



# Proceedings of the 40th International Congress of the ISAE

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## Proceedings of the 40th International Congress of the ISAE, Bristol, August 8th - 12th, 2006

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## ACKNOWLEDGEMENTS



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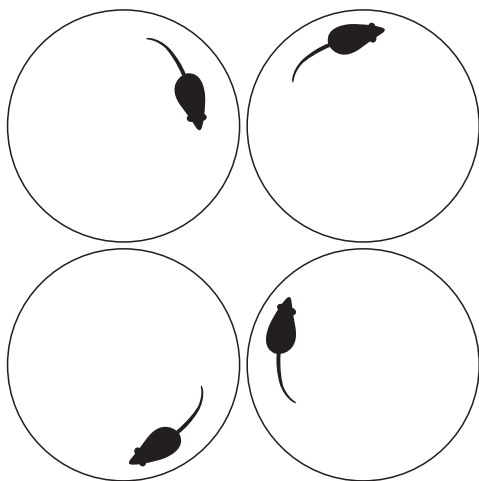
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## THE CONFERENCE VENUE

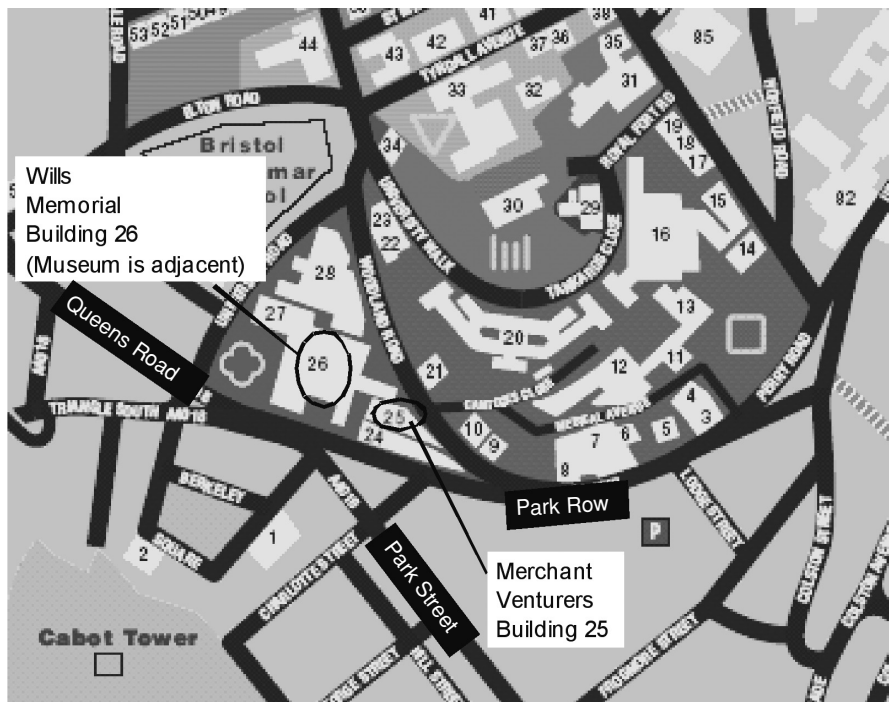


The Lecture theatres are located in the Wills Memorial Building, at the top of the stone staircase immediately upon entering the building.

The Merchant Venturers Building is where coffee will be served, the posters viewed, and sponsors' tables located. This building can be found by turning left out of the Wills Memorial Building, walking a short distance and turning left to cross a courtyard and up a flight of brick stairs. The entrance to the Merchant Venturers is to the right.

Merchant Venturers Building also contains the computer room where delegates can check their presentations and will have internet access. Note: Priority must be given to delegates checking their PowerPoint presentations.

The Welcome reception is in the Museum located next to the Wills Memorial Building.





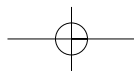
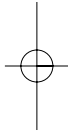
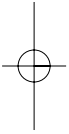
## LOCAL TRAVEL INFORMATION



**Taxis and Mini-cabs.** Hackney Carriages (identified by the 'TAXI' sign on the roof) can be easily flagged down from the pavement. Private Car Hire Services (including mini-cabs) are not allowed to pick up passengers on the street and can only be booked in advance by telephone. Both types display official licence plates on the outside of the vehicle and all legitimate drivers carry identification cards.

For delegates staying in the Wills Hall student accommodation –

- **Coaches** will be provided to take you to the Conference venue, setting off at 08:15 on each morning of the conference, however, you must make your own arrangements for your return trip each day after the conference.
- **Buses.** There are regular buses to the Wills Hall during the day – nos 1, 41, 42, 54, 55 all serve stops nearby. For more details on buses see the **First City Line** web site <http://www.firstgroup.com/ukbus/southwest/bristol/home/>
- **Driving.** (directions from Wills Memorial Building (talks) to Wills Hall student accommodation). Pass the Wills Memorial Building and the Museum on your right. Take the right hand fork around the Triangle and then get into the right lane and follow the one way system to the roundabout. At the roundabout, take the 2nd exit, Whiteladies Road, passing the Victoria Rooms on the left. Continue all the way along Whiteladies Road which runs into Blackboy Hill. Continue up the hill. At the traffic lights at the top of the hill take the centre lane turning right then left, following signs to Westbury-on-Trym. At the next roundabout (White Tree Roundabout) turn left into Parry's Lane. You will see the gateway on the left hand side after approx. 150m.
- **Walking.** Wills Hall is approximately two miles (3 kms) from the main University buildings. Many residents walk over the Clifton Downs then on into the City, which takes from 20 to 40 minutes depending how fast you walk.

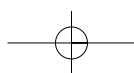
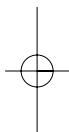




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CONFERENCE PROGRAMME  
ORAL PRESENTATIONS AND  
SOCIAL PROGRAMME

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**Tuesday 8th August 2006**



10:00 **Council meeting** (Boardroom 5.68 in the Wills Memorial Building)

14:00 **Registration** (Wills Memorial Building)

14:00 **Installation of Group 1 Posters** (Merchant Venturers Building)

19:00-21.30 **Welcome Reception**  
(In the Museum adjacent to the Wills Memorial Building)



Wednesday 9th August 2006



- 08:00 **Registration** (Wills Memorial Building)  
 08:00 **Installation of Group 1 Posters** (Merchant Venturers Building)  
 09:00 **Congress opening** (The Great Hall) To be opened by The Right Honourable the Lord Mayor of Bristol, Councillor Peter Abraham

	<b>THE D.G.M. WOOD-GUSH MEMORIAL LECTURE</b> <b>The Great Hall</b> <b>Chair:</b> Marek Spinka
09:30	<b>Author:</b> Alistair Lawrence <b>Title:</b> Is there a future for applied ethology?

- 10:30 **Coffee Break and Poster Session 1** (Merchant Venturers Building)  
*Sponsored by the RSPCA*

11:15 **Spoken Papers**

	<b>The Great Hall</b>	<b>The Reception Room</b>
	<b>Chair:</b> Hans Erhard	
11:15	<b>Plenary Paper: 1</b> <b>Author:</b> Mike Appleby <b>Title:</b> Where did it all go right? Applying applied ethology worldwide	
	<b>TOPIC: GENES AND BEHAVIOUR</b> <b>Chair:</b> Mark Rutter	<b>TOPIC: MOTHER AND OFFSPRING</b> <b>Chair:</b> Anna Olsson
12:00	<b>Author:</b> Per Jensen <b>Title:</b> Genetic inheritance of acquired stress responses in chickens	<b>Author:</b> Cathy Dwyer <b>Title:</b> Contributions of ewe and lamb behaviour to the maintenance of body temperature in neonatal lambs of two breeds
12:15	<b>Author:</b> Andrew Fisher <b>Title:</b> The identification of quantitative trait loci for stress and learning responses in the sheep	<b>Author:</b> Gudrun Illmann <b>Title:</b> Responsiveness of sows towards piglet vocalization during 24 h after birth
12:30	<b>Author:</b> Joop Lensink <b>Title:</b> Parental effects on the behaviour of 6-month-old gilts	<b>Author:</b> Jenny Loberg <b>Title:</b> Weaning and separation at different times is less stressful for foster cows
12:45	<b>Author:</b> James Serpell <b>Title:</b> Breed differences in aggressive behaviour in dogs	<b>Author:</b> Emma Baxter <b>Title:</b> Predictors of neonatal piglet survival in an outdoor farrowing system

- 13:00 **Lunch:** Sandwiches in the Merchant Venturers Building





Wednesday 9th August 2006



14:30 Spoken Papers

	The Great Hall	The Reception Room
	<b>TOPIC: SOCIAL BEHAVIOUR (I)</b> <b>Chair:</b> Harold Gonyou	<b>TOPIC: EARLY EXPERIENCE</b> <b>Chair:</b> Suzanne Millman
14:30	<b>Author:</b> Carol Petherick <b>Title:</b> Mate choice by female beef Bos taurus cattle	<b>Author:</b> Hanno Würbel <b>Title:</b> Developmental plasticity and animal welfare: adaptive plasticity, phenotypic mismatch or pathology?
14:45	<b>Author:</b> Anja Wasilewski <b>Title:</b> 'Friendsheep'? Non-reproductive bonds between conspecific ungulates - implications for welfare and husbandry practice	<b>Author:</b> Jolanda Pluijmakers <b>Title:</b> Is there a "sensitive period" at the start of the socialisation phase in the domestic dog?
15:00	<b>Author:</b> Anette Wichman <b>Title:</b> Influence of light/dark incubation on social behaviour in domestic chicks	<b>Author:</b> Angelica Terrazas <b>Title:</b> High-energy food supplementation in the last 15 days of pregnancy facilitates the establishment of non-olfactory recognition of the kid in underfed goats.
15:15	<b>Author:</b> Johannes Baumgartner <b>Title:</b> Preferences for littermates or non-littermates in social behaviour of weaned pigs kept in mixed groups of different size	<b>Author:</b> Severine Henry <b>Title:</b> Influence of various early human-foal interference on subsequent human-foal relationship

15:30 **Coffee Break and Poster Session 2** (Merchant Venturers Building)  
*Sponsored by the RSPCA*



Wednesday 9th August 2006



16:15 Spoken Papers

	The Great Hall	The Reception Room
	<b>TOPIC: SOCIAL BEHAVIOUR (II)</b> <b>Chair:</b> Per Jensen	<b>TOPIC: FEEDING BEHAVIOUR</b> <b>Chair:</b> Birte Nielsen
16:15	<b>Author:</b> Hans Erhard <b>Title:</b> Dominance has a quantitative component	<b>Author:</b> Sarah Redgate <b>Title:</b> Post-ingestive feedback on diet selection in horses ( <i>Equus caballus</i> ); dietary experience changes feeding preferences
16:30	<b>Author:</b> Susanne Waiblinger <b>Title:</b> Social bonds of dairy cows affect reactions in a challenging situation and relate to health	<b>Author:</b> Nicky Roberts <b>Title:</b> Absence of variation between sheep in motivation to feed
16:45	<b>Author:</b> Karen Thodberg <b>Title:</b> The acute effect of a synthetic pig appeasing pheromone on open field and intruder test behaviour	<b>Author:</b> Fernando Borderas <b>Title:</b> Feeding behaviour and response to weaning of calves fed limited or ad libitum milk using an automated feeding system
17:00	<b>Author:</b> Janne Winther Christensen <b>Title:</b> Habituated companion horses reduce fear responses in naïve test horses	<b>Author:</b> Lesley Smith <b>Title:</b> Grazing behaviour of herbivores is affected by nutritional environment and maternal investment
17:15	<b>Author:</b> Suzan Dudink <b>Title:</b> Announcing the arrival of enrichment increases play behaviour and reduces weaning stress induced behaviours of piglets	<b>Author:</b> Laura Hänninen <b>Title:</b> Effect of method of feeding colostrum on sleep in young calves
17:30	<b>Author:</b> Lisa Collins <b>Title:</b> A birds-eye view of stocking density: How do broilers perceive the crowded conditions in which they are kept commercially?	<b>Author:</b> Andrea Ellis <b>Title:</b> Effects of high concentrate versus high fibre diets on the behaviour of horses

17:45 - 18:45 **Poster Session 3** (Merchant Venturers Building)

20:00 - 22:00 To be announced...



Thursday 10th August 2006



09:00 Spoken Papers

	The Great Hall	The Reception Room
	<b>Chair:</b> Joseph Garner	
09:00	<b>Plenary Paper: 2</b> <b>Author:</b> Jaak Panksepp <b>Title:</b> Affective neuroscience and the ancestral sources of socio-emotional feelings within animal minds	
	<b>TOPIC: EMOTION</b> <b>Chair:</b> Carol Petherick	<b>TOPIC: ASSESSING LAMENESS, PAIN AND INFLAMMATION</b> <b>Chair:</b> Dan Weary
09:45	<b>Author:</b> Elizabeth Paul <b>Title:</b> Doing emotion and feeling emotion: constructing a framework for investigating subjective emotional states in animals	<b>Author:</b> John Church <b>Title:</b> The effects of using lidocaine on the response of yearling bison to dehorning
10:00	<b>Author:</b> Mike Mendl <b>Title:</b> Studies of emotion-cognition links in humans as a basis for developing new measures of animal emotion	<b>Author:</b> Mitja Sedlbauer <b>Title:</b> Lameness and pain in dairy cows
10:15	<b>Author:</b> Lucile Greiveldinger <b>Title:</b> Ability of lambs to form expectations	<b>Author:</b> Jeffrey Rushen <b>Title:</b> Local anaesthetic as a means to validate measures of lameness in dairy cows
10:30	<b>Author:</b> Bart Houx <b>Title:</b> What do 50-kHz vocalizations tell about the internal state of a rat?	<b>Author:</b> Anne Marie de Passillé <b>Title:</b> Effects of lameness on activity in dairy cows and the effects of hoof trimming
10:45	<b>Author:</b> Alain Boissy <b>Title:</b> Inconsistent behavioural and cardiac patterns in ewes' responses to the separation from their lambs	<b>Author:</b> Andrew McMullan <b>Title:</b> Associations between behavioural indicators and inflammatory disease in dairy cows.
11:00	<b>Author:</b> Stephanie Buijs <b>Title:</b> Anticipation as a tool to explore positive emotions in laying hens	<b>Author:</b> Eranda Rajapaksha <b>Title:</b> Development and assessment of a gait scoring system for zoo elephants

11:15 **Coffee Break and Poster session 4** (Merchant Venturers Building)

11:45 **Remove Group 1 Posters**



Thursday 10th August 2006



12:00 Spoken Papers

	The Great Hall	The Reception Room
	<b>TOPIC: PERSONALITY, INDIVIDUAL DIFFERENCES</b> <b>Chair:</b> Kate Breuer	<b>TOPIC: GAS</b> <b>Chair:</b> Charlotte Nevison
12:00	<b>Author:</b> Suzanne Held <b>Title:</b> Changes and individual consistency over several parities in two tests of maternal responsiveness in outdoor sows	<b>Author:</b> Richard Kirkden <b>Title:</b> Strength of aversion to carbon dioxide in rats during a gradual-fill euthanasia procedure
12:15	<b>Author:</b> Corinna Clark <b>Title:</b> Do age and experience matter? Consistency of aggressive responses and the effect of repeated resident intruder tests on pigs	<b>Author:</b> Lee Niel <b>Title:</b> Rat responses to CO <sub>2</sub> euthanasia: effects of novelty versus distress
12:30	<b>Author:</b> Hilde Vervaecke <b>Title:</b> Measuring dominance styles in bovids	<b>Author:</b> Ellen Jongman <b>Title:</b> Aversion of finisher pigs to CO <sub>2</sub> and other gasses
12:45	<b>Author:</b> Emma Creighton <b>Title:</b> Animal personality and animal welfare	<b>Author:</b> Victoria Sandilands <b>Title:</b> Aversion of chickens to various gases: methods for humane culling

13:00 Preparation for Excursions

13:30 Excursions Bus Departure



Friday 11th August 2006



08:30 **Installation of Group 2 Posters** (Merchant Venturers Building)

09:00 **Spoken Papers**

	<b>The Great Hall</b>	<b>The Reception Room</b>
	<b>Chair:</b> Janice Swanson	
09:00	<b>Plenary Paper: 3</b> <b>Author:</b> Innes Cuthill <b>Title:</b> Other ways of seeing: Vision, ecology and welfare	
	<b>TOPIC: PERCEPTION AND LEARNING</b> <b>Chair:</b> Cathy Dwyer	<b>TOPIC: ENRICHMENT</b> <b>Chair:</b> Kate Littin
09:45	<b>Author:</b> Ashleigh Bright <b>Title:</b> Plumage colour and feather pecking in laying hens, a chicken perspective?	<b>Author:</b> Oliver Burman <b>Title:</b> A multidisciplinary study of the long-term effects of environmental enrichment on laboratory rat welfare
10:00	<b>Author:</b> Go Kurosu <b>Title:</b> Preference for visual variability in Lister-hooded rats and European starlings	<b>Author:</b> Helena Chaloupkova <b>Title:</b> Enrichment of pre-weaning housing decreases later agonistic behaviour in domestic pigs
10:15	<b>Author:</b> Claire Guest <b>Title:</b> Individual differences in a complex scent discrimination task: Cancer Detection Dogs	<b>Author:</b> Camilla Munsterhjelm <b>Title:</b> Effects of environmental enrichment early in life on aggressive and explorative behaviour in growing pigs
10:30	<b>Author:</b> Dorthe Rasmussen <b>Title:</b> Learning performance differs with weight in fattening pigs	<b>Author:</b> Arianna Manciocco <b>Title:</b> The response to different environmental enrichments in the common marmoset ( <i>Callithrix jacchus</i> ): Comparison among laboratory and zoo colonies
10:45	<b>Author:</b> Jan Langbein <b>Title:</b> Learning how to learn - learning set formation in dwarf goats during voluntary visual discrimination learning	<b>Author:</b> Kamara Scott <b>Title:</b> Environmental enrichment for pigs: Quantity or quality?

11:00 **Coffee Break and Poster session 5** (Merchant Venturers Building)

*Sponsored by CIWF Trust*



Friday 11th August 2006



11:45 Spoken Papers

	The Great Hall	The Reception Room
	<b>TOPIC: PREFERENCES AND MOTIVATION (I)</b> <b>Chair:</b> Anna Valros	<b>TOPIC: COMPANION ANIMAL BEHAVIOUR AND HUMAN-ANIMAL INTERACTIONS (I)</b> <b>Chair:</b> Paul Koene
11:45	<b>Author:</b> Georgia Mason <b>Title:</b> Substitutability effects in a closed economy preference set-up: An example using mink	<b>Author:</b> Nicola Cross <b>Title:</b> Causal factors for excessive barking in central Brisbane dogs
12:00	<b>Author:</b> Ragen Trudelle-Schwarz McGowan <b>Title:</b> 'Need' or 'luxury'? Measuring motivation for contrafreeloading in laboratory mice	<b>Author:</b> Yoshiko Uchida <b>Title:</b> Dogs' social hierarchy in the household
12:15	<b>Author:</b> Louise Holm <b>Title:</b> The importance of a food feedback in rooting materials for pigs	<b>Author:</b> Eva Baranyiova <b>Title:</b> Dog bites to children in the Czech Republic
12:30	<b>Author:</b> Alexandra Harlander-Matauschek <b>Title:</b> Motivation in laying hens for feathers and wood shavings when presented in a food context	<b>Author:</b> Sabine Gebhardt-Henrich <b>Title:</b> Feeding behaviour and daily energy expenditure of domesticated budgerigars ( <i>Melopsittacus undulatus</i> )

12:45 Lunch: Free-Foraging in Bristol



Friday 11th August 2006



14:15 **Spoken Papers**

	<b>The Great Hall</b>	<b>The Reception Room</b>
	<b>TOPIC: PREFERENCES AND MOTIVATION (II)</b> <b>Chair:</b> Georgia Mason	<b>TOPIC: COMPANION ANIMAL BEHAVIOUR AND HUMAN-ANIMAL INTERACTIONS (II)</b> <b>Chair:</b> James Serpell
14:15	<b>Author:</b> Anne Lene Hovland <b>Title:</b> Using the 'maximum price paid' to measure motivational strength in farmed silver foxes ( <i>Vulpes vulpes</i> )	<b>Author:</b> Helene Leruste <b>Title:</b> On-farm measurement of the human-animal relationship for veal calves housed in groups
14:30	<b>Author:</b> Tarja Koistinen <b>Title:</b> The preference for sand floor in farmed blue foxes: the effect of early experience	<b>Author:</b> Janet Talling <b>Title:</b> The influence of driving style on the welfare of sheep during transport
14:45	<b>Author:</b> Eva Sønndergaard <b>Title:</b> Horses' motivation for three levels of social contact as measured by operant conditioning	<b>Author:</b> J. Elizabeth Bolhuis <b>Title:</b> Effects of social support by a familiar person or conspecific on responses to acute stress in pigs

15:00 **Coffee Break and Poster session 6** (Merchant Venturers Building)

*Sponsored by CIWF Trust*

16:00 - 18:00 **ISAE Annual General Meeting**

18:00 **Preparation for Banquet**

20:00 **Buses depart for Banquet**

20:30 - 24:00 **Banquet**



Saturday 12th August 2006



09:00 Spoken Papers

	The Great Hall	The Reception Room
	<b>Chair:</b> Deborah Goodwin	
09:00	<b>Plenary Paper: 4</b> <b>Author:</b> Jane Hurst <b>Title:</b> What the nose knows: How scents underlie social recognition and assessment	
	<b>TOPIC: TESTS, METHODS AND MODELS (I)</b> <b>Chair:</b> Gudrun Illmann	<b>TOPIC: HUSBANDRY SYSTEMS AND HUSBANDRY PROCEDURES (I)</b> <b>Chair:</b> Alain Boissy
09:45	<b>Author:</b> Barbara Schoening <b>Title:</b> Validation of a behavioural test of aggression for adult dogs	<b>Author:</b> Frank Tuytens <b>Title:</b> Long-term consequences of early and late castration of male piglets on social behaviour
10:00	<b>Author:</b> Joanne van der Borg <b>Title:</b> Behavioural test for the diagnosis of separation related problems in dogs	<b>Author:</b> Gry Færevik <b>Title:</b> Behaviour and social interactions of dairy calves kept at different group sizes
10:15	<b>Author:</b> Paul Koene <b>Title:</b> Vocal expressions of density, group size and welfare in laying hens	<b>Author:</b> Laura Boyle <b>Title:</b> Behaviour and welfare of yearling dairy heifers out-wintered on an all-weather pad or housed indoors in cubicles
10:30	<b>Author:</b> Rachel Casey <b>Title:</b> Refinement and validation of the Kessler/Turner/McCune Cat-Stress-Score	<b>Author:</b> Jonathan Cooper <b>Title:</b> Competition for resources by laying hens in enriched cages
10:45	<b>Author:</b> Mairi Stewart <b>Title:</b> Changes in eye temperature, measured using infra-red thermography, can detect pain due to disbudding in calves	<b>Author:</b> Bas Rodenburg <b>Title:</b> Welfare of laying hens in furnished cages and in non-cage systems

11:00 Coffee Break and Poster session 7 (Merchant Venturers Building)





Saturday 12th August 2006



11:45 Spoken Papers

	The Great Hall	The Reception Room
	<b>TOPIC: TESTS, METHODS AND MODELS (II)</b> <b>Chair:</b> Jonathan Cooper	<b>TOPIC: HUSBANDRY SYSTEMS AND HUSBANDRY PROCEDURES (II)</b> <b>Chair:</b> Alison Hanlon
11:45	<b>Author:</b> Rob Thomas <b>Title:</b> Impacts of capture and handling on wild birds	<b>Author:</b> Cassandra Tucker <b>Title:</b> Sprinklers and shade cool dairy cows and reduce insect-avoidance behaviours
12:00	<b>Author:</b> Lindsay Matthews <b>Title:</b> A novel method for automatically quantifying resource requirements of pastoral livestock in naturalistic settings	<b>Author:</b> Virginie Remience <b>Title:</b> Effects of space allowance on the welfare of pregnant sows housed in dynamic groups
12:15	<b>Author:</b> Gesa Neisen <b>Title:</b> Automatic recording of social behaviour in dairy cows	<b>Author:</b> Marcus Karlen <b>Title:</b> Aggression, stress and immune responses of gestating sows in stalls and in large groups on deep litter
12:30	<b>Author:</b> Mariko Lauber <b>Title:</b> Behavioural responses to novel and startling stimuli in dairy calves	<b>Author:</b> Paul Hemsworth <b>Title:</b> Behaviour and stress physiology of gestating sows in a combination of stall and group housing
12:45	<b>Author:</b> Mark Rutter <b>Title:</b> Using GPS animal tracking, grazing behaviour recording and vegetation mapping to estimate diet selection in cattle grazing semi-improved pastures	<b>Author:</b> Kathalijne Visser <b>Title:</b> The effect of different housing conditions on the welfare of two-year old horses

13:00 Lunch: Free-Foraging in Bristol



Saturday 12th August 2006



14:30 Spoken Papers

	The Great Hall	The Reception Room
	<b>Chair:</b> Stine Christiansen	
14:30	<b>Plenary Paper: 5</b> <b>Author:</b> Joe Garner <b>Title:</b> Standardization and the Red Queen: applying methodologies from ethology, neuropsychology, and field biology to problems in high-throughput behavioural methods	
	<b>TOPIC: TESTS, METHODS AND MODELS (III)</b> <b>Chair:</b> Hanno Würbel	<b>TOPIC: HUSBANDRY SYSTEMS AND HUSBANDRY PROCEDURES (III)</b> <b>Chair:</b> Heleen van de Weerd
15:15	<b>Author:</b> Lynne Sneddon <b>Title:</b> Using selective attention strategies to understand the importance of the subjective "painful" experience in fish	<b>Author:</b> Keelin O'Driscoll <b>Title:</b> Effect of milking frequency and nutritional level on grazing and lying behaviour of dairy cows
15:30	<b>Author:</b> Maarit Mohaibes <b>Title:</b> The importance of external validity in welfare studies: farmed mink as an example	<b>Author:</b> Lorenz Gyax <b>Title:</b> Comparing stress in two types of automatic milking systems operated with either partially forced or free cow traffic: daily periodicity in milk cortisol concentration
15:45	<b>Author:</b> Daniela Lexer <b>Title:</b> The Analytic Network Process - a promising tool in animal welfare assessment?	<b>Author:</b> Usama AbouIsmail <b>Title:</b> Let sleeping rats lie: does the timing of husbandry procedures compromise laboratory rat welfare?
16:00	<b>Author:</b> Jim McLeod <b>Title:</b> From Boids to Sheepoids	<b>Author:</b> Charlotte Burn <b>Title:</b> Early experience of cage-cleaning does not affect adult rat anxiety, but identification tail-marking does

16:15 Coffee Break and Poster session 8 (Merchant Venturers Building)



Saturday 12th August 2006



17:00 Spoken Papers

	The Great Hall	The Reception Room
	<b>TOPIC: STEREOTYPIES</b> <b>Chair:</b> Ruth Newberry	<b>TOPIC: HUSBANDRY SYSTEMS AND HUSBANDRY PROCEDURES (IV)</b> <b>Chair:</b> Janet Talling
17:00	<b>Author:</b> Maria Andersson <b>Title:</b> Behaviour problems in horses - a further look into factors associated with crib biting and weaving	<b>Author:</b> Moira Harris <b>Title:</b> Assessing the welfare, housing and husbandry of elephants in U.K. zoos
17:15	<b>Author:</b> Andrew Hemmings <b>Title:</b> Opioid circuitry and the aetiology of equine oral stereotypy	<b>Author:</b> Verity Howell <b>Title:</b> Positive reinforcement training and human interaction reduces the stress of capture
17:30	<b>Author:</b> Megan Jones <b>Title:</b> To stereotype or not to stereotype?	<b>Author:</b> Nora Lewis <b>Title:</b> Group versus multiple individual behaviour, can we distinguish between the two?
17:45	<b>Author:</b> María Díez León <b>Title:</b> Are stereotypies less interruptible than normal behaviour?	<b>Author:</b> Drewe Ferguson <b>Title:</b> Effect of duration of road transport on behaviour and physiology of cattle
18:00	<b>Author:</b> Naomi Latham <b>Title:</b> We've got to get out of this place: frustration, enrichment and the development of stereotypies in laboratory mice ( <i>Mus musculus</i> )	<b>Author:</b> Sandra Edwards <b>Title:</b> Supplementation of pregnant ewe diets with docosahexaenoic acid reduces lamb suckling latency

18:15-18:45 Close of the Congress (The Great Hall)

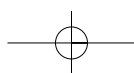
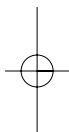
20:00 FAREWELL PARTY



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CONFERENCE PROGRAMME  
POSTER PRESENTATIONS

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**Group 1 Posters**  
**Wednesday 9th – Thursday 10th August 2006**



Each poster will be presented for 4 sessions. There will be 8 poster sessions in total. Authors are expected to stand by their poster for all of the 4 sessions to which their poster is allocated.

