd., Japan

*Correspondence: rikakokimura@hotmail.com

They say the production by hybridizing domestic female donkeys with male Indian wild asses has continued since ancient period around the Little Rann of Kutch (Indian wild ass Sanctuary) in Gujarat, India. The purpose of this study is to assess the traditional and regional production system that produces hybrids of wild and closely related domestic species, by means of analysis of production method, market value, draughtability, characters and temperament of the hybrid.

The method was adopted as fact-finding on the spot from producers, consumers and dealers. For the hybrids and local donkeys, loading and speed tests accompany with checking recovery rate of heartbeat. G-banded karyotypes and body measurements were investigated, and the evaluation was done with words as indicator for temperament analysis.

Average body size of the hybrids (n=6) were significantly bigger than the donkeys (n=124) and the total points of draughtability (weight of pulling load, speed and recovery rate) were also significantly better (n=3) than donkeys (n=6), but the temperament is more nervous (n=10, n=146). The hybrid was thought to be low fertile or sterile by result of Karyotype analysis (n=4). The production by semi-nomadic communities was subject to rainfall and accident during pasturing and travelling. The market value was up to 10 times that of a donkey

The reasons that they can avoid contaminating wild gene pool by domestic one are what they take advantage of social structure “territoriality” of wild ass which does not make family group intimately and the principle that semi-nomadic communities does not resist the accident and weather.

Monitoring accidental hybridisation and vaccinating of domestic horses, donkeys and hybrids to minimise disease threat to the wild population should be encouraged. Moreover owners of the mature hybrid s should keep them fenced in to avoid them intruding to the sanctuary.

Keywords: Khur, hybrid, draughtability, temperament, traditional production

SEABIRD AVOIDANCE TECHNIQUE FOR REDUCING INCIDENTAL CAPTURE OF SEABIRDS IN LONGLINE FISHERY

Masashi Kiyota*, Hiroshi Minami

National Research Institue of Far Seas Fisheries, Fisheries Research Agency, Japan

*Correspondence: kiyo@affrc.go.jp

Large-sized surface scavenging seabirds, mostly albatrosses and large petrels, are attracted to fishing baits and hooked accidentally during longline fishing operations. The seabird-longline interaction pause negative impacts on both seabird populations and fishing industry because they increase seabird mortality and reduce fishing efficiency through bait loss. Since the interference of seabirds with baited hooks occurs at a narrow zone near the sea surface around fishing vessels, it is possible to avoid incidental hooking of seabirds by incorporating mitigation technique to the bird zone. Various avoidance techniques have been invented which take advantage of behavioural characteristics of seabirds. We introduce the results of our mitigation experiments in the North Pacific and in the Southern Ocean.

Deterrent devices make use of poor flight maneuverability of albatrosses and keep them away from baited hooks. A “Tori-pole” is a line and streamers towed from a pole installed on the stern of a ship. On average, a Tori-pole could reduce the catch rates of seabirds down to 1/3 of the control. A water-cannon is another deterrent device but it requires large machinery. Improvement of sinking speeds of branch lines makes baited hooks less accessible to surface scavenging seabirds that have limited diving ability. Adding weights to branch lines, avoiding propeller turbulence, underwater line setting, use of less buoyant thawed bait, have been tested. Concealing baits is another way to protect fishing baits from seabirds which search foods visually. Use of blue-dyed baits diminished feeding activity of seabirds and reduced the incidental take of seabirds dramatically. Line setting at night can avoid seabirds because most surface scavenging seabirds are inactive at night. Proper control of offal discharge is not mighty but very important to keep seabirds away from fishing vessels. Combination of multiple methods improves the effectiveness and practicality of these techniques.

Keywords: albatross, bycatch, mitigation measures

BEHAVIOUR OF STABLED HORSES PRESENTED WITH FORAGING DEVICES IN MANGERS AND BUCKETS

Deborah Goodwin[1*], Pat Harris[2], Nell Davidson[2]

1 School of Psychology, University of Southampton, UK.

2 Equine Studies Group, WALTHAM Centre for Pet Nutrition, UK

*Correspondence: D.Goodwin@soton.ac.uk

Processed feed for stabled horses is usually presented in buckets or mangers, and is easily and rapidly consumed. Foraging devices based on the Edinburgh Foodball can be used to provide part of the ration. Current designs are all placed on the floor, raising concerns about ingestion of foreign materials with the dispensed food. Alternative devices were evaluated, used within suitable, clean containers to prolong food-handling times but avoid such issues.

In four Latin Square designed replicated trials we investigated behaviour of 12 stabled horses with three foraging devices. These were separately presented for five minutes, varied in sensory complexity (Round, Square, Polyhedral) and contained 500g high fibre pellets. In Trials I and II six geldings were presented with devices in buckets then mangers. All individuals foraged successfully from at least one of the devices and behaviour was compared. However, all individuals exhibited some frustration while using the devices (either pawing or biting them). Horses frequently removed the devices from the buckets in Trial I terminating these sessions. In Trial II mean device foraging duration was ranked Polyhedral>Round>Square. Mean pawing rate in Trial II was calculated for horses (frequency of pawing per individual/summed duration manipulation and foraging) and was highest with Square (0.11, n_{pawers}=6). In Trial III six stabled mares were presented with the same foraging devices in mangers. Mean foraging duration with devices again ranked Polyhedral>Round>Square. Mean pawing rate was highest with Device round (0.08, n_{pawers}=4). Trial IV investigated behaviour of six horses when devices initially containing five high fibre pellets became empty. Mean foraging duration with devices again ranked Polyhedral>Round>Square. Mean pawing rate was highest with Square (0.05, n_{pawers}=3).

Device polyhedral had highest mean duration of foraging in all Trials. Devices met objective but unpredictability of pellet rewarding stimulus may indicate a source of frustration and warrants further investigation.

Keywords: horse, domestic, foraging devices, foraging behaviour, enrichment

THE RELATIVE ATTRACTIVENESS OF SIX DIFFERENT ROOTING MATERIALS FOR GROWING PIGS

M. B. Jensen*, L. J. Pedersen, M. Studnitz

Danish Institute of Agricultural Sciences, Research Centre Foulum, Denmark

*Correspondence: margitbak.jensen@agrsci.dk

According to EU legislation pigs must have access to a rooting material, and the aim was to assess which materials pigs prefer. The relative attractiveness of six rooting materials was assessed in an operant conditioning set-up using concurrent schedules of reinforcement. Twelve pigs worked for all six combinations of a reference material and one of the six test materials in a balanced design. The cost of access to both reference material and test material was varied (reference/test: FR8/FR40, FR16/FR32, FR24/FR24, FR32/FR16, FR40/FR8). For each combination, demand functions for both materials were estimated as a function of cost of reference material (peat). The intercept of the demand functions for the test materials differed (1.27, 0.97, 0.91, 0.64, 0.53, 0.48 (± 0.14) for straw mixed with maize silage, compost, wood chip, seed grass hay, sisal rope and chopped straw, respectively; $P<0.001$). The slopes of the demand functions for the six test materials did not differ (0.03). Furthermore, the demand functions for the reference material were not affected by test material ($2.18 x - 0.033$). The cross point of the two demand functions for each of the six combinations was calculated to assess the relative attractiveness of the six test materials using the reference material as a common scaling factor. The cross points (95% confidence interval in brackets) revealed the following ranking (the lower values are most preferred): straw mixed with maize silage (14.2 (9.5-18.5)), compost (18.2 (13.8-22.3)), wood chip (18.0 (13.8-21.9)), sisal robe (25.5 (21.4-29.6)), seed grass hay (27.1 (22.7-31.8)), chopped straw (28.5 (24.5-32.8)). The results confirm that pigs prefer more complex and compound rooting materials.

Keywords: rooting materials, pigs

BEHAVIOURAL EFFICACY OF ENVIRONMENTAL ENRICHMENT IN THE REDUCTION OF STEREOTYPY IN TWO CAPTIVE VICUGNA (*VICUGNA VICUGNA*)

Matthew Parker[1]*, Deborah Goodwin[1], Edward Redhead[1], Heidi Mitchell[2]

[1] Department of Psychology, University of Southampton, UK.

[2] Enrichment Coordinator, Marwell Zoological Park, Winchester, UK

*Correspondence: mop101@soton.ac.uk

Increasing foraging behaviour and promoting substrate choice as methods for reducing stereotypy in captive animals are widely practised and generally accepted as effective. In the present study we examined the efficacy of offering foraging patch and substrate choice in an attempt to reduce motor stereotypy in two captive vicugna (F1 and F2). Browse were added to the vicugna's enclosure as an additional forage substrate and also split the vicugna's normal feed: half being delivered outside of the sleeping enclosure and half inside to offer a split patch choice. The study employed an ABACA design (A: Baseline, B: Browse, C: Split Feed).

There was a significant effect for condition, $P = 0.017$. T-tests revealed a significant condition effect in F1 between the Browse and Baseline one, $P < 0.05$ with the frequency of stereotypy during the Browse condition being higher. In addition in F1, a higher frequency of stereotypy was observed during the Browse condition as compared to Baseline two and this approached significance, $P = 0.06$.

T-tests revealed several significant inter-condition differences in F2. The frequency of stereotypy during the Browse condition was significantly higher than during Baseline one, $P < 0.05$, Baseline 2, $P < 0.01$ and the Split Feed condition, $P < 0.05$.
The frequency of stereotypy was also significantly higher in the Baseline 3 condition than in the Split Feed condition, $P = 0.05$.

In the wild, vicugna are the only camelids who sleep and eat in different areas. However, the subjects used for the present study were fed in their sleeping enclosure. The decrease in stereotypy during the split-feed condition may be indicative the relative reinforcer value of stereotypy as compared to simulated wildtype foraging opportunities. The reason the browse increased stereotypy may be because it represented a supernormal stimulus.

Keywords: enrichment, vicugna, supernormal stimuli, browse

BLUE FOXES' (*ALOPEX LAGOPUS*) MOTIVATION FOR ACCESS TO VARIOUS FLOOR MATERIALS MEASURED BY USING OPERANT CONDITIONING

Tarja Koistinen, Jaakko Mononen

Institute of Applied Biotechnology, University of Kuopio, Finland

*Correspondence: tarja.koistinen@uku.fi

Farmed foxes are traditionally housed on wire-mesh floor, which may not provide sufficient environmental complexity for the foxes. The present experiment was designed to evaluate blue foxes' motivation for various floor materials by using consumer demand indices.

The subjects were seven trained blue fox males, housed in standard wire-mesh cages. The foxes were tested daily for three hours in self-made, automated test cages. A four-minute reward on a floor material was delivered after a fixed number of lever-presses (FR) by moving the cage from a wire-mesh floor to the reward floor material. In a cross-over design, four different floor materials were tested: a deep sand floor (SF), concrete floor with a thin layer of sand (SCF), concrete floor (CF) and wire-mesh floor (WMF). On each material, the foxes were exposed to three replications of four FR values. During the rewards of one replication, the duration of 'floor use' (digging, sniffing, playing, rolling on the floor) was recorded continuously on each material. Demand functions were estimated by linear regression from the log-transformed data. Variables were analysed with Mixed Model Analysis.

There was no difference ($P>0.05$) in the demand elasticity between the floor materials (SF=-0.33, SCF=-0.40, CF=-0.38, WMF=-0.47). The area under the demand curve was greatest ($P=0.005$) for SF (SF=1.1^{a}, SCF=$1.0^{a,b}$, CF=0.8^{b}, WMF=0.8^{b}, values with different superscripts differ, i.e. $P<0.05$). Difference in the demand elasticity for floor use was not found ($P>0.05$) between the floor materials (SF=-0.25, SCF=-0.34, CF=-0.17, WMF=-0.41). The area under the floor use demand curve was greatest ($P=0.001$) for SF (SF=2.93^{a}, SCF=$2.67^{a,b}$, CF=2.58^{b}, WMF=2.37^{b}).

The blue foxes were motivated to work for access to more complex floor materials. Based on the area under the demand curve, the foxes valued floor materials with sand more than materials without sand.

Keywords: Operant conditioning, Demand curve, Floor material, Blue fox

BEHAVIOURAL RESPONSES TO A MIRROR AS A VISUAL ENRICHMENT TOOL FOR CAPTIVE PRIMATE SPECIES

Amanda Fernie, Nicola Cross, Clive Phillips.

Centre for Animal Welfare and Ethics, University of Queensland Gatton 4343 Australia

*Correspondence: s4010321@student.uq.edu.au

Two experiments evaluated mirrors as enrichment for common marmosets, cotton-top tamarins, spider monkeys and baboons. Mirrors (M, 104 x 38 cm) were attached to the side of six enclosures in a switchback design with 1-week periods, with a plywood sheet as a Control. Behaviour was recorded at the beginning and end of each period by manual observation. In Experiment 1, subjects looked at the mirrors more than the control (treatment M: 5.1, treatment C 0.3 times/d, $P < 0.001$), and touched the mirror more (treatment M 4.8; treatment C 0.3 times/d, $P < 0.001$). Mirrors increased *self-grooming* (Treatment M: 6.3, treatment C: 4.3, SED 0.66 times/d, $P = 0.006$). There was no difference in response to treatment on days 1 and 7. In Experiment 2, which focused on grooming activity, subjects looked at and touched the mirror more than the control (looking: treatment M: 16, treatment C 5 times/d, $P < 0.001$; touching: treatment M 18; treatment C 5, $P < 0.001$). Subjects presented with the mirror spent more time grooming other subjects' head and neck (treatment M: 15, treatment C 9 times/d, $P = 0.05$) and less grooming other subjects' legs (treatment M: 0, treatment C 4 times/d, $P = 0.03$). In treatment M, subjects were more likely to be groomed when curled up (4, Vs treatment C 0 times/d, $P = 0.03$) and less likely to be groomed when standing (3 Vs 8 treatment C times/d, $P = 0.08$). Responses did not change from d 1 to d 7. However, on d 1, treatment M subjects reduced self-scratching (2.5 Vs treatment C 4.3 bouts/d), but this difference had disappeared by d7 (treatment M 6.4, treatment C 4.7) ($P = 0.007$). It is concluded that significant attention was paid to a mirror, which did not diminish over time. The increase in self-grooming and more allogrooming head than legs suggests that awareness of self and others may have increased.

Keywords: Enrichment, Primate, Behaviour

DOES ENVIRONMENTAL ENRICHMENT AFFECT THE WORK PERFORMED AND NUMBER OF REWARDS OBTAINED BY RATS WORKING CONCURRENTLY FOR TWO DIFFERENT TYPES OF WATER?

Louise Holm, Jan Ladewig

Department of Large Animal Sciences, The Royal Veterinary and Agricultural University, Grønnegaardsvej 8, DK-1870 Frederiksberg C, Denmark

*Correspondence: lhl@kvl.dk

Double demand curves, obtained by allowing animals to work concurrently for two different resources by pressing two operant levers a fixed number of times (Fixed Ratio, FR), provide a measure of resource preference. However, studies have shown that animals may work for more rewards than they are motivated to use, and even work when not reinforced. This indicates that working may be rewarding in itself, which constitutes a methodological problem.

It is likely that working is in particular rewarding for animals housed under stimulus poor conditions. Therefore, the aim of this experiment was to investigate if environmental enrichment affects the amount of work performed by rats allowed concurrent access to two types of drinking water, distilled water and quinine water. According to a balanced design 16 laboratory rats were subjected to four different housing conditions: no enrichment (NE), object enrichment (OE), social enrichment (SE), and both object and social enrichment (SOE). Rats worked in Skinner boxes in concordance with a closed economy for rewards consisting of 0.1 ml of water. The daily test sessions lasted 2 hours. Rats went through four runs of the following five FR combinations: 10/50 (distilled/quinine), 20/40, 30/30, 40/20, and 50/10.

A significant interaction between operant lever (i.e. type of water) and enrichment was found for the number of times of pressing the levers ($P<0.05$). No difference was present for quinine water, but in contrast to expectation rats were found to press the distilled water lever most when SE housed and least when OE housed. In favour of the method, though, this difference was not sufficient to cause an effect on number of rewards obtained ($P=0.20$).

The results indicate that enrichment may exert some effect on work performed. However, working in excess seems not to be particularly rewarding to rats offered no environmental enrichment.

Keywords: Rats, environmental enrichment, double demand curves

CONSEQUENCES OF A HOMOGENOUS ENVIRONMENT ON THE BEHAVIOUR OF LABORATORY MICE

Julia Lacey*, Jane Hurst

Animal Behaviour Group, University of Liverpool, UK

*Correspondence: jcl@liverpool.ac.uk

Inbred mouse strains are homozygous at the majority of loci and express a relatively simple pattern of major urinary proteins (MUPs) in urine scent cues. Furthermore, laboratory mice are housed within strains in a simple and constant environment, where they only experience one pattern of genetically determined scents. These two factors compound the ability of inbred mice to link social status with individual identity within their own strain. We investigated the effect of repeated exposure to soiled bedding from males of either the same or different strain on urine counter-marking and investigation and on aggressive behaviour within same-strain pairs of BALB/c (N = 22) and C57BL/6 (N = 22) males. Males pre-exposed to different strain scents in the home cage had more defined social relationships, in that dominant males were more aggressive (Mann-Whitney U test: $U = 2$, $N_1 = 6$, $N_2 = 5$, $P = 0.018$) while subordinate males suppressed counter-marking near other male urine (non-parametric two-way ANOVA: $Z = 2.11$, $N = 21$, $P = 0.035$). Exposure to male urine from the same or different strain outside the home cage stimulated increased aggression when males returned home, an effect that was exacerbated by different strain scents in the home cage ($Z = 2.32$, $N = 21$, $P = 0.020$). The duration of urine investigation varied according to both strain and experience of home cage scents (**$Z = 2.64$, $N = 42$, $P = 0.008$). Results demonstrate the importance of olfactory experience in determining competitive behaviour among male mice. To protect welfare, we recommend that males are not exposed to male urine when temporarily removed from their social groups and that care is taken to avoid contamination of home cages with different strain scents.

Keywords: Laboratory mice, social scents, competitive behaviour, welfare

CHANGES IN RATES OF SNIFFING IN AIR-TRAILING DOGS

Sara Jackson, John W. S. Bradshaw

Anthrozoology Instititute, Department of Clinical Veterinary Science, University of Bristol, Langford, UK, BS40 5DU

*Correspondence: sara.jackson@bristol.ac.uk

Use of the domestic dog to locate hidden objects is still regarded as the best method for scent based source location. Depending on the task dogs use different search methods; ground trailing (following a recent human trail), air trailing (drugs or explosives) or a combination of both (mountain search and rescue).