GROUP 1            Poster session 1 (10:30-11:15 Wednesday 9th August)  
                          Poster session 2 (15:30-16:15 Wednesday 9th August)  
                          Poster session 3 (17:45-18:45 Wednesday 9th August)  
                          Poster session 4 (11:15-11:45 Thursday 10th August)

GROUP 2            Poster session 5 (11:00-11:45 Friday 11th August)  
                          Poster session 6 (15:00-16:00 Friday 11th August)  
                          Poster session 7 (11:00-11:45 Saturday 12th August)  
                          Poster session 8 (16:15-17:00 Saturday 12th August)

**GROUP 1 POSTERS**

The following posters will be presented during Poster sessions 1-4. They should be installed before the beginning of Poster session 1 (10:30 Wednesday 9th August) and removed at the end of Poster session 4 (11:45 Thursday 10th August).

Number	Title	First name	Last name
P1/01	The impact of two different milking systems on cow behaviour and physiological parameters	Anna-Maija	Aisla
P1/04	Applying animal sentience to human morality	Jonathan	Balcombe
P1/05	Ontogeny of the nursing vocalization in domestic pigs	Kristyna	Belska
P1/06	Can behavioural observations give an evaluation of welfare? The time budget and social behaviour of Arab mares in a paddock	Haifa	Benhajali
P1/07	Using simple behavioural scorings to identify sows who crush piglets	Dorothee	Bizeray
P1/08	Animal welfare measures in broiler production and their economic, ecological and societal consequences	Eddie	Bokkers



**Group 1 Posters**  
**Wednesday 9th – Thursday 10th August 2006**



Number	Title	First name	Last name
P1/09	Adaptation of pregnant sows to an electronic feeding system: the effect of learning and hierarchy	Èlia	Buisan
P1/10	The nearest neighbour distance of male European Bison at the Prioksko-Terrasniy nursery	Evgeniya	Chikurova
P1/11	Effects of microflora change on social behaviour in grouped weaner pigs	Andrew	Colgoni
P1/12	Pre-laying behaviour and nest-box use by hens	Greg	Cronin
P1/13	Development of sexual behaviour in commercially housed broiler breeders	Ingrid	De Jong
P1/14	Effects of raclopride on aggression and stress in diversely selected chicken lines	Rachel	Dennis
P1/15	Size of entrance through which Formosan squirrel ( <i>Callosciurus erythraeus</i> ) can pass	Yusuke	Eguchi
P1/16	Effects of chronic social stress on circulating levels of hormones in three genetic strains of Leghorn hens	Alan	Fahey
P1/17	Spatial variation of access to food affects maternal behaviour, but has no lasting effects on offspring fearfulness in mice	Anne-Christin	Friedrich
P1/18	The effects of the presence of an observer, and time of day, on welfare indicators for working police dogs	Samantha	Gaines
P1/19	The effects of aromatherapy oils on the behaviour of stabled horses	Christine	Glover
P1/20	Behaviour and stress levels of cows in handling stockyards in the dry tropics	Alejandro	Gomez-Danes
P1/22	The behaviour of cows and calves during their reunion after 7 weeks of separation for weaning	Derek	Haley



**Group 1 Posters**  
**Wednesday 9th – Thursday 10th August 2006**



Number	Title	First name	Last name
P1/23	A preliminary investigation into verbal cue - colour association learning in horses ( <i>Equus caballus</i> )	Elke	Hartmann
P1/24	The effect of acute stress on behavioural and hormonal responses in supposedly chronically stressed Military working dogs (MWD)	Anouck	Haverbeke
P1/24a	Outcomes assessment of an online animal welfare assessment course	Camie	Heleski
P1/25	Effect of restricted suckling on behaviour, feed intake and growth of dairy calves	Helena	Hepola
P1/26	Effects of pen floor heating on piglets' use of heated area 0-120 h postpartum	Birthe	Houbak
P1/27	Validation of salivary cortisol as an indicator of HPA activity in horses	Tamsin	Hughes
P1/28	Age at introduction to the group affects dairy calves' use of a computer-controlled milk feeder	Margit Bak	Jensen
P1/29	Farmers' perceptions of animal welfare: utilitarian and moralistic views	Tiina	Kauppinen
P1/30	The effect of latency to ejaculation on conception in thoroughbred horses	Mark	Kennedy
P1/31	Effects of year-round nestbox and temperament on welfare in blue foxes	Hannu	Korhonen
P1/32	Validation of scan sampling methods for aggressive behaviour of weaned pigs	Nadege	Krebs
P1/33	Management implications of behavioural studies in the Indian Honeybee	Thiyagesan	Krishnamoorthy
P1/34	Problem-solving abilities of dogs in hidden food tasks	Franziska	Kuhne
P1/35	Behavioural tests in sheep - what are we really measuring?	Caroline	Lee



**Group 1 Posters**  
**Wednesday 9th – Thursday 10th August 2006**



Number	Title	First name	Last name
P1/36	Behaviour and reaction time of dairy bulls during semen collection	Lena	Lidfors
P1/37	Merino sheep selected for low vs. high agitation display differences in social reactivity	S��verine	Ligout
P1/38	Behavioural effects of cage enrichment on female mink housed in standard cages	Helene	Lindberg
P1/39	Surgical castration affects the behavioural response to low-dose lipopolysaccharide (LPS) challenge in weaned pigs	Sara	Llamas Moya
P1/40	Stockmanship and the human-animal relationship: effects on the health and welfare of family farmed dairy calves	Vonne	Lund
P1/41	An accelerometer-based method for analyzing equine oscillation	Akihiro	Matsuura
P1/42	The effect of colour on toy use in adult dogs	Ralph	Merrill
P1/43	Behavioural reactivity to separation and reunion with a social partner or an object in weaned piglets	Marie-Christine	Meunier-Sala��n
P1/44	The development of sow and piglet skin, claw and nipple lesions on two concrete flooring materials during the lactation period	Marianna	Norring
P1/45	Undernutrition during pregnancy impairs the establishment of non-olfactory recognition of the lamb by its mother in ewes	Alan	Olazabal
P1/46	Histological differences of the adrenal glands and cortisol levels of enriched and non-enriched lactating dairy goat kids	Alma Patricia	Rosas Trigueros
P1/47	Evaluation of "One standing One feeding" strategy for control of cattle defecation using automatic feeding stations	Tomoko	Saitoh





**Group 1 Posters**  
**Wednesday 9th – Thursday 10th August 2006**



Number	Title	First name	Last name
P1/48	Feeding and social behaviour of grower-finisher pigs in large social groups	Thusith	Samarakone
P1/49	Handling practices during rearing are linked to the cow-human relationship	Claudia	Schmied
P1/50	Variations in Adélie Penguin heart rate and behaviour	Ka	Schuster
P1/51	Two-day-old lambs recognize the individual acoustic signature of their mother	Frédéric	Sèbe
P1/52	Physiological and behavioural responses in different stocking density of Indonesian native chicken	Iman Rahayu Hidayati	Soesanto
P1/53	Use of behavioural studies in water bird habitat management- a case study	G	Sridharan
P1/54	Development of a propensity to chew test as a predictor of tail-biting in pigs	Poppy	Statham
P1/55	Behavioural and heart rate response of dairy calves to separation from their mothers: effect of calves' age and auditory/visual contact	Ilona	Stehulova
P1/56	Individual urinary cortisol changes in kennelled dogs	Jacqueline	Stephen
P1/57	An investigation into the use of straw racks by sows in large dynamic groups	Charlotte	Stewart
P1/58	Is the way we feed lambs important for the development of an affinity to their caregiver?	Céline	Tallet
P1/59	Comparison of behaviour, physical condition and productivity of laying hens in four molting methods	Toshio	Tanaka
P1/60	Behavioural and cardiac responses to changes in the social and non social environment in quail	Dorotheé	Valance



**Group 1 Posters**  
**Wednesday 9th – Thursday 10th August 2006**



Number	Title	First name	Last name
P1/61	Pig enrichment: legislation, science and reality	Heleen	Van de Weerd
P1/62	Horses actively safeguard their social network: the effects of interventions on horse interactions	Machteld	Van Dierendonck
P1/63	Applying fundamental dust bath research in the evaluation of poultry husbandry systems	Jeroen	Van Rooijen
P1/64	Frustration of walking due to tethering in dairy cows	Isabelle	Veissier
P1/65	Behavioural responses by dairy cows subjected to different dry-off procedures	Marina	Von Keyserlingk
P1/66	Who's a clever boy then? Methods to assess learning to evaluate brain function in horses	Bethan	Whitham
P1/67	Reliability of avoidance distance recording in dairy cattle in different test locations	Christoph	Winckler
P1/67a	The effect of location and variety on foraging behaviour of stabled horses	Tina	Yates
P1/68	Competitive interactions in feedlot beef cattle	Gosia	Zobel



## Group 2 Posters

### Friday 11th – Saturday 12th August 2006



#### GROUP 2 POSTERS

The following posters will be presented during Poster sessions 5-8. They should be installed between the end of Poster session 4 (11:45 Thursday 10th August) and the beginning of Poster session 5 (11:00 Friday 11th August). Please note that the excursions take place on Thursday afternoon.

Number	Title	First name	Last name
P2/69	The welfare of captive starlings	Lucy	Asher
P2/70	An investigation into factors affecting internal hoof structure in dairy heifers	Lorna	Baird
P2/71	Locomotory behaviour in dairy cattle: the impact of walking surfaces on claw loading and locomotion	Bonne	Beerda
P2/72	Preferences of different types of flooring at moderate and low ambient temperature in dairy goats	Knut Egil	Bøe
P2/73	Lambs' affinity towards a human results from attraction rather than familiarisation	Xavier	Boivin
P2/74	The effect of extending lactation on the welfare of sows post-weaning using quantitative and qualitative behaviour assessments	Kate	Breuer
P2/75	Thermography of captive cetacean respiratory activity	Andrew	Butterworth
P2/76	Effects of visual exposure on body weight, chromodacryorrhea secretion and behaviour of laboratory rats	Sylvie	Cloutier
P2/77	Intracranial fat bodies and motor incoordination in crested ducks ( <i>Anas platyrhynchos</i> ) - an analysis of their relationship and implications for animal welfare	Julia	Cnotka
P2/78	Familiarity of the feeder smelling does not improve post-weaning feeding behaviour in piglets	Violaine	Colson



**Group 2 Posters**  
**Friday 11th – Saturday 12th August 2006**



Number	Title	First name	Last name
P2/79	Dairy cattle exploratory and social behaviour: a comparison of cloned and control heifers	Marjorie	Coulon
P2/80	Effects of maternal environment on maternal behaviour and offspring fearfulness in mice	Laurence	Coutellier
P2/81	Aversion to the inhalation of different gas mixtures to stun pigs	Antoni	Dalmau
P2/82	Behaviour of bitches while not nursing puppies	Claire	Diederich
P2/83	Effect of two different roughage sources on behaviour of lactating dairy cows	Martina	Dorigo
P2/84	An exploration of behaviour problems in racing Standardbred horses	Michelle	Drissler
P2/85	Cumulative effect of environmental enrichment on behaviour and productivity of dairy goat kids after weaning	Andres	Ducoing
P2/86	Vocalisations associated with fear conditioning in the domestic pig	Sandra	Düpjan
P2/87	It is possible to define the aversiveness threshold of stray voltage when animals are allowed to avoid it	Christine	Duvaux-Ponter
P2/88	Sensory ecology and animal welfare - The effect of flicker from fluorescent lights on the welfare of European starlings	Jennifer	Evans
P2/89	Using ecological theory to test the nature of individual traits: impact of fearfulness on the responses to pain	Ashley	Frost
P2/91	Improved housing affected activity in Golden Hamsters	Andrina	Hauzenberger
P2/92	Light type preferences in laying hens	Matti	Heikkilä



**Group 2 Posters**  
**Friday 11th – Saturday 12th August 2006**



Number	Title	First name	Last name
P2/94	Supplementation with flaked maize during late gestation and recognition of the kid at 4 h postpartum in goats grazing under extensive conditions	Horacio	Hernandez
P2/95	Does punishment work? Rider responses and behaviour problems in ridden horses	Joanna	Hockenhull
P2/96	Social interactions and social hierarchy in a dairy herd	Maria José	Hötzel
P2/97	Adaptation to automatic milking within extensive grazing systems	Jenny	Jago
P2/98	The effect of broody hens on chicks' activity cycles and synchrony	Anja Brinch	Jensen
P2/99	Ambulatory tool for cardiac activity measurements in animal research	Jutta	Kaihilahti
P2/100	Exposure of calves to noise in dairy farms	Risto	Kauppinen
P2/101	Keeping children safe: how reliable are children at interpreting dog behaviour?	Nelly	Lakestani
P2/102	Horse's temperament and suitability for riding activity can be predicted from 8 months of age	Léa	Lansade
P2/103	Comparison of methodologies to measure fear of humans in sows	Daniel	Laws
P2/104	Avoidance towards humans in two genetic populations of pheasants	Christine	Leterrier
P2/105	Eating sequences of gestating sows in group housing with electronic sow feeders	Yuzhi	Li
P2/106	Can environmental enrichment help detect welfare and onset of disease in mice?	Kate	Littin
P2/107	Horse personalities differ between breeds	Adele Sian	Lloyd
P2/108	Training and timing - how to facilitate the daily inspection of extensively kept cattle	Anna	Lundberg



**Group 2 Posters**  
**Friday 11th – Saturday 12th August 2006**



Number	Title	First name	Last name
P2/109	Correlations between cow behaviour, health and production and an Animal Needs Index (ANI 35L for cattle) in Finnish dairy herds	Paula	Martiskainen
P2/110	Cross-modal habituation-dishabituation test of individual recognition in pigs	Morven	McLeman
P2/112	The effect of inter-zoo transportation on reproductive success of three felid species	Heidi	Mitchell
P2/113	Applying fundamental ethological research: studying predator-prey interactions to improve predictions in estuarine conservation	R	Nagarajan
P2/114	Plumage colour and feather pecking - behavioural differences associated with PMEL17 genotypes in chicken ( <i>Gallus gallus</i> )	Daniel	Nätt
P2/115	A new technique to evaluate the effects of height of available forage on selectivity and intake rate by cattle	Shin-Ichiro	Ogura
P2/116	Validation of a subjective temperament score and its correlation with hair whorl position in beef cattle	Gabriela	Olmos
P2/117	Maternal behaviour in <i>Mus musculus</i> - a review	Anna	Olsson
P2/118	Relationships between the social rank of male goats and their testosterone levels, aggressiveness, and libido	Ana	Ortiz-Demontellano
P2/119	New monitoring methods of dairy cattle behaviour and welfare in Finland	Matti	Pastell
P2/120	The welfare of sheep transported by sea from Australia to the Middle East	Clive	Phillips
P2/122	Behavioural responses of minipigs to the pigturn®: a novel laboratory penning system	Rosangela	Poletto



**Group 2 Posters**  
**Friday 11th – Saturday 12th August 2006**



Number	Title	First name	Last name
P2/123	Preliminary study of dependent relationships in dogs	Stéphanie	Porret
P2/124	Stereotypic behaviour in captive African ( <i>Loxodonta africana</i> ) and Asian ( <i>Elephas maximus</i> ) elephants in five UK zoos	Una	Quaid
P2/125	Do specific individuals lead activity synchronization in beef cattle?	Radka	Sárová
P2/126	Does a synthetic plate improve the quality of the lying area in housing systems for fattening pigs?	Pascal	Savary
P2/127	The effect of newborn calves vigour in their mortality probability	Anita	Schmidek
P2/129	A case-study: faecal corticosteroid and behaviour as indicators of welfare during relocation of an Asiatic elephant	Chris	Sherwin
P2/130	Comparisons of behaviour, use of facilities and physical condition between dominant and subordinate hens in furnished cages	Tsuyoshi	Shinmura
P2/131	Effect of environmental enrichment on behaviour and productivity of dairy goat kids after weaning	Anne	Sisto
P2/132	Effect of day or night grazing on behaviour and production of swamp buffalo heifers	Pipat	Somparn
P2/133	A device aiming at improving welfare of rats housed in standard metabolic cages	Dorte Bratbo	Sørensen
P2/134	Breedspecific preferences of White Crested Polish chickens in mate choice	Inga	Tiemann
P2/135	In search of the relationship between candidate genes and behaviour: a comparison of pet dogs and police dogs	Jozsef	Topal
P2/136	Behavioural changes following 21 to 57 h of feed deprivation in swine	Michael	Toscano

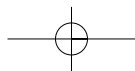
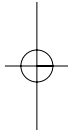
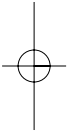


**Group 2 Posters**  
**Friday 11th – Saturday 12th August 2006**



Number	Title	First name	Last name
P2/137	Effect of temperature and flooring type on the behaviour and physiology of weaned piglets	Sarah	Trickett
P2/138	Welfare of horses used in therapeutic riding programs	Katja	Van Driel
P2/139	Behavioural indicators of pain in Belgian White-blue cattle	Jeroen	Vandeloek
P2/140	Basic behavioural patterns and welfare in Belgian Blue Beef: diurnal and stall-meadow variation	Inge	Vercauteren
P2/141	Hunger behaviour in dairy calves	Andreia	Vieira
P2/142	Effect of milk allowance and age on meal patterning of dairy calves	Daniel	Weary
P2/143	Maternal behaviour in laboratory mice: the effect of housing environment	Elin	Weber
P2/144	Perceptions of the veterinary profession's role in animal welfare	Sean	Wensley
P2/145	Effects of feed frequency on feeding pattern, rumination and ruminoreticular motility in sheep	Atusi	Yamazaki

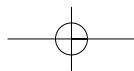






DAVID WOOD-GUSH  
MEMORIAL LECTURE





David Wood-Gush Memorial Lecture  
Wednesday 9/8/06 – The Great Hall



## IS THERE A FUTURE FOR APPLIED ETHOLOGY?



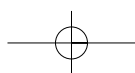
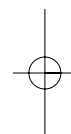
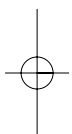
Alistair B. Lawrence

SAC Edinburgh, UK

This Wood-Gush lecture provides an opportunity for a retrospective analysis of applied ethology from David Wood-Gush's era to the present day. This 'historical' analysis can help in understanding how the field has changed over this time, what factors have shaped these changes and to give insights into the future. The 'Wood-Gush era' (1952-1993) was characterised by: the small size of the field especially in the years leading up to 1985, the emphasis on 'curiosity driven' research primarily focused on understanding the biology of domestic animal behaviour, with a strong foundation in basic behavioural (and related) sciences. It is likely that both the small size of the field and its primary focus on strategic questions related to domestic animal behaviour contributed to the sense that applied ethology by the end of the Wood-Gush era had not met its potential in delivering benefits to animal welfare. The 'post Wood-Gush era' (1993-the present) has seen a considerable increase in public concern and global interest in animal welfare which is reflected in the level of welfare research activity. In response to this public interest there has been a significant and progressive shift for funders to support research based on its relevance to animal welfare as opposed to applied ethology research *per se* with the main aims being to 'Find solutions to welfare problems' and to 'Develop scientific tools to assess animal welfare'. This research is increasingly required to be multi-disciplinary with links to both 'reductionist' and 'social' sciences and to industry. Other recent trends have been for an emerging focus on health and welfare which in some countries stems from concern over animal disease epidemics, and an increased emphasis on issues related to 'globalisation' of animal production and trade. This description of the current position of applied ethology in relation to wider trends in animal welfare will provide the basis for an analysis of the future opportunities and challenges facing our science.

Professor Alistair B. Lawrence  
Animal Behaviour and Welfare  
SAC  
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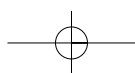
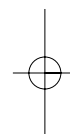
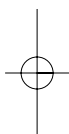
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## PLENARY TALKS







## WHERE DID IT ALL GO RIGHT? APPLYING APPLIED ETHOLOGY WORLDWIDE



Michael C. Appleby

World Society for Protection of Animals, UK

The ultimate link in the fundamental-applied chain is application to actual treatment of animals, and for farm animals it is increasingly necessary to consider this on a worldwide scale. A major reason for this is increased trade in animals and animal products, both because this has direct impacts on the animals concerned and because it increases competition within and between countries and hence pressure to reduce production costs. In this context, advances over recent years in consideration of farm animal welfare can be regarded as a major success story. Just as on a national basis, international rules and guidelines should be based wherever possible on careful scientific and ethical foundations, and to a great extent this has been the case. Notably, the World Organisation for Animal Health (OIE) has produced the first global welfare standards (for transport and slaughter) largely based on knowledge and judgments acquired by applied ethology. Similarly the International Finance Corporation (part of the World Bank Group, with a portfolio of \$17 billion in 140 countries) has produced a Good Practice Note on welfare of animals in production projects, with many arguments derived from applied ethology. The European Union continues to promote farm animal welfare, relying strongly on reports from the Scientific Committee on Animal Health and Welfare, rather than reversing this approach in the face of likely increases in trade. However, attention to these issues needs to be increased rather than decreased as the World Trade Organisation moves to liberalise agricultural trade: negative effects of trade on sustainability and welfare can not be addressed by WTO procedures. Applied ethologists will continue to play a key role in determining whether standards and guidelines are actually implemented on a national and international basis, and those concerned for animal welfare should be ready to contribute in this way.

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Plenary Talk  
Thursday 10/8/06 – The Great Hall



## AFFECTIVE NEUROSCIENCE AND THE ANCESTRAL SOURCES OF SOCIO-EMOTIONAL FEELINGS WITHIN ANIMAL MINDS



Jaak Panksepp

Washington State University, USA

Advances in animal well-being issues must be premised on a better understanding of brain processes that mediate the affective infrastructure for mind. Neuroscience has confirmed the existence of a variety of basic emotional action systems that exist as evolutionary birthrights within mammalian brains. These emotional state control systems allow newborn organisms to begin navigating the complexities of the world and to learn about the values and contingencies of the environment. Among the identified systems FEAR, RAGE, LUST, PLAY, PANIC, CARE, and SEEKING urges are most prominent. As will be summarized, basic emotions can now be defined by the functions of the underlying circuitries - characteristics which help coordinate behavioral, physiological and psychological aspects of emotionality, including the valenced affective feeling states that provide fundamental values for the guidance of behavior. I will highlight i) how our understanding of evolved neuropeptide chemistries are providing neural substrates for specific emotional and motivational processes and ii) how the emergence of neural conceptualizations of brain emotional systems may impact future work on other animal and human well-being issues. I will specifically focus on the likelihood that the PANIC or separation distress system is an essential substrate for sadness and depression, with implications for understanding social-bonding problems. The PLAY system promotes social engagement, learning and joy, with implications for long term life adjustments, which also provides generalized vocal measures of positive affect in rodent models (i.e. 50 kHz chirps). An understanding of these systems in other mammals also provides an opportunity to scientifically understand how basic social feelings such as sadness and happiness, shared by all mammals, emerge from human brain neurodynamics. The implications for a cross-species psychiatric issues as well as the nature of primary-process affective consciousness will be highlighted.

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## OTHER WAYS OF SEEING: VISION, ECOLOGY AND WELFARE



Innes C. Cuthill

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We readily accept that other animals may rely on different senses, to different degrees, from us and that this may have implications for optimising their welfare in captivity. Humans are highly visual creatures and, in common with many other primates, have better colour vision and higher acuity than most other mammals. Therefore, the natural tendency has been to assume that as long as lighting conditions are adequate for human vision, then they will be more than satisfactory for other animals. However, even within the vertebrates, many species have quite different and, in some cases, superior visual capabilities to humans. Birds, for example, can see ultraviolet wavelengths to which humans are blind, have colour vision based on four rather than three retinal cone photoreceptor types, and some species may have visual systems with sufficiently high temporal resolution to perceive the flicker in fluorescent lighting. Therefore, on theoretical grounds, the welfare of birds kept under artificial lighting designed for human vision may be impaired. The same may be true for some other vertebrates, like certain reptiles and fish, which are not kept in captivity in such huge numbers, but may be individually valuable (e.g. bred in captivity for conservation purposes). I review the key differences between the visual systems of humans and other vertebrates, and the empirical evidence that the behaviour and welfare of captive species is adversely affected by artificial lighting. I conclude that the effects are typically subtle (and so perhaps of lesser welfare concern than some other factors) but nevertheless real, and this has implications not only for husbandry practices but for the interpretation of scientific results obtained under artificial lighting.

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Plenary Talk  
Saturday 12/8/06 – The Great Hall



## WHAT THE NOSE KNOWS: HOW SCENTS UNDERLIE SOCIAL RECOGNITION AND ASSESSMENT



Jane L. Hurst

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Chemical scents are widely used by animals for communication and we are now starting to understand the complexity of these signals, the types of information that they convey and how this information is used. While scents emanating from the body provide immediate information during interactions, scent marks in the environment often persist over extended periods. To provide information in the absence of the signaller, scents must provide reliable and stable information about the owner's identity. Mammalian scents typically also provide a wide range of information about the signaller's current status including social class, competitive success, reproductive condition, health status and diet. Understanding how these signals are used for social recognition and assessment has a wide range of applications for managing the health and welfare of animals in captivity. Firstly, scent signals underlie most aspects of social behaviour in a number of important species such as laboratory rodents. Inbreeding, artificial selection and restricted social experience also impact on scent production and response, leading to differences in behaviour according to strain and management or experimental conditions. Appropriate management and experimental design is thus essential to avoid problems of aggression and to reduce unnecessary variation between animals. Secondly, in the wild animals choose mates that will maximise the fitness of their offspring. Understanding the importance of different drivers influencing this choice promises to provide considerable insight into the main factors underlying individual vigour and genetic variation, to help us manage healthy and sustainable animal populations. The signals that animals use for assessment are also likely to provide sensitive indicators of individual health or disease status. I will review current understanding of how mammals use scent signals for social recognition and assessment together with some of our recent work on how scents influence competitive aggression and mate choice in mice.

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## STANDARDIZATION AND THE RED QUEEN: APPLYING METHODOLOGIES FROM ETHOLOGY, NEUROPSYCHOLOGY, AND FIELD BIOLOGY TO PROBLEMS IN HIGH- THROUGHPUT BEHAVIORAL METHODS



Joseph P. Garner<sup>1</sup>, Collette M. Thogerson<sup>1</sup>, Joy A. Mench<sup>2</sup>, Hanno Würbel<sup>3</sup>

<sup>1</sup>Purdue University, USA

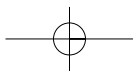
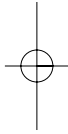
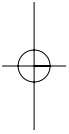
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Standardization is at the heart of any good experiment, as it aims to reduce unwanted variation, increasing power, reliability, validity, and replicability. Recent studies have shown that the power, validity, and replicability of many widely used high-throughput behavioral tests are surprisingly poor, primarily because extraneous variables often dominate the animals' responses. The solution to these problems is contested, with most high-throughput researchers arguing for further environmental (and measure) standardization. We argue in contrast that arbitrary environmental standardization, combined with the nature of the behavioral methods employed, is the root of the problem. To test these hypotheses, we simulated the replication of a behavioral experiment in four different laboratories. We varied the standardisation of the behavioral measure and the within-laboratory environment. At each combination of these parameters, we repeated the simulation 250 times, randomly changing the environment in each lab and thereby directly observing the effects of different standardisation techniques and experimental designs on power, reliability, validity, and replicability. The simulation demonstrated that standardizing animals by housing them in arbitrarily constant and barren environments constrains individuals to unnaturally narrow variation around arbitrary means determined by extraneous environmental variables - thereby compromising validity and replicability, and artefactually inflating reliability. Attempting further standardization by controlling more environmental variables may thus be just as counter-productive as Alice chasing the Red Queen. Instead standardization methodologies common in other disciplines - 'ecologically relevant' measures in ethology, blocking factors in field biology, and internal control variables in psychology - may radically improve the standardization of high-throughput behavioral experiments. The simulation demonstrates the improved power, reliability, replicability and validity provided by these techniques. Finally, using data from our recent mouse experiments, we demonstrate increased power over typical high-throughput designs. The projected decreases in sample size argue for our recommendations on the grounds of experimental efficiency and animal welfare.

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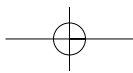
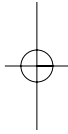
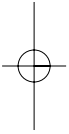
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ORAL PAPERS  
WEDNESDAY 9th August 2006







## GENETIC INHERITANCE OF ACQUIRED STRESS RESPONSES IN CHICKENS



Per Jensen<sup>1</sup>, Andrew Janczak<sup>2</sup>, Daniel Isaksson<sup>1</sup>, Izabella Baranowska<sup>1</sup>,  
Christina Lindqvist<sup>1</sup>

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Prenatal stress may have strong effects on behaviour and development of the offspring. This is usually assumed to be mediated by the organisatory effects of stress hormones during embryonic development, and therefore not genetically inherited. We raised 40 White Leghorn (WL) and 40 red junglefowl (RJF) in an environment with unpredictable light rhythm (stress condition), and the same number in a control 12:12 light-dark rhythm. Neither growth nor egg production was affected by the treatments, but at 200 days of age, stressed birds of both strains had a significantly poorer ability to solve a T-maze spatial learning task ( $P < 0.05$ ; chi<sup>2</sup> test). The effect was stronger in WL. This demonstrates, as expected, that a chronic unpredictable environment affected the behaviour more in domesticated Leghorns than in red junglefowl. We then collected eggs from both breeds and treatments and hatched 30 offspring from each group in the same incubator and bred them to four weeks of age under control light conditions. In the same T-maze test as for the parents, there was a significant reduction in spatial learning in WL, but not in RJF ( $P < 0.05$ , chi-square test). Furthermore, in WL, but not in RJF, offspring from stressed parents had higher weight at eight days of age ( $P < 0.01$ ; ANOVA), a higher competitive ability in a feeding test ( $P < 0.05$ ), and tended to have higher levels of fear of humans ( $P < 0.06$ ). Based on cDNA-microarray analysis of gene expression in hypothalamus and pituitary, we found that 25 genes were differentially expressed ( $B > 0$ ; fold-change  $> 1$ ) in offspring from stressed WL parents, compared to none in RJF. Hence, offspring inherited an altered behaviour and this was accompanied by a modified gene expression pattern. This shows that an acquired stress response may be inherited through genetic mechanisms in chickens, suggesting a novel pathway for rapid evolutionary adaptation.

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Oral Paper: Genes and behaviour  
Wednesday 9/8/06 – The Great Hall



## THE IDENTIFICATION OF QUANTITATIVE TRAIT LOCI FOR STRESS AND LEARNING RESPONSES IN THE SHEEP



Andrew D. Fisher<sup>1</sup>, Caroline Lee<sup>1</sup>, Sonja Dominik<sup>1</sup>, Anna Murrell<sup>1</sup>,  
Alain Boissy<sup>2</sup>, Dominique Blache<sup>3</sup>

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Adaptation to farming conditions can be improved by reducing stress reactivity and increasing learning abilities of animals. Genetic selection for these traits may be of economic and ethical significance for livestock production. The identification of quantitative trait loci (QTL) linked with stress and learning response traits was conducted in sheep. A gene mapping flock (N=215) of ewes and wethers was generated by back-crossing two Romney × Merino rams to Merino ewes. A full genome scan utilised 176 microsatellite markers on the 26 chromosomes. At 5 years of age, the sheep were individually exposed to three tests. Their stress reactivity was estimated in response to: 1) isolation and novelty (agitation score); and 2) shearing (plasma cortisol response). Their learning abilities were estimated in a maze test by recording the improvement in time taken and error score over 3 days of testing. Data were analysed for fixed effects, and then the genotype and phenotype data were analysed by half-sib regression interval mapping using Haley-Knott regression. Ewes were faster through the maze than wethers (63.9 vs. 72.0 s;  $P < 0.05$ ), and had higher cortisol responses to shearing (185 vs. 161 nmol/l;  $P < 0.01$ ). There were no effects of sire. A significant QTL for time improvement in the maze was identified on chromosome 13 at 124 cM. In addition, different putative QTL close to significance were identified for improvement in both maze time and error score (C9; 88 cM), maze time improvement (C12, 40 cM), maze error improvement (C23; 24 cM), maze time (C23; 0 cM), agitation score (C22; 52 cM), and cortisol response (C13; 4 cM). These results suggest a genetic basis for some stress and learning responses in sheep. Further research is being conducted to confirm linkages in order to identify genes that may exert a quantitative effect on these behavioural traits.

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## PARENTAL EFFECTS ON THE BEHAVIOUR OF 6-MONTH-OLD GILTS



Joop Lensink<sup>1</sup>, H  l  ne Leruste<sup>1</sup>, Marie-Laurence Le Grannec<sup>2</sup>,  
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There is an increasing demand from genetic selection companies to use behavioural characteristics such as docility and low responsiveness to handling in their selection schemes. Previous studies show that some behavioural traits might be heritable, which could allow a selection of animals based on behaviour. The objective of this study was to determine if some behavioural traits can be detected in 6-month-old gilts and if these traits are influenced by the animals' genetic origin. A total of 556 gilts were observed in the following situations: 1) voluntary approach of a human standing at the feeding trough; 2) reaction to being touched by a human inside their pen; 3) reaction to a novel object. These observations were performed when the animals were in their home pen (10-12 gilts). The gilts were marked individually during 4-min observation periods, each observation leading to a note from 1 (rapid contact or no fear) to 5 (no contact or highly fearful). Gilts were also observed individually based on their ease of handling when transferred to a weighing scale (note 1 - very easy to 5 - very difficult) and their behaviour when in the weighing scale (note 1 - very calm to 5 - very agitated). The paternal (16 boars) and maternal genetic (144 sows) effects on their behaviour were determined through analysis of variance and principal component analysis. Significant paternal effects were found on the gilts' reaction to being touched by a human ( $P < 0.01$ ), the reaction towards a novel object ( $P < 0.001$ ), the ease of handling ( $P < 0.001$ ) and the behaviour in the weighing scale ( $P < 0.01$ ). Maternal effects were found on reaction to being touched ( $P = 0.03$ ) and the behaviour in the weighing scale ( $P < 0.01$ ). These results suggest that a selection of the gilts based on behavioural traits may be possible, especially from the paternal side.

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Oral Paper: Genes and behaviour  
Wednesday 9/8/06 – The Great Hall



## BREED DIFFERENCES IN AGGRESSIVE BEHAVIOR IN DOGS



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A previous factor analytic study using the Canine Behavioral Assessment & Research Questionnaire (C-BARQ), identified three distinct categories of aggressive behavior in a large (N=2054) sample of dogs of various breeds: stranger-directed aggression (SDA), owner-directed aggression (ODA) and dog-directed aggression (DDA) (Hsu & Serpell, 2003). This paper examines the distribution of these three traits in a subset (N=1563) of this sample comprising eleven common breeds. Significant breed differences in behavior were found for all three categories of aggression (K-W test, SDA,  $H=237.1$ ,  $P < 0.0001$ ; ODA,  $H=83.13$ ,  $P < 0.0001$ , and DDA,  $H=53.54$ ,  $P < 0.0001$ ), although breeds that scored high in one category did not necessarily do so in others. Significant within-breed differences were also detected in two breeds when field and conformation (show) bred lines were compared. In English Springer Spaniels conformation bred dogs tended to be more aggressive in all three contexts than the field bred ones (Mann-Whitney U test, SDA,  $U=4043.5$ ,  $P < 0.001$ ; ODA,  $U=5690.0$ ,  $P=0.054$ , and DDA,  $U=5265.0$ ,  $P < 0.05$ ), while in Labrador Retrievers the field bred animals were more aggressive than the show bred (M-W U test, SDA,  $U=12258.0$ ,  $P < 0.001$ ; ODA,  $U=15306.0$ ,  $P < 0.01$ , and DDA,  $U=13265.5$ ,  $P < 0.001$ ). Overall, male dogs obtained significantly higher scores for ODA than females (M-W U test,  $U=233977.5$ ,  $P < 0.001$ ), but not for SDA or DDA. Considered separately, the different breeds were affected unpredictably by sex and neutering, and to differing extents. The results point to a possible genetic basis for the expression of aggressive behavior in dogs that would repay further investigation. From a practical standpoint, the findings support the exercise of caution in the use of surgical sterilization as a means of controlling aggressive behavior in some breeds.

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## CONTRIBUTIONS OF EWE AND LAMB BEHAVIOUR TO THE MAINTENANCE OF BODY TEMPERATURE IN NEONATAL LAMBS OF TWO BREEDS



Cathy M. Dwyer, Kirstin M. Watt, Colin A. Morgan

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The ability to maintain body temperature is vital for newborn mammals, particularly when born into cold environments. Breed differences exist in the ability of neonatal lambs to maintain temperature. Here we assess the contributions of behavioural and physiological mechanisms in maintaining body temperature. Data were collected from 73 lambs of two breeds (Scottish Blackface, Suffolk). Rectal temperature and thyroid hormone concentrations were determined at 1, 24 and 72h after birth. Behaviours related to preventing heat loss (standing quickly, maternal grooming) and heat conservation/production (sucking, lying with the dam, activity) were recorded over the first 3 days of life. Relationships between lamb temperature, physiology and behaviours were determined by REML or Kruskal Wallis tests and multivariate Factor Analysis. Lamb temperatures were lower in Suffolk lambs compared to Blackface and triplets compared to singles or twins (median temperature (°C): Suffolk=39.45, Blackface=40.10,  $H=9.49$ ,  $d.f.=1$ ,  $P<0.005$ ; Single lamb=40.00, Twin=40.10, Triplet=39.45,  $H=7.47$ ,  $d.f.=2$ ,  $P<0.05$ ). Thyroid hormone concentrations were greater in Blackface lambs compared to Suffolk (Wald=11.30,  $d.f.=1$ ,  $P<0.001$ ), but unaffected by litter size. Suffolk and triplet lambs took longer to stand and suck than Blackface, single or twin lambs ( $P<0.001$ ), and were groomed less (Median % time groomed: Suffolk=36.4, Blackface=57.5; Single=70.4; Twin=48.7, Triplet=37.8;  $P<0.05$ ). Separate factor analyses were carried out for data at 1 and 24h after birth. One hour after birth lamb temperature loaded positively with standing quickly but not with maternal grooming attention or lamb thyroid hormone concentrations. At 24 hours after birth lamb temperature loaded positively with thyroid hormone concentrations, lamb activity and sucking quickly after birth but was not related to the frequency that lambs were lying with the ewe or other lambs. The data suggest that neonatal lambs use both behavioural and physiological mechanisms to maintain body temperature. Further modelling will help to determine their relative importance in different environments.

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Oral Paper: Mother and offspring  
Wednesday 9/8/06 – The Reception Room



## RESPONSIVENESS OF SOWS TOWARDS PIGLET VOCALIZATION DURING 24 H AFTER BIRTH



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Domestic sows are relatively immovable and passive after parturition and this has been interpreted as good maternal behaviour. However, a sow should have a high responsibility towards vocalization of crushed piglets independently of the time after birth. It is unknown (i) whether sows are responsive to different types of piglet vocalization or if they respond exclusively to vocalization of crushed piglets within the first 24 h post partum and (ii) whether the responsiveness of the sow to piglet vocalizations changes within the first 24 h. The behaviour of 12 sows was video taped for 24 h post partum. Three phases were distinguished: birth (start to end of parturition, P1 (end of birth to 12 h post partum.), P2 (12 to 24 h post partum). In every phase a 1-min playback of crushed piglets during a lying down event and a 1-min playback of fighting piglets during a nursing was presented to the sow. A 1-min playback of a driving tractor was used as control. The loudness level was the same for all playbacks. The order of playbacks was randomised. For the statistical analysis we applied the GENMOD procedure in SAS in the brackets presenting the chi-square values. (i) The results showed that sows reacted significantly more to the playbacks of crushed piglets (Proc GENMOD ; chi-square(1)= 4.55 P=0.03) and fighting piglets than to the control playback (Proc GENMOD ; chi-square(1)=3.39, P=0.07). (ii) The phases had no significant influence on the sows' reaction to playbacks of crushed piglets vs tractor (Proc GENMOD ; chi-square(2)=1.19, NS) and on playbacks of fighting piglets vs tractor during the first 24 h post partum (Proc GENMOD ; chi-square(2)=0.24, NS). In conclusion, sows have a higher responsiveness towards piglet vocalization compared to a non-biological sound independently of the time after birth.

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## WEANING AND SEPARATION AT DIFFERENT TIMES IS LESS STRESSFUL FOR FOSTER COWS



Jenny M. Loberg<sup>1</sup>, Carlos E. Hernandez<sup>2</sup>, Margit Bak Jensen<sup>3</sup>,  
Charlotte Berg<sup>4</sup>, Lena Lidfors<sup>1</sup>

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<sup>2</sup>Ruakura Research Centre, New Zealand

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<sup>4</sup>Animal Welfare Board, Sweden

The aim of this study was to investigate if foster cows reacted more strongly if their calves stopped suckling and were separated from their foster calves simultaneously compared to if this was done in two steps. Seven Swedish Holstein (SH) and five Swedish Red and White (SRW) dairy cows were used as foster cows for four calves each. A foster cow-calf group was formed when the calves were one week old and the calves were weaned at 10 weeks of age. In six of the groups the calves stopped suckling and were separated simultaneously (control). In the other six groups the calves were prevented from suckling by placing a Quiet Wean-device in their nose. They were then kept together with the cow for another two weeks before they were separated (two-step). The behaviour of the foster cows was observed 0-2, 9-10, 24-26 and 72-74 hours after the calves stopped suckling (two-step), after separation (two-step), and after the calves stopped suckling and were separated simultaneously (control). Behaviour was recorded as frequencies per minute. All behaviours were analysed with a PROC GENMOD (SAS). The control foster cows vocalised more than the two-step foster cows after the preventions of suckling during the second (104 vs 27 times/h,  $P<0.001$ ) and third observation (52 vs 3.5 times/h,  $P<0.001$ ). The control cows also walked more during the same observations (7 vs 2 times/h and 3.7 vs 1.2 times/h,  $P<0.001$ ). Both breeds vocalised with a high frequency in the control treatment, but SH cows vocalised less frequently in the two-step treatment than the SRW cows (0.5 times/h vs 10.5 times/h,  $P<0.001$ ). Our conclusion was that separating the two events - "stop suckling" and "separation", mimics the way calves are weaned naturally and therefore reduces the stress experienced by foster cows.

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Oral Paper: Mother and offspring  
Wednesday 9/8/06 – The Reception Room



## PREDICTORS OF NEONATAL PIGLET SURVIVAL IN AN OUTDOOR FARROWING SYSTEM



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The neonatal period is the most vulnerable stage in the piglet's life and the majority of pre-weaning mortality occurs during the first few days post-partum. With current estimates of pre-weaning live-born mortality at 12%, piglet mortality continues to be a major welfare concern and production problem. We aimed to develop and measure behavioural and physiological indicators of neonatal survival, and to determine treatment effects in populations of piglets selected for high survival and control lines. Thirty-eight sows were served by selected boars, characterised for the survival trait, to produce two treatment groups; 19 high survival litters (HS), 19 control litters (C). Measurements were taken throughout the neonatal period. Total live born mortality did not differ between treatment groups ( $\text{Chi}^2 = 0.762$ ,  $P=0.383$ , HS 12.0% vs. C 15.0%). However, when still-births were included, HS piglets showed less total mortality than C piglets ( $\text{Chi}^2 = 3.754$ ,  $P=0.05$ , HS 14.0% vs. C 21.0%). Higher birth weight was a critical survival factor (died vs. survived,  $F_{1,436} = 37.82$ ,  $P<0.001$ ), and consequently was fitted as a co-variate for analysis of remaining variables. Blood glucose levels at 24h post-partum (indicative of successful suckling) were higher in piglets subsequently surviving ( $F_{1,392} = 19.76$ ,  $P<0.001$ ). Adequate thermoregulation also proved significant for survival (Birth rectal temp  $F_{1,411} = 7.84$ ,  $P<0.01$ , 1hr temp  $F_{1,387} = 16.15$ ,  $P<0.001$ ). HS piglets maintained their 24h body temperature better than C piglets (HS: 38.7°C (10.070, N=215) vs. C: 38.4°C (10.38, N=219), Mann-Whitney  $W=43757.5$ ,  $P<0.01$ ). Survival behaviours of the population are being analysed. In conclusion, birth weight, thermoregulation and suckling success constitute critical factors in neonatal survival and piglets selected for high survival appear to thermoregulate more effectively than control piglets. A study of second generation piglets will develop these indicators further and examine the maternal and direct effects within these selected lines with respect to neonatal survival.

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## MATE CHOICE BY FEMALE BEEF *BOS TAURUS* CATTLE



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Cattle are polygynous and extensive beef cattle enterprises frequently use multiple bulls in their breeding herds at proportions of 2-6%, which could be 2 to 30 bulls per herd. Mating success and fertility of bulls within herds show significant individual differences. Social relationships and sexual competition between males play a role in determining mating success, but sexual selection theory suggests that females should also exhibit mate choice because of their greater investment in their offspring compared to males, and this could also contribute to differences between bulls in mating outcomes. We examined mate choice of 20 oestrous female cattle during a 1-h test in which each female was individually tested in an arena which contained three bulls confined in individual pens or two female group-mates in a fourth pen. The position of the stimulus animals was randomly allocated on each test. The location of the test females in the arena was continuously recorded, with preference determined by the relative amounts of time spent in proximity to the pens of the stimulus animals. Taking into consideration the different sized arena areas associated with being near to, and away from the stimulus animals, the test females spent a greater proportion of time near to the stimulus animals ( $t = 6.61$ ; 19 df;  $P < 0.001$ ). One-way ANOVA showed that test females spent significantly ( $P = 0.003$ ) more time with their group-mates over the bull they spent most time near (35.8% v 13.6% SE = 4.9). Only 4 females spent more time with a bull than with their group-mates. When the proportion of time spent adjacent to bulls was investigated there was evidence ( $P < 0.001$ ) that it differed between bulls, indicating some preference, although different females preferred different bulls and the proportion of time spent near bulls was generally low.

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Oral Paper: Social Behaviour (I)  
Wednesday 9/8/06 – The Great Hall



## 'FRIENDSHEEP'? NON-REPRODUCTIVE BONDS BETWEEN CONSPECIFIC UNGULATES – IMPLICATIONS FOR WELFARE AND HUSBANDRY PRACTICE



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As domestic ungulate species are highly social, adequate social environments are crucial for their welfare. To date, studies into inter-individual bonds of livestock have focused mainly on reproductive relationships (kin / sexual partners). Since modern husbandry systems rarely allow long-term maintenance of reproductive bonds, knowledge on extent and strength of non-reproductive sociopositive relationships is relevant for farm animal welfare. This study tested the Null-Hypothesis that ungulates do not engage in inter-individual bonds outside the reproductive context and quantified extent and strength of these relationships in horses, donkeys, sheep and cattle (11-60 herd members). It was based on a total of 234 animals and 1,500 hours of observation. Study set-up excluded kinship and sexual motivation as alternative bases for bonds (single-sex herds or all males castrated). In six herds, frequency of spatial proximity (two nearest neighbours) was used as an indicator of inter-individual preferences and subjected to multivariate statistical tests (MDS, Cluster Analysis). The Null-Hypothesis was rejected for all six herds. Three quantitative measures were derived to assess extent (percentage of members that could be attributed to distinct groups within the herd; maximum group size) and strength (maximum relative dyadic neighbour frequency) of associations. Both extent and strength of neighbour preferences were greatest in horses (95 to 100%; 9; 90 to 100%), intermediate in sheep (30 to 90%; 4; 40 to 80%), and lowest in cattle (30 to 65%; 3; 30 to 40%). Bonds in donkeys were the least extensive (15-25% of members in distinct groups; maximum group size 2). Their strength, however, was similar to that in horses (maximum neighbour frequencies = 65-100%). Using a simplified nearest-neighbour method, non-reproductive bonds can be expeditiously identified during routine herd checks. Taking such bonds into consideration when deciding about regrouping can contribute to supporting sociopositive herd structures, thereby benefitting animals and owners alike.

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## INFLUENCE OF LIGHT/DARK INCUBATION ON SOCIAL BEHAVIOUR IN DOMESTIC CHICKS



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The aim of this study was to investigate the effect of light exposure during the last days of incubation on the social behaviour of domestic chickens. This exposure is known to lead to asymmetry in one of the visual pathways and to lateralization of visual behaviour. Day-old male chicks (White Leghorn x Australorp cross) were housed in groups of eight in three different treatments pre-hatching (six groups/treatment) 1) Dark; chicks incubated in dark during the last five days of incubation 2) Light; chicks exposed to light over the same period before hatching and 3) Mixed; four light and four dark incubated chicks. Each day from day three to seven social pecking was recorded (20 minutes/day) and competition for food was tested. On day nine a vigilance test was carried out where each group of chicks was exposed to an overhead image of a predator. We found no difference between the treatments in the amount of social pecking performed. The lowest ranking individuals in the Dark groups gained more access to food compared to the lowest ranking individuals in the Light and Mixed groups ( $P=0.041$ ,  $F_{2,43}=3.44$ ), indicating that groups comprised of chicks without visual lateralization (Dark groups) had formed a less rigid social structure. More dark incubated chicks than light incubated chicks reacted the first time the image of the predator was presented ( $P=0.033$ ,  $F_{2,15}=4.30$ ), but when tested in social isolation, dark-incubated chicks were less responsive to an overhead predator (Rogers et al., 2004, Proc. R. Soc. 271, s420-s422). These opposite results suggest that Dark chicks are more influenced by the social context than Light chicks. Differences between treatments implies that manipulating incubation conditions may be a means to improve welfare.