Sniffing is considered to be of primary importance during any source location that relies on scent. In ground trailing dogs, sniffing occurs continuously throughout source location, with the number of sniffs between each respiratory ventilation changing depending upon which phase the dogs are in.

There have been no similar studies in air-trailing dogs so 25 dogs (125 trials), wearing a microphone to record sniffing, were videotaped locating a hidden training aid in a 30m x 60m grid.

Through observation scent detection was deemed to have occurred when the dog showed a check pace behaviour, that is a distinct, sudden, change in direction. Time searching prior to check pace was named the scent detection phase (mean duration = 20seconds). Time spent searching after check pace, until the training aid was located, was named the source location phase (mean duration = 4 seconds). The percentage of time spent sniffing in the scent detection phase was compared to the percentage of time spent sniffing in the source location phase.

Sniffing occurred in discrete bouts, totalling 13% (S.E ± 3%) of time in the scent detection phase and 38% (S.E ± 4%) of time in the source location phase ($F=23.9_{(1, 22)}$ $p<0.001$), both considerably less than the 100% reported for ground-trailing dogs.

In conclusion, it would appear that in source location via air-trailing, sniffing does not play the major role that would have been expected. If active sniffing reduces the efficiency of breathing, for example by making panting impossible, then dogs may have to trade-off obtaining detailed olfactory information, by sniffing, against the need to move quickly which requires deeper breathing.

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Keywords: Dog, sniff, scent, source location

DOES KINSHIP MATTER WHEN HORSES MIX WITH UNFAMILIAR CONSPECIFICS?

Kate Sawford[1], Hrefna Sigurjonsdottir[2], Suzanne T Millman*[1]

[1]Department of Population Medicine, University of Guelph, [2]Department of Biology, Iceland University of Education,
*Correspondence:smillman@uoguelph.ca

Horses engage in mutual grooming, but this contact is directed towards specific herd members. While several studies have investigated the social bonds within established herds of horses, little is known about the formation of these social bonds. The objective of this study was to explore the importance of kinship and coat colour on formation of social bonds.

Two groups of unfamiliar two-year-old Icelandic mares were assembled, each consisting of six individuals. Groups were composed of two mares descended from each of three sires. Coat colour of the dam of each mare was determined using Worldfengur, a searchable database of Icelandic horses. Following mixing, direct observations were conducted five days per week for four weeks and data recorded using the Observer. During one-hour observation periods, frequencies and durations of aggression, allogrooming and other social interactions were recorded, and 5-minute scan sampling was used to record proximity data, in which the horse nearest to each individual recorded. Each group was observed during each of two daily time periods: 06.00-08.00 and 16.00-18.00. Data was analysed using a multivariate repeated measures analysis.

Duration of allogrooming did not differ between kin and non-kin ($df = 1,28$, $F = 2.231$, $p = 0.146$) and individuals were not less aggressive towards kin than non-kin ($df = 1,58$, $F = 1.139$, $p = 0.290$). Interestingly, individuals allogroomed more with mares whose coat colour was the same as that of their dam ($df = 1,43$, $F = 4.314$, $p = 0.044$), but were not less aggressive towards mares whose coat colour was the same as that of their dam ($df = 1,43$, $F = 0.241$, $p = 0.626$).

In conclusion, kinship does not appear to affect social interactions between unfamiliar horses, but horses may preferentially bond with individuals who are similar in colour to their dam.

Keywords: equine, social behaviour, allogrooming

EFFECT OF DIET DURING GESTATION/NEONATAL PERIOD ON BEHAVIOUR AND LEARNING ABILITY OF OFFSPRING

Andrew A. Ponter[1] Christine Duvaux-Ponter[2]

1 Ecole Nationale Vétérinaire d'Alfort, 7 av. du Général de Gaulle, 94704 Maisons-Alfort, France

2 Institut National Agronomique Paris-Grignon, 16 rue Claude Bernard, 75231 Paris Cedex 05, France

Correspondence: aponter@vet-alfort.fr

The adult mammalian brain contains approximately 50–60% of its dry weight as lipid. Docosahexaenoic acid (DHA, C22:6n-3) and arachidonic acid (AA, C20:4n-6) are the main long chain polyunsaturated fatty acids (LCPUFA). DHA represents roughly 15% of the total fatty acids in the brain. Requirements for LCPUFA are very high during the last trimester of gestation. The LCPUFA supply to the foetal brain must be ensured via adequate supply in the diet of the dam during gestation, efficient transfer across the placenta/synthesis in foetal liver and incorporation into the brain.

Newborn piglets given an infant formula devoid of long chain LCPUFA had lower levels of DHA in the brain than sow milk-fed piglets and the fluidity of their synaptosomal membranes was reduced. Diets deficient in linoleic acid and linolenic acid given to piglets significantly decreased frontal cortex AA, DHA and concentrations of dopaminergic and serotoninergic neurotransmitters. Dopaminergic and serotoninergic systems are involved in the regulation of certain behaviours, memory and learning processes. Indeed, piglets with neonatal dietary induced reductions in frontal cortex DHA had modified behaviour, less exploratory activity and more stationary periods in an elevated plus maze.

In rodents the severe depletion of brain DHA through a deficient diet was accompanied by decreased exploratory activity in novel environments and decreased performance in habituation and olfactory-based learning tasks. These effects have been linked to reduced noradrenaline and dopamine levels in several brain structures at birth. In addition, DHA deficient rat pups learnt less well in an active avoidance test compared to pups from DHA supplemented rats.

In conclusion, care should be taken when interpreting data concerning behaviour and learning in the neonatal period since *in utero* dietary fatty acid supply can modify brain neurotransmitter levels and therefore may influence these types of activity.

Keywords: polyunsaturated fatty acids, behaviour, learning

THE ROLE OF SECONDARY REINFORCEMENT DURING SHAPE DISCRIMINATION LEARNING IN DWARF GOATS

Jan Langbein[1*], Katrin Siebert[1], Gerd Nuernberg[2], Gerhard Manteuffel[1]

[1]Research Institute for the Biology of Farm Animals, Research Unit Behavioural Physiology, Germany

[2] Research Institute for the Biology of Farm Animals, Research Unit Genetics & Biometry, Germany

*Correspondence: langbein@fbn-dummerstorf.de

Primary reinforcers (e.g. food) satisfy essential needs of animals and are inherently understood by them whereas secondary reinforcers (e.g. sound or light) acquire their reinforcing power only through Pavlovian conditioning after initial pairing with a primary reinforcer. While the effectiveness of secondary reinforcers to facilitate the acquisition of new tasks have been shown in chimpanzees and rats, recent results in horses are not so unambiguous.

We studied independent shape discrimination learning in two groups of dwarf goats with and without secondary reinforcement applying an automated learning device integrated in the animals' home pen. As a secondary reinforcer we used an acoustical signal. In task one (T1), which lasted 13 days, both groups had to remember shapes they had already learned six weeks ago, one with secondary reinforcement (GS, n = 6) and the control group without it (GC, n = 5). In task two (T2, 13 days) both groups had to learn a new shapes, again GS with secondary reinforcement and GC without it.

We analysed learning data by applying the General Mixed Model procedure (SAS). The daily learning success in T1 showed a tendency to be higher in GS than in GC (ANOVA, $p = 0.07$). GS reached the learning criterion at day 3, compared to day 4 for GC. In T2, learning success was higher in GS than in GC ($p < 0.05$). GS reached the criterion at day 7, compared to day 12 for GC. In this task only 4 goats in GC reached the criterion within 13 days. We also analysed the number of trails required to attain the learning criterion in blocks of 20 trials. In T1 there was no difference between GS and GC (287 vs. 464; ANOVA, n.s.). In T2, however, this difference was significant (GS, 1320 vs. GC, 3700; $p < 0.05$).

Our results indicate that secondary reinforcement is more efficacious in facilitating the learning of a new task than in the case of remembering an already learned task.

Keywords: dwarf goats, shape learning, operant conditioning, secondary reinforcement

GROUPS OF NEWLY HATCHED BROILER CHICKS SHOW ULTRADIAN ACTIVITY RHYTHMS IN THE ABSENCE OF EXTERNAL TIME CUES

Birte L. Nielsen

Department of Animal Health, Welfare and Nutrition, Danish Institute of Agricultural Sciences, Denmark

*Correspondence:birte.nielsen@agrsci.dk

Young chicks raised by a mother hen exhibit ultradian (within day) rhythms of activity that have been ascribed to the presence of the hen. In three experiments I investigated ultradian activity rhythms in large groups of chicks housed without a mother hen. Activity patterns in groups of newly hatched chicks were monitored during the first three days after housing using passive infrared detectors (PIDs). Behavioural scannings were carried out in experiment 1 (4 groups) between 1800 hours and 2200 hours every 10 min for 200 min, registering number of chicks drinking, feeding and being otherwise active. Experiments 1 and 2 used female birds, experiment 3 used a mixture of males and females (as hatched). Experiments 2 and 3 had eight groups of 225 chicks, and at the time of housing the birds were approximately 16 hours old. In all three experiments groups were housed with 11 birds per m2 in solid-floor pens bedded with chopped straw, and fed ad libitum. The lower part of the pen walls were opaque to prevent visual contact between groups. PIDs logged activity every minute, and data were analysed using autocorrelation analysis and GLM. Ultradian rhythmicity was in agreement between the PID data and the scannings (Rsq=0.94, P<0.0001). The cycle length decreased during the first night (from 68 to 51 min (SD=2.2); GLM; P<0.01) and differed between groups of chicks; when the cycle lengths were similar no consistent synchrony was found between groups housed in the same room. The ultradian rhythms disappeared with time and little evidence of rhythmicity remained by the third night. These results show that newly hatched chicks generate ultradian activity rhythms in the absence of external time cues. The chick therefore may play an important role in the initiation of brooding cycles during the behavioural transition of the mother hen from incubation to brooding.

Keywords: ultradian activity rhythms, domestic chicks

MILK ALLOWANCE AND WEANING METHOD INFLUENCE CALF BEHAVIOUR

Per Peetz Nielsen[1*], Margit Bak Jensen[2], Lena Lidfors[1]

[1] Department of Animal Environment and health, Swedish University of Agricultural Sciences, P.O. Box 234, 532 23 Skara, Sweden.

[2] Department of Animal Health, Welfare and Nutrition, Danish Institute of Agricultural Sciences, Research Center Foulum, P.O. Box 50, 8830 Tjele, Denmark.

*Correspondence: per.peetz.nielsen@hmh.slu.se

The effect of milk allowance and type of weaning on behaviour in dairy calves was investigated. Four blocks of 12 calves, a total of 48 calves were used. Each block of calves were housed in one section and each section contained two straw-bedded pens each with a computer controlled milk feeder. Within block calves had access to either a low milk allowance (4.8 l/day for heavy breeds and 3.6 l/day for Jersey) or a high milk allowance (9.2 l/day for heavy breeds and 7.2 l/day for Jersey), while concentrate was feed ad libitum. The two groups in each block were assigned to either gradual weaning from six to eight weeks of age, or abruptly weaning at eight weeks of age. Behavioural recordings of feeding, exploratory and abnormal behaviours were done on days before weaning, during weaning and after weaning.

Abruptly weaned calves performed more cross sucking than gradually weaned calves both immediately after ($p < 0.01$; Wilcoxon signed ranks test), and 4 days after weaning ($p < 0.01$; Wilcoxon signed ranks test).

Abruptly weaned calves had shorter total duration and number of unrewarded visits to the milk feeder the last two days before weaning than gradually weaned calves ($P < 0.01$ and $P < 0.001$, respectively). However, the first two days after weaning they had longer total duration and number of unrewarded visits than gradually weaned calves ($P < 0.05$ and $P < 0.001$, respectively). Calves on high milk allowance had a shorter total duration and number of unrewarded visits to the milk feeder than calves on low milk allowance before the gradual weaning started ($P<0.05$ and $P < 0.01$, respectively).

These results show that gradual weaning of calves reduces cross sucking and unrewarded occupancy of the milk feeder compared to abrupt weaning**.** Furthermore, a high milk allowance reduces unrewarded occupancy.

Keywords: Automatic milk feeding, calves, cross sucking, feeder occupancy

TRAINING ZOO HOUSED PRIMATES: A LONG-TERM REVIEW OF ITS IMPACTS ON BEHAVIOUR.

Vicky Melfi*, Sian Thomas, Jacqui Caine

Paignton Zoo Environmental Park, Paignton, Devon, UK.

*Correspondence: vicky.melfi@paigntonzoo.org.uk

Operant conditioning (training) is actively incorporated into animal husbandry regimes in some zoos. It has been considered a refinement in animal husbandry and beneficial as it makes the completion of necessary husbandry procedures quicker, more reliably and the animals are considered to exhibit fewer signs of stress. Previous studies have not empirically tested the impact of training, outside of training sessions, on the behaviour of zoo animals.

This study tested the hypothesis that, the process of training a non-human primate species, Abyssinian colobus monkeys (*Colobus guereza,* N=8), would significantly affect their activity budgets, intra-group social behaviour and colobus initiated interactions with the public outside of training sessions.

Data were collected in blocks of 12 days, which were separated by at least 2 weeks; before training (baseline), immediately after training had commenced (PT1, PT2, PT3) and then 2 years later (PT4, PT5, PT6). Behavioural data were recorded daily following 2 methods: i) instantaneous scan sampling of all group members every 30 mins from 0800 – 1600 hrs, from which activity budgets were generated; ii) two 10 min focal follows using instantaneous sampling every 10secs, recorded social interactions. During these latter observations colobus initiated interactions with the public were noted on an all occurrence basis. There were 3 training steps: stationing, each colobus stayed in a designated position within the enclosure; targeting, the colobus had to touch a target (wooden spoon); and opening their mouths (gained through shaping).

Repeated measures ANOVAs demonstrated that significant changes occurred between the main conditions (baseline, short-term post training and long-term post training) for mean activity budget ($F_{[8,22]}$=154.63, $p<0.001$), social behaviour ($F_{[10,20]}$, $p<0.001$), and levels of colobus initiated interactions with the public ($F_{[6,24]}$=26.1; $p<0.001$). Interpretation of these data suggested that training probably did influence the level of colobus initiated interactions with the public, however other colobus-colobus socially linked behaviours were probably influenced by changing social dynamics within the group; as indicated by changes in dominance hierarchies.

Keywords: animal husbandry, behaviour, colobus monkey, operant conditioning, zoo

THE EFFECT OF ZOO VISITORS ON THE BEHAVIOUR AND FAECAL CORTISOL OF THE MEXICAN WOLF (*CANIS LUPUS BAILEYI*).

[1]María Pifarré, [2]Ricardo Valdez, [1]Carlos González, [2]Marta Romano, [1]Francisco Galindo*.

1 Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México.

2 Depto. de Fisiología, Centro de Investigación y Estudios Avanzados, CINVESTAV, México.

*Correspondence: galindof@servidor.unam.mx

The Mexican wolf (*Canis lupus baileyi*) is an endangered species, and most of the individuals of the species live in zoos. Most reproductive problems in these animals have been attributed to chronic stress related captivity. The effect of zoo visitors on the behaviour and stress of captive wolves has not been studied. The effect of the number of visitors was assessed in 16 wolves (7 males and 9 females) housed in seven exhibitors in three zoos of central Mexico, ranging in size from 170 to 580m^2. Each exhibitor had a varied physical environment with different substrates for the wolves to use including hiding areas of dense vegetation. Areas where animals were visible to people were identified in each exhibitor. Each wolf was observed for 72h during days of high (Fridays, Saturdays, and Sundays) and low number of visitors (Mondays, Tuesdays, and Wednesdays) 4h/day, during 3 weeks. On each day of observation a combination of scan and behaviour sampling was used to obtain information on the number of visitors in front of the exhibitor, time budgets, and social interactions in hiding areas and areas open to the visitors' eye. A faecal sample for each day was obtained for cortisol determination (RIA). The average time spent lying, hiding, in stereotypic pace and self grooming were higher ($p<0.05$) in days of high number of visitors with respect to days of low number of visitors (lying; 77.42%±7.10 and 68.25±9.10, respectively), hiding from visitors (82.5%±9.18 and 74.83±10.3), stereotypic pace (2.11%±4.19 and 0), self grooming (0.09±0.12 and 0). Wolves also had on average higher levels of faecal cortisol ($p<0.01$) during the days of high number of visitors (214ng/g± 9.02) than in days with a lower number of visitors (160±14.9) and there was a positive correlation between these cortisol levels and the proportion of time self-grooming ($Rs=0.8$, $p<0.05$). These results indicate the number of visitors in zoos influence the behaviour and adrenal activity of Mexican wolves which could be undesirable for the conservation of this endangered species.

Keywords: Mexican wolf, faecal cortisol, behaviour, zoo, conservation.

THE EFFECTS OF IMPLANTABLE BIOTELEMETRY DEVICES ON WEANLING GERBILS FOR USE IN A STUDY INVESTIGATING FUNCTIONAL ASPECTS OF STEREOTYPIES

P.H. Moons Christel[1*], Katleen Hermans[2], Luc Duchateau[3], Frank O.Ödberg[1]

1 Department of Animal Nutrition, Genetics, Breeding and Ethology, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium

2 Department of Poultry, Exotic and Laboratory Animals, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium

3 Department of Physiology, Biochemistry and Biometrics, Faculty of Veterinary Medicine, Ghent

*Correspondence: christel.moons@ugent.be

Before the age of 30 days, Mongolian gerbils (*Meriones unguiculatus*) develop two types of stereotypies: bar gnawing and stereotypic digging. An ontogenetic study, monitoring stereotypies from the onset in young animals, allows discerning between cause and consequence of differences found between stereotyping and non-stereotyping animals. Minimally invasive measurement of physiological parameters through biotelemetry aids in evaluating how animals respond to husbandry-related conflicts resulting in stereotypic behaviour. The use of implantable telemetry in young animals is often impossible because of the dimensions of the transmitters available. In addition, studies implanting telemetry devices in adult animals showed a recovery period to regain body weight and display normal behaviour is required.

The aim of this study was to test the intra-abdominal implantation of transmitters in weanling gerbils. We evaluated the effect of the surgery and the presence of the transmitter on body weight and behaviour to determine the minimum interval between surgery and valid data collection.

Transmitters were implanted in eight gerbils (19-34 days: mean 28 ± 1 days; 20.5 to 28.4 g: mean 24.8 ± 0.7 g). Each animal was housed with a control sibling and average daily weight gain was recorded during 4-day intervals. Behaviour (stereotypic and nonstereotypic digging, chewing, autogrooming, drinking, eating, resting, locomotion) was monitored during three 15-min sessions on days 4, 7, 9, 12, 15, 18, and 21 after surgery. Weight gain did not differ between implanted and control animals except during the first 4-day interval (implanted: -1.46 ± 1.02 g, control: 5.21 ± 1.45 g, ANOVA, $F_{4,63}$=5.18, P = 0.0011). Furthermore, no behavioural treatment differences were found when testing data from each day with a Wilcoxon rank sum test. The results indicated that the animals did not experience any adverse effects four days after surgery and that this can be considered as the minimum post-surgical recovery period.

Keywords: implantable telemetry, stereotypies, ontogeny, Mongolian gerbils

REDUCING FEEDING BY NATIVE BIRDS ON PEST BAITS

Lindsay Matthews[1*], Kay Clapperton[2], Richard Porter[2], Dai Morgan[1], Frankie Huddart[1]

[1]Animal Behaviour and Welfare, AgResearch, PB 3123, Hamilton, New Zealand.

[2]Wildlife Scientist, 49 Margaret Avenue Havelock North, NZ

*Correspondence:lindsay.matthews@agresearch.co.nz

Introduced pests (possums and rats) are serious threats to New Zealand's native fauna and flora. Toxic baits are used to control these animals. Even though routinely treated with a putative repellent (green cinnamon (GC)), the baits can pose a risk to native birds. The aim of the project was to determine the effectiveness of novel combinations of primary and secondary repellents compared with the industry standard (GC) for deterring feeding by birds (on non-toxic baits): firstly, with the house-sparrow, for initial testing; then, with a native robin using promising novel repellents; and finally, by testing the acceptance of repellent treated baits with pests. In the sparrow study, eight populations of free-ranging birds were offered a choice between a repellent treated (one of four) and untreated wheat. All populations received all treatments. The repellents were; standard GC, blue anthraquinone (high or low concentration) and cinnamon (BAHC, BALC), and BAH alone. There was a significant reduction in intake of all repellent treatments (ANOVA, $p<0.001$) compared to untreated wheat, with the greatest reductions for BAHC and BAH. In the robin study, individual free-ranging birds were exposed to baked dough pellets sprayed with one of five treatments (n=11-16: standard GC, BAHC, BALC, BAH, and blue, low anthraquinone with peppermint (BALP). The peck rates at the novel repellent treated baits were significantly lower than at the standard GC baits (ANOVA, $p<0.019$), with the greatest reductions for BAHC and BAH. Individually-housed possums and ship rats were offered a choice of repellent treated (n=8-10; either standard GC or BAHC) carrots and their normal diet. There was no significant difference in intake between treatments for either species.

The superior feeding deterrence provided by the novel repellents is likely to provide better protection for native birds in pest control operations while not adversely affecting consumption of baits by pests.

Keywords: mammalian pests, native birds, feed repellents

COMPARISON OF FEEDING BEHAVIOUR AND PERFORMANCE UNDER ARTIFICIAL MONOCULTURAL PASTURE AND ENRICHED HETEROGENEOUS PASTURE

Michiru FUKASAWA, Yumiko NOMOTO[1], Daisuke KOHARI[2], Hideharu TSUKADA, Takami KOSAKO, Ken-ichi TAKEDA[1]

National Institute of Livestock and Grassland Science (NILGS), Nasu-shiobara, Tochigi 329-2793, JAPAN

* Faculty of Agriculture, Shinshu University, Minamiminowa, Nagano, 399-4598, JAPAN

** School of Agriculture, Ibaraki University, Ami, Ibaraki, 300-0393, JAPAN

*Correspondence:shakecat@affrc.go.jp

The aim of this study was to examine behaviour and intake under free-choice grazing system, and to discuss the benefit of a free-choice grazing system in animal performance. Behaviour, intake and performance were compared under artificial monocultural pasture (ART) and enriched heterogeneous pasture (RICH) that contained an artificial pasture, a native pasture and a forest compartments. Behaviour observation and weighing were carried out once every month, and the ingested TDN and CP were estimated. Steers in RICH spent longer time grazing than did steers in ART ($P<0.001$), while spent less time stand resting ($P<0.001$). Steers in RICH spent about one third of their grazing time in the native pasture compartment, except in July. Grazing time in the artificial pasture compartment of RICH gradually increased as grazing progressed, while that in the native pasture decreased. A half of TDN in RICH was ingested from the native pasture compartment in May, June and August. The estimated ingested CP in RICH was almost equal to the required CP, while those in ART excess to the required. Steers in RICH selected a compartment for grazing as if their requirement for energy and protein satisfied simultaneously. The cumulative weight gain in both groups was almost the same at first, however, steers in ART gained little weight after the summer, while steers in RICH gained linearly. Eventually, steers in RICH gained more weight than did steers in ART ($P<0.001$).

Keywords: Cattle, Grazing, Enriched heterogeneous pasture, Diet selection

THE USE OF SUB-METRE GPS FOR THE PRECISE RECORDING OF THE FORAGING BEHAVIOUR OF CATTLE

S. Mark Rutter[1]*, Andrea Rogers[2], Robert A. Champion[1], James F. Cook[1], Lindsay R. Matthews[2]

[1]Institute of Grassland and Environmental Research, North Wyke Research Station, Okehampton, Devon EX20 2SB United Kingdom

[2]Animal Behaviour and Welfare, AgResearch, Ruakura Research Centre, Hamilton, New Zealand

*Correspondence: mark.rutter@bbsrc.ac.uk

The accuracy of standard Global Positioning System (GPS) receivers (approximately 7m) is insufficient for detailed studies of the foraging behaviour of livestock at the patch scale. Recent reductions in the cost and physical size of sub-metre GPS receivers have made their use viable in such studies. One problem with measurements at this precision is that the location of the GPS antenna relative to the points of the animal of interest (e.g. mouth for eating, rump for defecation/urination) becomes an issue. This study investigated whether the precision of data collected using a sub-metre GPS receiver could be improved using a digital compass to record orientation.

Six groups of three dry dairy heifers were studied. One focal animal in each group was fitted with a Trimble GeoExplorer XT GPS receiver connected to a Honeywell HMR3300 digital compass and housed in an enclosure. This was attached to a saddle fitted on the animal's back, just behind the front legs. The distance from the GPS antenna to the animal's head and rump were measured. The animals were observed for approximately 2 hours in a paddock with six bowls containing concentrate feed. The time at which the focal animal ate from a bowl, defecated or urinated was recorded.

The location of the bowls and defecation/urination patches were surveyed after each session. The GPS data were differentially corrected, and estimates of the foraging and elimination locations calculated both with and without the digital compass data.

The digital compass improved the mean error (n=72) in the location of foraging from 0.83m (SEM 0.052) to 0.64m (SEM 0.044) and the mean error (n=18) for elimination from 1.95m (SEM 0.122) to 1.26m (SEM 0.182). This demonstrates that a digital compass can be used to improve the precision of a sub-metre GPS receiver when measuring the spatial aspects of behaviour.

Keywords: GPS, foraging, cattle, recording

OXYTOCIN AND ARGININE VASOPRESSINE IN CEREBROSPINAL FLUID AND ITS RELATIONSHIPS WITH BEHAVIOURAL AND PHYSIOLOGICAL FUNCTIONS IN DRY COWS

Ken-ichi Yayou[1*], Shuichi Itoh[1], Masato Nakamura[2], Etsuko Kasuya[1], Hiroya Kadokawa[3], Hiroatsu Kawai[2], Satoshi Ohkura[1], Hiroaki Okamura[1]

1 Department of Physiology and Genetic Regulation, National Institute of Agrobiological Sciences, Japan, 2 Department of Animal Production and Grassland, National Agricultural Research Center for Hokkaido Region, Japan, 3 Department of Animal Breeding and Reproduction, National Institute of Livestock and Grassland Science, Japan

*Correspondence: ken318@affrc.go.jp

Evidence suggests that oxytocin (OT) and arginine vasopressin (AVP) distributing widely in the brain modulate animal behaviour. Their concentrations in the cerebrospinal fluid (CSF) from the third ventricle are not investigated in the cow, although the changes in those concentrations would reflect the activity of the neuropeptidergic system. To clarify their regulatory roles in behavioural and physiological functions in the brain, we determined the diurnal variations of OT and AVP concentrations in CSF and their relations with blood concentrations of the metabolites reflecting energy status, the stress-related hormones, and the behavioural states.

Three non-pregnant primiparous dry cows were implanted with third ventricular cannula for CSF sampling at least 19 days before the experiment. An indwelling jugular catheter for blood sampling was fitted 2 days before. They were accustomed to laboratory condition with 24h light on and temperature 20±3ºC and fed alphalpha hay at 9:00 and 16:00. The relationships between the CSF concentrations of OT and AVP measured every 1 hour for 48 hrs and the followings were determined: the concentrations of OT, AVP, metabolites (e.g. glucose, NEFA and total cholesterol), ACTH and cortisol in the plasma samples simultaneously collected, and the behavioural state (standing, lying, feeding or ruminating) sustained for at least 5 min before each sampling.

The concentrations of OT (mean±SD for each cow; 27.1±11.4, 39.6±12.3 and 38.0±22.4 pg/ml) and AVP (25.6±4.2, 21.0±10.5 and 9.3±10.2 pg/ml) in CSF were higher than those in plasma at any sampling points ($p<0.05$), but showed no correlation with each plasma concentration, suggesting that the central neuropeptidergic systems are regulated by different mechanisms from the peripheral ones. The OT concentrations in CSF positively correlated with the AVP concentrations in CSF ($p<0.05$). The concentrations of OT and AVP in CSF had no correlation with the plasma concentrations of metabolites, ACTH and cortisol, and behavioural states.

Keywords: oxytocin, arginine vasopressin, cerebrospinal fluid, dry cow

ABSTRACTS OF
POSTER PRESENTATIONS

INFLUENCE OF BRISKET BOARD AND POSITION OF THE NECK RAIL ON LYING IN DAIRY COWS

Michiko Takeuchi, Shigeru Morita, Shinji Hoshiba, Arina Kageyama, Ayano Murakami, Teppei Haruta, Taihei shimada

Faculty of Dairy Science, Rakuno Gakuen University

*Correspondence: takeuchi@rakuno.ac.jp

The objective of this study was to examine the influence of a brisket board and the position of the neck rail on the lying position and the angle of lying cows in the stall of free-stall barn.

The cows (33 cows on average) were kept in the free-stall barn with 42 stalls. The structure of all the stalls in the barn was changed as follows. Treatment 1: There was no brisket board, and the neck rail was 60 cm from the front of the stall, Treatment 2: a brisket board was installed, and neck rail position was 60 cm, Treatment 3: a brisket board was installed, and neck rail position was 45 cm. The position of the knee was measured as the length from the front of the stall, and the position of the pinbone was the length from the rear end of the stall. The angle of lying cows was measured as the angle between body axis and the stall axis.

The average knee positions were 48, 64 and 61 cm in Treatment 1, 2 and 3. The modal knee position of lying cows in the stall without a brisket board was 40-49 cm, and the percentage of cows in this position was 25%. In the stalls with a brisket board, the modal position was 60-69 cm and the percentage of cows was in this position over 80%. The average pinbone positions were 12, 2 and 5 cm in Treatment 1, 2 and 3. The position of the pinbone was shifted to the rear end of the stall with a brisket board. The average angles of lying cow were 17, 19 and 21 degrees in Treatment 1, 2 and 3. The modal angle of cows in stall 1 and 2 was 10-19 degrees, and in stall 3 was 30-39 degrees.

Keywords: cows, brisket board, neck rail, lying position, angle of lying

POWER SPECTRAL ANALYSIS OF HEART RATE VARIABILITY IN HOLSTEIN LACTATING COWS AND JAPANESE BLACK BREEDING COWS

Kanji Matsui, Naoki Mutsuro, Ken-ichi Takeda

Faculty of Agriculture, Shinshu University, Japan

*Correspondence: kmatsui@shinshu-u.ac.jp

Heart rate (HR) rhythm is an excellent parameter for investigating autonomic nervous function. We described autonomic nervous activity by power spectral analysis of HR variability in two different cattle breeds and systems in order to develop the methodology in this species.

Electrocardiograms in 6 Holstein (Holstein) lactating and pregnant cows (4 to 5 years) and 2 non-pregnant and no lactating Japanese Black (JB) cows (2 and 16 years) were recorded during 24 hours, using Holter electrocardiography monitoring and telemetry system, respectively. The Holsteins were kept in tie-stalls, milked and fed roughage in the morning and evening, and concentrates every 4 hours. JBs were kept in free barns, and behavior was simultaneously recorded using an infrared video camera. For selective blockade of parasympathetic and sympathetic (beta-adrenergic) nerves, atropine (AT; 0.1 mg/kg) and propranolol (PR; 0.5 mg/kg) were injected into the jugular vein in the younger JB. Parameters obtained by power spectral analysis using electrocardiograms were HR (bpm), low frequency (LF; 0.04-0.15 Hz) and high frequency (HF; 0.15-1.00 Hz) components ($msec^2$) and LF/HF ratio. This is only a descriptive study.

HR in Holsteins was 80 to 95 during 24 hours, and increased at feeding and milking, HF decreased at feeding and milking, though the fluctuation range was small. LF and LF/HF fluctuated, and were not clearly related with feeding and milking. HR in JBs was higher in the younger (50 to 80) than in the older (40 to 65), the peak of respiratory frequency clearly occurred at the HF range at rest. LF/HF in the younger JB was larger than that in the older JB; conversely, HF and LF were smaller. In JBs, HF was markedly larger during resting when lying than during resting while standing and feeding. AT increased HR, and abolished HF area, PR decreased the LF area. Thus, HF and LF were related to parasympathetic- and sympathetic-nervous activities, respectively. It is thought that the JBs in the free barns were parasympathetic-predominant, and Holsteins in tie-stalls were sympathetic-predominant. One conclusion might be that this technique seems to be useful on cows in both tie-stalls and free barns.

Keywords: autonomic nervous activity, cattle, heart rate, heart rate variability, power spectral analysis

EFFECT OF VIDEO IMAGES ON BEHAVIOURAL AND PHYSIOLOGICAL RESPONSES OF ISOLATED CALVES

Shuichi Ito[1*], Ken-ichi Yayou[1], Madoka Suto[2], Etsuko Kasuya[1], Satoshi Okura[1]. Hiroaki Okamura[1]

1 Department of Physiology and Genetic Regulation, National Institute of Agrobiological Science, Japan, 2 Department of Animal Breeding and Reproduction, National Institute of Livestock and Grassland Science, Japan

*Correspondence: shuichi@st.rim.or.jp

Social isolation is a stressor for calves. The objectives of this study were to determine whether exposures to video images of familiar or non-familiar conspecifics reduce the stress responses of social isolated Holstein calves.

Four castrated Holstein calves (7 months old) were habituated to be reared in stanchion stall. In the social isolation protocol, one test calf was isolated in its own stall by removing the peers for 3 hours. In the control experiment [C] the peers remained. Video movie (no image [N], familiar [F] or unfamiliar [U] calves) was projected to the screen during isolation period that had been set in front of the animal. Each animal saw each of the movies that were presented randomly. The duration (sec) of specific behavioural categories (feeding, drinking, standing, lying, ruminating, freezing) and the number of vocalizations during the isolation were scored. Blood samples were collected every 30 min during isolation via the jugular catheter for the assay of cortisol and ACTH. The difference between control and each test were statistically analysed by Student's paired t-test.

From comparison between C and N, social isolation tended to induce increase in vocalization and standing ($P = 0.0679$) and decrease in feeding, ruminating and lying ($P = 0.0679$). However, plasma concentration of cortisol and ACTH did not change by isolation. That physiological responses were not induced by such social isolation and that only the behavioral responses were induced are consistent with our previous report (ISAE 2003). The effect of video image was only found in that the time ratio of ruminating tended to be restored in F (36.0%±3.3) compared with N (16.9%±6.1) (Wilcoxon, $Z=-1.826$, $N=4$, $P = 0.0679$,). These results suggest that the video image of familiar animal reduce the behavioural stress response to isolation in part.

Keywords: video image, isolation stress, cortisol, calf

FORMATION OF AFFILIATIVE RELATIONSHIPS IMMEDIATELY AFTETR WEANING IN BEEF CALVES

Yoko Fujioka, Ken-ichi Takeda, Kanji Matsui

Fuculty of agriculture, Shinshu University, Japan

*Correspondence::a04a125@amail.shinshu-u.ac.jp

The calves tend to require social contact after weaning because a weaning breaks off mother-filial bond. The tendency might be strong for weaning stress level to rise. This study investigated the effects of affiliative relationships, maternal relationships before weaning, and weaning stress level on the formation of affiliative relationships among calves after weaning.

Fifteen Japanese Black calves aged 6-8 months, were used. They grazed in a pasture with their mothers from birth. The calves were weaned on November 19 and reared in the same pen after weaning. Six calves were selected as focal animals. They were observed individually for 6 h before weaning, and for 3 h at weaning (day 0) and on days 1, 7, 14, 28, 42, and 56, using the focal animal sampling method. We recorded the time spent allogrooming and maternal grooming and the frequency of vocalization after weaning as an indicator of weaning stress.

The time spent allogrooming and maternal grooming was 2.26±2.23 and 47.0±29.2 s/calf/h, respectively. The mean frequency of vocalization at weaning was 56.5±18.3 times/calf/h. The time spent allogrooming on days 14, 28, 42, and 56 was 8.6±17.0, 26.3±39.2, 77.6±119.4, and 73.1±65.5 s/calf/h, respectively. Allogrooming of focal animals was rare until day 14. Affiliative relationships may not form in the short term after weaning, even if calves are familiar with each other before weaning. The time spent maternal grooming was positively correlated with the time spent allogrooming on day 42 (Spearman rank correlation; $rs=0.93$, $p<0.05$), however was no correlated with the time spent allogrooming on other days ($p>0.1$). There was no correlation between the frequency of vocalization and the time spent allogrooming after weaning at each stage ($p>0.1$).

In conclusion, it is considered that strength of social motivation at the weaning may not be related to formation of affiliative relationship immediately after weaning.