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## PREFERENCES FOR LITTERMATES OR NON-LITTERMATES IN SOCIAL BEHAVIOUR OF WEANED PIGS KEPT IN MIXED GROUPS OF DIFFERENT SIZE



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Grouping of weaned pigs from different litters in pens with restricted space allowance is routinely used in pig production. The social behaviour of group members is influenced by group size. The existence and persistence of a preference for littermates were investigated. A total of 258 weaned pigs were assigned to two group size treatments: groups of nine piglets (9m: 3 piglets each from 3 litters) or groups of 36 piglets (36m: 9 piglets each from 4 litters), which were replicated six times. Pigs were housed in partially slatted pens for an experimental period of four weeks. All pigs of 9m and 16 focal animals of 36m (four randomly chosen pigs of each litter) were observed continuously for each 25 minutes on day 1, 2, 6, 13 and 27. Agonistic behaviour (displacing, head knocking, biting) and resting behaviour (lying down) were recorded with regard to the partner (littermate or non-littermate). Using the Binomial-test we analyzed if the empirical relative number ( $\rho^{\wedge}$ ) of a certain behaviour performed with littermates is consistent with its theoretical relative number ( $\rho^0$ ). If  $\rho^{\wedge} \neq \rho^0$  (confidence interval of 95 %) either littermates or non-littermates are preferred as partner for this behaviour. Preference was calculated for each day and each replicate and for the median of the replications. Pigs showed a preference for littermates when lying down (36m: day 1, 2, 6; 9m: day 1). In both group sizes displacing and head knocking were performed preferably to littermates whereas non-littermates were bitten more often on some days in some replicates. Preferences were more clear and longer lasting in group 36m compared to group 9m. It is concluded that in mixed groups littermates tend to interact in a more socio-positive and less violent way. The use of this strategy may not correlate with group size but may vary between groups.

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## DEVELOPMENTAL PLASTICITY AND ANIMAL WELFARE: ADAPTIVE PLASTICITY, PHENOTYPIC MISMATCH OR PATHOLOGY?



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Animal welfare depends not only on external (environment, manipulations) but also internal factors such as the animals' reactivity to, and capacity to cope with, external stressors. Internal factors reflect phenotypic traits, many of which are adjusted to the future environment based on early environmental cues. The outcome of such developmental plasticity is, however, not necessarily adaptive. If early environmental cues that trigger phenotypic adjustments do not accurately predict the future environment, phenotypic mismatch may occur. Moreover, adverse conditions may disrupt developmental processes, resulting in pathological outcomes. Research in rats has identified variation in maternal care as an environmental cue for adaptive plasticity of neuroendocrine systems mediating stress responses. Elevated levels of maternal care induced by a challenging maternal environment may act as an environmental cue in response to which pups downregulate their stress system in view of a challenging future environment. This raises the possibility that many laboratory rats are raised under false pretences, resulting in phenotypic mismatch. Thus, minimizing disturbance during the postnatal period may induce a highly stress reactive phenotype that is poorly adapted to cope with the stressors involved in life as a laboratory animal. However, the artificial nature of laboratory studies makes it difficult to interpret developmental outcomes in terms of adaptive plasticity or phenotypic mismatch, and adverse housing conditions may even disrupt normal maternal behaviour and pup development, resulting in pathological outcomes. Based on the available literature and our own recent research in rats (Macri et al. 2004, Macri and Würbel, in press a,b) and mice (see Abstracts by Friedrich et al. and Coutellier et al.), I will review evidence for the nature of, and constraints on, adaptive developmental plasticity of stress reactivity in rodents, discuss potential implications of this research for the well-being of captive animals, and highlight promising areas of future research.

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Oral Paper: Early experience  
Wednesday 9/8/06 – The Reception Room



## IS THERE A "SENSITIVE PERIOD" AT THE START OF THE SOCIALISATION PHASE IN THE DOMESTIC DOG?



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Current perceptions of the process of “socialisation” in the domestic dog largely stem from the ethological concepts of imprinting and critical periods. We have previously shown that the development of inappropriate avoidance and fear-related aggressive behaviour, as a consequence of inadequate socialisation, takes place over several weeks or even months, arguing against any “critical period”. However, it is possible that the capacity for dogs to integrate their early experiences relies upon a sensitive period at the beginning of the socialisation phase, i.e. between 3 and 5 weeks of age. We have begun to test this by exposing puppies to video images during this period and observing their subsequent reactions to novel situations. Test puppies (8 litters N= 29), exposed to video/audio playbacks of animate (e.g. people, dogs) and inanimate (e.g. traffic, vacuum cleaner) stimuli, for 30 minutes per day for 14 days between 3 and 5 weeks old were compared with unexposed control puppies (9 litters N= 34) for their reactions to objects in both familiar and unfamiliar environments at the age of 36 days. The control puppies made significantly more visits to the objects (Nested ANOVA;  $F_{(1,21)}=12.2$ ,  $P=0.002$ ), and visited more of the objects, than the exposed group ( $F_{(1,21)}=5.46$ ,  $P=0.03$ ). Another 6 litters (N=28), split equally between exposed and control, were given the same treatments and were tested at 7-8 weeks of age. The control puppies were no more or less exploratory than the exposed puppies (number of objects visited: ANOVA;  $F_{(1,18)}=0.96$ ,  $P=0.34$ ), but were significantly more fearful than the exposed, scoring higher for several postures associated with stress: e.g. body position maximally crouched ( $F_{(1,18)}=8.30$ ,  $P=0.01$ ). Exposure to video images therefore resulted in puppies being more confident in unfamiliar environments at 7-8 weeks of age, suggesting that very early experiences may potentiate learning during the later stages of socialisation.

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## HIGH-ENERGY FOOD SUPPLEMENTATION IN THE LAST 15 DAYS OF PREGNANCY FACILITATES THE ESTABLISHMENT OF NON-OLFACTORY RECOGNITION OF THE KID IN UNDERFED GOATS



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It is known that goats can recognize their kids on the basis of acoustic and/or visual cues at 8 h postpartum. Furthermore, preliminary results from our laboratory indicate that undernutrition during pregnancy impairs this early non-olfactory recognition. Therefore, we investigated whether a high-energy food supplementation at the end of pregnancy could counterbalance the negative influence of undernutrition on the display of non-olfactory recognition of the kid by goats maintained in indoors conditions. Three groups of multiparous mixed breed dairy goats were constituted: controls (N=10), goats underfed during the second half of pregnancy (70% of energy and protein requirements; N=6) and goats underfed from day 75 to day 135 of pregnancy as in the previous group and then supplemented until parturition with 0.6 kg of ground maize/animal (N=7). At 8hr postpartum, each goat was individually exposed to a 5 minute two-choice test between its own and an equivalent alien kid in order to assess its ability of non-olfactory recognition. Latency to leave the waiting pen and reach a kid, time spent near each kid, time spent looking towards each kid, and number of visits to each kid were recorded. Control goats spent more time near their own kid, watched their own kid more and visited their own kid more frequently than the alien (Wilcoxon;  $P < 0.05$ ). In contrast, underfed goats did not show a preference for either kid for any of the studied variables (Wilcoxon;  $P > 0.05$ ). Finally, underfed and supplemented goats spent significantly more time near their own kid, looked towards it and visited it more than the alien kid (Wilcoxon;  $P < 0.05$ ). Therefore, high-energy food supplementation at the end of pregnancy in underfed goats can promote the establishment of early non-olfactory recognition of the kid and may thus facilitate survival of the young. Supported by PAPIIT IN217205 - FIS B/3872-1 and CATEDRA IN2-07.

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Oral Paper: Early experience  
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## INFLUENCE OF VARIOUS EARLY HUMAN-FOAL INTERFERENCE ON SUBSEQUENT HUMAN-FOAL RELATIONSHIP



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Whereas the way animals perceive human contact has been mostly examined in pet animals, a small amount of investigations have been done in domestic ungulates. In the present study, we examined different early human-foal interactions. Three procedures were tested: 1) bringing the foal to the mare's teat in order to associate gentle human handling with food reinforcement; 2) exposure to a motionless person for 15 minutes during the first five days after foal's birth; 3) stroking the foal over the same period. We compared then the behaviour of foals which received one of these 3 additional human contacts at different ages to control foals that were exposed to humans only during routine procedures. Forty-three foals were involved in these experiments. The results indicate that forced stroking of foals in early life did not improve later human-foal relation. Thus, foals which were early stroked by the experimenter were not more willing to accept human contact at later ages (Mann-Whitney U-test:  $P > 0.05$ ), while foals that were brought to the dam's teat, a unique human handling, even tended to avoid human approach at 2 weeks (Binomial test  $P = 0.055$ ), and physical contact at 1 month of age (Mann-Whitney U-test  $P < 0.05$ ). Conversely, a mere passive presence for short periods over the five first days of life indicated a slight, but not statistically significant improvement of the relationship. In addition, we have previously demonstrated that the use of the mare-foal bond was a simple, rapid and non-invasive way to establish a positive and durable relation with the foal.

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## DOMINANCE HAS A QUANTITATIVE COMPONENT



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Dominance is often regarded as an all-or-nothing question, with one partner being dominant, the other subordinate. We believe that there is more to it. We looked at the behaviour of 10 one-year-old, female Scottish Blackface sheep during pairwise competition for food (blocking, aggressive displacements, time spent at the feeder during 5-minute tests) and, two months later, at their choice of nearest neighbours while grazing as a group (10 separate 1-hour sessions, nearest neighbour at 4 min intervals). The association index is equivalent to the percentage of scans that sheep in a dyad were each other's nearest neighbour. Dominance was based on whether blocking behaviour was only performed by one sheep in a dyad (37 of 45 dyads). Dominance score predicted the difference in aggressive displacements (dominant displacing more than subordinate in 28 of 38 dyads, sign-test,  $P < 0.001$ ) as well as the difference in time-at-feeder (dominant more time-at-feeder in 31 dyads, sign-test,  $P < 0.001$ ), which varied from -88.0 to 287.4 sec. The association index for dyads during grazing varied from 2.5 to 31.3 % of the scans. The difference in time-at-feeder between the two sheep in a dyad for the dyads with the lowest, intermediate and highest association index ( $N=10, 24, 11$ ) was 250.3, 91.1 and 47.0 sec (median, Kruskal-Wallis,  $H=12.11$ ,  $df=2$ ,  $P=0.002$ ). The subordinates in low-association dyads spent less time-at-feeder than those of intermediate or high association (5.0, 68.6 and 99.2 sec, respectively; median, Kruskal-Wallis,  $H=10.83$ ,  $df=2$ ,  $P=0.004$ ). We conclude that dominance relationships in sheep are reflected in the choice of nearest neighbours in the field. Sheep in dyads with low association show a large difference in competitive success. Therefore, dominance relationships are not all-or-nothing, but have a quantitative component, which is reflected in the animals' spatial distribution.

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Oral Paper: Social behaviour (II)  
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## SOCIAL BONDS OF DAIRY COWS AFFECT REACTIONS IN A CHALLENGING SITUATION AND RELATE TO HEALTH



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Social bonds were shown to ease coping with challenge in some species. In dairy cows, frequent regrouping hamper the development and maintenance of social bonds. Our aim was to investigate the possible role of social bonds for coping with challenge and health in dairy cows. Agonistic and non-agonistic social interactions of a herd of 56 Brown Swiss dairy cows were recorded for 6 hours on 50 days within 5 months. The observation period was disposed for further evaluation into three time sections. A pair of cows was defined to be bonded, if both licked each other significantly more frequent than others (chi-square test) during two time sections at least. Cases of lameness and other disease were taken from farm health records and incidence in bonded and not bonded cows compared by chi-square test. Ten cows were subjected to a novel object test in an arena twice, once together with a social bonding partner and once with a non-bonded herd member in a balanced order. Behaviour, heart rate and faecal cortisol metabolites were measured and data analysed using Wilcoxon test. Fewer cows with one or more bonding partners were lame (2 out of 17, 12%) compared to cows without a bonding partner (12 out of 30, 40%; chi-square test,  $P < 0.05$ ). In the arena test, cows showed less flinching and stayed closer to the novel object ( $P < 0.05$ ), tended ( $P < 0.1$ ) to approach the novel object quicker, to stay closer to the bonded cow and to lick her more than non-bonded. Cows did not vocalize when with their bonding partner. No difference was found in physiological parameters. The results suggest that social bonding partners have positive effects in stress situations and probably on health in the long term. Management strategies enabling long-lasting social bonds and avoiding frequent disruption should be developed and encouraged. We acknowledge funding by the Austrian Science Fund FWF, Project P13585-BIO.

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## THE ACUTE EFFECT OF A SYNTHETIC PIG APPEASING PHEROMONE ON OPEN FIELD AND INTRUDER TEST BEHAVIOUR



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Synthetic pheromones are used to calm down pigs in different situations during production e.g. mixing and transport. The aim of the present study was to evaluate the effect of a synthetic pig appeasing pheromone (PAP) on fear and aggression. Sixty-four 6 week-old pigs of both sexes were tested in an open field test (OFT) for twenty min. Half of the pigs were blood sampled before and after the test for cortisol measurement, while the other half was tested subsequently in an intruder test, which was interrupted if one of the pigs attacked. Each day 2x4 pigs were tested in two arenas. Twenty minutes before test start each arena was sprayed with either PAP or a placebo and spraying was repeated after the first two piglets. The results showed no effect of PAP on behaviour during testing. However, a greater increase in plasma cortisol level was found in animals tested with PAP as opposed to placebo (144.4 vs. 108.9 nmol/l;  $F_{1,17}=6.32$ ;  $P<0.05$ ). Pigs tested initially after spraying passed fewer squares in the last five minutes of the test (4.8 vs. 6.7 sq/min;  $F_{1,36}=5.41$ ;  $P<0.05$ ) irrespective of the type of spray used. Furthermore, these piglets had a lower cortisol level after the OFT as opposed to pigs tested second after spraying (164.8 vs. 204.7 nmol/l,  $F_{1,14}=6.07$   $P<0.05$ ). In the intruder test the female pigs had a shorter latency to contact the intruder (8 vs. 14 s; chi-square =5.25,  $P<0.05$ ) and tended to have a shorter latency to attack (187 vs. 338 s; chi-square =3.30,  $P=0.07$ ). In conclusion, PAP does not appear to have an acute effect on behaviour related to fear and aggression in the test situations used in this study, however caused a greater increase in cortisol. Spraying with an ethanol based substance (placebo) affected the behaviour towards a less reactive behaviour supported by a lesser increase in cortisol.

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Oral Paper: Social behaviour (II)  
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## HABITUATED COMPANION HORSES REDUCE FEAR RESPONSES IN NAÏVE TEST HORSES



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Although previous studies have failed to demonstrate social learning in horses in complex learning situations, transmission of behaviour is likely in simpler, biologically relevant situations, such as responses to fear-eliciting stimuli. Thirty-six, 2 year-old, minimally handled horses were used to investigate social transmission of fear responses. All horses were habituated to social isolation and to feeding from a feed container inside a test arena. The horses were assigned as either companion (N=18), or test (N=18) horses. Half of the companion horses (N=9) were habituated to an otherwise frightening test stimulus (a moving, black plastic bag; 0.5x0.8m), whereas the rest of the companion horses remained untrained. During the test, we exposed unique pairs of trained/untrained companion and test horses to the test stimulus while registering heart rate and behavioural responses. Two feed containers were present in the arena, and the horses were allowed to feed for one minute, before the stimulus was applied. Each of the 18 pairs was exposed to the stimulus three times. Between exposures, the horses were removed from the arena. On the following day, all test horses were exposed to the test stimulus alone. Data were analysed using a Mixed Model repeated measures ANOVA in SAS. Test horses, which were paired with a trained companion horse, received a lower behavioural score ( $F_{1,14}=4.71$ ;  $P=0.048$ ), and showed tendencies towards shorter latencies to return to the food ( $F_{1,14}=4.20$ ;  $P=0.058$ ) and lower heart rate responses ( $F_{1,14}=3.26$ ;  $P=0.092$ ), compared to test horses with untrained companions. In addition, trained companion horses reacted significantly more during paired exposure, than when they were on their own (e.g. behavioural score:  $F_{1,8}=14.24$ ;  $P=0.005$ ). When test horses were subsequently tested alone, there was no significant difference between the treatment groups. We conclude that the transmission of fear responses is bidirectional and that transmission affects mainly immediate responses.

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## ANNOUNCING THE ARRIVAL OF ENRICHMENT INCREASES PLAY BEHAVIOUR AND REDUCES WEANING STRESS INDUCED BEHAVIOURS OF PIGLETS DIRECTLY AFTER WEANING

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Piglets have difficulties with the abrupt changes at weaning associated with conventional pig production systems. Previously it has been shown in rats that reward and announcement of reward counteract impact of stress effects. In the present study it was investigated if announcement of an environmental enrichment, more than enrichment alone, could facilitate play behaviour and reduce weaning and mixing stress induced behaviours such as increased aggression, increased injuries and increased social manipulative behaviours (i.e. tail biting, belly nosing, mounting). Twenty-four litters of conventional housed fattening piglets were kept under three different experimental conditions: sound cue (conditioned stimulus, CS) paired with an environmental enrichment (unconditioned stimulus, US) with a maximum delay of 30 seconds (CS-US paired) in which anticipatory behaviour develops; cue-environmental enrichment unpaired (CS-US unpaired) and no cue and no environmental enrichment (No CS-US). At two weeks of age the so called 'anticipation procedure' started and ended two days after weaning. Growth, play, aggressive, social manipulative, eating and inactive behaviour, and injury rates were measured before and after weaning. Results of this study indicated that the announcement of enrichment and not enrichment alone significantly increased play behaviour after weaning. In addition, announcement of enrichment and to a lesser extent enrichment alone decreased aggression before and after weaning and also the amount of injuries after weaning. The most important finding of this study is that the effects of an expected enrichment are more pronounced than the effects of enrichment alone. It is therefore suggested that announcing enrichment through allowing piglets to anticipate the enrichment, has an additional effect on the impact of enrichment alone and can be used as a new tool to reduce weaning and mixing stress in piglets.

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## A BIRDS-EYE VIEW OF STOCKING DENSITY: HOW DO BROILERS PERCEIVE THE CROWDED CONDITIONS IN WHICH THEY ARE KEPT COMMERCIALY?



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The aversiveness of high stocking densities was tested in 16-day old broiler chicks by comparing the speed at which they traversed a raceway, passing chambers containing either high (50kg/m<sup>2</sup>) or low (8kg/m<sup>2</sup>) densities of conspecifics. Each chick performed a 'naïve' run and an 'experienced' run. Chicks distress-called more in the start and goal boxes than in the raceway ( $T=7.18$ ,  $P<0.001$ ,  $N=15$ ), and also called more when naïve than when experienced ( $T=2.48$ ,  $P=0.027$ ,  $N=15$ ). Chicks were quicker to enter the treatment area than to leave it ( $T=-3.80$ ,  $P=0.002$ ,  $N=15$ ), and were slower to leave low than high stocking densities of conspecifics ( $T_{27}=2.21$ ,  $P=0.036$ ). There was a trend for more calling at the lower stocking density ( $T_{27}=1.80$ ,  $P=0.083$ ). Videos filmed inside commercial broiler houses were analysed using a novel 'Virtual Raceway' method. From video, a feeding bird was randomly selected (a clear end-point analogous to the goal box of the previous experiment) and the tape was rewound to the point where the bird first stood up (analogous to the start box). The target bird was tracked along its path to the end-point, passing many other birds on the way. The birds could thus be seen as walking down an imaginary raceway to a goal. The Virtual Raceway method suggested that broilers may be more influenced by their local social environment than stocking density per se. Target bird behaviour was influenced by the behaviour of its nearest neighbour ( $F_{5,32}=3.08$ ,  $P=0.022$ ) and the number of other chickens 'in the way' of the closest point at the trough ( $F_{1,32}=5.20$ ,  $P=0.0294$ ). However, nearest neighbour behaviour was influenced by stocking density ( $F_{1,33}=4.34$ ,  $P=0.045$ ). Thus stocking density had no direct effect on target bird behaviour or the path taken to the feeder, though may have an indirect influence via neighbouring birds. Whether this effect is aversive is inconclusive.

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## POST-INGESTIVE FEEDBACK ON DIET SELECTION IN HORSES (EQUUS CABALLUS); DIETARY EXPERIENCE CHANGES FEEDING PREFERENCES



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This study examined whether horses selected and maintained preference for three diets having been presented with each diet singularly. Seven stabled horses of mixed breed were adapted to a mixture of the three fibre based diets. The diets were equal in energy and fermentable fibre content but rich in one of three energy sources: protein, hydrolysable carbohydrate or fat. Data collection was divided into three phases: (1) five days self selection with access to equal quantities of all three diets, (2) a monadic phase involving exposure to each diet for two separate periods of three days (18 days in total), and (3) a further five days self selection. This approach is designed to control for the horse's pre-trial preferences and allow adaptive changes in preference during the trial. Diet position changed daily during the self selection phases. The order that the diets were presented to the horses during the monadic phase was balanced to control for order effects. Total intake (kg) was measured four hours post presentation. Trial diets made up the majority of the daily diet; vitamins and minerals were fed separately. Horses had standardised time out of the stables each day either on a horse walker for 40 minutes (self selection) or at pasture for an hour (monadic phase). During the first self selection and the monadic phases, intake of the three diets was equal, suggesting random sampling. In the second self selection, there was a shift in selection away from the fat rich diet (Repeated measures diet\*phase,  $F_{2,12}=15.136$ ,  $P<0.001$ ). Horses selected for the protein and hydrolysable carbohydrate rich diets (mean kg+/-SE)  $2.4\pm 0.3$  and  $2.2\pm 0.2$  respectively, over the fat-rich diet,  $0.4\pm 0.1$ . Selection of the three diets altered after a period of exposure to each diet; indicating that horses modify their diet selection on the basis of post-ingestive feedback.

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Oral Paper: Feeding behaviour  
Wednesday 9/8/06 – The Reception Room



## ABSENCE OF VARIATION BETWEEN SHEEP IN MOTIVATION TO FEED



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Behavioural demand methodologies allow us to quantify the behavioural needs of farm animals. Traditionally, few animals are used due to the difficulties of training, and individuals are cycled through all experimental treatments. In order to conduct a behavioural demand experiment whereby animals are randomly allocated to treatments, it is necessary to know the inherent differences in motivation between animals. Therefore, the aim of this experiment was to investigate individual differences in the motivation of sheep to work for a food reward at a fixed level of feeding. Twenty-four two-year-old Merino ewes were trained to press a lever for an 8.5g reward of lupin seed. Each animal was tested in 20-minute sessions, carried out over 5 days, with an ascending sequence of fixed ratio values (FR; 5, 10, 20, 30, 50), changing daily. Total daily rations were 1.2 times maintenance requirements, half of which was fed as lupins 20 minutes prior to testing. The balance, minus reward consumption, was fed as lucerne pellets 2 hours after test completion. Data were log transformed before performing an Analysis of Variance. The number of rewards obtained declined as the FR increased ( $P < 0.001$ ) with mean rewards obtained being 45, 36, 24, 18 and 11 for FR-5 to 50 respectively. The difference between animals in the number of rewards obtained was significant ( $P < 0.001$ ), and there was no animal  $\times$  FR interaction ( $P = 0.20$ ). If motivation is defined as the rate of change in rewards obtained as workload increases, then the individual differences in this study imply a difference in work intensity not motivation, which would be reflected in a significant animal  $\times$  FR interaction. These results suggest that it would be appropriate to design a behavioural demand experiment for feeding motivation, in which sheep are randomly assigned to treatment groups.

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## FEEDING BEHAVIOUR AND RESPONSE TO WEANING OF CALVES FED LIMITED OR AD LIBITUM MILK USING AN AUTOMATED FEEDING SYSTEM



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There is little known about feeding motivation in group housed calves fed with an automated feeding system. To examine the advantages and disadvantages of increased access to milk in an automated feeding system, we fed calves either 4L milk replacer per day(d) or allowed ad lib intake (N=25 per treatment). Results were analysed using a mixed model including calf, treatment and time as factors, and feeding behaviour as variables. Differences were significant at P=0.05. Milk intake by ad lib fed calves increased from 4.8 L/d on d1 to 14-15L/d from d14 to d25 and then decreased to 11-14L/d until weaning on d45. Ad lib fed calves had 11-13 rewarded visits (i.e. when they consumed milk) to the milk feeder by d5, but this number decreased to 7-9 visits by the day of weaning. Ad lib calves made few (1 to 4 /d) unrewarded (i.e. no milk received) visits. By design, limit-fed calves had only 2 rewarded visits /d. However, these calves had 23 to 29 unrewarded visits/d between d7 and d21, and 13 to 24 unrewarded visits/d between d22 and d45. Ad lib fed calves consumed virtually no concentrate before d21 and by d44 were consuming <90g/d. During the first 4 d after weaning these calves consumed <650g/d. Restricted calves gradually increased concentrate intake such that they were consuming 2.0kg/d by d45, and consumed 2kg/d during the first 4 d after weaning. Weight gains of ad lib fed calves from d0 to d21 were higher (25.2kg) than for limit-fed calves (11.9kg). However, from d21 to weaning, limit-fed calves gained more than ad lib fed calves (24.1kg versus 19.1kg). In conclusion, ad lib access to milk improved weight gain and reduced unrewarded visits to the milk feeder until d21. However, ad lib access to milk reduced concentrate consumption and the advantages were less obvious after 3 wks of age.

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## GRAZING BEHAVIOUR OF HERBIVORES IS AFFECTED BY NUTRITIONAL ENVIRONMENT AND MATERNAL INVESTMENT



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To avoid parasites, herbivores avoid grazing near faeces. This results in a natural mosaic of gaps (short grazed areas) and tussocks (tall avoided areas), which represents a nutrition vs parasitism trade-off in that faeces-contaminated tussocks offer both nutritional benefits and parasite risk. We test the hypothesis that nutritional environment and maternal investment (via lamb number) affect sheep grazing behaviour when faced with this trade-off. There were two environmental treatments (low nutrient and high nutrient environments) and three animal treatments (barren ewes, ewes suckling single lambs and ewes suckling twin lambs). Grazing behaviour was measured using 5min direct focal observations on each animal twice a day. Ivlev's electivity index (IV) was used to determine whether animals selected or avoided tussocks (-1 = avoidance, +1 = selection). REML analysis was used to establish treatment effects. Sheep showed an overall strong and significant avoidance of tussocks across all treatments (mean IV = -0.57). However there was a significant reduction in the avoidance of tussocks by animals on the low nutrient plots (IV= -0.37; Wald=29.73, d.f=1, P<0.001). Ewes suckling twins showed a significantly reduced avoidance of tussocks (IV = -0.47) compared with barren ewes (IV = -0.64; Wald=30.98, d.f=2, P<0.001). Ewes suckling twins in low nutrient environments showed a further reduction in avoidance of tussocks (IV = -0.23; Wald=6.49, d.f=2, P<0.05). Nutritional environment and maternal investment affect the grazing behaviour of herbivores and thus their potential contact with parasites. Lactating ewes with twins have increased contact with tussocks and consequently increased exposure to parasites. This risk of exposure to parasites for ewes suckling twins is further increased in low nutrient environments.