Keywords: cattle, social behaviour, welfare

CHANGES IN PLASMA INSULIN AND METABOLITES WITH THE BEGINNING OF GRAZING PERIOD IN CATTLE

Akihisa Yamada[1*], Akinori Oshibe[2] ,Hiroshi Dohi[3]

1 Department of Animal Feeding and Management, National Institute of Livstock and Grassland Science, Japan

2 Department of Animal Production and Grasslands Farming, National Agricultural Research Center for the Tohoku Region

3 Department of Animal Production and Grasslands Farming, National Agricultural Research Center

*Correspondence: yamada@affrc.go.jp

In this study, we clarified the changes of blood constituents associated with the beginning of grazing period (the values at -90,-60,-30,0,30, 60, and 90 min after the beginning of grazing period were compared respectively) in cattle.

Four Holstein steers (500-550 kg body weight, 22-27 months old) were fit jugular vein catheters for the blood sampling. The changes in concentrations of plasma insulin and metabolites after the beginning of grazing period of the animals were measured. The summary of results are as follows.

(1) The decreases in plasma glucose level tended to be great as compared to the result of the previous studies those investigated in the housed animals ($p<0.05$).
(2)No distinct peak of plasma insulin levels was observed after the beginning of grazing period, however, a suppression of insulin secretion responded to a decrease in plasma glucose levels was observed.
(3)No increase in the plasma free fatty acids level was observed before feeding, however, the levels tended to increase after the beginning of grazing period.
(4)Rapid decrease in plasma levels of free fatty acids was not observed.
The results suggest that the grazing behaviour of the cattle resemble to the pre-feeding behaviour of hunting and gathering of monogastric animals .

Keywords: Grazing behavior, Grazing cattle, Plasma glucose, Plasma insulin

EFFECT OF MILK FLOW RATE ON NON-NUTRITIVE SUCKING AND MILK FEEDING BEHAVIOUR IN CALVES REARED BY AUTOMATIC MILK FEEDER

Tetsuya Seo*, Maya Hara, Fumiro Kashiwamura

Obihiro University of Agriculture and Veterinary Medicine, Japan

*Correspondence: seo@obihiro.ac.jp

The aim of the present study was to investigate the effects of reduced milk flow rate on non-nutritive sucking and visiting behaviour at milk feeding station in group-housed calves fed by automatic milk feeder. A walk-through feeding station (Seo et al., 38th ISAE, 2004) was used in this research.

The milk flow rate was altered by the diameter of the tube connecting the milk feeder unit to the teat. Nine Holstein female calves were fed 4.0 L of milk (4 meals × 1.0 L) per day. The following experimental procedure was carried out for fifteen days. All calves were fed using a reduced milk flow rate (tube diameter: 2 mm) for the first three consecutive days, followed by three consecutive days at the normal milk flow rate (tube diameter: 9 mm); thereafter, these treatments were alternated at 3-day intervals. On the last day of each three-day period, the behaviour for each calf was recorded in 20-second intervals over one hour just after suckling at two meals. The age of calves ranged from 12 to 44 days old at the start of the experiment. Data paired by corresponding observation days were analysed with the Wilcoxon test.

Duration of suckling was significantly longer when calves fed at reduced milk flow rate than when calves fed at normal milk flow rate (305 vs. 57 seconds / meal, $P<0.01$). Cross-sucking was significantly less for calves feeding at reduced milk flow rate than for calves feeding at normal milk flow rate ($P<0.05$). The reduced milk flow rate also tended to cause less object-sucking ($P=0.1$). Furthermore, both number and duration of unrewarded visits to the station were significantly fewer for the reduced milk flow rate ($P<0.05$). These results suggest that reduction in milk flow rate could suppress suckling motivation just after milk ingestion.

Keywords: calf, group housing, cross-sucking, feeding station

CHANGE IN LICKING BEHAVIOR OF YOUNG BEEF STEERS IN DIFFERENT SEASONS AND LOCATIONS OF SALT-MINERAL BLOCKS

Mizuna Ogino[1*], Katsuji Uetake[1], Toshie Ishiwata[1], Masanori Matsunaga[2], Miki Kohno[2], Yusuke Eguchi[1], Toshio Tanaka[1]

[1]Graduate School of Veterinary Medicine, Azabu University, Japan

[2]Nippon Zenyaku Kogyo Co., Ltd. Japan

*Correspondence: ma0408@azabu-u.ac.jp

To study the licking behavior of beef steers in different seasons and locations of salt-mineral blocks, 36 Japanese Black X Holstein steers were allocated to 3 pens (6.0 X 9.5 m each) that consisted of a feeding alley for grain feed, a trough for dry hay, a water bowl and a resting space. Pen A (n = 12) had two salt-mineral blocks (5 kg each) on both sides of the resting space. Pen B (n = 12) had two salt-mineral blocks in the feeding alley. Pen C (n = 12) had one salt-mineral block in the resting space and one in the feeding alley. Behavioral observations were made once a month from April to September during daylight at 10 min intervals. Salt-licking behavior was also observed simultaneously.

Although feed intake and daily weight gain were lowest in July, the daily intake (1023.3 ± 275.2 g/pen/day) and licking duration (31.5 ± 14.4 min/steer/day) and frequency (39.5 ± 17.5 times/steer/day) of salt-mineral blocks were all highest in July (monthly mean 26.7℃) for all pens. Steers licked salt-mineral blocks frequently just before and after feeding. The daily intake and licking frequency of salt-mineral blocks were higher in Pen B than in Pen A ($P < 0.05$). Steers in Pen C generally licked salt-mineral blocks longer than steers in Pen A ($P = 0.12$).The daily intake and licking duration and frequency of salt-mineral blocks in the feeding alley were higher than those in the resting space (all $P < 0.05$). Licking frequency of bars surrounding the pen was lower in Pen B and Pen C than in Pen A (both $P < 0.05$).

In conclusion, steers licked salt-mineral blocks more frequently in the month of higher temperature, and just before and after feeding, and in the feeding alley. It was also suggested that the separated setting of salt-mineral blocks could make steers lick easier, and that the more time animals spend licking salt might help reduce the incidence of disturbed behavior like bar-licking.

Keyword: beef cattle, licking behavior, salt-mineral block

A WIRELESS COUNTER WITHOUT A HALTER TO RECORD JAW MOVEMENTS FOR GRAZING BEHAVIOR

Kazuhiro Umemura[1*], Tsuyoshi Wanaka[2], Taishi Akiniwa[2], Takeshi Ueno[2], Yasuo Ogawa[3], Kenji Sudo[1], Nariyasu Watanabe[1], Seiichi Sakanoue[1], Tetsuo Matsumura[1],

1 National Agricultural Research Center for Hokkaido Region, Sapporo, 062-8555 Japan

2 Matsushita Electric Works, Ltd. Kadoma, 571-8686 Japan

3 National Institute for Agro-Environmental Sciences, Tsukuba, 305-8604 Japan

*Correspondence:umemura@affrc.go.jp

Recording jaw movements is useful for grassland/animal management. Conventional recorders have been used to detect jaw movements, usually with a sensor and halter, which often involved exposed wires. Halter drop or electrical disconnection sometimes occurred in long-term measuring. We made a simple compact recorder without a halter for dairy cows.

A pendulum with a small magnet and a reed switch are components of the sensor of jaw movements. Matsushita Electric Works, Ltd. made the recorder with the pendulum, a 8bit RISC CPU (PIC16LF873, Microchip Technology Inc.), a 64Kbytes memory (24LC515, Microchip Technology Inc.), a calendar IC (RTC-8564JE, EPSON), and a transmitter with a built-in pattern antenna. The memory stores 10-min additional data for 3 months and the battery (3.6V/2000mAh, Lithium battery) is durable for more than one year. Data is transferred to a PC by a wireless transmitter that requires short-range amplitude-shift keying (ASK) modulation (315MHz, 9600bps).

The recorder was attached to a cow's neck with a band. Correlation between jaw movements and numerical values measured by this recorder was linear（r2=.91, n=52). The recorder does not record jaw movements of rumination or vibration while cows are wandering. Two recorders were attached to the cows in a farm where they were allowed to whole-day graze throughout the grazing season. Jaw movements decreased in a specific field. The standing crop of that field seemed lower than the others.

Keywords: grazing, jaw movement, recorder

THE EFFECT OF HOOF TRIMMING ON DAIRY COW GAIT, ASSESSED BY THREE-DIMENSIONAL ACCELERATION SENSING

Yuki Koba[1]*, Hajime Tanida[1], Hirokazu Kubota[1], Hidekazu Yamashiro[1], Yoshimasa Tsumiyama[1], Shogo Kurozumi[2], Idaku Ishii[2]

1 Graduate School of Biosphere Science, Hiroshima University, Japan
2 Graduate School of Engineering, Hiroshima University, Japan

*Correspondence: yukikoba@hiroshima-u.ac.jp

Proper and regular hoof care promotes well being of dairy cows, but objective evaluation of hoof trimming effectiveness is difficult. Practitioners generally develop methods based upon empirical knowledge rather than scientific bases. Changes in walking gait might be a good indicator of hoof trimming effectiveness. Our long-term goal, therefore, has been to develop a gait analysis system using a three-dimensional acceleration sensor (MicroStone Co., Ltd.). In this report, image analysis is used to assess the reliability of that gait analysis system.

Twenty-five Holstein cows maintained in a loose housing system were used in the study. Gaits of 17 cows were measured once during the month before and once during the month after professional hoof trimming. Cows were led for 20 m with the three-dimensional acceleration sensor attached at the end of their thoracic vertebrae. Recorded data were analysed using the software MVP-A3 (MicroStone Co., Ltd.). For image analysis, markers were attached to the body surface at major skeletal joints of the cows, and they were videotaped while walking. The surface temperature of pastern joint on all four legs was recorded by infrared thermography (Chino. Co., Ltd.) both before and after trimming.

The three-dimensional acceleration sensor was able to characterize variation among gait patterns of the cows and could reproduce the pattern shown by image analysis. Variance of z-axis acceleration decreased significantly ($P<0.05$) following hoof trimming, suggesting improved gait pattern smoothness and rhythmicity. However, variance of acceleration increased ($P<0.05$) for a few cows with over-grown hooves. Probably, weight distribution on the newly trimmed hooves had not yet adjusted properly for these cows. Cows with improved gait patterns tended to have decreased surface temperature in pastern joints of their hooves. This study demonstrates that the gait analysis system using a three-dimensional acceleration sensor can evaluate the effectiveness of hoof trimming.

Keywords: dairy cows, gait analysis, hoof trimming, acceleration sensor, image analysis

EFFECT OF TEMPERAMENT ON MILK PRODUCTION IN LACTATING COWS

Aorigele[1]*, Wang Chun-Jie[1], Ken-ichi Takeda[2]

1 College of Animal Science and Animal Medicine, Inner Mongolia Agricultural University, China

2 Faculty of Agriculture, Shinshu University, Japan

*Correspondence: aori60@yahoo.com.cn

The temperament of cows is an important part of the cow–stockman relationship. A nervous cow will often kick off the teat cup, resulting in a decrease in milk yield. In the present study, we investigated the relationship between the temperament of cows and milk production.

In one free barn at the Educational Farm of Inner Mongolia Agricultural University, we reared 38 lactating Holstein cows, milked them twice each day, and fed them after milking. We evaluated the temperaments of these cows in a temperament judgement frame (1.6 × 0.6 × 1.5 m), established as an annex in the cowshed, because it was necessary to limit movement in order to evaluate each cow's temperament. Each cow was induced into the frame and the escape reaction of the cow in weighting was recorded for one minute. Escape reaction were divided into three categories: 1, mild (standing quietly); 2, restless (almost moving); 3, nervous (struggling violently). From each temperament category, we selected six cows of similar age, date of parturition, and body weight as experimental animals. The milk constituents of these cows were measured by an F120 automatic milk constituent measurement machine.

Milk yields differed significantly among different cow temperaments (ANOVA, $F_{2,15} = 24.9$, $P<0.001$). The milk yield of score 2 (restless) cows was significantly greater than that of cows in the other categories (23.5 ± 3.5 kg/day, Tukey-Kramer test, $P<0.01$). The milk yields of score 1 (mild) and score 3 (nervous) cows were almost the same (mild, 13.7 ± 2.2 kg/day; nervous, 16.1 ± 1.1 kg/day). There were no significant differences in the milk constituents (milk protein, milk fat, milk sugar) of cows among temperaments. In conclusion, we did not allow us to determine the cause of greater milk yield from score 2 (restless) cows.

Keywords: Cattle, Cows-Stockman relationship, Welfare

COW BEHAVIOUR AND DISTURBANCES AT AUTOMATIC CONCENTRATE FEEDER

Jutta Kaihilahti[1], Satu Raussi[1], Reima Kangasniemi[2], Juha Sariola[2], Hannele Khalili[2]

[1]Research Centre for Animal Welfare , MTT Agrifood Research Finland, Agricultural Engineering Research, Vakolantie 55, 03400 Vihti, Finland,

*Correspondence:jutta.kaihilahti@mtt.fi

Loose housed cows can get their daily concentrate from automatic concentrate feeders (ACF). The most common type of feeder is open from the rear, thus, other cows can disturb an eating cow by butting. Our aim was to find out the amount of disturbances at ACF and define factors affecting disturbing behaviour.

We used 44 Finnish Ayrshire cows in one loose housing unit. All cows were fed grass-silage ad lib. In addition, they got concentrate portions varying from 3.5 to 14.4 kg/day, depending on their state of lactation. In the unit, 2 ACF were used, one open from the rear and another type of feeder where cows had the possibility to eat without being disturbed. Preliminary results from open type of feeder are reported. The daily concentrate portion was distributed throughout the day in 4 periods. We made observations during 12 sessions, 2h each. The cows' eating behaviour, disturbances (butting a cow in the feeder) and dominance-subordinate interactions were observed. Data was analysed with SAS statistical program.

A total of 592 ACF visits were observed. In 52% of the visits cow got her own concentrate portion, with mean visit duration being 3 min. 94% of the visits were disturbed. Visits where a cow did not get her own concentrate portion but could get leftovers from the previous cow, had a mean visit duration of 1 min. 36% of these visits were disturbed. There was a tendency for a positive correlation (P=0.06) between the dominance value of the cow and the number of ACF visits where she was butting.

It is concluded that cows easily distinguish if other cows are getting their concentrate portion from ACF, because butting is then very common. Cows with high dominance value will more probably butt at ACF than cows with low dominance value.

Keywords: automatic concentrate feeder, cow, feeding behaviour, disturbing behaviour, butting

EFFECT OF MOON LIGHT AND TIME OF YEAR ON GRAZING BEHAVIOUR BY SWAMP BUFFALO (*BUBALUS BUBALIS*) HEIFERS

Pipat Somparn[1], Malcolm John Gibb[2], Kanchana Markvichitr[1], Narongsak Chaiyabutr[3], Sawat Thummabood[4] and Chanvit Vajrabukka[1]

1 Department of Animal Science, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand 2 Institute of Grassland and Environmental Research, North Wyke Research Station, Okehampton, Devon, U.K. 3 Department of Physiology, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, Thailand, 4 Department of Livestock Development, Misnistry of Agriculture and Co-operatives, Bangkok, Thailand

*Correspondence:somparn@tu.ac.th

An experiment was conducted to examine the effect of moonlight on the time spent grazing and wallowing by buffalo heifers during the late winter, summer and rainy seasons (February to December) in Thailand. Eight swamp buffalo heifers were stocked continuously on improved grass-dominant pasture. Grazing time was determined by visual observation at 10-minute intervals over ten 24-h periods during both the full and the new phases of the moon. Pedometers fitted to the buffaloes were used to measure walking activity during the measurement periods.

Parallel curve analysis showed that during nights with a full moon, eating time increased by 80 minutes longer ($P<0.001$) compared with when there was a new moon. However, the total grazing time during 24 h was not significantly affected by the phases of the moon, the mean time being 484 ± 16.8 min d^{-1}. During the first 5 months, the buffaloes walked significantly further during 24 hours, when there was a full moon compared with when there was a new moon ($P=0.042$). In addition there was considerable seasonal variation in the partitioning of grazing and wallowing activities between day and night, with total grazing time being reduced when there was an abundance of green vegetation during the early rainy season. Whilst, during the summer, wallowing activity was confined almost exclusively to daylight hours, as the rainy season progressed, the buffaloes spent less time wallowing during the day and increasing amounts of time wallowing during the night. These results show that whilst the total time spent grazing each day is affected by season and herbage mass, moonlight allows the animals to increase the proportion of their grazing activity spent at night, this would provide a more constant rumen and metabolic nutrient supply.

Keywords: Swamp buffalo, Grazing behaviour, Moon phases

BEHAVIOUR OF LAMBS IN THE OPEN FIELD TEST: EFFECT OF SEX AND RELATIONSHIP WITH STRESS-INDUCED HYPERTHERMIA

X. Manteca, G. Tedó, J.L. Ruiz-de-la-Torre

School of Veterinary Science, Universitat Autònoma de Barcelona, 08193 Bellaterra (Barcelona), Spain

*Correspondence: joseluis.ruiz@uab.es

Open field tests (OFT) are used to measure general fearfulness and response to novelty in rodents (Karl et al., 2003). However, in farm animals the validation of OFT needs an independent measure of fear. The aim of this study was to investigate the relationships between OFT behaviour and stress induced hyperthermia (SIH) in lambs.

Twenty-four 2-month-old lambs of the Ripollesa breed were used. Animals were randomly allocated to either the control (C) or the treatment (T) group in a sex-balanced design. The animals were individually marked, kept on a conventional farm as part of a larger flock and fed concentrate and hay.

In each animal rectal temperature was measured twice (T1 and T2) with a 10-min lapse. Control animals were released back to the flock between T1 and T2, whereas treatment animals were introduced into a 3x3 m open field arena with 9 equal sized squares painted on the floor. While inside the open field, several behavioural measures were recorded. SIH was defined as T2-T1. The same procedure was carried out on the following two days.

Several behavioural measures and SIH were significantly correlated between the three experimental days within the same individual ($p<0.05$). On first experimental day, SIH was found in all animals but was higher in T than in C animals. On days 2 and 3, only T animals showed SIH ($p<0.05$). In the T group, SIH was higher in males than in females on the first experimental day ($p<0.05$). Males showed higher activity than females ($p<0.05$). Within the same individual on the first experimental day, total time standing stationary and number of escape attempts presented negative and positive correlation with SIH respectively ($p<0.05$).

These results suggests that (1) OFT behaviour and SIH are consistent in a given individual, (2) OFT behaviour may actually be a measure of stress in lambs and (3) male and female lambs may behave differently in a novel situation.

Keywords: open field test, lambs, behaviour, fear, SIH.

DETERMINATION OF A STRAY VOLTAGE THRESHOLD LEADING TO AVERSION IN SHEEP

Christine Duvaux-Ponter [1], Sabine Roussel[1], Francois Deschamps[2]

1 Institut National Agronomique Paris-Grignon, 16 rue Claude Bernard, 75231 Paris cedex 05, France

2 Centre national d'ingénierie réseaux / d'expertise réseaux, Immeuble Ampère, 34-40, rue Henri Regnault, 92068 Paris la Défense cedex 48

*Correspondence: duvaux@inapg.inra.fr

Stray voltage (usually less than 10V) can be observed in farms. It is often caused by a faulty connection between the electrical circuit and the earth. Above a certain level, animals may receive a mild shock which can cause changes in behaviour such as flinching in response to low voltages. Avoidance behaviour together with physiological effects and reductions in performance can be observed at higher voltages. Little work has been performed on the effects of stray voltage on sheep. The aim of this experiment was to determine the threshold level at which sheep perceive the electric shock, as well as their behavioural responses using an avoidance test.

Over a 3-week period, eighteen ewes learned to eat concentrate from two metallic feeders at the end of a 3-m long corridor. A voltage was then applied for 2-min to the feeder in which the ewe initially started to eat. This allowed the ewe to change to the non-electrified feeder if it wanted to. The voltage was increased daily in steps of 0.5V from 1V up to 8V (maximum voltage possible 12V). The ewe was earthed via a metal floor-plate.

Above 5.5 V, the ewes tended to spend more time eating and to eat more from the non-electrified feeder compared with the electrified feeder (paired t test: $p<0.10$ and $p<0.035$, respectively). The number of ewes which suddenly removed their heads while eating in the electrified feeder was higher at 4V and 5V compared to no voltage ($\chi 2>11.03$; $p<0.001$).

A voltage of 5.5 V appears to be the threshold at which avoidance behaviour starts for a large number of the ewes. However, large variations in the responsiveness of animals were observed. Further research is necessary to study whether individual resistance and left-right preference may explain some of the variability in the voltage threshold.

Keywords: sheep, stray voltage, threshold, avoidance

A STUDY OF AGGRESSION IN GROUP-HOUSED PREGNANT SOWS WITH TWO DIFFERENT FEEDING SYSTEMS

Jose Luis Ruiz de la Torre[1*], Núria Chapinal[1], Xavier Manteca[1]

1 School of Veterinary Science, Universitat Autonoma de Barcelona, Spain

*Correspondence: joseluis.ruiz@uab.es

Aggression during feeding is one of the main welfare problems in group-housed pregnant sows. Two of the most commonly used feeding systems are electronic sow feeding (EF) and slow feeding (SF), in the latter competition over food is reduced due to a slow delivery of feed. The aim of this study was to compare aggressive behaviour of sows in EF and SF systems.

Forty pregnant sows (LW x LD) from first to eighth parity were group-housed from day 29 of gestation to 1 week before parturition with two different feeding systems: EF (1 pen, 20 animals/pen) and SF (2 pens, 10 animals/pen), having. Space allowance was 2,32 m^2/sow, excluding space occupied by the feeding system. Sows in SF were fed once every day at 7:00, the same time as the feeding cycle commenced in EF. Animals were observed 3 days during the first fortnight and then one day every week. Each observation day, they were observed from 7:00 to 8:00, from 8:30 to 9:30 and from 14:00 to 15:30. All aggressive interactions were scored and the location in the pen and the identity of the sows involved were recorded. When possible, the sow that initiated the encounter and the sow that won were identified. This information was used to establish the dominance index (RI) of the individuals within each group.

Number of aggressions observed per animal and day was higher in EF than SF ($p<0,004$). Score was higher in EF aggressions, although they were mainly interactions without physical contact in both treatments. Proportion of aggressions in feeding area was higher in EF, whereas proportion of aggressions in non-feeding areas was higher in SF ($p<0,001$). Correlation between RI and parity was positive in both treatments ($r_s=0,48$; $p<0,04$). Correlation between RI and initial liveweight was positive only in EF ($r_s= 0,65$; $p=0,002$).

It is concluded that aggressive behaviour appears to be more severe in EF systems, probably due to competition caused by sequential feeding. Dominance order appears to be weaker in SF than in EF feeding system, the latter having higher correlation between RI and parity and between RI and liveweight, although the size of the groups could affect the results.

Keywords: sow, pregnant, group-housing, feeding system, aggression

SYNTHETIC PIG APPEASING PHEROMONE RELIEVES AGONISTIC STRESS IN ADULT FEMALE PIGS

Miyuki Koori[1], Tomohiro Yonezawa[2], Takefumi Kikusui[3], Kevin Stafford[4], Patrick Pageat[5], and Yuji Mori[3]

[1]Animal Resource Science Center

[2]Veterinary Physiology and

[3]Veterinary Ethology, The University of Tokyo, Japan,

[4]Applied Ethology and Animal Welfare, Institute of Veterinary, Animal & Biomedical Sciences, Massey University, NZ,

*Correspondence: akikus@mail.ecc.u-tokyo.ac.jp

Behavioral problems in sows such as aggression toward other sows and farmers cause management difficulties and deteriorate pig meat productivity. Recently, a synthetic pig appeasing pheromone (PAP) has become commercially available, of which efficacy in piglets was scientifically proved. In the present study, we examined whether the PAP is also effective in adult sows for reducing their agonistic behavior and associated stress responses.

Adult female miniature pigs were used. Each sow was subjected to both the PAP and vehicle treatment according to a within-subject design protocol. They were housed in individual pens during the first two weeks, when either the PAP (5 ml) or vehicle was sprayed around the nest twice a week. Then females from the same treatment group were paired in a new pen, which was at first divided with a wire-meshed fence in order to prevent physical attacks. The fence was sprayed with 5 ml of PAP or vehicle before the pairing. Twenty-four hours later, the fence was removed and the pigs were allowed physical contact for the subsequent 3 hours. Behaviors of each animal were video-recorded at the 0-1 and 23.5-24 hours after pairing in addition to the first 1.5 hours of physical confrontation. Agonistic behaviors, were defined as “head-knocks”, ”biting”, and “parallel/inverse pressing” and submissive behaviors as “escape” and “avoidance”. Saliva samples were obtained for measurement of cortisol concentrations before, during and after the confrontation. As a result, although there was no obvious behavior difference when the pigs were pair-housed with fence regardless of pheromone treatment, after the physical confrontation the PAP treated sows showed longer latency to the first agonistic behavior (PAP 31.5±3.0sec, Control 1085.2±267sec, $P<0.05$). Furthermore, PAP treatment suppressed the increase of salivary cortisol 3hrs after the confrontation (PAP 3.6±1.0ng/ml, Control 9.1±1.5ng/ml, $P<0.05$). These results suggest that the PAP is effective in relieving the social stress not only in piglets but also in adult sows.

Keywords: Pig, appeasing pheromone, social conflict, cortisol, behavior

BEHAVIOURAL CONDITIONING AND REGROUPING STRATEGIES IN FINISHER PIGS

Stephanie M. Hayne[1,2*], Harold W. Gonyou[1]

1 Prairie Swine Centre Inc., Canada

2 Department of Animal and Poultry Science, University of Saskatchewan, Canada

*Correspondence:smhayne@hotmail.com

Learning to cope in one challenging situation may enable better coping in other situations. This study investigated the effect of positive human contact on the reactions to regrouping and novelty. The individual approach behaviour, to three different novel objects, of 228 nursery pigs (3-8 weeks of age) was assessed during three different three-minute novel arena tests (NAT). After the first, and before the second NAT, half the pigs were conditioned to positive human interactions (two minutes per day for two weeks). Pigs were classified as either slow or fast to approach a novel object during the second NAT. Pigs were regrouped based on time to approach (creating uniform or diverse groups) and whether they had received the human interactions (conditioned or unconditioned). This resulted in six treatments that were replicated five times: all unconditioned and slow (UUS) or fast (UUF), all conditioned and slow (CUS) or fast (CUF), conditioned and diverse (fast and slow) (CD) or unconditioned and diverse (UD). The data were analyzed by analysis of variance using a general linear model. Behavioural conditioning did not affect the pigs' subsequent responses to novelty ($P > 0.1$). Following regrouping, pigs in the CUS treatment fought longer (217.8 versus $< 119.6 \pm 34.3$ s / pig; $P < 0.05$) than the other regrouping treatments. The CUS pigs also fought more often than the other treatments (except the UD treatment) (3.6 versus $< 1.9 \pm 0.5$; $P < 0.05$). They also had higher salivary cortisol concentrations on the first day following regrouping than the other treatments (except the CD treatment) (2.0 versus < 1.2 ug / dL; $P = 0.01$). Behavioural conditioning to a human did not affect responses to novel objects. However, conditioning did appear to affect how seemingly passive pigs respond to being regrouped with behaviourally similar individuals. A greater degree of uniformity may have resulted among passive pigs due to conditioning.

Keywords: Pigs, Behavioural Conditioning, Novel Arena, Regrouping, Coping

SOW STEREOTYPIC BEHAVIOUR IN RELATION TO DIETARY SODIUM BICARBONATE

J.N. Marchant-Forde[1], E.A. Pajor[2*]

[1]USDA-ARS, Livestock Behavior Research Unit, University, W. Lafayette, IN 47907, USA.

[2]Department of Animal Sciences, Purdue University, W. Lafayette, IN 47907, USA.

*Correspondence: pajor@purdue.edu

Stereotypies performed by confined sows have been implicated as indicating poor welfare. There is evidence in horses that oral stereotypies serve to buffer pH and reduce gastric ulceration. Gastric ulceration is prevalent in sows and a weak link with stereotypies has been established. The objective of this study was to determine whether stereotypic behaviours were affected by dietary $NaHCO_3$.

Sixteen crated sows were subjected to changing diets over a 6-week period, with each animal acting as its own control. During weeks 1&2 and weeks 5&6, all sows were fed commercial ration. During weeks 3&4, all sows were fed commercial ration containing 2% $NaHCO_3$. Behaviour and heart rate (HR) were recorded once per week from ½h pre-feeding to 2h post-feeding and analysed to determine incidence and durations of stereotypic behaviours, posture and HR responses to feeding. Comparisons used Friedman ANOVA with dietary treatment as between-subjects factor, blocked by sow. Post-hoc comparisons used Wilcoxon signed rank tests.

Pre-feeding, sows spent 46.2% of time engaged in stereotypies, increasing to 55.23% post-feeding ($P<0.05$). Pre-feeding behaviours were crate-nosing (NC=11.7%) and bar-biting (BB=11.6%). Post-feeding behaviours were floor-nosing (NF=22.3%) and sham-chewing (SC=10.2%). The post-feeding durations of BB and NF were lower after bicarbonate (BB weeks 1&2=330s, weeks 3&4=166s weeks 5&6=175s, $P<0.01$, NF weeks 1&2=2010s, weeks 3&4=1412s, weeks 5&6=1140s, $P<0.05$), but the post-feeding duration of trough-nosing (NF) increased (weeks 1&2=192s, weeks 3&4=514s, weeks 5&6=559s, $P<0.001$). Post-feeding, sows spent longer lying (weeks 1&2=2108s, weeks 3&4=2945s, $P<0.01$) and less time standing (weeks 1&2=4402s, weeks 3&4=3444s, $P<0.01$) when the diet contained bicarbonate. HR response to feeding was higher ($p<0.01$) in week 4 (163bpm) than any of the other weeks (151bpm).

Addition of dietary bicarbonate may affect both the performance of feeding-related stereotypies and the cardiac response to feeding. Further investigation is required to elucidate the mechanisms by which bicarbonate may be acting.

Keywords: Stereotypies, sodium bicarbonate, swine, gastric ulceration. Welfare

DEVELOPMENT OF A DEVICE FOR ESTIMATING THE OPTIMAL ARTIFICIAL INSEMINATION TIME OF INDIVIDUALLY STALLED SOWS USING IMAGE PROCESSING.

Dong-ju Kim[1], Jung-hwan Jeon[1], Sung-chan Yeon[2], Hong-hee Chang [1]*

[1]Division of Animal Science and Technology, Gyeongsang National University, Jinju 660-701, Republic of Korea

[2]Department of Surgery, Gyeongsang National University, Jinju 660-701, Republic of Korea

*Correspondence: hhchang@nongae.gsnu.ac.kr

The optimal artificial insemination estimator(OAIE) consisted of a computer, a multiplexer, three CCD cameras and three LED lamps. The OAIE was designed to measure the amount of sows' activities at the stalls. The computer program used for the OAIE to quantify the lying and non-lying(sitting and standing) rates of sows was written in LabWindows/CVI. For the purpose of establishing references that would help estimate the optimal artificial insemination time for sows, the author first observed and recorded the lying rate of the 50 Berkshire×Hampshire crossbred sows. For the observation and recording, a time lapse VCR, a multiplexer, three CCD cameras, and three LED lamps were used. The observation was made from the second day after the sows were moved into the stalls to the day when they were artificially inseminated.

The results of above process, which compared the rates of lying of the day of estrus and the other days, showed that there were no significant differences at the following time bands: 00, 08, 09, 16, and 17. Thus, only the time bands other than these time bands were used to establish the references for determining the onset of the estrus.

Based on the lying rates observed and the references established by the procedures above, the study assigned "0" to the lying rate of the non-estrus time band, "0.5" to the lying rate between the non-estrus and estrus time bands and "1" to the lying rate of the estrus time band. The author of the study assumed that if the OAIE produced "0.5" or above more than 4 times in a row and if the results included "1" at least once, the estrus would have started. In addition, it was assumed that the optimal artificial insemination time for sows were between the 26th hour and the 34th hour after the beginning of estrus. The results of artificial insemination of sows based on the estimated optimal artificial insemination showed that the success of pregnancy was 92.5%, which was the same rate of the controlled group of the sows and that there were no significant differences in the litter size.

Keywords: Sow, Estrus, Artificial insemination, Time estimation

BEHAVIOURAL CHANGES AND PRODUCTION PERFORMANCE OF LAYING HENS IN FURNISHED CAGES VS. CONVENTIONAL CAGES

Heng-wei Cheng, Kim Pohle

Livestock Behavior Research Unit, USDA-ARS, USA

*Correspondence::hwcheng@purdue.edu

Housing environment affects animal social stress responses. This study was designed to investigate the effects of different cage systems on hen behaviour and production performance. One hundred seventy-two W-36 White Leghorn laying hens aged 19 wk were used in the experiment. The hens were randomly assigned into conventional cages at 6 hens per cage or furnished cage at 10 hens per cage (about 610 cm^2 of floor space/hen in each system). The finished cages contained nests, perches, scratch pads, and dust baths (Big Dutchman, Germany). Production data were collected from a period of 25 to 50 wk of age, and behavioural data were collected on every Monday from 30 to 50 wk of age using 10-min scan samples at each hour from 0700 – 2300. Data were analyzed using the GLM. Compared to hens housed in conventional cages, furnished cage hens spent more time feeding ($P < 0.05$), but there was no caging effects on egg mass and accumulated egg production; in addition, furnished cage hens laid a greater proportion of dirty eggs (eggs laid in the litter areas or with blood spots), with a peak at 25 wk of age (1%), then, the proportion consistently dropped to below 0.1% at 50 wk of age. At 50 wk of age, furnished cage hens spent more time preening, while conventional cage hens spent more time performing exploratory pecking ($P < 0.01$). There were no differences in drinking between the two groups. These results indicate that furnished cages may provide a certain comfort level for laying hens; however, economic productivity in the furnished cages may be lower than in the conventional cages.

Key words: Furnished cage, Conventional cage, chicken,

BEHAVIOURAL CHANGE OF LAYING HENS AFTER INTRODUCTION TO BATTERY CAGES, FURNISHED CAGES AND AN AVIARY

Tsuyoshi Shinmura, Yusuke Eguchi, Katsuji Uetake, Toshio Tanaka

School of Veterinary Medicine, Azabu University, Japan

*Correspondence:: slow-but-steady@j04.itscom.net

A variety of investigations about alternative systems and furnished cages for layers are conducted mainly in EU. However, studies about the behaviour of hens just after introduction to these housing are few. Therefore, this study aimed to investigate the changes of location and behaviour of hens just after introduction to three housing systems.

181 White Leghorns were used. 72 birds were allocated to 12 battery cages with 3 birds/cage (613 cm^2/bird) and 9 furnished cages with 4 birds/cage (1170 cm^2/bird), and 109 birds were transferred to an aviary (1130 cm^2/bird). Direct observations using scanning techniques at 10 min intervals were conducted over 2 weeks for 4 h/day from the day following the introduction.

The average proportion of birds that stayed at each location in the furnished cages was stable during the observation period, while in the aviary, 78% of birds were observed on the floor on the first day, and thereafter the proportion linearly decrease ($p<0.01$). The proportions of eating in both the battery and furnished cages were stable, indicating that the caged birds would adjust to these environments wihin a short period. Aggression of birds was less in both the cages (both 0.3±0.1) than in the aviary (3.5±1.0, $p<0.01$), which indicates early establishment of social order in both cage systems. In the aviary, the birds performed less eating behaviour than in both the cages on the first day, and thereafter linearly increased the proportion of eating ($p<0.01$), and the use of tiered wire floors with feeders accompanied this ($p<0.01$). Comfort behaviour including dust-bathing were less in the aviary than in the furnished cages through out the observation period (both $p<0.05$). These results suggest that adjustment of aviary birds to their new environment had been delayed compared with caged birds because of the environmental complexity of the aviary.

Keywords: adjustment, aviary, battery cage, behaviour, furnished cage

AVIATION NOISE ALTERED BEHAVIOUR AND PHYSIOLOGY BUT DID NOT IMPAIR REPRODUCTIVE PERFORMANCE IN FARMED BLUE FOXES

Teija Pyykönen[1], Jaakko Mononen[1], Leena Ahola[1], Petteri Nieminen[2], Anne-Mari Mustonen[2], Jyrki Juntunen[3]

[1] Institute of Applied Biotechnology, University of Kuopio, Finland

[2] Department of Biology, University of Joensuu, Finland

[3] Eastern Command Headquarters, Finland

* Correspondence: teija.pyykonen@uku.fi

Sudden noise is assumed to cause reproductive failure in farmed foxes, and the Finnish Air Force pays indemnifications yearly for cub losses claimed to be caused by flight action. We studied the effects of severe aviation noise during breeding season on behaviour, physiology and reproduction in farmed blue foxes.