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## EFFECT OF METHOD OF FEEDING COLOSTRUM ON SLEEP IN YOUNG CALVES



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In rats, sucking milk reduces anxiety and promotes quiet sleep (QS) and in calves it induces resting but the effect on their sleep is not known. We aimed to study how calves' sleep could be affected by the milk feeding. Forty-one calves were blocked by birth date and randomly allotted within blocks to the treatments. Calves were either housed for four days with their dam (DAM), or individually with warm colostrum feeding (2l four times a day) either from a teat-bucket (TEAT) or from an open bucket (BUCKET). Calves' sleeping and sucking behaviour was filmed continuously for 48 hours from two days of age on. Behavioral sleep (BS) was defined as calves resting at least 30s head still and raised (QS) or head against body or ground (active sleep, AS). Latency from the end of milk feeding to the start of BS was recorded. The differences between TEAT and BUCKET or DAM were analysed with mixed models. Milk meal duration was longer for TEAT calves compared to BUCKET ( $7.1 \pm 1.4$ min vs.  $5.2 \pm 1.4$ min,  $P < 0.05$ ) but equally to DAM calves. There was no effect of feeding method on the duration of daily BS (mean  $\pm$  se 12h 59 min  $\pm$  1hr 38min). However, BUCKET calves had less QS per day than TEAT calves ( $378 \pm 45$ min vs.  $468 \pm 45$  min,  $P < 0.05$ ) and also longer latencies from milk ingestion to BS compared to TEAT calves ( $22.9 \pm 1.9$  min vs.  $16.2 \pm 0.8$  min,  $P < 0.05$ ). DAM calves slept longer bouts than TEAT calves and less often ( $10.7 \pm 1.6$  min vs.  $8.7 \pm 1.6$  min and  $79 \pm 10$  vs.  $92 \pm 10$ ,  $P < 0.05$  for both). Sucking colostrum from a teat bucket compared with drinking from a bucket increased sleepiness and the amount of QS. Individually housed calves slept more fragmentarily than dam-reared calves.

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Oral Paper: Feeding behaviour  
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## EFFECTS OF HIGH CONCENTRATE VERSUS HIGH FIBRE DIETS ON THE BEHAVIOUR OF HORSES



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Domesticated horses are often fed high levels of processed concentrate feed and the concentrate:forage ratio increases with work level and intensity. The aim of this study was to assess equine behaviour in relation to forage levels in the diet. Thirty-six, three year old, Dutch Warmblood horses, were fed either a high fibre diet (HF) (concentrate:haylage=1: 4, N=18) or an isoenergetic low fibre diet (LF) (concentrate:haylage = 4:1, N=18) for three months. Horses were exercised in a horsewalker (40m diameter: walk, trot and canter) at increasing training levels (phase1-3) up to medium level work (Phase 3:72 minutes). Behaviour and heart rate data were collected in the stable, on the horsewalker and during a 15 minute exercise test on a treadmill at the end of each phase. To obtain homogeneous variances, behavioural data were transformed prior to ANOVA to test for effect of diet and sex. LF horses spent 56% less time on ration eating than HF horses ( $F=26$ ;  $P<0.001$ ) and 44% more time eating bedding material and faeces ( $F=47$ ;  $P<0.001$ ). However, when adding ration and 'bedding foraging' together there was no significant difference between treatments. In the first and third training phase LF horses showed significantly more walking activity in the boxes compared to HF horses ( $F=4.7$ ,  $P<0.05$ ;  $F=8.1$ ,  $P<0.01$ ). Two LF horses were observed to develop recurring crib-biting behaviour by phase 3 ( $F=5.3$ ,  $P<0.05$ ). In the horsewalker and on the treadmill LF horses were more excited and less manageable than HF horses ( $F=2.7$ ;  $P<0.05$ ). Results confirm that horses on high concentrate diets are more likely to develop abnormal behaviours and are less calm. Ingestive behaviour observations point towards an 'ethological' minimum requirement for time spent foraging.

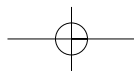
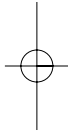
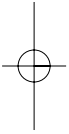
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ORAL PAPERS  
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DOING EMOTION AND FEELING EMOTION:  
CONSTRUCTING A FRAMEWORK FOR  
INVESTIGATING SUBJECTIVE EMOTIONAL  
STATES IN ANIMALS



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Central to any animal's welfare are its conscious, 'subjective', emotional experiences (Dawkins 1990, Duncan and Petherick 1991, Duncan and Fraser 1997, Mendl and Paul 2004). Of particular importance is its capacity to suffer: the ability to experience unpleasant, negative states. For the majority of lay observers, any animal that patently does emotion (e.g. vocalizing as if in pain, fleeing as if in fear) is clearly also feeling emotion. But, for many scientists, the possibility that many animals may 'do' emotion but not feel it, is equally clear (e.g. Hinde 1985, Le Doux 1996, Macphail 1998, Rolls 1999). Establishing methods by which to detect and measure emotional experiences in animals, if they occur, must be an ultimate goal in animal welfare research (Paul et al 2005). The aim of this review, therefore, is to address the theoretical and philosophical issues pertinent to the measurement of subjective emotion in animals. We aim to clarify the research issues that need to be considered in this area, and propose a framework for exploring the possibility that subjective emotional states of some kind occur in animals. Our approach is based predominantly on the human psychological and neuroscience literature on emotion. These are the principle fields in which the processes and possible functions of subjective emotional states have been considered at some length. We describe research findings in these areas and highlight their potential relevance to animal research. In particular, we consider research that has investigated the role of subjective affective states in information processing and risk taking, and propose that these functions may also be present in non-human animals.

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Oral Paper: Emotion  
Thursday 10/8/06 – The Great Hall



## STUDIES OF EMOTION-COGNITION LINKS IN HUMANS AS A BASIS FOR DEVELOPING NEW MEASURES OF ANIMAL EMOTION



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Accurate measurement of animal emotion is an important goal in animal welfare science. Human emotion research can help in this endeavour because it reveals links between linguistic report of subjective emotions and non-linguistic indicators that could be used in animals. For example, a person's emotional state can be characterised by their cognitive bias (e.g. depressed people tend to judge ambiguous stimuli as negative rather than positive). We recently developed a non-linguistic test of cognitive bias for animals. Here we investigate whether a computerised version of this test can be used with humans. Participants initially saw a line on a screen with symbols of a happy face (HF) at one end and a sad face (SF) at the other. The line then vanished and a cross appeared at some point along its length. Participants were trained to press a 'happy' key if the cross was nearer where HF had been (to gain points and see an appealing animal image), and to press the 'sad' key if it was nearer SF (to avoid losing points and being shown a threatening animal). In the test phase 33% of crosses were presented in an ambiguous position (mid-point of the line). In experiment 1 (N=77 students), subjects who scored highly on a questionnaire measure of positive affect were more likely to classify ambiguous stimuli as positive ( $r_s=0.379$ ,  $N=67$ ,  $P=0.002$ ), while high negative affect subjects did the opposite ( $r_s=-0.241$ ,  $N=67$ ,  $P=0.049$ ). In experiment 2 (N=96 students), subjects exposed to happy mood inducing music classified ambiguous stimuli as positive more than those exposed to sad music ( $t_{91}=2.98$ ,  $P=0.004$ ). The results indicate that non-linguistic measures of cognitive bias reveal the same emotion-cognition links in humans as do linguistic measures, hence supporting the development of non-linguistic cognitive bias tasks for animals and allowing human-animal comparisons using analogous tasks.

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## ABILITY OF LAMBS TO FORM EXPECTATIONS



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The concern for animal welfare relies on the acknowledgement that animals can feel emotions. Appraisal theories developed in cognitive psychology offer a framework to study emotions in animals. Emotion is assessed by measuring the behavioural and physiological responses of the individual and by considering its evaluative process of the triggering situation based on few elementary criteria. Lambs are known to respond differently to the criteria of suddenness, unfamiliarity, and unpredictability. Here, we investigated the criterion of discrepancy from expectations in lambs subjected to successive contrasts (i.e. reward decrease or increase). Forty-five lambs were trained to obtain a small or a large food reward by introducing their muzzle in a hole. Then, in a first step, half of them were shifted to the large or small reward while the remaining half continued to get the same sized reward. In a second step, the shifted lambs were returned to their initial sized reward while the unshifted lambs were subjected to extinction. Behaviour and cardiac activity were recorded and treatments compared with ANOVAs for repeated measures. Compared with unshifted lambs, those that were shifted to a small reward visited the hole more often (respectively  $6.21 \pm 0.34$  vs.  $7.22 \pm 0.31$ ,  $F(\text{period} \times \text{treatment})=99.05$ ;  $P<0.001$ ). The extinction decreased the cardiac variability (RMSSD) more when the negative contrast was greater (after the extinction of the large vs. small reward, respectively  $35.7 \pm 10.4$  ms vs.  $65.3 \pm 10.4$  ms,  $F(\text{period} \times \text{treatment})=44.5$ ;  $P<0.001$ ). The same responses were observed in lambs subjected to a negative contrast after having experienced a positive one. Lambs are thus sensitive to negative contrasts and their responses depend on the discrepancy from expectations. In addition a previous positive contrast increases the responses to a negative one. Hence our study shows that lambs are able to feel negative emotions such as frustration.

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Oral Paper: Emotion  
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## WHAT DO 50-KHZ VOCALIZATIONS TELL ABOUT THE INTERNAL STATE OF A RAT?



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The "50-kHz calls" of adult rats are often emitted in (anticipation to) pleasurable situations. However, they are also emitted in novel environments with scents of other rats and even by victims of aggression. How reliable are 50-kHz calls as indicators of internal (welfare) states? We tested the effects of potentially positive prior experience with experimental situations and of test-context on the quantity and quality of 50-kHz calls. Vocalizations of two groups of socially and enriched housed male rats were recorded during the first 15 minutes in an empty cage with scents of another rat, on 3 consecutive days. The 12 rats that experienced a prior training in an appetitive T-maze learning task had to be discarded from further analysis, as they barely vocalized (18±6 calls). In contrast, the 12 naïve rats emitted a surprisingly high number of 50-kHz vocalizations (598±11; T=5.75, P<0.001), which was stable over three days. The number of calls gradually decreased from 77.9±17.4 in the first minute to 8.8±2.8 in the 15th minute (T=4.1, P<0.001). On the second day, half of the rats were recorded in a clean cage without rat scents, which did not affect calling rates (scented vs. unscented subgroups: U=11, P=0.31). Twenty days later, vocalizations and behaviour were recorded in a 5-min Open-Field test (diameter: 75cm) and Elevated-Plus Maze. In contrast to pilot tests, there were almost no vocalizations. Interestingly, we found some indications that anxiety-related behaviour was correlated to call-characteristics in the earlier recordings. However, due to the enormous intra-individual variety in call-characteristics, this needs further research. Conclusion: 50-kHz calls should be interpreted with care: they are not only pleasure-related, and are affected by experience and possibly by anxiety. Considering the enormous intra-individual variation, it's likely that "50-kHz calls" is a rather diffuse category of call(type)s with multiple levels of information.

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## INCONSISTENT BEHAVIOURAL AND CARDIAC PATTERNS IN EWES' RESPONSES TO THE SEPARATION FROM THEIR LAMBS



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The dam-offspring relationship is a good model to investigate emotions in animals. Removing the lamb induces behavioural responses in ewes (e.g. agitation and vocalisations), which may be more pronounced in primiparous dams. Even separation from the lambs only by a lattice fence is stressful for ewes. We analysed behavioural and physiological responses of ewes to separation from their lambs according to levels of visual separation and maternal experience. Twelve primiparous and 12 multiparous ewes were individually exposed to two successive 3-min phases: 1) in contact with their lamb placed behind a grid, and 2) at 6m away from the lamb either visible or not. After having been familiarised to the experimental procedure, the ewes were tested twice following a cross-over design. Behaviour, vocalisations and cardiac activity (via adhesive external electrodes) were recorded and blood was collected by venipuncture for cortisol assay. A mixed model of ANOVA was performed for data except for vocalisations that were analysed by non-parametric tests. After the lamb was moved away, the ewes were more active ( $F_{1,22}=97.72$ ,  $P<0.0001$ ) and more vigilant ( $F_{1,22}=411.51$ ,  $P<0.0001$ ), they also bleated more ( $W=33.8$ ,  $P<0.001$ ), and their heart rate and cortisol levels dramatically increased ( $F_{1,22}=42.25$ ,  $P<0.0001$ ;  $F_{1,22}=40.31$ ,  $P<0.01$ ). When the lamb was visible, the ewes were more vigilant ( $F_{1,22}=7.73$ ,  $P<0.01$ ) and vocalised more ( $49.3\pm 4.2$  vs.  $36.4\pm 2.1$ ;  $U=112.5$ ,  $P=0.02$ ) than when the separation was total. Surprisingly, their tachycardia was less pronounced ( $124.3$  vs.  $134.3$  bpm;  $F_{1,22}=6.29$ ,  $P<0.05$ ). Parity had very little effect: cortisol response was less marked in primiparous than in multiparous dams ( $F_{1,22}=5.05$ ,  $P<0.05$ ). Therefore, the sight or not of lambs during separation induces inconsistent behavioural and cardiac responses in ewes. Spectrographic studies of vocalisations and heart rate variability analyses are in process to better investigate the reactivity of the autonomic nervous system and to identify possible vocal markers of emotional states.

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## ANTICIPATION AS A TOOL TO EXPLORE POSITIVE EMOTIONS IN LAYING HENS



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The aim of this study was to identify parameters indicating a positive emotional state in laying hens by investigating their anticipatory behaviour. We trained 18 laying hens to associate three different sound cues with either a positive (access to a mealworm), a negative (a squirt of water) or a neutral event (nothing). After they reached criterion, all birds received one test session per day for 4 consecutive days. One session comprised eight, pseudo-randomised trials per bird (5 positive (POS), 1 negative (NEG), 1 sounded neutral (SN) and 1 muted neutral (MN) trial). All test trials consisted of a 15-sec waiting period, during which no sound was played, followed by a 15-sec anticipation period and the event. The intertrial-interval was 10-30 secs. Video recordings were used and data were analysed using a linear mixed model. During MN trials, behaviour did not differ between the waiting and anticipation periods. During POS, SN and NEG trials, the number of head flicks ( $P<0.001$ ) and head movements ( $P<0.001$ ) increased during anticipation compared to the waiting period, whereas foraging decreased ( $P<0.001$ ). Standing alert (bird stands upright with eyes open and neck stretched upwards) was higher during anticipation than during waiting periods in POS trials ( $P<0.05$ ). Comfort behaviour tended to increase in POS ( $P<0.10$ ) and decrease in NEG trials ( $P=0.10$ ). The number of steps was higher for NEG and SN compared to POS trials ( $P<0.01$ ) during anticipation. Standing alert was higher in POS than in NEG anticipation periods ( $P<0.05$ ). Comfort behaviour was higher in POS than in SN ( $P<0.05$ ) and NEG trials ( $P<0.01$ ) during anticipation. Thus, the behavioural changes unique to anticipation of a positive stimulus were lower levels of locomotion and higher levels of standing alert and comfort behaviour. However, whether these changes are actually associated with a positive emotional state still needs to be validated.

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## THE EFFECTS OF USING LIDOCAINE ON THE RESPONSE OF YEARLING BISON TO DEHORNING



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Bison (*Bos bison*) that are farmed for meat in North America are horned animals and presently no polled phenotypes exist. Maternal bison are extremely aggressive in defense of their young thus dehorning calves at an early age is not viable. Dehorning older calves is more invasive and various methods are used, typically without pain mitigation. A 3×2 factorial design was used to examine the effects of two horn removal procedures (dehorning, tipping) and control, each with and without the use of anaesthetic (Lidocaine). Weight gain and behaviour were measured. A total of 12 pens were studied, each containing 6 intact male bison (mean body weight (BW) = 199.6±2.8kg). Each dehorning method×anaesthesia combination was applied to 2 pens. Bison were weighed at dehorning, 15d after and every 30d for 6 months. Behaviour was observed by interval sampling pens every 5min during daylight hours both for 24h before and 48h after dehorning. Mixed model procedure was used to analyze the BW and transformed behavioural data. Overall, there was no significant effect of dehorning methods ( $P = 0.30$ ) or method×anaesthesia combination ( $P = 0.55$ ) on BW, however, anaesthesia significantly improved BW ( $P < 0.008$ ). Over a 6 mo period Lidocaine treated dehorned, and tipped animals gained 16.7 and 6.5 kg more BW, respectively than the animals without treatment in the same group. Twice as many bison were observed eating in Lidocaine treated groups for both dehorn and tipped procedures (11 and 18% vs. 5 and 10%, respectively). Results suggest application of Lidocaine during dehorning procedure can improve bison productivity and welfare.

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Oral Paper: Assessing lameness, pain and inflammation  
Thursday 10/8/06 – The Reception Room



## LAMENESS AND PAIN IN DAIRY COWS



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The objective of this study was to detect the attributes of impaired gait that are associated with pain, using subjective and objective methods. Lamé Holstein cows (N=27) were assigned to 3 ketoprofen doses: 0, 1.5, and 3.0 mg/ kg IV. The experiment consisted of 3 phases: before, during and after ketoprofen treatment, each phase lasting 3 days. Subjective assessment of gait was scored from video. Overall gait and intensity of 4 specific attributes (head bob, tracking-up, back arch and reluctance to bear weight) were evaluated with a visual analogue score (VAS - scale from 0 to 5). Kinematic measures (stride length, stride height, stride duration and hoof speed) were calculated from digitized video recordings using Peak Motus software. Observed values were averaged to form one value per cow per phase and compared across the two baseline phases (before vs. after). Variables with significantly different baseline values were dropped from the analysis. All other variables were averaged across the baseline phases. The means of during phase were then subtracted from those of the baseline phases, to calculate a difference value for each cow. The resulting differences were regressed against the dose of ketoprofen to test the effect of dose of the analgesic on changes in gait. Overall gait improved with increasing dose of ketoprofen ( $R^2=0.27$ ; 22df;  $P= 0.011$ ). Cows receiving an intermediate dose improved by 0.13, while those receiving the highest dose improved by 0.3. Tracking-up also varied with dose of ketoprofen ( $R^2=0.24$ ; 22df;  $P= 0.01$ ), such that cows receiving the highest dose were 0.19 VAS units over cows receiving no ketoprofen. Kinematic measures differed between the before and after phases of the experiment and were therefore dropped from the analysis. This study provides the first direct evidence to validate specific gait attributes as measures of pain due to lameness.

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## LOCAL ANAESTHETIC AS A MEANS TO VALIDATE MEASURES OF LAMENESS IN DAIRY COWS



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To validate two potential methods for detecting lameness in dairy cows, we gait scored lame and healthy lactating Holstein cows (N=12) while walking and used load cells to measure weight placed on each leg while standing, before and after injections of local anaesthetic (2ml 2% lidocaine HCL) into the leg most responsible for the lameness. Before injection, healthy cows had lower gait scores than lame ones (2.4 vs 3.9±0.1 P<0.05). After injections, gait scores of healthy cows remained constant, while gait scores of lame cows were reduced over 15 min (3.4±0.1 P<0.05). Lidocaine reduced scores on some of the components of the gait score, most noticeably head bobbing, tracking up, joint flexion, asymmetric stepping, and reluctance to bear weight (P<0.05). However, there were no significant effects on swinging out or back arch. Healthy cows placed their weight more evenly among their four legs than did lame cows. Lame cows placed less weight on the injured leg (19.0% vs 26.1±1.7% P<0.05) and placed more weight on the contralateral leg than did healthy cows (P<0.05). Furthermore, the variability in weight applied to the injured and the contralateral leg was much higher for lame cows than for healthy cows (P<0.05), suggesting more frequent shifting of weight between contralateral legs. After injection, the percent of weight applied to the injured leg increased (21.8±1.7) and the variability in weight applied to the injured and contralateral legs was reduced (P<0.05). The system of gait scoring and the measure of weight applied to each leg were both able to detect lame cows and were both sensitive to local anaesthetic, indicating some degree of validity, although some of the components of the gait scoring system appeared not to be related to the pain of lameness. Lameness is most apparent in weight shifting between contralateral legs.

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## EFFECTS OF LAMENESS ON ACTIVITY IN DAIRY COWS AND THE EFFECTS OF HOOF TRIMMING



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Lameness is a serious welfare problem of dairy cattle but detection of lameness is difficult. Improved gait scoring techniques and automated means of assessing time spent standing have great potential to improve early detection. Lameness is often treated by regular hoof trimming (usually twice a year) but we know little about how hoof trimming affects gait or the other behavioural changes associated with lameness. We examined the gait using video-recordings, hoof health, and automated measures of resting behaviour of 48 lactating dairy cows before and after hoof trimming. Gait scores (1, good to 5, lame) were based on judgements of the changes in the components of gait known to be affected by lameness: tracking up, head bobbing, swinging out, arched back, joint flexion, reluctance to bear weight and asymmetric stepping. Hoof trimming did not affect ( $P>0.10$ ) gait scores of lame cows (mean $\pm$ SE =  $3.30\pm 0.11$ ) but gait scores of healthy cows increased ( $P<0.01$ ) after hoof trimming (before:  $2.35\pm 0.10$ ; 6 weeks after  $2.65\pm 0.11$ ). Overall, lame cows lay down for longer each day than healthy cows ( $817.7\pm 19.4$ min versus  $735.6\pm 15.4$ min;  $P<0.01$ ). This increased lying time was due to a reduced duration of bouts of standing by lame cows ( $66.0\pm 4.5$ min versus  $77.7\pm 4.4$ min,  $P=0.07$ ). After hoof trimming, the difference between healthy and lame cows increased for total lying time ( $P=0.04$ ) and duration of bouts of standing ( $P<0.01$ ). Lame cows clearly lay down for longer than healthy cows. The effects of hoof trimming were complex and varied according to the hoof health of the cow and the time since hoof trimming. The results confirm the ability of our improved gait scoring technique to identify cows with hoof problems. While hoof trimming leads to improved hoof health in the long term, we found no evidence that hoof trimming improves the gait or mobility of cows in the short term.

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## ASSOCIATIONS BETWEEN BEHAVIOURAL INDICATORS AND INFLAMMATORY DISEASE IN DAIRY COWS



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Behavioural changes associated with pain and disease in dairy cows have rarely been documented and, generally, anecdotally. In this study associations between behaviour, mastitis and inflammatory limb lesions were observed. It was hypothesised that cows with inflammatory disease would show signs of greater arousal and reactivity. Commercial dairy farms (22) in Scotland were each visited twice (with cows housed and while at pasture) with approximately 30% of lactating cows randomly selected. Locomotion score (1-normal, 2-mildly lame,  $\geq 3$ -lame), body condition score and Somatic Cell Count (SCC) for milk from individual teat quarters were recorded for each of 1431 cows. The reactivity of 1324 of these cows was assessed in a surprise effect test (SET). Each cow was subjected once to a spray of water applied to the para-lumbar fossa by an experimenter standing at a distance of approximately 2m. The behaviour of a sub-sample of 605 cows was also observed in the milking parlour using focal animal observations. Immediately following the SET, lame cows twitched more than non-lame cows ( $\chi^2 = 14.14$ ;  $P < 0.001$ ). Cows with sub-clinical mastitis (SCC  $> 150,000$  cells/ml) also jumped more after the SET than cows with SCC  $< 150,000$  cells/ml ( $\chi^2 = 6.22$ ;  $P < 0.013$ ). A principal components analysis showed that milking parlour behaviours indicative of reactivity loaded onto the first component in the same direction, (28% variation explained). A total Reactive Score (RS) was therefore created. The mean log RS differed between locomotion score groups ( $F = 8.93$ ;  $df = 553$ ;  $P < 0.0005$ ) with lame cows (score  $\geq 3$ ) having a significantly greater mean log RS than non-lame cows. These results support the hypothesis that inflammatory disease is associated with increased reactivity in cows. This study was supported by the BBSRC (Grant no. 17/S15384).

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Oral Paper: Assessing lameness, pain and inflammation  
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## DEVELOPMENT AND ASSESSMENT OF A GAIT SCORING SYSTEM FOR ZOO ELEPHANTS



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Zoo elephants sometimes experience lameness. A gait scoring was devised for the standardised assessment of lameness in elephants. We developed a Numerical Rating Score (NRS) and assessed 16 elephants at five collections. Animals were walked at two speeds, and videos used to record walking and turning. Repeatability and reliability of the scoring system were evaluated by 9 gait experts and 9 inexperienced postgraduates. The scoring system was compared with a Visual Analogue Scale (VAS) using the same observer groups. Faecal samples were taken from 13 of the elephants to determine mean cortisol metabolite concentrations. Intra-observer repeatability was determined using Wilcoxon signed rank tests and Spearman rank correlation for both NRS and VAS. High intra-observer repeatability was observed in both groups for NRS and lower intra-observer repeatability for VAS. Inter-observer reliability was analysed by Cohen's Kappa values and Kendall's coefficient of concordance against gold standards derived from scores given by experts. The expert group had better reliability compared to students when using the NRS (kappa=0.4,  $P<0.01$ ;  $W=0.61$ ,  $P<0.01$  and kappa=0.16,  $P<0.01$ ;  $W=0.58$ ,  $P<0.01$  respectively) and also the VAS (kappa=0.07,  $P<0.01$ ;  $W=0.57$ ,  $P<0.01$  and kappa=0.01,  $P<0.01$ ;  $W=0.54$ ,  $P<0.01$  respectively). The data indicated good intra-observer reliability and repeatability for the gait scoring method. For the gait scores, four elephants scored 0 (normal); six scored 1 (abnormal gait); two scored 2 (mildly lame); three scored 3 (moderately lame) and one scored 4 (severely lame). There was no significant difference between African and Asian elephants in gait scores (ANOVA:  $F=0.17$ ;  $d.f.=1,14$ ;  $P=0.687$ ) or faecal cortisol concentrations (ANOVA:  $F=0.000$ ;  $d.f.=1,11$ ;  $P=0.985$ ). There was a strong tendency for a positive correlation between gait score and faecal cortisol concentration ( $r^2=0.274$ ;  $d.f.=12$ ;  $P=0.066$ ). When data from the lamest elephant were omitted, this correlation was highly significant ( $r^2=0.642$ ;  $d.f.=11$ ;  $P=0.002$ ) indicating a possible relationship between lameness and chronic stress.

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## CHANGES AND INDIVIDUAL CONSISTENCY OVER SEVERAL PARITIES IN TWO TESTS OF MATERNAL RESPONSIVENESS IN OUTDOOR SOWS



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Two previous studies on indoor breeds suggest that a sow's responsiveness to playback of a simulated trapped piglet scream is related to the number of crushed piglets in her litter (Wechsler & Heggin 1997, Andersen et al. 2005). Responses in the Piglet Scream Test have therefore been proposed as indicators of mothering ability where this is defined solely in terms of offspring survival. Little is known about the responses of outdoor sows kept under commercial conditions in this or other putative tests of mothering ability, or about their relationship to piglet mortality. We therefore investigated changes and individual consistency in test responsiveness over several parities in these animals, and the relationship between responsiveness and piglet mortality. Tests comprised a Piglet Scream Test on Day 5/6 post-partum, and a test of the sows' responses to handling of their piglets on Days 1, 9/10, and 24/25 (Piglet Defence Test). Data were collected on 41 sows, but we included in the across-parity analyses only sows for which data were available for all parities (first, second or third, fourth). Responses in the Piglet Scream Test declined from first to fourth parities (Repeated Measures Analysis:  $N=12$ ,  $F_{2,22}=3.55$ ,  $P=0.046$ ), as did the sows' defensiveness scores (Friedman's Analysis of Variance of Ranks (Repeated Measures) tests;  $N=33$ ,  $\text{Chi-square}=6.37$ ,  $\text{d.f.}=2$ ,  $P=0.041$ ). There was some evidence for consistency in individual differences across parities (Piglet Scream Test: Pearson's Correlation; P1 and P2/3:  $N=12$ ,  $r=0.682$ ,  $P=0.015$ ; P1 and P4:  $r=0.521$ ,  $P=0.08$ ; P2/3 and P4:  $r=0.534$ ,  $P=0.074$  (Piglet Defence Test: Spearman Rank Correlations; P1 and P2/3:  $N=33$ ,  $r_s=0.227$ ,  $P=0.204$ ; P2/3 and P4:  $N=33$ ,  $r_s=0.438$ ,  $P=0.011$ ; P1 and P4:  $N=33$ ,  $r_s=0.249$ ,  $P=0.162$ ). Responses in the two tests were correlated in the sows' first, but not subsequent parities (Pearson correlation;  $N=29$ ,  $r=0.399$ ,  $P=0.032$ ). This finding cautions against the generalisability of relationships found in gilts or primiparous sows to later maternal behaviour. There was no evidence for an association between test responses and piglet mortality. This suggests that the Piglet Scream Test may have limited usefulness as a measure of mothering ability, at least in outdoor sows on commercial units.

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DO AGE AND EXPERIENCE MATTER?  
CONSISTENCY OF AGGRESSIVE RESPONSES  
AND THE EFFECT OF REPEATED RESIDENT  
INTRUDER TESTS ON PIGS



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Pigs fight when they encounter unfamiliar conspecifics, but some are more aggressive than others. If aggressive behaviour is part of an individual's temperament then responses should be consistent over time. Resident Intruder Tests (RITs) were used to assess whether pigs were consistently aggressive to a social challenge (unfamiliar pig) and if repeated testing and age at testing altered responses. 163 pigs were allocated to treatments determining the number of RITs performed. To measure consistency over time 90 pigs underwent RITs on 2 consecutive days at 60, 95 and 130 days of age. The remainder were tested on days 60 and 130, 95 and 130, or day 130 only. Pigs were consistent in attacking or not attacking (Fishers Exact, days 60-90  $P < 0.05$ , days 90-130  $P < 0.001$ ), aggressive pigs being the most consistent (3% never attacked, 27% always attacked). Rank order aggressiveness remained consistent (Kendall's Coefficient of Concordance,  $W = 0.279$ ,  $N = 90$ ,  $P < 0.001$ ), so aggressive pigs were aggressive throughout, independent of absolute levels. Previous experience improved consistency, as pigs that had been tested on day 60 were more consistent between days 95 and 130 (Spearman's  $r = 0.54$   $P < 0.001$ ) than pigs who had not ( $r = 0.47$   $P < 0.05$ ). However, there was no effect of experience on absolute aggression levels, since on day 130 the number of previous experiences did not affect attack latency. Pigs tested for the first time on day 130 were slower to attack than those tested first on day 60 (Mann-Whitney,  $W_x = 1096.5$   $N = 139$   $P < 0.05$ ), although latencies were affected by sex and maturity. Males took significantly longer to attack on day 95 ( $W_x = 714.0$   $N = 90$   $P < 0.05$ ) and 130 ( $W_x = 1848.5$   $N = 163$   $P < 0.001$ ) due to increased mounting. Although pigs were consistent in aggressiveness for the period of the experiment, this was affected by test experience. Absolute aggressiveness, measured by latency to attack, altered with age and sex.

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## MEASURING DOMINANCE STYLES IN BOVIDS



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Dominance styles have been extensively studied in primates and species were classified as "despotic" or "egalitarian" based on a complex of correlated traits such as aggressive tendencies, formation of coalitions, reconciliation and formal status signals. The disadvantage hereoff is that dominance styles can only be determined for animals that perform the whole array of these behaviours. We aim to quantify dominance styles beyond the primate order. We used Normalised David Scores (NDS) to measure the dominance gradient or steepness measure which varies from 0 (shallow or egalitarian) to 1 (steep or despotic), based on agonistic interactions that are also used in more traditional measures of dominance hierarchies, such as linearity and unidirectionality. We compared a herd of 26 *Bos taurus* cows of mixed breed (62.25 h) to a herd of 40 *Bison bison* females (95 h) and related steepness of dominance hierarchies to other measures of dominance style (intensity and symmetry of aggression). Both herds had ad libitum acces to hay and grazed on a large meadow, with a higher density for *Bos* (5.2 ind/ha) compared to *Bison* (2.67 ind/ha). The hierarchies were significantly linear ( $h'=0.39$  *Bos* versus 0.27 *Bison*). Using the steepness measure, we found that the hierarchy was slightly less steep in *Bison* than in *Bos* (slope NDS: 0.27 in *Bos* versus 0.22 in *Bison*). Aggressive encounters were only slightly more frequent in *Bos* compared to *Bison* but aggression was more bidirectional in *bison* and there was a significantly higher proportion of contact aggression and severe aggression in *Bos*. The steepness measure was in the same line as these behavioural traits of dominance style and thus seems a valuable tool to assess dominance style in bovids. *Bos* behaved more despotically compared to *Bison*, resulting in slightly steeper hierarchies in the first. Possibly this could be explained by the slightly higher density of *Bos*. The dominance style concept can be readily applied in these bovids and other domestic group living animals.

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*Oral Paper: Personality, individual differences*  
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## ANIMAL PERSONALITY AND ANIMAL WELFARE



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In this paper we examine the scope for valid measures of animal personality to advance animal welfare science. In a wide-ranging review of research on animal personality S.D. Gosling (*Psychological Bulletin* 127: 45-86, 2001) made a strong case for the existence of stable behavioural styles or personality in a range of different taxa, and explored how valid measures of animal personality may progress pure research in psychology and bioscience. We expand this analysis into the applied science of animal welfare. We address the scope of the published research on animal personality in animal welfare and the strength of the reported methodology. We draw conclusions on the contributions to improvements in welfare identified to date, and identify areas for further research. Four broad areas of reported contribution emerge: selection of service animals, selection for ability to cope with captive environments, compatibility of breeding individuals in endangered species, and likelihood of survival in reintroduction programmes. We add to Gosling's emphasis on the need for valid methodology in measuring animal personality, and reiterate the need for valid measures of animal welfare. We identify an economic influence on the issue of fitting the animal to the environment or the environment to the animal, and we warn of the dangers of selecting by personality without taking into account variation in ability to cope with a range of environmental parameters.

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## STRENGTH OF AVERSION TO CARBON DIOXIDE IN RATS DURING A GRADUAL-FILL EUTHANASIA PROCEDURE



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Rats avoid high concentrations of CO<sub>2</sub> used for euthanasia, but it is not known how aversive rats find this exposure. In two replicate experiments, 7 male Wistar rats aged 15 months (replicate 1), or 10 months (replicate 2), were required to choose between leaving a chamber that was gradually filling with CO<sub>2</sub> and remaining to consume an attractive food (Cheerios), at various levels of food deprivation. The gas was turned on at the moment the rat started eating and flowed at a fixed rate of 16.5% of cage volume per min. Subjects were tested at 7 levels of food deprivation, defined as percentages of estimated ad libitum intake given in the preceding 24 hours: 0%, 17%, 33%, 50%, 67%, 83% and ad libitum, in a Latin square design. Test trials were separated by a 2-3 day wash-out period with ad libitum feeding and an air re-training trial. GLM analysis showed there was no effect ( $P > 0.05$ ) of food deprivation time upon latency to stop eating (mean  $\pm$  SE:  $40 \pm 1s$ ), latency to leave the chamber ( $45 \pm 1s$ ), the CO<sub>2</sub> concentrations at which these events occurred ( $14.4 \pm 0.3\%$  and  $16.3 \pm 0.4\%$ ), or the number of Cheerios consumed ( $4.1 \pm 0.1$ ). This lack of effect was probably due to a delayed, rapid increase in the aversiveness of CO<sub>2</sub>. The main finding was that on all trials, regardless of deprivation level, rats left the chamber before CO<sub>2</sub> rendered them unable to do so, indicating that they were strongly averse to even the moderate CO<sub>2</sub> concentrations experienced when they chose to leave the chamber. It is concluded that the welfare of rats is poor during gradual-fill CO<sub>2</sub> euthanasia.

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## RAT RESPONSES TO CO<sub>2</sub> EUTHANASIA: EFFECTS OF NOVELTY VERSUS DISTRESS



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Carbon dioxide (CO<sub>2</sub>) gas is the most widely used euthanasia method for laboratory rats. However, exposure to CO<sub>2</sub> has been shown to increase exploratory and escape behaviours. The objective of this study was to determine what part of this response is due to novelty. Thirty-two Wistar rats were either euthanized with CO<sub>2</sub> (N = 16) or exposed to a novel odour (air passed through peppermint extract; N = 16). Rats were acclimatized to the chamber with air flow for 27 minutes, and then the treatment gas was added at a rate of 17% per minute. We recorded behavioural responses for 135s before and after gas initiation, as all rats had ceased purposeful movement in CO<sub>2</sub> within 135s. Rearing and time spent with the nose touching the chamber lid were analyzed using a mixed model that included rat as a random effect (30 d.f.), and examined the effect of period (1 d.f.), gas treatment (1 d.f.) and period by gas treatment interaction (1 d.f.). Increased activity and escape behaviours (scratching and pushing at the chamber lid) during gas exposure were analyzed using a G-test with a William's correction. After initiation of either CO<sub>2</sub> or peppermint odour, we observed similar increases in rearing and time spent with the nose touching the chamber lid ( $P < 0.01$  for both), and there was no effect of gas treatment on these behaviours. Activity increases did not differ between the two treatments, but escape behaviours were performed by more rats during CO<sub>2</sub> exposure than during peppermint odour exposure (10 rats versus 1 rat;  $G = 11.9$ ,  $P < 0.001$ ). These results demonstrate that a novel odour increases behaviours associated with exploration, but not those associated with escape, and suggests that exploratory behaviours must be interpreted with caution when assessing distress during gas exposure.

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## AVERSION OF FINISHER PIGS TO CO<sub>2</sub> AND OTHER GASSES



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In many countries CO<sub>2</sub>-stunning is the most common method for stunning pigs, however CO<sub>2</sub> is aversive to pigs. This study compared exposure to CO<sub>2</sub> with exposure to argon, ammonia and air. Over three days, 99 finisher pigs were fed only 80% of their daily requirement and trained to individually run down a raceway and lift a lid in the bottom of an airtight box in order to access feed. The gasses tested were: air (control); ammonia at 100ppm, 300ppm and 900ppm; 90% argon; 30% and 70% CO<sub>2</sub>; and a mixture of argon and 30% CO<sub>2</sub>. The experiment had an incomplete block design with 12 blocks, each including 4 of the 8 treatments. On the fourth day, when the pigs had learned to eat from the test-box, the box was filled with the experimental gas. Each pig was exposed to one gas treatment only, and was free to withdraw from the test-box at any time during the 3-min test. No pig lost consciousness during the test. Measurements included duration of first eating-bout/exposure, total time eating/exposure, percentage of food consumed, number of eating bouts and number of times the lid was lifted. Data were analysed using a REML algorithm, as a treatment by gender factorial with nested blocking effects that were induced by the design structure. While 70% CO<sub>2</sub> appeared to be the most aversive gas, it was not significantly different from 30% CO<sub>2</sub> or the CO<sub>2</sub>/argon mixture. Argon was less aversive than the CO<sub>2</sub> gasses (P<0.01) and appeared to be equally aversive to 900ppm ammonia. However, argon was more aversive (P<0.01) than ammonia at lower concentrations and air. In conclusion, pigs did showed aversion to all CO<sub>2</sub> gasses. The CO<sub>2</sub>/argon mixture appeared only slightly less aversive than 70% CO<sub>2</sub> and may not be a good alternative for stunning pigs.

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Oral Paper: Gas  
Thursday 10/8/06 – The Reception Room



## AVERSION OF CHICKENS TO VARIOUS GASES: METHODS FOR HUMANE CULLING



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Disease control measures can require poultry to be killed on-farm to minimise risks of disease transmission beyond the infected premises. One technique used during recent avian influenza outbreaks was to kill birds in-situ by injecting lethal concentrations of gas into the poultry house. This experiment was designed to identify how aversive poultry found candidate gases and therefore which were most preferred on welfare grounds. Thirty-six chickens (26-32 days old) were tested for aversion to various levels of carbon dioxide (CO<sub>2</sub>) in air (low=50%, medium=55%, high=60%), argon in CO<sub>2</sub> and nitrogen in CO<sub>2</sub> (both low=70%, medium=80%, high=90%). Individual birds were allowed to choose to feed and drink for one hour from three feeding/drinking stations (FDS), which they were trained to use, after overnight food deprivation. Each of the FDS was infiltrated with a different gas (with all low, medium and high levels of gases tested together, to limit permutations of gas x level x FDS position). Birds were video recorded during the test, and time spent with 'head-in' each FDS was noted. Least aversive combinations (though not significant) tended to be 90% nitrogen, 80% argon, and 50% CO<sub>2</sub> based on time spent with 'head-in' (126 ± 41, 98 ± 35, and 58 ± 21 sec, ± SE, respectively) (P = 0.084 by ANOVA). These three treatments were tested together on a further 12 chickens. Birds found 80% argon least aversive, followed by 90% nitrogen and 50% CO<sub>2</sub>, based on time spent with head in (201 ± 65, 179 ± 42, 46 ± 11 sec respectively) (P < 0.001 by ANOVA). All gases were aversive to some degree, which is to be expected since, at the levels used here, they impair biological functions, however there is scope for using gases, preferably inert gas mixtures (such as argon + CO<sub>2</sub>), for humane culling.

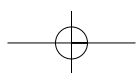
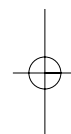
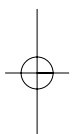
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ORAL PAPERS  
FRIDAY 11th August 2006







## PLUMAGE COLOUR AND FEATHER PECKING IN LAYING HENS, A CHICKEN PERSPECTIVE?



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In three commercial free-range flocks of Oakham Blue laying hens (black, white and grey plumage variants), we investigated whether feather damage due to feather pecking (FP) and bird behaviour were influenced by plumage colour. We also investigated reflectance properties of feathers and spectral composition of light environments experienced by the hens. 979 birds were inspected and scored for feather damage. 11.5 hours of video recorded feather pecking and bird behaviour. We tested for effects of plumage colour on feather damage and feather pecks/10 mins/30 birds (GLM). The behaviour of birds when giving (assailant), or receiving (victim) FP's was compared with a  $\chi^2$  analysis. Feathers and light environments were measured using a USB-2000 spectrometer and DH-2000-CAL-DTH lamp. Birds with white plumage had significantly less feather damage than black or grey birds ( $F_{2,970} = 22.91$ ,  $P = 0.008$ ). Plumage colour did not influence feather pecking rate ( $F_{2,8} = 1.47$ ,  $P = 0.41$ ), behaviour of FP assailants ( $\chi^2_{14} = 20.35$ ,  $P = 0.12$ ) or victims ( $\chi^2_{14} = 16.94$ ,  $P = 0.26$ ). Thus, the propensity of black and grey birds to become victims of FP may be due to their appearance to conspecifics. White feathers reflected more in human visible and UV wavelengths than black or grey feathers. Light intensity inside the poultry house was  $100 \times$  (UW/cm<sup>2</sup>/nm) less than on the range and there was low or no UV reflectance. Under the dim artificial lights in the house, birds with white feathers may be more visible to conspecifics than black or grey birds because their plumage reflects at a higher intensity. White birds may appear different or more unusual (than black or grey birds) inside compared to outside because of the relatively high UV reflectance of their plumage. Rather than encouraging FP, this unusual appearance may inhibit FP. Further research on the importance of UV and plumage reflectance intensity for stimulating and inhibiting FP is warranted

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Oral Paper: Perception and learning  
Friday 11/8/06 – The Great Hall



## PREFERENCE FOR VISUAL VARIABILITY IN LISTER-HOODED RATS AND EUROPEAN STARLINGS



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Recent welfare studies across a wide range of captive animals indicate that a certain level of variability in the captive environment has a positive effect on welfare. In addition, there is a literature suggesting that animals are motivated to seek information about changes in the environment in order to reduce uncertainty. Here, we devised a simple experiment on Lister-hooded rats and European starlings, looking at preference for visual variability in the environment using a four-arm choice chamber. The visual stimulus consisted of an 8x6 blue and yellow square checkerboard displayed on a LCD monitor placed on the back wall of each choice chamber. Two of the chambers showed constant visual stimuli, displaying static images of the checkerboard display (C1) or its inverse (C2). The other two chambers showed variable stimuli, switching between C1 and C2 either at a regular interval or at a random interval with the mean of the regular interval. In separate treatments, the duration of this interval was 'short' (0.5s), 'medium' (10s) or 'long' (200s). Starlings, showed a significant difference in the time spent in different choice chambers for the 'medium' and 'short' interval treatments ( $F_{3,33}=13.882$ ,  $P<0.001$ ;  $F_{3,33}=35.05$ ,  $P<0.001$  respectively), but not for the 'long' treatment ( $F_{3,33}=0.26$ ,  $P=0.856$ ). Contrast estimates showed a significant preference for random over regular switching intervals and regular over constant intervals in 'medium' interval treatment. Significant preferences in the 'short' interval treatment were in the reverse order (constant>regular>random). In rats, no significant preference was found in any of the treatments. Results for starlings show a preference for variability in certain visual environments, and this is the first experiment where an animal shows this type of preference without any training or reinforcement. As rats have limited visual capabilities compared to starlings, future studies may look for preference in olfactory variability.

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## INDIVIDUAL DIFFERENCES IN A COMPLEX SCENT DISCRIMINATION TASK: CANCER DETECTION DOGS



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A recent study determined that dogs can be trained to identify people with bladder cancer on the basis of urine odour more successfully than would be expected by chance alone. Six dogs of varying breeds (3 working strain Cocker, 1 Labrador, 1 Papillon and 1 Mongrel) ages (18-84 months), and gender (2 male : 4 female) completed a seven month training period and were taught to indicate the appropriate sample by lying beside it. None of the dogs had been previously trained for search or scent discrimination tasks. Dogs were formally tested on a series of 9 randomised, blinded tests per dog, using previously unencountered urine specimens. Each test required the discrimination of one cancer sample from 6 sex-matched controls of which two-thirds exhibited some form of non-malignant urological disorder. The challenge in this task was to teach the dogs to identify a scent that is present in varying concentrations without first presenting the dog with the pure target scent. The dogs had to learn to ignore the scent of other diseases which have symptomatic responses in common with those resulting from malignancy. Taken as a group, the dogs correctly selected urine from patients with bladder cancer on 22 out of 54 occasions. This gave a mean success rate of 42% (95% confidence intervals 23% to 58% under assumptions of normality and, 26% to 52% using bootstrap methods) compared to 14% expected by chance alone ( $P=0.045$ , Sign test). There were individual differences between dogs, the success rate ranged from 56% in the best performing dogs to 11% in the worst performing dog. Further work is in progress to improve accuracy rates for detection and train dogs to detect other types of human cancer. Dogs are now being specifically bred and selected for this role.

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Oral Paper: Perception and learning  
Friday 11/8/06 – The Great Hall



## LEARNING PERFORMANCE DIFFERS WITH WEIGHT IN FATTENING PIGS



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Studies with different animal species have shown that individuals may differ in their learning performance. The present study aimed at testing whether fattening pigs of the same age but of different weight classes differ in their learning performance in an operant conditioning test. The study was carried out with 60 fattening pigs from 10 groups of 40 pigs. Six experimental animals (2 lightweight, 2 middleweight and 2 heavyweight) were selected from each group. Starting at the age of 19 weeks (mean weight  $\pm$  s.d.:  $67.4 \pm 10.1$ ), the experimental animals were tested individually in an operant conditioning test to quantify their learning performance. In the training sessions the individuals had to push one of two buttons at a fixed ratio of 2 pushes in order to obtain a feed reward. Once they had learned this task, they were subjected to the reversal test in which the rewarded side was reversed. The learning criterion was achieved when a pig had been rewarded 10 times in succession for pushing the rewarded button exclusively within one session. In the training sessions, there was a tendency for more lightweight and middleweight individuals to reach the learning criteria than heavyweight pigs ( $P=0.066$ ). In the reversal task, the latency to the first positive choice was longer for the lightweight animals ( $P=0.011$ ), but they tended to reach the learning criteria faster than heavyweight individuals ( $P=0.054$ ). In conclusion, the results suggest that lightweight fattening pigs perform better in operant conditioning tests.

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## LEARNING HOW TO LEARN - LEARNING SET FORMATION IN DWARF GOATS DURING VOLUNTARY VISUAL DISCRIMINATION LEARNING



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Up to now, the learning-to-learn phenomenon, in which animals are able to draw from previous experience to improve subsequent learning performance has been demonstrated in farm animals only in horses. We investigated learning set formation during visual discrimination learning of dwarf goats in a familiar environment and normal social settings. Applying a fully automated learning device, we analysed learning performance of 22 animals in two identical experimental groups (N = 11, each), solving nine consecutive discrimination tasks. Using a four choice design, goats had to discriminate different sets of black shapes presented on a white computer screen. Goats could act at the learning device the whole day, but only one animal could enter the device at a time. Task one to three ran for 14 days each, and tasks four to nine for seven days each. The learning criterion in all tasks was defined as 46 % of correct choices in two consecutive blocks of 20 trials ( $P < 0.05$ , Binomial test with  $N = 20$  and  $p_0 = 0.25$ ). Applying a General Mixed Model (SAS), we found an effect of task ( $P < 0.001$ ) and group ( $P < 0.05$ ) on learning performance. The mean number of trials to reach the criterion (TtC) was 409, 309, 421 in task one to three, but decreased significantly ( $P < 0.001$ ) to 127 and 72 in task four and five. In task five, seven goats reached the learning criterion within the first 20 trials. Surprisingly, TtC increased significantly ( $P < 0.001$ ) again in task six (238), but declined throughout the following tasks. TtC was lowest (50) in task nine. In this task 10 goats reached the criterion within the first 20 trials. Results clearly indicate that dwarf goats showed learning set formation after four learning problems. Reasons for the reincrease of TtC in task six to eight will be discussed in the talk.

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Oral Paper: Enrichment  
Friday 11/8/06 – The Reception Room



## A MULTIDISCIPLINARY STUDY OF THE LONG-TERM EFFECTS OF ENVIRONMENTAL ENRICHMENT ON LABORATORY RAT WELFARE



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Beneficial environmental enrichment effects on welfare are often inferred from potentially transient changes in behaviour and physiology. Multidisciplinary studies that also measure longer-term changes (e.g. growth, organ weight/pathology) are required to establish whether enrichment has substantial long-term effects. For laboratory animals, where arguments against environmental enrichment are raised, this is particularly important. This study used a comprehensive multidisciplinary approach to investigate environmental enrichment in rats. Forty-eight male Wistar rats were housed (4 rats/cage) in enriched (E: shelter, nesting material, novel objects) or unenriched (U) standard cages (N=6/treatment) for six weeks during which behaviour, faecal corticosterone and body weight were measured. At post-mortem, organ weights and histological structure, immune function, fluctuating asymmetry, and plasma corticosterone were measured. Principal components analysis for all 48 rats for 16 variables generated six factors, each describing more than 9% of the variance. Factor scores were averaged for each cage and compared between treatments. Three factors differed significantly between treatments following adjustment for multiple comparison. The first showed positive loadings for body weight and weight gain, and negative loadings for kidney, seminal vesicle and testes weight, with 'E' rats scoring higher than 'U' rats ( $F_{1,6}=43.6$ ,  $P=0.02$ ). The second factor revealed positive loadings for secondary follicles/area in the mesenteric lymph nodes and negative loadings for agonism, movement, exploration and social investigation, with 'E' rats scoring higher than 'U' rats ( $F_{1,6}=103.4$ ,  $P=0.01$ ). The third factor revealed positive loadings for bar-chewing, self-grooming and adrenal weight, but a negative loading for thymus weight, with 'E' rats scoring lower than 'U' rats ( $F_{1,6}=118.1$ ,  $P=0.008$ ). These results, from a comprehensive multidisciplinary study, indicate that enriched cages had substantial long-term benefits for welfare relative to unenriched cages (e.g. greater weight gain, heavier thymus glands, more secondary follicles/area in the mesenteric lymph nodes, lighter adrenal glands, reduced agonism and less bar-chewing).