The 160 experimental vixens were artificially inseminated at their home farm, and 35 multiparous and 45 primiparous vixens were transferred to both aviation noise (A) and control (C) farm. Animals at the A farm were exposed 3-5 times to severe aviation noise (duration 14-66 min, maximum noise level 112-121 dB_{AF}) during late pregnancy and nursing period. Cubs were calculated at both farms at weaning (49 days postpartum). The behaviour of the animals at the A farm was analysed on the day before, on the day of and on the day after the noise exposures. Thermo-sensitive data loggers were implanted into ten non-reproducing extra vixens to assess possible stress induced hyperthermia (SIH) during noise exposures.

The vixens at the A farm spent less time in their nest boxes during (71±28% of observations) than before (82±19%) or after the flights (86±30%) ($p<0.05$, GLM for repeated measures). The body temperature of the vixens was higher during the flights (38.4±0.26ºC) than at the same time on a day without flight action (37.9±0.35ºC) ($p<0.01$). Reproductive performance (weaned cubs per inseminated vixens) was 7.0±3.6 and 7.0±4.4 ($p>0.1$, Mann-Whitney U-test) in multiparous and 4.1±3.5 and 4.0±3.7 ($p>0.1$) in primiparous vixens at the A and C farm, respectively.

We conclude that severe aviation noise exposure resulted in restless behaviour and stress induced hyperthermia in blue fox vixens, but did not impair their reproduction.

Keywords: aviation noise, behaviour, blue fox, physiology, reproduction,

BEHAVIOURAL SEQUENCE OF MOCK-FIGHTING TO THE HANDLER IN BEEF CATTLE

Naoshige Abe[1], Hirotoshi Takazaki[1], Shusuke Sato[2], Kazuo Sugawara[2]

1 Faculty of Agriculture Tamagawa University
2 Graduate School of Agriculture Tohoku University
Correspondence: naoabe@agr.tamagawa.ac.jp

The aim of this study was to clarify the sequence of mock-fighting to the handler (MF) and to suppress it in cattle. 5 (Exam. 1) and 12 (Exam. 2) Japanese crossbred bull calves aged one month were used. In Exam. 1, the animals were caressed, brushed, and softly spoken for 10 minutes per day for 45 days, totalling 450 minutes. In Exam.2, the same treatment as in Exam.1 was applied for 5 minutes per animal per day for 24 days, totalling 120 minutes. The cattle were reared in individual stalls. MF to the handler increased after the second caressing stage (10^{th}-18^{th} day of the caressing treatment). All animals performed the head butting to the handler until the end of experiment. The head butting to the handler was accompanied by sniffing and licking, vocalizing, and stomping. There were a positive correlations between licking and head rubbing and butting and between head rubbing and butting to the handler ($P<0.05$). As the MF to the handler frequently occurred immediately after the weaning, it is suggested that the suckling motivation relates to the MF to the handler. The butting to the handler was more in Exam. 2 than Exam. 1 , while the sniffing to the handler was more in Exam. 1 than Exam.2. As the MF was more and sniffing was less performed by caressing calves, it is suggested that sniffing and MF are performed with the affiliation to the handler under the high level of the suckling motivation.

Key words: cattle, mock-fighting, caressing, handler, behavioural- sequence

HUMAN-MARE RELATIONSHIPS AND BEHAVIOUR OF FOALS TOWARD HUMANS

S. Henry[1], D. Hemery[1], A. Lemasson[1], M.-A. Richard[1], M. Hausberger[1*]

UMR CNRS 6552 "Ethologie-Evolution-Ecologie, Université de Rennes 1, France

*Correspondence::martine.hausberger@univ-rennes1.fr

We investigated in two different sites (which differed by the breeds present and by the amount of human contact) the influence of the establishment of positive human-mare relationships on foals' behaviour toward humans. Twenty-one mares were softly brushed and fed by hand during a short period (total of 1.25 hours) during the first 5 days of their foals' lives (experimental group), whereas 20 other mares were not handled experimentally and their foals received no contact with the experimenter (control group). The reactions of both experimental and control foals were recorded under various conditions (presence of a motionless experimenter, approach test, saddle-pad tolerance test) when they were 30-35 days old. Approach-stroking tests were also performed successively by the familiar experimenter and by an unfamiliar person when they were one year old.

Several observations strongly suggest that mares can influence their foals' behaviour toward humans: 1) During the handling procedure, experimental foals of protective mares were further from the handler than foals of calm mares (Spearman: Stud 1, $rs = -0.79$, $p < 0.01$; Stud 2, $rs = -0.83$, $p < 0.01$). 2) Experimental foals remained, at all ages, closer to the experimenter (Mann-Whitney: Stud 1 & 2, $p < 0.05$) and initiated more physical contacts with the experimenter (M-W: Stud 1 & 2, $p < 0.05$) than control foals. 3) Avoidance and flight responses of experimental foals were considerably reduced during approaches by the experimenter (M-W: Stud 1 & 2, $p < 0.01$) and they accepted saddle-pads on their back more easily (M-W: Stud 1 & 2, $p < 0.01$) and more quickly (M-W: Stud 1 & 2, $p < 0.01$) than control foals. Finally, the consequences of handling mares had effects that lasted at least until foals were one year old (M-W: Stud 2, $p < 0.05$) and were generalized from experimenter to unfamiliar humans. Similar results were interestingly found in both studs.

This is the first report of an attempt to use observation of mother by foals to facilitate human-foal relationships.

Key Words: Horses, Human-animal relationship, Maternal influence, Early experience.

INFLUENCE OF EQUINE BODY-SIZE ON THE RIDER'S OSCILLATION

Akihiro Matsuura[1*], Emiko Ohta[2], Koichiro Ueda[1], Hiroki Nakatsuji[1], Seiji Kondo[1]

1 Graduate School of Agriculture, Hokkaido University, Japan

2 Riding for the Disabled Association Japan, Japan

*Correspondence: momyun@anim.agr.hokudai.ac.jp

Equine conformation could strongly relate to the horse's and the rider's kinematics. However, very little work is currently available about the rider's kinematics. In this study, the influence of equine body-size on the rider's oscillation was investigated.

Thirty-five horses and one rider were used. The height at the withers of the horse and the length between both knees of the rider as an indicator of the width of the horse's trunk were used for parameters. The accelerations at the waist of the rider were recorded by an accelerometer when the horse walked or trotted at fixed speeds. The rider's oscillation was evaluated by two indices; the frequency and the amplitudes of the spatial positions estimated by double integration of the acceleration. Two-way analysis of variance was used to reveal the difference between indices of rider's oscillation.

According to the height at the withers and the length between knees, horses were classified into 4 groups using cluster analysis; Short and Narrow (SN, n=9), Short and Wide (SW, n=8), Tall and Narrow (TN, n=13), and Tall and Wide (TW, n=5). On short horses, the frequencies of the rider's oscillation both at walk and sitting trot were higher ($P<0.01$), and the vertical amplitudes at sitting trot (cm) were smaller than those on tall horses (SN: 3.2, SW: 3.5, TN: 4.3, TW: 4.0, $P<0.01$). For the rider on wide horses, the vertical amplitudes at walk (cm) were smaller (SN: 1.5, SW: 0.9, TN: 1.3, TW: 1.1, $P<0.05$), while the lateral amplitudes at sitting trot (cm) were larger (SN: 1.7, SW: 2.2, TN: 1.5, TW: 2.2, $P<0.01$) than that on narrow horses.

The rider's oscillation was significantly influenced by the height at the withers and the width of the equine trunk.

Keywords: equine, withers height, width, rider's oscillation, acceleration

ACCELERATION AND IMAGE ANALYSIS OF THE EFFICICACY OF EXERCISE CONDITIONING OF THE RIDING HORSE

Mitsuyo Hayashi[1], Yuki Koba[1], Hajime Tanida[1], Toshihide Takechi[2]

1 Graduate School of Biosphere Science, Hiroshima University, Japan

2 Toyohira Equestrian Centre, Hiroshima, Japan

*Correspondence: htanida@hiroshima-u.ac.jp

Some riders in Japan use two-track conditioning as warming-up exercises for the riding horse. In two-track conditioning, the rider directs the horse through a series of positional changes that contract and stretch the muscles and joints of both the axial and appendicular skeleton. Some riders believe that this procedure stretches all major muscles of the horse, but effectiveness of the system has not been scientifically assessed. Accordingly, we used a three-dimensional acceleration sensor and a motion recorder (MVP-A3: MicroStone Co., Ltd.) to evaluate two-track conditioning of the riding horse. Four horses were used for in the study. Each workout consisted of six exercises. Each exercise continued until the riders felt that suppleness of the horse had been achieved, which usually took 10 to 20 minutes. A sensor attached at the end of the lumber vertebrae was used to measure the 3-D movement of the horses while walking. Recorded data were analysed using the software Vibration Measurement Pack, which graphs the 3-D movement of the horse. We also used image analysis of digital video recordings to assess horse movement. Markers for the image analysis system were attached to the body surface of the horse, including major skeletal joints. Walking motion of each horse was assessed prior to and after two-track conditioning. The sensor also detected the motion of the horse to be recreated by image analysis. According to the Wilcoxon signed-rank test, acceleration of z-axis movement (which shows the up and down movement of the horse) increased ($P<0.05$) following two-track conditioning, which suggests increased engagement of the hind legs. The frequency of gait patterns also increased ($P<0.01$), suggesting that exercises made the horses more active. Results of this study suggest that 3-D sensory analysis is useful to evaluate changes in ambulatory motion of the horse.

Keywords: riding horse, acceleration sensor, image analysis, two-track conditioning

QUESTIONNAIRES FOR GUESSING HORSES EMOTIONS FROM THEIR FACIAL EXPRESSIONS

Masato Aoyama[1]*, Makoto Yamazaki[1], Yoshitaka Komazaki[1], Shoei Sugita[1], Ryo Kusunose[2]

1 School of Agriculture, Utsunomiya University, Japan

2 Equine Research Institute, Japan Racing Association, Japan

*Correspondence: aoyamam@cc.utsunomiya-u.ac.jp

For horse handlers, such as horse trainers, riders and grooms, to care for horses emotions are very important during managing horses. They may be able to discriminate the horse emotions from their facial expressions and behaviors. We investigated whether horse handlers can discriminate the horse emotions from their facial expressions and which parts of horse faces they observed for the discrimination.

We distributed the questionnaires, which asked them to guess horses state only from pictures of its faces and asked which parts they observed for guessing. In order to fix the correct answers, this questionnaire asked them to guess the facts (horses environmental situations or behaviors) instead of mental state. Each question asked them to select one correct picture from several (generally three) choices.

The average score of 143 horse handlers was 53.5 (100 points for perfect), and it was significantly higher than the average of 111 persons (39.4 points) who were unfamiliar with horses (Mann-Whitney U-test, $P < 0.01$). This result indicates that horse handlers, at least to some degree, can guess horses states only by observing horse faces. The most frequently observed part for guessing was the ears, and that the better raters (above 55 points; $n = 68$) observed the ears more frequently than the ones scoring less point ($n = 75$) (U-test, $P < 0.01$). These results indicate that the horse ears can be a useful indicator for guessing their states. Especially in a question showing a threatening horse with a distinctive ear position, more than 90 % horse handlers answered correctly, and more than 90 % of them observed the ears for guessing. Because some horses facial states can be caused by horses mental states, horse handlers, at least to some degree, can discriminate their mental states from their facial expressions, especially from their ears.

Key Words; Horse, Horse handler, Emotion, Facial expression

BEHAVIOURAL AND CATECHOLAMINE DIFFERENCE BETWEEN BODY SIZES, AND BETWEEN INTACT AND CONTRACEPTED FEMALE DOGS SERVED IN ANIMAL ASSISTED ACTIVITIES

Nona Otsuka[1]* ,Takayuki Horii[2] ,Katsuji Uetake[1] ,
Yusuke Eguchi[1] ,Toshio Tanaka[1]

[1]Graduate School of Veterinary Medicine, Azabu University, Japan
[2]ZECS Pet Community Co., Ltd. YOKOHAMA Pet Community College
*Correspondence::ma0406@azabu-u.ac.jp

To investigate the body-size and contraception related differences in stress susceptibility, seventeen dogs (10 large and 7 small dogs) that participated in assisted activities in three elderly-people institutions were studied. The dogs contained 8 intact and 9 contracepted females. Their behaviour was recorded with continuous observation for yawning, panting, raising a limb, smelling, self grooming, shuddering, refusing, struggling. The frequency of each behaviour and the urinary concentration of catecholamine were compared between body sizes, and between intact and contracepted females. Correlations between the behavioural and physiological variables and of these variables with total activity time, substantial activity time, contact time with elderly people, and restricted time by the handler were determined.

Catecholamine concentration was not different between body sizes, and between intact and contracepted females. The frequencies of shuddering and struggling against elderly people were higher in small dogs (shuddering: 0.08 ± 0.04; struggling: 0.15 ± 0.14) than in large dogs (shuddering: 0.04 ± 0.03, $P = 0.05$; struggling: 0.01 ± 0.02, $P < 0.01$). No difference was found between intact and contracepted females for all behaviours. In large dogs, significant correlations were shown between the adrenaline concentration difference before and after the activities and the frequencies of smelling to the handler ($P < 0.05$) and self grooming ($P < 0.05$), and between the dopamine concentration difference and the frequencies of panting ($P < 0.05$), refusing ($P < 0.05$) and smelling elderly people ($P < 0.05$). Restricted time by the handler was correlated with the noradrenaline ($P < 0.05$) and dopamine ($P < 0.05$) concentration differences. In small dogs, correlation was found between the dopamine concentration difference and the frequency of smelling ($P < 0.05$).

In conclusion, no difference in the physiological level of stress between body sizes, and between intact and contracepted females was demonstrated. However, some behaviours and their relation to catecholamine indicators suggested that small dogs received somewhat stronger stress compared to large dogs during activities.

Keyword: dog, animal assisted activities, behaviour, catecholamine

THE EFFECT OF EMOTIONAL CONTENT OF VERBAL COMMANDS ON THE RESPONSE OF DOGS

M. Fukuzawa, D.S. Mills, J.J. Cooper

Animal Behaviour Cognition and Welfare Group, University of Lincoln, UK

*Correspondence: meguhanna@hotmail.com

Although it has been indicated that dogs have become sensitive to human communicative signals through domestication (Topal et al., 1998; Soproni et al., 2001), the interaction between the emotional content of speech sound and dog behaviour has not been the subject of much serious scientific investigation.

Ten pet-dogs (four male, six female) were trained individually in six stages, to respond reliably to two commands "sit" and "come" with the experimenter hid behind a screen (described by the authors previously, in press). Test sessions were organised into two parts: a pre-test series of commands and an experimental command. In the pre-test situation, both commands were presented with no obvious emotional emphasis and randomly until the dog instigated a quick correct response to both commands on five successive commands. When the dog could respond to all five commands reliably, the trainer presented a sixth command which varied in its emotional content. This was with sighs ('gloomy'), with intense stress ('angry'), with a cheery high-pitch ('happy'), or without alteration ('neutral'). The dog's response to each of these commands was assessed using response latencies. The relationship between commands was investigated with a general linear modal analysis of variance to assess significant difference and with a linear regression to examine the relationship between each command with emotional stress and the 'neutral' one. The analysis of variance revealed no significant difference between the response times to the different commands, but response time differed significantly between individual dogs. The regression revealed a significant relationship between the response times to the 'happy' and 'neutral' for both commands ("sit", $r= 0.77$, $p< 0.001$; "come", $r= 0.56$, $p< 0.05$), though the correlation between 'neutral' and 'angry' ("sit", $r= 0.41$, $p= 0.06$; "come", $r= 0.19$, $p= 0.21$), and 'gloomy' ("sit", $r= 0.09$, $p= 0.44$; "come", $r= 0.55$, $p< 0.05$) was more variable.

There was great individual variation in response times, but the results suggest that whilst the response to an emotionally neutral command might predict response to a happy command, this relationship is less predictable when the command is issued with negative emotion.

Keywords: BEHAVIOUR, TRAINING, DISCRIMINATION, DOG AND HUMAN INTERACTION

A CLINICAL APPROACH TO STRESS REACTIONS IN CATS

J. Fatjo, M. Amat, X. Manteca

Department of Physiology Barcelona School of Veterinary Medicine Universitat Autònoma de Barcelona Bellaterra 08193 Barcelona, SPAIN

*Correspondence: jaume.fatjo@uab.es

Stress is thought to be part of most behaviour problems in cats. However, a few studies have been conducted to describe this common clinical finding. The purpose of this work is to provide a clinical description of 22 cases where a stress reaction is suspected. Stress in cats can be expressed through a wide range of physical and behavioural symptoms, including apathy, anorexia, reduction of exploratory behaviour, reduction of the proportion of the available space used, reluctance to play, reduced facial marking, urine spraying, psychogenic alopecia, hyperesthesia syndrome, defensive aggression, and a less affectionate attitude than previously observed. Situations that most commonly elicit these responses are the introduction or a conflict with another cat or a person in the family, changes in the physical environment or moving to a new territory. Treatment includes three main strategies: environmental manipulation, psychotropic drugs and treatment with synthetic pheromones. Environmental intervention is based on providing the cat with a safe zone containing food, water, a litterbox and a resting location. It is important not to force the cat to abandon that place or to establish an unwanted interaction with people or other cats. Pharmacological treatment includes different drugs with antianxiety properties, like benzodiazepines, tricyclic antidepressants, serotonin selective reuptakes inhibitors and azapirones. A decision algorithm to choose the right drug depending on clinical manifestations will be proposed. In addition, synthetic pheromones from the F3 fraction of the natural feline facial secretion seem to be very useful to control stress reactions in cats.

Keywords: cat; stress; aggression; spraying; pheromone

THE CLASSIFICATION OF VOCABULARY BY THE ANALYSIS OF SONOGRAMS IN JUNGLE CROW *(Corvus macrorhynchos)*

Naoki Tsukahara*, Masato Aoyama, Shoei Sugita

School of Agriculture, Utsunomiya University, Japan

*Correspondence: noktkhr@hotmail.com

Cohabitation of crows and human raises many problems such as picking trash and biting agriculture products making them unsuitable for human consumption. It is important to solve these problems. Crows are highly social animals that communicate with each other using vocalizations. Understanding their vocal communications could be useful for solving the problems caused by crows. The aim of this study was to create a vocabulary for deciphering the vocalization of crows.

Crow's vocalizations were recorded using microphone and digital audio tape recorder. Simultaneously, their behaviors were recorded using digital video camera. Approximately 500 vocalization samples were collected and analyzed sonogrammatically. The vocalizations were classified by their acoustic characters, and their functions determined from the behavior.