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## ENRICHMENT OF PRE-WEANING HOUSING DECREASES LATER AGONISTIC BEHAVIOUR IN DOMESTIC PIGS



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The effect of the pre-weaning housing system on agonistic behaviour after post-weaning mixing and during the fattening period was investigated in 32 litters of domestic pigs. Three pre-weaning housing systems were compared: poor crate (standard farrowing crate without straw), enriched crate (crate with straw, 20% larger), and, as a control, a farrowing pen (pen with straw, 60% larger than the poor crate). After weaning the housing system was same for all pigs. Four weeks post partum, piglets were weaned and two litters from the same housing system were mixed in a new pen. During mixing, the frequency of agonistic behaviour was recorded for 3 hours, and after 6 hours, the number of wounds was counted. Before weaning four focal pigs from each litter were chosen (2 females and 2 males) and their agonistic interactions were measured during a food competition test at the age of 3 and 6 months. For the statistic analysis we applied the Mixed Model procedure (SAS, version 9). The pre-weaning housing system did not affect the frequency of agonistic behaviour (GLMM,  $F_{2,16}=1.56$ , ns) and the number of wounds (GLMM,  $F_{2,11.7}=1.78$ , ns) after mixing. During the food competition tests at 3 and 6 months pigs reared in the enriched pens were much less aggressive than the pigs reared in both types of crates (GLMM,  $F_{2,9.56}=10.18$ ,  $P<0.01$ ). Our results suggest that aggression during post-weaning mixing of piglets does not seem to be affected by pre-weaning enrichment but the enrichment of the pre-weaning environment through straw and enlarged space reduces the agonistic interactions during food competition later in life.

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Oral Paper: Enrichment  
Friday 11/8/06 – The Reception Room



## EFFECTS OF ENVIRONMENTAL ENRICHMENT EARLY IN LIFE ON AGGRESSIVE AND EXPLORATIVE BEHAVIOUR IN GROWING PIGS



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Environmental enrichment is shown to reduce aggressive behaviour and increase exploration in pigs (Beattie V E et al. (1996) *Appl Anim Behav Sci* 48:151-158). Effects of enrichment early in life were evaluated in a trial with four weight- and sex-matched siblings as the experimental unit. During different stages (farrowing = 0-4, weaning = 5-9 and finishing = 10-24 weeks of age) pens either were (=E) or were not (=0) moderately bedded with 2/3 wood shavings and 1/3 chopped straw. Treatments were 1) 000 (N=7); 2) E00 (N=9); 3) EE0 (N=9); 4) 00E (N=10); 5) 0EE (N=10) and 6) EEE (N=9). Animals were videotaped for 24 hours in weeks 5, 9, 10, 14 and 21. Aggressive, agonistic and explorative behaviour was recorded continuously for 3x10 minutes between 1.00 and 3.00 p.m. Kruskal-Wallis non-parametric ANOVA, Mann-Whitney U and an applied chi-square test were used for statistical analyses. Data for each recording was analysed separately. Explorative behaviour increased when piglets from barren pens were given bedding at weaning. The increase was floor-directed. Enrichment of the farrowing pen affected behaviour during fattening. Early enriched groups spent more time exploring fixtures in weeks 10 and 14 regardless of enrichment status. They had less bouts of ear biting and aggressive behaviour and shorter fights in week 14 compared to groups from barren farrowing pens. Tail- or ear-biting was recorded in fewer groups from treatment 6 (EEE) than 1 (000) ( $P=0.02$ ). Moving pigs from barren to enriched pens at 27 kg decreases adverse social behaviour and increases exploration. The opposite treatment has opposite effects (Day J E L et al. (2002) *Appl Anim Behav Sci* 76 (3): 189-202). Presented results indicate that the critical time for these effects is during the first four weeks of life.

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THE RESPONSE TO DIFFERENT  
ENVIRONMENTAL ENRICHMENTS IN THE  
COMMON MARMOSET (*CALLITHRIX  
JACCHUS*): COMPARISON AMONG  
LABORATORY AND ZOO COLONIES



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The aim of this study was to show that different factors, such as the history of a colony and the environmental context, can influence the effectiveness of a particular environmental enrichment. To investigate this hypothesis the same enrichments, a movable bridge, a puzzle-feeder and three manipulable objects, were presented to two laboratory colonies and one zoo colony of common marmosets (*Callithrix jacchus*). During the baseline period (ten days prior to the enrichments) and during the presentation of the movable bridge and the puzzle-feeder, data were collected two times daily using all-occurrences focal sampling over 10min for a total of 24 individuals. During the enriched phases one additional scan sampling was conducted. For the manipulable objects, every 15 sec we recorded the identity of the individuals, the objects and the type of manipulation, over daily sessions 30 min long, for ten days. An ANOVA was used and the Tukey post hoc-test was performed. Baseline results showed different activity patterns in the three colonies. The three groups showed differences in resting ( $F_{2,17}=10.39$ ,  $P=0.0011$ ), locomotion ( $F_{2,17}=6.31$ ,  $P=0.0089$ ), and social activities ( $F_{2,17}=2.80$ ,  $P=0.003$ ) on the bridge, with all the three behaviours displayed much more in the zoo. In the case of the puzzle feeder, all the groups obtained the food from the device, but the zoo colony in larger quantities ( $F_{2,17}=3.64$ ,  $P=0.0484$ ). The colonies showed age differences in interest for the manipulable objects ( $F_{2,18}=9.25$ ,  $P=0.0017$ ), and different object preferences ( $F_{4,36}=8.80$ ,  $P<0.0001$ ). In conclusion, these results confirm the idea that the history and the environmental context can influence the behavioural needs of the animals, and therefore the effectiveness of a particular enrichment. These results can be useful in planning effective enrichment plans for different captive colonies of non-human primates.

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Oral Paper: Enrichment  
Friday 11/8/06 – The Reception Room



## ENVIRONMENTAL ENRICHMENT FOR PIGS: QUANTITY OR QUALITY?



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This study assessed the effects of quality of environmental enrichment (straw bedding or hanging manipulable toy), and the ratio of pigs to environmental enrichment when toys are provided. 1024 Large White cross pigs were allocated at 35 kg to either a straw-bedded (ST) or fully-slatted building (FS) of otherwise similar design (16 pens/building). In each building, half of the pens received additional enrichment in the form of a single hanging 'helicopter toy' (1T). The remaining pens received either four such toys (4T) in FS, or only straw bedding in ST. Paired T-tests were carried out for specific valid comparisons within (e.g. 1T v 4T in FS) and between buildings (e.g. 1T in ST v 1T in FS). ST pigs spent 21% of observations in straw-directed behaviour, which was unaffected by toy provision. Levels of toy manipulation did not differ in pair-wise comparison of 1T in the different buildings (ST=0.3%, FS=0.9%, SEM 0.20, P>0.05). The different number of toys per pen (FS) did not affect levels of toy manipulation (1T=0.9%, 4T=1.4%, SEM 0.21, P>0.05). The number of skin lesions, as an indicator of aggression, did not differ between FS pigs provided with one or four toys (1T=7.7, 4T=8.1, SEM 0.31, P>0.05). Pen- (ST=3.2%, FS= 11.9%, SEM 0.53, P<0.001) and pig-directed (ST=5.0%, FS=6.5%, SEM 0.37, P=0.06) behaviours were higher overall in FS than ST, but were unaffected by ratio of pigs to enrichment in FS (P>0.05). Environmental enrichment in the form of a hanging toy failed to provide the same level of occupation as seen with straw bedding. Since the ratio of pigs to enrichment had no effect on adverse behaviours or apparent aggression in the FS system, it is concluded that the low level of occupation provided by the hanging toy was unrelated to spatial restriction of access to the enrichment.

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## SUBSTITUTABILITY EFFECTS IN A CLOSED ECONOMY PREFERENCE SET-UP: AN EXAMPLE USING MINK



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The external validity of preference tests is affected by resources/stimuli which alter animals' motivations for the test resource (e.g. via substitutability effects). To explore this, we used American mink (*Mustela vison*) as a model. Mink find swimming-water rewarding: they work hard to access it, and increase cortisol output if access is denied. However, this could stem from motivations to drink from an open water-source which is preferred over their standard water-bottles: thus a small bowl of water could be a motivational substitute for a large swimming-bath. Using 12 females, and a set-up in which an access door could be weighted (in 750g steps) to make a resource costly, we investigated whether i) providing a free small bowl reduces usage of a free bath, the work put into accessing a costly bath, and frustration when bath-access is denied; and conversely ii) whether providing a free bath would reduce the usage of a free bowl, the work put into accessing the bowl, and frustration when bowl-access is denied. A free bowl did not significantly decrease usage of a free bath nor how hard mink worked when made the bath was costly ( $P > 0.10$ ). Preventing bath-access induced access attempts ('scrabbling';  $F_{1,23}=6.24$ ,  $P=0.018$ ), although no significant corticosteroid response; and providing a free bowl did not significantly reduce scrabbling ( $P > 0.10$ ). In contrast, providing a free bath did reduce usage of a free bowl ( $F_{1,23}=14.83$ ,  $P=0.003$ ) and the work put into accessing the bowl (e.g. consumer surplus:  $F_{1,23}=7.03$ ,  $P=0.023$ ); it also somewhat reduced the scrabbling shown when access to the bowl was blocked ( $t = 2.46$ ,  $P = 0.08$ ). Thus the minks' usage of a water-bowl, and their motivation for it, was reduced by a superior substitute. More generally, this illustrates how context resources can affect test subjects' measured motivations.

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Oral Paper: Preferences and Motivation (I)  
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## 'NEED' OR 'LUXURY'? MEASURING MOTIVATION FOR CONTRAFRELOADING IN LABORATORY MICE



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Contrafreeloading occurs when animals choose food that requires effort to exploit ('earned food') when identical food is freely available ('free food'). Explanations for contrafreeloading have invoked the idea of 'behavioral needs,' whereby animals are motivated to perform specific behavior patterns even if the physiological needs served by the behavior are fulfilled. However, little is known about motivation in relation to contrafreeloading. We hypothesized that mice are motivated to contrafreeload, predicting that mice would work preferentially for access to a contrafreeloading opportunity. We utilized a consumer demand approach, requiring mice (female C57BL/6J, N = 28) fed ad libitum to pay a 'cost' (climbing tubes) to gain access to foraging resources. We constructed a test arena containing two climbing tubes, each leading to a foraging compartment (compartment 1='Free'-shelled, compartment 2='Contrafreeloading'-mixture of shelled and intact sunflower seeds). The incline of the tubes was systematically increased to manipulate the effort required to gain access to the compartments (0 , 22.5 , 45 , 67.5 and 90 ). Two consecutive trials were conducted whereby individual mice were observed continuously for 10 min/angle, with one angle/day, for five days (10 days total). The number of climbs and time spent in the resource compartments were used to construct demand curves. The slopes of the demand functions indicate that, despite the increasing cost of gaining access, motivation remained high (i.e. demand was relatively inelastic) and equal for accessing both the free food (-0.355) and the contrafreeloading (-0.357) compartments (t=0.44, P=0.67). Though mice were equally motivated to access both foraging compartments, mice entered the contrafreeloading compartment more frequently (median=7) than the free food compartment (median=6, S=2792, P<0.01) and remained in it for longer durations (median=60 s vs 54 s, respectively; S=2617, P<0.05). These results suggest that mice may actively seek opportunities to engage in contrafreeloading behavior.

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## THE IMPORTANCE OF A FOOD FEEDBACK IN ROOTING MATERIALS FOR PIGS



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In Europe, pigs must have permanent access to a material that enables proper investigation and manipulation activities. Pigs investigate and manipulate either in order to obtain food, or to achieve information about resource accessibility. An earlier study revealed a preference in pigs for straw with maize silage over e.g. straw. Thus, food feedback may be an important quality of rooting materials. Operant conditioning techniques were applied to investigate if pigs prefer a rooting material with food feedback, and prefer to obtain hidden food. Ten ad lib fed growing pigs worked for two materials simultaneously in daily 50-min sessions. Workload varied between FR8, 16, 24, 32, and 40 (no. of panel presses) for one material and was kept at FR24 for the other. Curves should cross at FR24 ('midpoint') if two materials were equally preferred. Sand (S), whole carrots (C), and sand with sliced carrots (SC) were used. The materials varied according to whether the pigs could both root and eat (SC), only root (S), or only eat (C). All possible combinations were tested. Three replications of the five workloads were conducted. Linear double demand curves were fitted in log-log scales and cross-points were estimated. SC was preferred to S since the cross-point for SC-S ( $5.0 \pm 0.4$  SE) was higher than the midpoint (3.2) ( $P < 0.001$ ). SC and C were equally preferred since the cross-point for SC-C ( $2.5 \pm 0.5$  SE) did not differ significantly from the midpoint ( $P = 0.21$ ). C was preferred to S since the cross-point for C-S ( $4.3 \pm 0.2$  SE) was higher than the midpoint ( $P < 0.001$ ). Results showed that the pigs highly preferred a rooting material with food feedback. Furthermore, non-hidden and hidden food was valued equally. In conclusion, rooting is a highly valued activity but food feedback appears to be an important quality of rooting materials for pigs, even when fed ad lib.

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## MOTIVATION IN LAYING HENS FOR FEATHERS AND WOOD SHAVINGS WHEN PRESENTED IN A FOOD CONTEXT



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Previous work demonstrated an association between feather pecking and feather eating in laying hens. The aim of the present study was to investigate the birds' demand for feathers compared to their demand for litter and food as feather pecking has been described as redirected ground pecking/foraging. The maximum price in terms of the number of pecks that birds were prepared to pay was recorded to determine the importance for feathers, wood shavings and food (as a standard) in operant conditioning tests. Nine birds from a line selected for low feather pecking (LFP) and 11 from a high feather pecking line (HFP) were kept in individual cages. To familiarize birds with the two different substrates, feathers were inserted into small holes in a piece of plastic next to the feed trough and shavings were provided in plastic containers inserted in the feed trough in the home cage for 30 days prior to testing. Thereafter birds were tested under progressive ratio schedules (PR), where ratio values were progressively incremented by 10 each time reward was earned. Both HFP birds and LFP birds achieved the highest maximum prices with feed as reinforcement followed by wood shavings and feathers. HFP and LFP birds did not differ in their achieved maximum PR with feed as reinforcement. HFP birds achieved higher maximum prices than LFP birds with feathers as reinforcement (mean  $\pm$  SD;  $23 \pm 15$  vs.  $12 \pm 11$ ;  $F_{1,19} = 4.28$ ;  $P < 0.05$ ). No line differences were found in maximum ratios completed with wood shavings. The results showed that feathers and wood shavings were reinforcing when presented in a food context. For feathers, this was more pronounced in HFP birds. The results demonstrate that HFP birds are clearly motivated to access feathers also outside a feather pecking context.

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## CAUSAL FACTORS FOR EXCESSIVE BARKING IN CENTRAL BRISBANE DOGS



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The companion dog is a popular addition to many households in today's society. However, as companion dogs continue to increase in popularity, many parts of the world are becoming increasingly urbanized; property and yard sizes are decreasing, people are living within closer proximity to neighbours and owners may be working increasingly long hours away from the home environment. Factors such as these may, unfortunately, have deleterious effects on our pets and companion animals, such as dogs, may not always be housed in conditions that are optimal for their psychological and physical well-being. This may cause pets to experience stress and frustration which, when combined with certain genetic factors or prior experiences, may predispose some pets to develop problem behaviours. Excessive barking (or hypervocalisation) in dogs is a largely underestimated problem in urban areas and, in some cases, can seriously effect the welfare of the dog's owner, the surrounding neighbours and neighbour's dogs. We performed a case/control survey of dog owners living in Central Brisbane with the aim of identifying the key factors influencing the onset of excessive barking. Surveys consisted of questions relating to the dog, its owner and its immediate environment. Multivariate analysis showed that five main factors influenced the onset of excessive barking behaviour. These factors were: 1. the breed of dog (OR=3.229); 2. the number of dogs residing in the household (OR=5.611); 3. the age of the dog (OR=11.237); 4. where the dog was obtained (OR=3.963) and 5. whether the dog was allowed free (uncontrolled) access to the home (OR=2.534). It is hoped that this research will allow those working with behavioural problems in companion dogs to make educated decisions regarding the treatment of barking and will aid owners in making an informed selection when choosing a canine companion.

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## DOGS' SOCIAL HIERARCHY IN THE HOUSEHOLD



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Dominance aggression is a common canine behaviour problem treated in behaviour clinics. But some behaviourists and trainers insist that not many dogs have any interest in their "status" or "rank" in the family. To clarify the hierarchial behaviour, this study evaluated behavioural differences between the dogs in households keeping two dogs. In 100 volunteer families (including 50 dog owners, 25 dog trainers, 25 veterinarians) and their 200 dogs, the owners completed a questionnaire on each dog. The questionnaire gave 13 profiles, e.g. breed, sex and age, and 13 behavioural questions, e.g., "This dog can rest in its favorite place," "This dog mounts the other dog," "This dog muzzle-controls the other dog." Answers to the behaviour questions were analyzed by frequency from 0 to 10 for each dog. Rank difference (RD) between the two dogs was calculated by the absolute value of the sum of remainders, and was classified as small RD (under 5), medium RD (from 6 to 35), or large RD (over 35). Statistical difference was assessed using chi-square, variance analysis, etc. Rank differences ranged from 0 to 80, with 76% of the RDs being 0 to 20. The RD was larger in households where both dogs were male ( $P < 0.05$ ) than between dogs of opposite sexes or inter-female; in addition, the RD between different breeds was larger than that between dogs of the same breed. Dogs in the large-RD group exhibited a high frequency ( $P < 0.05$ ) in 5 behaviour patterns (muzzle control, striding astride the other dog, etc.) compared to the other 8 behaviours examined. The results of this study show that where two dogs share the same household, hierarchial behaviour is minimal. With so little inter-dog interest in hierarchy, the dogs would appear unlikely to show dominance outside their species, such as over human family members.

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## DOG BITES TO CHILDREN IN THE CZECH REPUBLIC



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Our aim was to document situations in which children incur dog bites and to identify associated risk factors. Data were obtained from a questionnaire completed with the children in randomly selected schools. A total 103 bite incidents were documented. Most bites occurred when children played with their own dog (69.2%), familiar dog (30.8%), whereas there were no bites by unknown dogs ( $\chi^2=25.397$ ,  $df=2$ ,  $p<0.001$ ). Children were bitten when approaching a playing dog or tried to take away the plaything: familiar dog (70.0%), own dog (30.0%), and unknown dog (0%) ( $\chi^2=6.804$ ,  $df=2$ ,  $p<0.035$ ). Children were further bitten while petting a familiar dog (56.5%), unknown dog (26.1%) and own dog (17.4%) ( $\chi^2=5.550$ ,  $df=2$ ,  $p<0.055$ ). Children were bitten when dogs tried to take food or objects from them: by own dog (71.4%), familiar dog (14.3%) or an unknown dog (14.4%) ( $\chi^2=11.113$ ,  $df=2$ ,  $p<0.004$ ). Own dogs bit mostly within (57.6%), familiar dogs mostly outside (62.2%), and unknown dogs only outside the home (100.0%) ( $\chi^2=24.796$ ,  $df=2$ ,  $p<0.001$ ). Males bit in 66.7% cases, females 33.3% ( $\chi^2=6.338$ ,  $df=1$ ,  $p<0.014$ ). Males bit outside (77.5%), within the home (22.5%); females bit within home (55.0%), outside (45.0%). In the home, small dogs bit (51.5%), whereas medium-size (73.1%) and large animals (80.5%) bit outside ( $\chi^2=9.022$ ,  $df=2$ ,  $p<0.011$ ). Medical attention was sought for children bitten by large (54.5%), medium-size (27.3%), and small dogs (18.2%) ( $\chi^2=3.585$ ,  $df=2$ ,  $p<0.166$ ). The number of bites inflicted by own dogs seems to indicate insufficient education and supervision of children and dogs during joint activities. Results can be applied in interactive dog bite prevention programmes at schools, materials in veterinary offices and childrens hospitals. Supported in part by FRVS 2345/2006.

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## FEEDING BEHAVIOUR AND DAILY ENERGY EXPENDITURE OF DOMESTICATED BUDGERIGARS (*MELOPSITTACUS UNDULATUS*)



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Obesity is a common health problem in captive budgerigars (*Melopsittacus undulatus*). The welfare of budgerigars would be increased in a housing condition limiting obesity. The aim of this study was to measure the influence of 3 different housing types on feeding behaviour and energy balance. Fifty-four budgerigars were housed in male-female pairs in boxes or aviaries, with feeders 37 cm under perches in boxes and one type of aviary, and 120 cm under perches in the other type of aviary during 3 series of 5 weeks. We predicted that birds would expend more energy when the feeder/perch distance was greater. Treatment effects were evaluated by 15-minute live behavioural observations, 10 to 14-hour feeder video recordings (both all-occurrences recording), single DLW (Doubly Labelled Water) measurements, and biometric measures. In summary, birds modified their feeding behaviour according to the treatments to keep the energy expenditure constant. When feeders were closer to perches birds spent more time feeding (0.33 and 0.48 percent vs. 0.5 percent of daylight time,  $F_{2,24} = 13.3$ ,  $P < 0.0001$ ), fed more often (0.4 and 0.5 vs. 0.2 times/hour,  $F_{2,18} = 21.4$ ,  $P < 0.0001$ ) with shorter bouts (112 and 147 vs. 158 s,  $F_{2,22} = 5.7$ ,  $P < 0.01$ ), and flew less frequently than birds with feeders at the bottom (10 and 23 vs. 36 times/15 min,  $F_{2,15} = 6.6$ ,  $P < 0.01$ ). There was no effect on body mass change or Daily Energy Expenditure (DEE). Courtship feeding was associated with a significant increase of DEE in males ( $r_s = 0.51$ ,  $P = 0.01$ ,  $N = 24$ ). DEE was significantly lower during the summer. From a welfare perspective, housing conditions may modify the behaviour but may not reduce the risk of obesity of budgerigars. Instead, individual behaviour of the birds (especially courtship behaviour) as well as seasonal factors were important.

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## USING THE 'MAXIMUM PRICE PAID' TO MEASURE MOTIVATIONAL STRENGTH IN FARMED SILVER FOXES (*VULPES VULPES*)



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Animals' motivation for social contact can be examined by operant conditioning techniques in where the subjects control their own resource interaction time. However, this set-up may invalidate demand functions as a motivational measure due to the lack of linear co-variance between access costs and resource consumption. Thus, we sought to test an alternative motivational measure, the 'maximum price paid', in an operant apparatus constructed for measuring foxes' motivation for access to social contact. The maximum price paid is the highest price a subject is willing to pay for resource-access. Six male silver foxes' maximum operant responses, measured as pulls to a weighted chain, was recorded for access or proximity to three different resources differing in biological significance: food, vixens in heat and males. If valid, the maximum price paid would be highest for food and vixens. Maximum price were  $970 \pm 399$  for food,  $677 \pm 173$  for vixens and  $389 \pm 101$  for males ( $P < 0.05$ ). None of the demand curve based measures separated significantly between the resources. To examine potential motives for seeking contact the foxes' behaviour was recorded. Proximity to vixens tended to elicit higher levels of tail wagging ( $P < 0.08$ ) and lower levels of pacing ( $P < 0.05$ ) than proximity to males, indicating a positive motivation. Proximity to males elicited higher pacing levels ( $P < 0.05$ ) and agonistic gaping compared to closeness to vixens, suggesting aggressive motives for seeking contact. Although the method revealed a drive to approach other males the possible aggressive motives suggest that this sort of social contact would not necessarily improve their welfare in a conventional housing system. The results confirm the maximum price paid as a useful motivational measure and pinpoint the importance of assessing the animals' motives for seeking intraspecific contact because of its potential welfare implications.

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## THE PREFERENCE FOR SAND FLOOR IN FARMED BLUE FOXES: THE EFFECT OF EARLY EXPERIENCE



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It has been reported that farmed blue foxes with access to a sand floor from weaning (eight weeks of age) onwards prefer wire-mesh to sand as floor material, when measured as time allocation. We studied whether cubs' earlier experience with sand floor affects this preference. In the sand group there were eight male-female blue fox pairs. From the age of four weeks (first emergence from the nest box, July), they were housed with access to two traditional fox cages, one with a wire-mesh floor and one with a 30-40 cm deep sand floor. Both cages were enriched with a resting platform. Feed was available in both cages. Eight male-female pairs of control group were housed in corresponding cage systems with two wire-mesh floors. The foxes' behaviour was video recorded for 24h in September, October and December. The behaviour was observed using instantaneous sampling with a 5-minute sampling interval. The data were analysed with Linear Mixed Model. The sand group allocated more time to the bottom (64.5% of observations,  $P < 0.001$ ) and to the platform (17.3%,  $P < 0.05$ ) of the wire-mesh cage than to the bottom (7.0%) and to the platform (11.1%) of the sand floor cage. Controls used both bottoms (39.6% vs. 40.7%,  $P > 0.05$ ) and platforms (10.7% vs. 8.9%,  $P > 0.05$ ) equally. Resting ( $P < 0.01$ ) and activity ( $P < 0.001$ ) on sand decreased with advancing autumn. Most common behaviours on the sand were exploration with muzzle (26.1% of observations on sand), eating (15.9%) and resting (15.4%). Digging was observed in 6.3% of observations on sand. The control group performed more ( $P < 0.01$ ) stereotypies (3.0%) than the sand group (1.3%). Blue foxes with an early experience of sand floor do not prefer sand floor to wire-mesh floor when measured as time allocation. However, sand floor provides possibilities for species-specific behaviour, and therefore may improve fox welfare.

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## HORSES' MOTIVATION FOR THREE LEVELS OF SOCIAL CONTACT AS MEASURED BY OPERANT CONDITIONING



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Horses are by nature social animals but are often housed singly with limited access to social contact with conspecifics. Previous work suggests that allowing horses to sniff but not touch each other may not fulfil their need for social contact (Christensen et al., 2002, AABS, 75, 233-248). In our experiment we assessed the motivation of 8 young female horses for social contact using operant conditioning. Each horse worked individually for rewards of 3 min access to a known companion horse under 3 different degrees of social contact. These were full contact (both subject and companion loose in an arena), head contact (companion behind a solid 1.2m high screen) or muzzle contact (companion behind a solid 1.2 m high screen with bars on top). An empty arena was used as control. During non-experimental periods the subject horses were housed next to their companions with visual contact only. The required operant response was to touch a panel with the muzzle. FR-values were 8, 16, 24, 32 and 40, applied in random order within each week. Horses were tested for 3 weeks at each degree of social contact. Daily session lengths were between 20 and 45 min. Results from the first runs show that, across all treatments, rewards declined with increasing FR ratio. The average number of rewards varied from 8.3 at FR 8 to 5.7 at FR 40. This indicates that the demand for social contact was elastic. There was high variation between horses in the number of rewards taken but so far, no apparent effect of degree of social contact. Results on various demand parameters (elasticity, area under curve etc) will be available as well as recordings of the behaviour of the horse during the reward period.