The vocalizations of Jungle Crows were classified in 41 types. This result suggests that Jungle Crows have the richest vocabularies in Avian species. Furthermore, the functions of 12 of the 41 types of vocalizations could be assessed from behavior. One type of call, defined as the 'Alarm call', consisted of several repeated elements of the call and this call was recorded from crows that were approached by humans in all cases; it was significantly different from the random occurrence (Fisher's exact test: $P < 0.05$). The pattern of the 'Alarm call' seemed to reflect the degree of cautions, because the repeated numbers of elements of the call were increased, and the durations and intervals of each element were shortened, when humans kept approaching the crows. This call was thought to play a role as a precautionary warning because neighboring crows often flew away when hearing it. Understanding of meaning these vocalizations could be applied to control of their behaviors (*e.g.* Play back of the 'Alarm call' may be able to keep crows away from a certain plaice).

Keywords: Jungle Crow, sonogram, vocal communication

BEHAVIORAL RESPONSES OF JAPANESE WILD BOARS TO WOLVES' URINE

Y. Eguchi[1], H. Ueda[2], K.Uetake[1], T. Tanaka[1]

[1] School of Veterinary Medicine, Azabu University, Japan

[2] National Agricultural Research Center for Western Region, Japan

*Correspondence: eguchiy@azabu-u.ac.jp

Japanese wild boars, like Asian and European wild boars, have been causing damage to agriculture. The farmers who hope for an effective repellent tried a variety of materials in order to keep wild boars away from their crop fields, but they could not protect their crops. It is important to understand the behavioral characteristic of wild boars in order to protect the crops. We have reported that Japanese wild boars do not show any avoidance behavior to urine, blood and gall of wild boars and dung of lions, tigers and black leopards (Annual Meetings of JSMS, 2001; JSAS, 2003).

In this study, the behavioral response of wild boars to wolves' urine was observed. The straw that soaked urine of a pair of Gray wolves at Hamura City Zoo in Tokyo was collected. The urine from male and female was mixed. The response of 9 Japanese wild boars, 4 individuals (2 males, 2 females) and 5 individuals (3 males, 2 females) kept in the Amagi wild boar park in Shizuoka prefecture and National agricultural research center for western region in Shimane prefecture, respectively, were videotaped for 20 min after the straw soaked urine was put between the each wild boar and feeds. Eight wild boars of 9 never showed warning and avoidance behavior, and one sniffed the straw and ate feeds though signalled alarm by raising its mane and tail for 3 sec. In female wild boars, the ratio of the time spent in sniffing the urine soaked straw (7.3%) was more than that in male wild boars (2.5%, $P<0.05$). Six wild boars ate the urinated straw without raising their mane and tail.

These results showed that wild boars do not fear nor avoid wolves' urine. This means wild boars do not sense the danger of wolves by instinct. Therefore, it might be difficult to keep wild boars away from crops using the wolves' smell.

Keywords: wild boar, wolf, urine, repellent

SEASONAL VARIATION IN EFFECTS OF ENRICHMENT USING BRANCHES AND SUPPLEMENTAL FEEDING FOR CAPTIVE JAPANESE BLACK BEARS

***Yoshitaka Deguchi[1], Aya Yamamoto[1], Masaki Maruyama[2], Tsunenori Tsujimoto[2]**

[1]Faculty of Agriculture, Iwate University and

[2]Morioka zoological park

*Correspondence:deguchi@iwate-u.ac.jp

High incidence of stereotypic behaviors of captive bears was reported. Environmental enrichment for bears is demanded from the viewpoint of animal welfare. This study investigated behaviors of three Japanese black bears of the Morioka Zoological Park with environmental enrichment (use of branches and supplemental feeding) during three seasons (spring, summer and autumn). The bears lived from 9:00 to 16:30 in the yard, which has rocks, a pergola and a pool. The bears fed once per day in a shed at about 16:30. Branches were put on the poolside and near a pergola. Chestnuts were hidden three each at ten openings in the rocks and branches of the yard before 9:00. Those hiding points were changed daily throughout the experimental period. We investigated their behavior every 1 min by direct observation before and 1 day, 1 week, 2 weeks, and 1 month after enrichment.

Exploratory behavior 1 day after enrichment (10.24 times/h) was greater than that before enrichment (4.54 times/h) in spring ($P<0.05$). In summer and autumn respectively, those of 1 day after enrichment were 8.79 and 11.77 times/h, representing an increase over that before enrichment: 4.65 and 5.34 times/h, respectively. Those of 1 week, 2 weeks and 1 month after enrichment were 6.83, 5.02 and 4.97 times/h, respectively for spring, 4.45, 3.57 and 4.25 times/h for summer, and 8.23, 6.43 and 5.87 times/h for autumn. Those figures are lower than that of 1 day after enrichment. That of 1 week after enrichment was less than that before enrichment in summer. It was suggested that environmental enrichment activated the bears. However, this effect of enrichment had a limited duration, especially in summer.

Keywords: environmental enrichment, captive animal, food-hiding, *Ursus thibetanus*

ANALYSIS OF STEREOTYPIC PACING IN CAPTIVE LEOPARDS AND SNOW LEOPARDS

Naoko Suda*[1], Hisashi Yanagawa[1], Kenji Tsujiei[2], Seiichi Ogawa[3]

1 Obihiro University of Agriculture and Veterinary Medicine, Hokkaido, Japan,. 2 Asahiyama Zoological Park, Asahikawa, Hokkaido, Japan, 3 Kushiro Zoological Park, Hokkaido, Japan

*Correspondence: s12161@st.obihiro.ac.jp

Captive animals exhibit abnormal behaviour patterns because of a restricted environment. Captive felids often exhibit stereotypic pacing as a form of abnormal behaviour. Analysis of the cause of stereotypic pacing in captivity could supply useful information on environmental enrichment. Therefore, in this study, we analysed the stereotypic pacing of leopards (*Panthera pardus*) and snow leopards (*P. uncia*) in detail.

We observed the behavioural characteristics of zoo-housed leopards and snow leopards. One male leopard was singly kept at the Kushiro zoo, Kushiro City, and two males kept singly and one male and one female snow leopard kept in pair at the Asahiyama zoo, Asahikawa City, were observed. These cats were observed in their familiar surroundings during the observation. They were routinely housed in an outdoor enclosure from 9:30 to 16:30. They were let in indoor and fed at 16:30. Zoo-visitors were present during observation period. All cats were observed in an outdoor enclosure from 9:30 to 16:30 with the focal sampling method. The continuance record method was used to gather behavioural data. A period of observations was for five days. In this period, we observed each cat for seven hours per day.

A large individual variation in the level of stereotypic pacing was seen (Kruskal Wallis: H=21.024, P<0.001), ranging from 0 to 145 minutes per day. High level of stereotypic pacing was exhibited at 15:30-16:30. A high frequency of “attention” and “elimination”, suggesting a high level of arousal, preceded pacing. However, the duration of pacing was not affected by the type nor the duration of preceding behaviour.

In conclusion, the temporal dispersion of the pacing behaviour suggests that this behaviour is not due to simple locomotory motivation. Furthermore, high levels of arousal seem to be linked to stereotypic pacing in these species.

Keywords: abnormal behaviour, stereotypic pacing, leopard, snow leopard, zoo animals

EFFECT OF ENVIRONMENTAL ENRICHMENT ON BEHAVIOR AND PRODUCTIVITY OF LACTATING DAIRY GOAT KIDS

Alma Rosas, Anne Sisto, Andrés Ducoing, Alicia Soberón, Javier Gutiérrez

Facultad de Medicina Veterinaria y Zootecnia, Departamento de Etología y Fauna Silvestre UNAM

*Correspondence: sisto@servidor.unam.mx

The objective of this study was to evaluate the effect of the environmental enrichment in lactating Alpine kids under confinement on behavior, as well as the weaning age (at 10 kg) and the weight of adrenal glands of the male kids.

Forty kids were randomly assigned to two treatments (enriched and non-enriched), with two replicates each (n=10). Scan sampling was used every 5 minutes during 100 hours of observations of individual time budgets. The kids were weighed every week and at the end of the experiment weaning age was recorded and the adrenal glands of the male kids were weighed. A complete randomized design was used to assess the effect of enrichment on the variables studied.

The kids in the enriched groups spent more time in locomotive play ($P < 0.05$), while those of the non-enriched groups engaged more time in resting behaviors ($P < 0.05$). There were not significant differences neither in the weaning age nor in the weight of the adrenal glands between the enriched and non enriched groups.

This study suggests that simple and low cost changes in the environment have significant effects on the behavior of goat kids under confinement conditions, becoming more active. Although weaning age was not significantly affected, the increase in play behavior can be a good indication of welfare.

Keywords: environmental enrichment, goat kids, play behavior.

DOES THE PROVISION OF ENVIRONMENTAL ENRICHMENT INFLUENCE BEHAVIOURAL COPING STRATEGIES IN PIGS?

Caroline Docking[1,2], Heleen Van de Weerd[1,3], Jon Day[2], Sandra Edwards[1]

[1]University of Newcastle, School of Agriculture, Food and Rural Development, King George VI Building, Newcastle upon Tyne, NE1 7RU, UK [2]ADAS Pig Research Unit, Terrington St Clement, King's Lynn, Norfolk, PE34 4PW, UK. [3]Pig and Poultry Research Group, ADAS Gleadthorpe, Meden Vale, Mansfield, Nottinghamshire, NG20 9PF, UK.

*Correspondence: Caroline.Docking@adas.co.uk

Different forms of environmental enrichment were provided to pigs at different times in early life, to investigate whether the enrichment modified behavioural responses indicative of different coping strategies. Tonic immobility and restraint tests were used, in which a short latency to attempt escape may suggest an active coping strategy and a long latency may suggest a passive coping strategy.

Forty-eight litters were exposed to one of eight treatments. Four enrichment strategies were provided for a four week period, either post-partum or post-weaning; barren (B; negative control), straw (S; positive control), rooting box with substrate (R) and liquid dispenser with chewing bars (L).

Two male and two female pigs from each litter underwent tonic immobility tests within 24 hours of birth (T1) and at four weeks (T2). The piglets were laid on their back, in a cradle, and the latency to first escape attempt recorded. These pigs also underwent restraint tests at eight weeks (R1) and prior to slaughter at 19-22 weeks (R2). They were restrained in a weigh crate and the latency to first escape attempt recorded. Data were analysed using ANOVA and Pearson correlations.

The results showed that the latency to first escape attempt, for any of the tests, was not affected by treatment, either in terms of enrichment strategy or timing (e.g. main effect of enrichment type in R1: B=27.9, S=30.0, R=34.3, L=25.4 seconds, s.e.d.=5.36). Latency increased over time ($P<0.001$) in each test (T1=5.7, T2=20.9 seconds, s.e.d.=3.05; R1=29.0, R2=41.9 seconds, s.e.d.=3.83). Correlations were found between T2 and R1 (0.331, $P<0.001$) and R1 and R2 (0.637, $P<0.001$), suggesting individual consistency of response.

The provision of early life environmental enrichment did not modify the behavioural coping strategies of pigs, as tested using tonic immobility and restraint tests.

Acknowledgements: This study was conducted using experimental animals from Defra project AW0124.

Keywords: environmental enrichment, pigs, coping strategies.

EFFECTS OF REMOVAL OF INDIVIDUALS ON SOCIAL BEHAVIOUR IN A CAPTIVE GROUP OF CAMPBELL'S MONKEYS

Alban Lemasson[1*], Ronan Jubin[1], Martine Hausberger[2]

1 Institute of Primate Research, Kyoto University, Japan

2 Ethologie-Evolution-Ecologie, CNRS-UMR6552, Universite de Rennes1, France

*Correspondence: lemasson@pri.kyoto-u.ac.jp

We investigated the social effects of the removal of two adult females, the founder of a matriline and a non-reproductive female, in a group of captive Campbell's monkeys (*Cercopithecus campbelli campbelli*). Social behaviour in the group was recorded one month before, one week after, and seven months after removal of the females. Each observation period lasted 12 days.

We collected data on vocal (contact calls) and non-vocal (affiliative, play, avoidance, aggression, directed gaze) interactions using focal animal sampling. We also collected nearest neighbour data using instantaneous scan sampling. The effects of removal on: (1) the global frequency of interactions for each behavioural category (Wilcoxon tests); (2) the networks of significant preferential partners (drawing sociograms based on Chi-square and Binomial tests); (3) the hierarchy of dominance (Zumpe & Michael's index), were analysed.

Before removal, social interactions were mainly affiliative and occurred mostly within matrilines. Moreover, play was rare and no kin bias was observed in the hierarchy. Immediately following removal, social interactions (play in particular), increased among matrilines and this increase was still present seven months later. The role of the younger individuals was important in this increase of play among matrilines. Moreover, following removal, a clear inter-matriline dominance emerged in the hierarchy as members of the disturbed matriline received aggression more often than members of the other matriline.

The results of this study add to the existing literature on the effects of the removal of adult females in primates. The removal would have to be planned according to species and social networks. Individuals who are less involved in social interactions can probably be removed without too much effect on the group but removing a mother can expose her progeny to aggression. The presence of younger animals however may favour the maintenance of stable social networks.

Keywords: Social organisation, Social disturbance, Play, Matriline, Guenon.

CATTLE ROAMING BEHAVIOUR AMONG THE SIX MAIN FEEDING-SITES ON FENCELESS AGRO-FORESTRY SYSTEM

Takeshi Yasue[1]*, Midori Sugiyama[2], Shusuke Sato[3]

1 School of Agriculture, Ibaraki University, Japan

2 Graduate School of Agriculture, Tohoku University, Japan

3 Department of Grazing Animal Production, National Institute of Livestock and Grassland Science, Japan

*Correspondence: tyasue@mx.ibaraki.ac.jp

Roaming among feeding-sites (FS) is important for the understanding of cattle feeding strategy. In this study, we analysed the cattle roaming behaviour among the several FSs on the fenceless agro-forestry system in Japan.

The agro-forest allotment is comprised of many lots, which the area sizes (AS) are approximately 10ha and the years after plantings (YP) are varied, and cattle are roaming among these lots during grazing season. The 5 Japanese Shorthorn cows were located every 2h for 6 months from May to October 2001 by GPS. Daily FS was decided as a lot with the greatest number of the location points during daytime (6-18:00). The number of days until the FS changed (NDC) and the intervals until cattle returned to the same FS (ICR) were calculated in the 6 lots where cattle utilization was relatively high. The AS, YP and mean distance from other lots (MDOL) of these 6 lots varied from 6.8-17.0 ha, 2-5 yrs and 1.2-2.1 km, respectively. NDC and ICR were analysed among 6 lots by Steel-Dwass test. The relationships between these values and lot's characteristics (AS, YP, MDOL) were tested by Pearson's correlation analysis.

Mean NDC were differed among 6 lots (range: 1.3-2.4d, $P<0.05$) and this value was correlated with MDOL ($n=6$, $r=0.93$, $P<0.01$). In the frequency distribution of all ICR, a gap was confirmed around 7 d, that is, the ICR reflected two different type of roaming. ICR less than 8 d were not different among lots (2.8-5.0d). However, ICR more than 8 d were significantly different among lots (12.8-24.7d, $P<0.05$). Additionally, longer ICR was significantly correlated with YP ($n=6$, $r=-0.98$, $P<0.01$).

Because edible plant mass and its variety increased with YP (Sugiyama et al. 2004), it is suggested that cattle did roaming behaviour according to the YP and the relative arrangement of each FS.

Keywords: agro-forest, cattle, feeding-site, GPS, roaming behaviour

CONTROL OF CATTLE DEFECATION IN RESTING AREA USING FEEDING STATION

Tomoko Saitoh*, Tetsuya Seo, Fumiro Kashiwamura

Obihiro University of Agriculture and Vetarinary Medicine, Japan

*Correspondence:tomoko.s39@obihiro.or.jp

This study evaluated the possibility of decreasing defecation on deep litter in a loose housing system by inducing cattle to visit a feeding station soon after standing.

An experimental paddock (11.3 × 6.8 m) was made outdoors. Half of the paddock was roofed and bedded with straw to form a resting area. A feeding station was situated in the paddock's remaining area, which was designated as the feeding area. Six test subjects, Holstein heifers, were grouped together in the paddock. A standing detection device was developed and attached to each heifer's left hind leg. The device emits a radio frequency signal of the standing event. The signal is detected by a controller connected to a personal computer that controls all systems.
This experiment included a 16-day control period and a 51-day experimental period. The feeding station was closed during the control period. During the experimental period, the heifers were allowed to obtain the concentrate at the feeding station within a limited time after standing. During the first 25 days of the experimental period, that limited time was 60 min (Tr 60). During the next 26 days, that limited time was changed to 10 min (Tr 10). The fecal masses in the resting area were counted in the morning and in the evening before cleaning.

The average number of instances of defecation in the resting area during the experimental period (10.7±3.5) was significantly lower than that of the control period (16.5±4.1) (t-test,$p<0.01$).The average number of defecation tended to increase from the periods of Tr 60 (10.1±3.7) to Tr 10 (11.2±3.4), although no significant difference was found. The average number of feeding station visits was significantly higher during the period of Tr60 (14.4±5.7) than during Tr10 (8.8±2.7) (t-test,$p<0.01$).

This study verified the possibility of control of cattle defecation in a resting area.

Keywords: cattle, defecation control, feeding station

VALIDATION OF AN AUTOMATIC RECORDING DEVICE FOR LYING BEHAVIOUR IN CATTLE

Christoph Winckler

University of Natural Resources and Applied Life Sciences (BOKU), Department of Sustainable Agricultural Systems, Austria?

*Correspondence: christoph.winckler@boku.ac.at

Investigations of lying behaviour in cattle using direct or video-based observations are usually time-consuming and costly. It was therefore the aim to develop a simple miniaturized recording device for lying behaviour which can be easily used in either on-farm or experimental conditions.

The recording is based on the position of the cow's legs during standing (vertical) and lying (horizontal). For this purpose, inclination sensors connected to Tinytag® dataloggers (34x57x80mm) were used. The datalogger is attached to the distal part of the legs (metatarsus/metacarpus) using a soft canvas bag and selfadhesive tape.

In the present validation study, dairy cows housed in sand-bedded cubicles (n=11) and a deep-littered sloped floor loose housing system (n=6) were used. For the cubicle housed cows, the recording device was set at 11 (n=3), 30 and 120 s recording intervals (n=4 each). In the sloped floor system, a 11s interval was used. Recordings were performed for 48h (cubicles) and 24h (sloped floor). Raw data were corrected for a minimal bout duration of 30s and 60s for standing and lying, respectively. Parallel time lapse video recordings were analyzed using continuous recording.

Analyzed on a 24h basis, lying times obtained from video or datalogger recordings were highly correlated irrespective of the recording interval or the housing system (11s: r=1.00/0.99; 30s: r=1.00; 120s: r=.98). The mean relative deviation from the video data ranged between .08 and .10 %. With regard to the number of lying bouts, the correlation coefficients were 1.00/0.88 (11s), .99 (30s) and 0.63 (120s), respectively. Fixation to the front or hind limb did not affect reliability with regard to lying time. However, recording of lying bouts was less accurate when attached to the front legs.

In conclusion, the automatic recording device provides a valid and feasible tool for the recording of lying behaviour in cattle.

Keywords: cattle, lying behaviour,automatic recording

EFFECT OF MATERNAL GROOMING ON THE NUMBER OF BACTERIA ADHERING TO THE COATS OF CALVES IN CATTLE

Daisuke Kohari[1]*, Shusuke Sato[2], Yutaka Nakai[3], Kazuo Sugawara[3]

1Experimantal Farm of Agricultural Production Technology, College of Agriculture, Ibaraki University, Ami, Ibaraki,300-0393, JAPAN

2National Institute of Livestock and Grassland Science,768 Senbonmatsu, Nishinasuno, Nasu, Tochigi 329-2793, JAPAN

3Graduate School of Agricultural Science, Tohoku University, Naruko, Miyagi, 989-6711, JAPAN

*Correspondence: kohari@mx.ibaraki.ac.jp

Hygienic function of maternal grooming (MG) in cow was investigated. Three Japanese Black and 3 Japanese shorthorn cow-calf pairs were used in 3 to 4 weeks after parturition. The numbers of bacteria adhering to the calves' coats were compared between "before-MG samples" which was deprived MG and "after-MG samples" which was allowed MG. Collected bacteria were incubated on Luria-Bertani (LB) agar, a normal medium for general bacteria, and Desoxycholate- hydrogen sulfide-lactose (DHL) agar, a conventional differential medium for enteric bacteria. In addition, 3 artificially reared calves (1 Japanese Black calf and 2 Holstein calves) in individual calf-hutches were collected of bacteria samples which have never experienced MG.

In the LB plate, bacteria were detected in all of 6 calves, and the numbers decreased significantly from the before-MG sample to the after-MG one (before-MG: 300,000-1,200,000 CFU / 100 cm^2, after-MG: 24,000-100,000 CFU / 100 cm^2; paired t-test: $df = 5$, $t = 3.93$, $P<0.01$). While in the DHL plate, bacteria were detected in 2 of 6 calves, and averaged number was 125 CFU / 100 cm^2 before MG. In the after-MG sample, bacteria were mostly disappeared on the DHL plate. In the calves reared in individual calf-hutches, the number of bacteria on the coats was almost the same as that in the before-MG sample (in the LB: 80,000-600,000 CFU / 100 cm^2; in the DHL: 0-600CFU / 100cm^2). The quantity of cow's MG and the decrement of bacteria were not correlated. It is suggested that maternal grooming has bacteria removing effect and contributes to maintain hygienically the calves' body in cattle.

Keywords: cattle, maternal grooming, bacteria, hygienical function, *Eshelichia coli*

EARLY TRAINING FOR LEADING AND THE EFFECTS ON THE LATER TRACTABILITY OF JAPANESE BLACK CATTLE

Takami Kosako[1]*, Tsuyoshi Imura[2], Hideharu Tsukada[1], Michiru Fukasawa[1]

1 Department of Grazing Animal Production, National Institute of Livestock and Grassland Science, Japan

2 Department of Livestock and Grassland Science, National Agricultural Research Center for Western

*Correspondence: kosako@affrc.go.jp

This study examined the effects of early training for cattle being led by humans and early rearing conditions on the later tractability of Japanese Black cattle. Calves received the training that a trainer attempted to induce a calf to follow him for 20 minutes a day until the seventh day after birth.

Firstly, using four calves, behavioural characteristics during the training were observed using a scale of 1-5, and the calves' walking speed was measured. They showed more active movement day by day. The calves followed the trainer consistently throughout the seven days except on the third day. On the second and third days after birth, their exploratory behaviour increased, and following response and walking speed decreased. These results might relate to the sensitive period of calves' early learning.

Next, nine calves received the training and nine other calves don't. Four trained (AT) and four control (AC) calves were artificially reared in a group pen (A-calves). The other five trained (NT) and five control (NC) calves were naturally suckled on a pasture (N-calves). After weaning at three months of age, all calves were reared together. AT had the shortest flight distance at four months of age ($P<0.05$). The leading test, in which each calf was led by a human with rope for ten meters to a novel platform, was conducted once a day for six days at seven months of age. As the test progressed, the leading time for A-calves was shortened, while that of N-calves was extended. Therefore, after the fourth day, there were significant differences in the leading time for A-calves and N-calves ($P<0.05$). Overall, the early training reinforced A-calves' affinity to humans, and the leading time of AT tended to be shorter than that of AC. However, N-calves showed little response to early training.

Key words: cattle, tractability, early training, rearing condition

GRAZING ACTIVITY AND MOVEMENT IN FEEDING STATION AND FEEDING PATCH FOR THE HORSE AND THE CATTLE ON WOODLAND PASTURE

Yuko Shingu[1]*, Seiji Kondo[2], Masahiko Okubo[2]

1Grass and Forage Section, Hokkaido Prefectural Tenpoku Agricultural Experiment Station, Japan

2Graduate School of Agriculture, Hokkaido University, Japan

*Correspondence:shing@agri.pref.hokkaido.jp

The grazing by the horse or the cattle would have different effects on woodland because of their behavioural differences of grazing strategies. To take a sustainable utilization of woodland, we need to understand grazing activity, such as at a Feeding Station (FS). In this study, we observed grazing activity and movement in FS and Feeding Patch (FP), which was defined as a cluster of FSs, for the horse and the cattle on woodland pasture, comparatively.

Ten mares (BW 347.7kg) and two foals of Hokkaido native horses in Exp.1 (13.3ha) and five non-lactating cows of Hereford (BW 652.3kg) in Exp.2 (5.8ha) were kept for 12 days on separate two woodland pastures, in which undergrowth vegetation were consisted of mainly bamboo-grass (*Sasa nipponica*). On Days 2, 6 and 11, the activity at a FS was recorded with video-camera in three focal animals through 18 sets of 10min-observetions per day. FP was statistically defined on the number of steps moved between two FSs with log-survivor method.

The number of steps moved between two FSs was mostly one step for the horse and the cattle (54.7 and 68.9%). The number of steps moved within one FP for both animals were similar, suggesting the FP size for both animals would be similar. The mean number of bites in a FP for the horse was higher than the cattle (21.3 and 18.6 bites, $P<0.05$). The number of steps moved between two FPs for the horse was longer than the cattle (7.1 and 5.6 step, $P<0.01$). The horse was suggested to employ a strategy to move wide to get high quality plant, because they moved further between two FPs and grazed more selectively in each FP than the cattle. According to differences of their grazing characteristics, the woodland management should be different for between horses and cattle.

Keywords: Feeding Station, Feeding Patch, Horse, Cattle

BEHAVIORAL DIFFERENCES OF COWS UNDER DIFFERENT TYPES OF COW TRAFFIC IN AN AUTOMATIC MILKING SYSTEM

Shigeru Morita, Arina Kageyama, Michio Komiya, Michiko Takeuchi, Teppei Haruta, Shinji Hoshiba

Faculty of Dairy Science, Rakuno Gakuen University, Japan

*Correspondence:smorita@rakuno.ac.jp

The objective of this study was to examine the behavioral differences of cows under different types of cow traffic in an automatic milking system. The cows were reared in a free-stall barn with an automatic milking machine (Lely "Astronaut") under one-way traffic (8 months) and in free cow traffic (6 months). The observations throughout the 24 hours period were conducted every month. The position of the cow (feeding trough, stall, and alley in barn) and behavior (standing, lying, and eating) were observed. The average number of cows was 22 and daily milk yield was 34 kg/cow during this study.

The cows in one-way traffic visited the automatic milking machine significantly ($P<0.05$) more than the cows in free traffic (8.6 and 5.7 visits/day). There were no differences between the different types of traffic in the milking frequency of cows (about 3.0 milkings/day). The daily eating and lying time were about 5.0 and 11.5 hours/cow in both types of traffic. The daily number of eating period (6.1 meals/cow) and lying period (10.2 times/cow) of the cows under one-way traffic was similar with the cows under free traffic (6.5 meals/cow and 10.7 times/cow). There was an individual variation of the visiting frequency to the automatic milking machine. The percentage of cows that visited the machine less than 5 times per day was about 10 % in one-way traffic and 40 % in free traffic. In both traffic types, the milking times of cows that visited the machine less than 5 times was lower than that the other cows. The daily number of eating period increased with visiting frequency to the machine in both traffics. Regardless of the type of traffic, eating time was longer and lying time was shorter in the cows that visited the machine more frequently than cows that visited it less.

Keywords: Cow, Traffic, Automatic milking

THE PERFORMANCE OF TWO MILKING ROBOTS FOR ONE GROUP OF COWS KEPT IN A LOOSE BARN

Masahiko Tokida[1*], Shigeru Morita[2], Yasuharu Wada[3]

1 Research & Development Center for Dairy Farming, Japan

2 Faculty of Dairy Science, Rakuno Gakuen University, Japan

3 Wada farm, Japan

*Correspondence: rdcd-tokida@snowbrand.co.jp

The objective of this study was to examine a cow's visit to and the performance of each milking robot in a loose barn that had two milking robots for a group of cows. The data were collected in a Wada farm located in Nagano prefecture. Two milking robots (DeLaval "VMS") were installed in a loose barn. The survey was carried out in June 2003 and the data was collected from 28 October to 10 November in 2003. There were 98 cows used in this study. The visiting and milking frequency per day in individual cows was 3.2 times and 2.5 times, respectively. The milk yield per day in individual cows was 24.2kg.

In the Wada farm, each robot did over 120 milkings per day, and from 6 to 8 cows could visit the milking robot per hour except when the robot was in self-cleaning mode. The number of times the cows could visit the milking robot and the milking frequency was significantly ($p<0.05$) different between the milking robots ("VMS-1": 123.2 milkings, "VMS-2": 127.3 milkings). Twenty-six cows visited one of two robots over 90%. Fourteen cows used "VMS-1", and twelve cows used "VMS-2", frequently. These inequable using cows tended to visit milking robot in low frequency (90%: 3.0 times/d, 50-60%: 3.5 times/d) and they occupied milking robot longer (90%: 7.2min, 50-60%: 5.9min).

It was concluded that there were some inequable visit to the milking robot cows in a group, and it might be necessary the balance of the number of such cows to achieve a high performance in the automatic milking system as the Wada farm.

Keywords: milking robot, loose barn, inequable visit

THE EFFECT OF SOCIAL GROUP SIZE ON AGGRESSION OF GROWER-FINISHER PIGS

T.S. Samarakone[1,2], H.W. Gonyou[1]

[1] Prairie Swine Centre Inc. P.O. Box 21057, 2105-8th Street East, Saskatoon, Sask. S7H 5N9

[2] Department of Animal and Poultry Science, University of Saskatchewan

Correspondence: thusiths@hotmail.com

The social organization of pigs in larger groups is not well understood. It has been suggested that pigs in large social groups could organize themselves differently compared to those in smaller social groups. Our objective was to assess the influence of large group sizes on the social aggression in grower-finisher pigs. Eight blocks, each comprising four pens of 18 pigs (SG) and two pens of 108 pigs (LG) on fully slatted floors (0.76 m^2/pig) were used. Pigs were 11 weeks old at initial group formation. Two distinct experiments were conducted. The first investigated the aggression of pigs with SG or LG social experience, when added to established SG or LG groups. Wk 1, 6 and 12 following group formation, two randomly selected pigs with SG or LG social experience were incorporated into another SG or LG for a period of 2 hours and the aggressive behaviour was observed. Four test combinations were used (SG to SG (SS), SG to LG (SL), LG to SG (LS) and LG to LG (LL), 88 pigs/combination). There was less aggression (percentage time spent) in the LL compared to SS, SL and LS (3.1 versus 7.6, 6.0, and 7.4, respectively, $P<0.05$). No week into test combination interaction was observed. In the second study, 8 wk following group formation, a total of 200 pigs were re-grouped for 2 hours in groups of four in a neutral test arena to asses the effect of prior social experience (SG vs. LG) on aggression. Pigs were re-grouped with their own pen mates, or with unfamiliar pigs from either SG or LG. Pigs derived from SG showed an increase level of aggression towards unfamiliar pigs, compared to those derived from LG ($P<0.05$). Our results indicate a lower level of aggression in pigs of LG. This suggests that pigs may adapt a tolerant social strategy in Large Groups.

Keywords: Large groups, Aggression, Grow-finisher pigs

EFFECTS OF SNOW DEPTH ON INTAKE AND GRAZING BEHAVIOR OF HOKKAIDO NATIVE HORSES IN WINTER WOODLAND

Masahito Kawai[1*], Hisae Ono[1], Yusuke Yamamoto[2], Sakae Matsuoka[1]

1 School of Agriculture, Obihiro University of Agriculture and Veterinary Medicine, Japan

2 Breeding and Genetics Research Unit, Hokkaido Animal Husbandry Experiment Station, Japan

*Correspondence: kawaim@obihiro.ac.jp

Hokkaido native horses have been kept in Hokkaido area, the northernmost island in Japan, since the previous century. They are fed outdoors all year round including grazing in winter woodlands traditionally. In this study, voluntary intake and grazing behavior were investigated in winter woodland and compared on the different snowfall conditions.

Twenty Hokkaido native horses were grazed on a flat woodland pasture on the different snowfall conditions (0cm in November, 20cm and 40cm in December, 80cm in January) on the different 4 years. The woodland pasture consisted of 8.5ha of broadleaf trees and underlying vegetation composed mainly of bamboo grass (*Sasa senanensis*). Three mares were used to determine the intake and grazing behavior. The feces of each mare were collected for 3 days and intake was determined with the double-indicator method. Behavior was observed for 24-hrs during fecal collection, and grazing, resting and other behaviors were recorded at 1-min intervals. The location point, behavior at that point, and the route of movement among the location points of each mare were recorded on a map at 10-min intervals.

Dry matter intake was 10.3, 7.3, 7.9 and 4.9kg/d on 0, 20, 40 and 80cm of snow depth, respectively. Grazing time was 387min/d on 80cm of snowfall, which was shorter than those on the lower snowfall and resting behavior increased inversely. Snow depth did not affected the total distance covered (4.0-5.8km/d), but the distance covered through grazing with 40cm and 80cm of snowfall were shorter than those with 0cm and 20cm. Daily grazing area was 0.3ha with 80cm of snowfall, which was considerably smaller than those with 0 to 40cm of snowfall (2.0-4.6ha).

Fallen snow, even with a depth of 20cm, inhibited the grazing behavior and intake by horses in woodland, and there was quite a large effect with over 40cm of snowfall.

Keywords: Hokkaido native horses, grazing behavior, woodland pasture, snow depth

INTERACTION BETWEEN MONGOLIAN NOMADS AND MIXED FLOCKS OF SHEEP AND GOATS—CASE EXAMPLE OF BURD UVURKHANGAI PROVINCE

Hirofumi Naekawa[1], Batarjin Myakhdadag[2]

1 Senior High School Attached to Shonan Institute of Technology, Japan

2 Government Implementing Agency of Mongolia、State Veterinary and Animal Breeding

*Correspondence：naekawa@sh.shonan-it.ac.jp

The purpose of this research was to study the types of controlling activities that are initiated by nomads in Mongolia on mixed flocks of sheep and goats and features of the activities of the mixed flocks while they are kept under control. In the research performed in 1995 (Research I) and 2004 (Research II) in Burd, Uvurkhangai Province, the interaction between nomads and mixed flocks of sheep and goats in one-day pasturing was observed. The mixed flocks of sheep and goats were comprised of 590 heads in Research I and 420 in Research II. The nomads performed frequent shepherding activities during the 30 minutes after departure from the summer pasture, 30 minutes before arriving there, and 30 minutes before and after drinking or resting. A significant difference was observed in the volume of shepherding activity between Term I, which refers to the above mentioned hours, and Term II, which refers to hours excluding Term I ($x^2 = 69.68$, $P<0.001$). All the flocks of sheep and goats were frequently observed to be moving in a massed state in Term I and in a dispersed state in Term II. The intervention activities initiated by nomads during pasturing were intended to provide orientation to the pasturing route, restrain movement of the mixed flocks of sheep and goats, control the speed of their movement, gather dispersed flocks of sheep and goats, and prevent mixing in with other flocks. In Research II, the activities of the mixed flocks were kept under control for 9.1 ± 7.5 minutes during moving and grazing, and the activities were controlled at the interval of 19.9 ± 22.5 minutes. The nomads controlled activities of the flocks by piloting horses at a walking pace, at a trot, and at a canter while vocalizing instructions.

Key words：interaction, sheep and goats, nomads

A SURVEY OF THE PUBLIC'S UNDERSTANDING OF STRAY DOG PROBLEMS IN TAIWAN

Yu Chun Chen, Liang Chou Hsia*

Department of Animal Science, National Pingtung University of Science and Technology, Taiwan

*Correspondence: lchsia@mail.npust.edu.tw

The purpose of this survey was to determine the ordinary people's understanding of stray dog problems. The study was made from February 1, 2003 to February 21, 2004. A total of 1200 questionnaires were distributed and 1120 were useable. The questionnaire included two parts. The first part was to study the understanding of stray dogs and animal protection laws by public. The second part was to study the understanding of shelters by the public. The survey showed the following results. Small sized of dogs, which weight less than 9 kg are preferred by 48.7% people. A high percentage (76.3%) of people agree that dogs should be neutered or spayed before adoption. Over half the people (65.4%) adopt dogs because of their appearance. The opinion of family members was considered by 48.8% of people when adopting a dog. Euthanasia is considered necessary by 62.4% of people. A very high percentage of people (94.6%) believe stray dogs can be trained to become good dogs. Many people (87.8%) believe an injected chip for each stray dog is necessary. Many people (94.7%) believe that people who give away dogs on purpose should be punished. People (81.9%) believe that dogs should be protected by law. If the dogs are injured or are ill then may people prefer to cure them. People still not quite understand the center of shelter (44.7 vs 55.3). People believe the shelter should promote the adoption of dogs. Only 52.9% people are willing to become a volunteer. People want the shelter to provide various training courses for them.

Keywords: Stray dog, Survey, Shelter