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## ON-FARM MEASUREMENT OF THE HUMAN-ANIMAL RELATIONSHIP FOR VEAL CALVES HOUSED IN GROUPS



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The development of on-farm welfare monitoring systems creates a need for human-animal relationship measurement through simple tests for animals housed in groups. We studied the repeatability of several tests which assess veal calves' fear of humans. Three tests were developed and performed on 10 veal calves farms in Brittany with calves housed in groups (20-40 calves). The reaction of the group to the entry of two unfamiliar observers in the room (*reaction1*), and to these persons standing in front of the pen (*reaction2*) was expressed as the percentage of calves reacting. The reaction to the crossing of the pen by the observers was determined by the percentage of calves escaping (*escape*) and following them (*follow*). The voluntary approach of the calves toward the observers in the pen was assessed during 3 min and these data were transformed into an *approach* score (0 - 600). The tests were performed on four days. Inter-observer repeatability was assessed for these four observations (N=151). Between-day correlations were assessed for observations 1 and 2 performed at a 2 day interval (N=38). Pearson's correlations were used. Good repeatability was found between observers for all tests (*reaction1*  $r=0.79$ ; N=95;  $P<0.01$  / *reaction2*  $r=0.87$ ; N=143;  $P<0.01$  / *escape*  $r=0.69$ ; N=151;  $P<0.01$  / *follow*  $r=0.68$ ; N=153;  $P<0.01$  and *approach*  $r=0.99$ ; N=112;  $P<0.01$ ). *Reaction2* was repeatable between days ( $r=0.48$ ; N=37;  $P<0.01$ ) whereas *reaction1* was not ( $r=0.10$ ; N=26;  $P=0.64$ ). The percentage of calves escaping and following the observers showed medium correlations between days ( $r=0.48$ ; N=38;  $P<0.01$  and  $r=0.43$ ; N=38;  $P<0.01$ ). *Approach* was highly correlated between days ( $r=0.75$ ; N=25;  $P<0.01$ ). These results demonstrate that the assessment of the human-animal relationship in group housed calves is possible and that observations are repeatable between observers. The calves' reactions seem to be consistent over days except for the reaction to the human entering the room.

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## THE INFLUENCE OF DRIVING STYLE ON THE WELFARE OF SHEEP DURING TRANSPORT



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This project aimed to quantify to what degree stress in sheep during transport is influenced by driver behaviour. Twelve groups of 18 sheep each were transported in a single-deck trailer, for 2 hours over a standard route including both major and minor roads. Six groups were driven by a 'defensive' driver (DD), who accelerated and cornered slowly; the other six were driven by a 'forward' driver (FD), who was an experienced livestock haulier and asked to complete the journey as quickly as possible but taking consideration of the welfare of the sheep. Differences in time taken to complete the route and data from accelerometers confirmed the subjective classification of the drivers. A further six groups of sheep were loaded but not driven and served as controls (C). Heart rate and salivary cortisol were measured on a subsample of sheep in each group, and behaviour was determined post trial from video records. Frequency of slipping and falling were the only behaviours that differed significantly between the treatments; sheep slipped and fell more often during in the FD group (mean  $\pm$ se slips per sheep per journey FD, 31.4  $\pm$ 3.9; DD, 4.6  $\pm$ 1.4,  $U_{6,6} = 0.0$ ,  $P < 0.001$ , mean  $\pm$ se falls per sheep per journey FD, 0.5  $\pm$  0.07, DD, 0.05  $\pm$  0.02,  $U_{6,6} = 0.0$ ,  $P < 0.002$ ). Heart rate was significantly higher than controls during transport but no effect of driving style was found (ANOVA  $F_{2,15} = -4.97$ ,  $P = 0.022$ ). Cortisol levels measured immediately post transport were significantly higher than basal levels, and sheep in the FD group had significantly higher levels than those in the DD group (mean  $\pm$ se FD=3.90  $\pm$ 0.55 ng/ml, DD=1.88  $\pm$ 0.40 ng/ml, C=0.146  $\pm$ 0.05 ng/ml, repeated measures ANOVA  $F_{4,114} = 13.08$ ,  $P < 0.001$ ). These results show that stress in sheep during transport can be influenced by driving style and will be discussed in terms of practical relevance.

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Oral Paper: Companion animal behaviour and human-animal interactions (II)  
Friday 11/8/06 – The Reception Room



## EFFECTS OF SOCIAL SUPPORT BY A FAMILIAR PERSON OR CONSPECIFIC ON RESPONSES TO ACUTE STRESS IN PIGS



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Adriana S. Souza, Henry Van Den Brand, Bas Kemp

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Aim of this study was to investigate whether the presence of a familiar individual during a stress test affects stress reactivity in pigs. Starting from 10 weeks of age, individually housed pigs, habituated to handling by humans, were visited daily by either a person (UH pigs) or a pig (UP pigs), both unfamiliar until the first visit, a sister (FP pigs), or nobody (N pigs), N=8 per treatment. At 14 weeks of age, pigs were subjected to a 15-min restraint test (immobilisation in a cage) during which their partner (UP, UH, FP pigs) or nobody (N pigs) was present. Heart rate variability (HRV) was determined from  $t=-15$  until  $t=60$  min using the Polar system. Saliva samples were taken at  $t=-15$ , 0, 20, 30, 45 and 60 min. Data were analysed using a mixed model. Behaviour and HRV were analysed for UH and N pigs only. N pigs showed more escape behaviour, standing alert and defecating than UH pigs ( $P<0.05$ ). UH and N pigs did not differ in HR(V) before restraint. HR tended to be lower in UH pigs during restraint ( $P<0.10$ ). Indices of overall HRV (SDNN, SD2, SD/RR) and of parasympathetic modulation (RMSSD, SD1) were higher in UH than in N pigs between 15-30 min ( $P<0.05$  and  $P<0.10$  respectively) and 30-45 min ( $P<0.10$ ) after restraint. Treatment did not affect salivary cortisol before restraint. At  $t=30$  ( $P<0.05$ ) and 45 ( $P<0.10$ ), cortisol concentrations were higher for N than for UH, UP and FP pigs. The results indicate that the presence of a familiar individual reduces stress responses and accelerates stress recovery in pigs as compared to pigs without a human or porcine partner. Whether these stress-reducing effects result from having a 'bonding partner' per se, or are due to the presence of this or any individual during stress, remains to be elucidated.

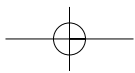
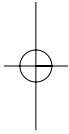
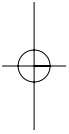
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ORAL PAPERS  
SATURDAY 12th August 2006







## VALIDATION OF A BEHAVIOURAL TEST OF AGGRESSION FOR ADULT DOGS



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Strategies used in Germany for the prevention of dog attacks have included a) banning breeds which are supposedly more aggressive than others, and b) applying behavioural tests for aggression to dogs of all breeds, to identify those with elevated aggressiveness. Several such tests exist but few have been scientifically validated. Here a non-random sample of 254 dogs from different breeds, with some "dangerous" breeds over-represented, was tested. From their responses, six distinct sets of releasers for aggression were identified in the formal test (A=accidental interaction, B=threats, C=noise, D=dogs, E=play, F=strange person), and a further three in a supplementary test conducted in-home (G=threat, H=manipulation, I=friendly people), following Jaccard cluster analysis. These subscales were internally validated by Cronbach alpha (values between 0.83 and 0.48), and externally validated by comparing aggression scores within each subscale with biting history, by logistic binary regression. Scores of two or higher in Group D were significantly predictive of a history of biting other dogs ( $P=0.010$ ), producing 61.4 % correct positives. Scores in Groups B and E were significantly predictive of biting humans (B:  $P=0.033$ ; E:  $P<0.001$ ). The percentage of correct positives was 82.7 % for the mean scores of Groups B+E, and 89.0 % when only Group E was considered. The in-home test did not predict biting history, but may be useful in assessing temperament. The formal test, done in a standardised way by experts, appears to be a useful retrospective tool for identifying danger originating from dogs. Whether the test is of any prospective use needs to be investigated further, but ethical considerations also dictate that it should only be used in conjunction with many other pertinent factors before deciding about euthanasia.

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Oral Paper: Tests, methods and models (1)  
Saturday 12/8/06 – The Great Hall



## BEHAVIOURAL TEST FOR THE DIAGNOSIS OF SEPARATION RELATED PROBLEMS IN DOGS



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Separation related problems are common in dogs and the syndrome is often referred to as separation anxiety (SA). SA may be defined as problem behaviour motivated by anxiety and occurring exclusively in the absence of the owner. The diagnosis for SA is usually based on owner reports and lacks the use of objective criteria. The goal of the present experiment was to validate a behavioural test for a standardized and objective diagnosis of SA. In total 63 dogs were selected based on the behavioural history according to the owner and their age (< 7 years). Owners of 39 problem dogs and 24 control dogs filled out the C-BARQ questionnaire (developed and validated by Hsu & Serpell, JAVMA 2003) on the behaviour of their dog and participated in a behaviour test. The test consisted of three intervals (I: dog + owner, 3 minutes; II: dog alone, 20 min; III: dog + owner, 3 min). Preliminary results of a principal component analysis (PCA) indicate that the major components were related to “walking aimless” (28.14% of variance, walking, etc.), “restlessness” (19.37% of variance, jumping, walking, etc.) and “greeting behaviour” (14.7% of variance, greet jumping, mouth licking, etc.) of interval 1, 2 and 3 respectively. In interval II problem dogs scored significantly higher on the “restlessness” component and on howling and urinating. More time was spend on destruction in problem than in control bitches. No such difference was found for male dogs. Barking, whining, howling, urinating and destructing in interval II of the test were correlated positively with the owners opinion (answers C-BARQ questionnaire) on how often these behaviours occurred when the dog was left at home (Spearman's rho 0.2-0.6;  $P < 0.05$ ). We conclude that this behavioural test could be a useful tool to obtain a standardized and objective diagnosis for separation related problems in dogs.

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## VOCAL EXPRESSIONS OF DENSITY, GROUP SIZE AND WELFARE IN LAYING HENS



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Vocalizations in laying hens may be indicative of hunger, motivation to lay an egg or to dust bath. Can vocalizations also be indicative of high density, large group size or welfare per se, without any additional motivation? The effects of stocking density and group size on vocalisation and interactive behaviour of laying hens were measured. Subsamples of 40 Lohman Brown laying hens were tested in 25 crossed combinations of group size (2, 4, 6, 8, and 10 birds) and density (1, 3.2, 10, 17.8 and 31.6 hens/m<sup>2</sup>) during tests of 15 minutes. Using behavioural sampling, all vocalisations and overt interactive behaviour were measured. Using multiple regression and non-linear statistical catastrophe models the complex relations between vocalizations, overt behaviour, density and group size are analyzed. There were strong significant relations between vocal and overt behaviour and stocking density and group size. An increase in group size led to less vocalizations (a.o. Gakel-calls) per hen ( $P < 0.004$ ), while an increase in density led to more vocalizations (a.o. Gakel-calls) per hen ( $P < 0.001$ ). Analysis using statistical catastrophe models shows that in most cases the explained variance increased significantly using a so-called cusp model (example:  $R^2$  cusp = 0.56 vs.  $R^2$  linear = 0.24). This indicated that part of the data show linear relations and part show non-linear relations between vocalizations and density and group size. The findings concerning Gakel-calls suggest a negative relation with welfare aspects in the test, while for other vocalisations a positive relation is found (a.o. contact grunts). An explanation for the findings could be that an increase in group size increases social support, while an increase in density increases social stress. Furthermore, a non-linear cusp catastrophe model offers a better description of the effects of group size and density of vocalisations and overt behavioural interactions than a linear model.

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Oral Paper: Tests, methods and models (1)  
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## REFINEMENT AND VALIDATION OF THE KESSLER/TURNER/MCCUNE CAT-STRESS-SCORE



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The Cat-Stress-Score (CSS), based upon postures and behaviour, is widely used to assess the welfare of cats in shelters. As many individuals score either 3 ("weakly tense") or 4 ("very tense") we added intermediate intervals, scoring 2.5 and 3.5 (CSSr), to increase sensitivity. A visible human observer scored cats during their first week in an animal shelter (mean of 4 per day), and these were compared with scores obtained remotely by video (mean of 2 per day). Average scores for days 2-7 were similar for the two methods (remote mean 3.48, visible mean 3.47;  $N=77$ ,  $t=0.32$ ,  $P=0.75$ ). From day 1, half of the cats had received 20 minutes interaction daily from the observer; from day 2, the visible CSSr was about 0.2 points lower (repeated-measures GLM:  $F_{1,71}=6.22$ ,  $P=0.02$ ) in these cats than in the remainder, which had received less than 2 minutes contact per day. By contrast, the additional interaction had no effect on the remote CSSr (repeated-measures GLM:  $F_{1,67}=0.10$ ,  $P=0.75$ ). Half of the cats in each of these groups had been given cardboard boxes, 26x36x26 cm with one long side removed, which they lay inside for an average of 60-70% of the day. Cats with boxes scored about 0.2 points lower on the CSSr on days 1-7 than cats without boxes (repeated-measures GLM:  $F_{1,67}=9.02$ ,  $P<0.001$ ), but the visible CSSr was unaffected (repeated-measures GLM:  $F_{1,71}=0.55$ ,  $P=0.46$ ). The two methods of measuring CSS were therefore affected differently by the environment and experience of the cats. Cats which had not been habituated to the observer through repeated contact appeared slightly more stressed when they could see the observer, but the habituation did not appear to have any effect on stress when no people were present; in the latter situation, the opportunity for partial concealment resulted in cats adopting slightly more relaxed postures.

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## CHANGES IN EYE TEMPERATURE, MEASURED USING INFRA-RED THERMOGRAPHY, CAN DETECT PAIN DUE TO DISBUDDING IN CALVES



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The possibility that changes in eye temperature can detect stress and pain in livestock was examined in calves using disbudding as a painful procedure. The effects of local anaesthetic (LA) on the eye temperature response of thirty calves to disbudding with a cautery iron was studied using a 2x2 factorial design. All animals were handled the same and in place of treatments, sham procedures were carried out. Maximum temperature of the eyelid and caruncula lacrimalis, measured using infrared thermography (IRT), heart rate variability (HRV), interbeat interval (IBI), and activity (e.g. kicking, slipping, falling and rearing) were recorded continuously for 40 min for each animal, including 15 min baseline, LA administration (10min pre-treatment) and 15 min post-treatment. Differences between treatments were detected by ANOVA. There was no change in eye temperature following sham procedures. Eye temperature dropped rapidly following disbudding without LA and was lower 2 min post-treatment than baseline ( $-0.3^{\circ}\text{C}$ ,  $P<0.05$ ). Eye temperature then increased and was higher for the last 10 min post-treatment than baseline ( $+0.6^{\circ}\text{C}$   $P<0.0001$ ). A rise in eye temperature also occurred following disbudding with LA ( $+0.7^{\circ}\text{C}$ ,  $P<0.0001$ ). Activity was higher than baseline during the first 2 min post-treatment following disbudding with and without LA ( $P<0.0001$ ). The IBI was lower than baseline for 5 min post-treatment following disbudding without LA ( $-156\text{ms}$ ,  $P<0.0001$ ) and with LA ( $-97\text{ms}$ ,  $P<0.001$ ) and HRV was lower during this period following disbudding without LA only ( $P<0.01$ ). The synchronised drops in eye temperature, IBI and HRV suggest that the fall in eye temperature may be caused by an acute sympathetically mediated change in blood flow to the eye. Furthermore, IRT is a useful non-invasive method to detect acute sympathetic responses arising from pain and stress that may occur during management of livestock.

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Oral Paper: Husbandry systems and husbandry procedures (1)  
Saturday 12/8/06 – The Reception Room



## LONG-TERM CONSEQUENCES OF EARLY AND LATE CASTRATION OF MALE PIGLETS ON SOCIAL BEHAVIOUR



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Castration of piglets is an old and common practice. More humane alternatives for reducing boar taint are required as castration induces stress and pain. This welfare-problem must be weighed against increased aggressive and sexual behaviour in case entire males are produced. We randomly assigned 24 litters of piglets to three treatments: all male piglets were surgically castrated at day 3 (early), at week 3 (late), or were not castrated (control). The litters were raised separately and every 4 weeks (week 5 - 21) aggressive, sexual and play behaviour was analysed from 4 x 1h video-tape recordings during day-time. Behaviour did not differ between early and late castrates. Frequency of aggression was generally higher in the control than other treatments, but the difference was significant only during week 5 ( $P < 0.001$ ). Sexual behaviour was always more frequent in the control versus castration treatments, but the difference was significant only from week 17 onwards ( $P < 0.05$ ). Play behaviour did not differ between treatments. The gender of the receiver at which female pigs directed their social interactions to was not affected by treatment. However, the gender of the receiver of social interactions initiated by male pigs differed between treatments. In comparison with intact males, castrated ones directed a greater proportion of their aggressive interactions to females in week 5 ( $P < 0.05$ ), and a smaller proportion of their sexual interactions to females in week 21 ( $P < 0.05$ ). Compared to late castrated males, a smaller proportion of sexual interactions initiated by early castrated ones was directed to females in week 9 ( $P < 0.05$ ). Castration reduces both pre-pubertal aggressive behaviour and pubertal sexual behaviour in pigs. Both behavioural alterations can be interpreted to be beneficial for the welfare of closely confined litters. Castration and age of castration may also affect the gender preference for social interaction.

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## BEHAVIOUR AND SOCIAL INTERACTIONS OF DAIRY CALVES KEPT AT DIFFERENT GROUP SIZES



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This experiment investigated how group size influences behaviour and social interactions in group-housed dairy calves. Newly weaned dairy calves ( $58.6 \pm 0.7$  days old) were put together in groups of 4, 8 or 16 animals, balanced for sex as far as possible, and in which half of the calves were unfamiliar to each other. The three treatments were replicated three times, giving a total number of 84 calves. The total pen area, the size of the straw-bedded resting area (1.5 m<sup>2</sup> per calf), and the number of eating places (one per calf) were kept constant for all group sizes. General behaviour and distance to nearest calf when eating and lying were recorded using instantaneous sampling at 15 min. intervals over 24 hours on day 1, 3 and 11 after grouping, whereas social interactions and play behaviour were recorded continuously for four hours from feeding at 08:00 am at the same days. Time spent eating and resting were not significantly affected by group size, but calves in larger groups spent more time eating ( $P < 0.01$ ) and lying ( $P < 0.01$ ) close to another calf than calves in groups of four. In addition, calves in groups of sixteen spent less time standing inactive ( $P < 0.05$ ) and were more active ( $P < 0.05$ ) than calves in smaller groups. The number of displacements from the resting area and the level of other aggressive interactions was low and not affected by group size, neither was the occurrence of inter-sucking. However, the number of displacements from the feed-rack was higher in groups of four than in larger groups ( $P < 0.05$ ), and the displacements were more frequently directed towards an unfamiliar calf than a familiar calf ( $P < 0.01$ ). In conclusion, calves kept in larger groups were more active, spent more time lying and eating close to another calf and performed fewer displacements from the feed-rack.

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Oral Paper: Husbandry systems and husbandry procedures (1)  
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## BEHAVIOUR AND WELFARE OF YEARLING DAIRY HEIFERS OUT-WINTERED ON AN ALL-WEATHER PAD OR HOUSED INDOORS IN CUBICLES



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Housing dairy animals on concrete during the winter is costly and has negative welfare implications. The aim of this experiment was to compare behaviour, health and performance of yearling heifers out-wintered on a wood-chip pad [PAD] or housed in cubicles [CUB]. Ninety-six yearlings were blocked and assigned randomly to treatment in groups of eight for 14wks. Animals were inspected for skin lesions, weighed and body condition scored at the beginning and end of the trial. These data were analysed using the animal (48/treatment) as the experimental unit. Data collected on behaviour, feed intake and dirtiness scores were analysed with the group mean as the experimental unit (i.e. 6/treatment). All data were analysed by SAS. Behaviour and dirtiness scores were analysed by the Mann-Whitney U test, skin lesion data by Fishers Exact test and performance data by general linear models. PAD animals performed more comfort ( $Z=-2.80$ ) and play ( $Z=-2.81$ ) behaviours ( $P<0.01$ ) and were involved in more social grooming ( $Z=-2.66$ ;  $P<0.01$ ). Trips and slips were only recorded indoors ( $0.26\pm 0.665$  vs. 0;  $Z=2.99$ ,  $P<0.01$ ). More CUB yearlings were affected by adventitious bursa (23% [11/48] vs. 0% [0/48];  $P<0.001$ ) but they were cleaner than PAD animals ( $Z=-2.81$ ;  $P<0.05$ ). PAD yearlings tended to have lower weight gains (0.77kg/day vs. 0.85kg/day,  $F_{1,93}=3.64$ ;  $P=0.06$ ) but these did not fall below recommended targets. They also had a smaller body condition score change (0.26 vs. 0.10,  $F_{1,93}=7.40$ ;  $P<0.05$ ). These findings were partly explained by lower feed intakes outdoors (5.0 vs. 5.8 kg DM/day,  $F_{1,11}=7.22$ ;  $P<0.05$ ). Nevertheless, PAD animals used their feed more efficiently than CUB animals (-0.34 [UFL intake] versus -0.03 [UFL intake] lower than what was required to meet the weight gains achieved). In conclusion, out-wintering yearling heifers on a wood-chip pad improved their welfare relative to housing indoors in cubicles and did not adversely affect performance.

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## COMPETITION FOR RESOURCES BY LAYING HENS IN ENRICHED CAGES



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It is not clear whether the minimum space allowance (600cm<sup>2</sup> per bird) laid out in Directive 1999/74/EC for enriched cages is appropriate, as there are few data on behaviour and resource use under commercial conditions. This study evaluated the effects of cage height (38cm and 45cm) and space allowance (initially 609cm<sup>2</sup>-870cm<sup>2</sup> based on flocks of 10, 9, 8 and 7 birds in cage with useable floor space of 6090 cm<sup>2</sup>) on behaviour of medium-hybrid laying hens housed in furnished cages. Behaviour was sampled at 33, 46 and 68 weeks of age in birds housed from 16 weeks of age under commercial conditions (N=180). Few behavioural differences due to cage height or stocking density were detected, though hens housed at 609cm<sup>2</sup> and 762cm<sup>2</sup> had longer feeding bouts than hens housed at 870cm<sup>2</sup> per hen (P<0.05). In the taller cages, hens' heads were scanned above 35-41 cm from the cage floor in 15% of observations and head scratches were more common in cages with greater cage height (P<0.05). In a second flock with space allowance between 609cm<sup>2</sup> and 1016cm<sup>2</sup> per hen (10 to 6 birds per cage), feeding behaviour was sampled in more detail at 30, 48, 60 and 67 weeks of age (N=144). Hens housed at the lowest space allowance of 609cm<sup>2</sup> had the longest mean feeding bout, greater than that for hens housed at 762cm<sup>2</sup> but not hens housed at 1016cm<sup>2</sup> per hen (P<0.05). More unsuccessful attempts to reach the feeder and sideways and backwards displacements from the trough occurred at 762cm<sup>2</sup> and 609cm<sup>2</sup> than at 1016cm<sup>2</sup> per hen (P<0.001). A maximum of eight hens were observed feeding synchronously at any time. These results suggest that additional horizontal and vertical space over the ranges we studied had little effect on behaviour other than feeding behaviour. Specifying a minimum space at the feeder, rather than length of feeder, might help avoid crowding and disturbance at the feed-trough and improve quality of feeding bouts.

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Oral Paper: Husbandry systems and husbandry procedures (1)  
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## WELFARE OF LAYING HENS IN FURNISHED CAGES AND IN NON-CAGE SYSTEMS



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From 2012 onwards, all laying hens in Europe must be housed in either furnished cages or non-cage systems (aviaries or floor-housing systems). Furnished cages and non-cage systems both seem to have their pros and cons regarding animal welfare. Data on a direct comparison of welfare in these systems are limited. The aim of this study was to do an on-farm comparison of the welfare of laying hens in furnished cages and non-cage systems. To meet this aim, five farms with furnished cages and seven farms with non-cage systems (three aviaries and four floor-housing systems) were visited when hens were around 60 weeks of age and a number of measures was collected at each farm: behavioural observations, fearfulness (tonic immobility), plumage- and body condition, incidence of bone breaks and other measures. Data were analysed with farm as experimental unit, using ANOVA to study the effect of type of housing system. No major differences were found between aviaries and floor-housing systems. Birds in non-cage systems showed more foraging (16 vs. 2% of time;  $F_{1,11}=11.97$ ;  $P<0.01$ ) and more walking (16 vs. 3% of time;  $F_{1,11}=24.05$ ;  $P<0.001$ ) than birds in furnished cages. Furthermore, birds in non-cage systems were less fearful than birds in furnished cages, as indicated by their shorter tonic immobility response (44 vs. 133 s;  $F_{1,11}=147.14$ ;  $P<0.001$ ). There was no difference in plumage condition between systems. In non-cage systems more keel bone breaks were found than in furnished cages (88 vs. 57% of all examined birds;  $F_{1,11}=23.09$ ;  $P<0.001$ ). This may be explained from the fact that there is an increased opportunity to break bones through collision in non-cage systems. These results indicate that welfare of laying hens was better in non-cage systems than in furnished cages, although the high level of keel bone breaks in non-cage systems gives cause for concern.

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## IMPACTS OF CAPTURE AND HANDLING ON WILD BIRDS



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Large numbers of wild birds are captured, handled and released each year in the course of scientific research, but surprisingly little is known about the effects of capture and handling on birds. As well as having ethical and welfare implications, this is an important scientific issue as any impact on subsequent behaviour has consequences for the correct interpretation of data obtained from captured birds. I investigated the impact of capture and handling on the body mass regulation and foraging behaviour of free-living songbirds attending feeding stations where they could be automatically weighed. I found that the daily patterns of foraging and mass change differed between control days, and days on which the birds were captured and handled. The body mass reached by the birds at dusk was significantly lower following capture (Wilcoxon test:  $Z = -2.701$ ,  $N = 10$  birds,  $P = 0.004$ ). I also investigated the effect of capture handling on the incubation behaviour of free-living breeding songbirds, by using temperature loggers to monitor ambient and within-nest temperatures. I compared incubation routines in control nests, and in matched treatment nests, where we used mist nets to capture the incubating female (away from the nest). I found great variability in the time taken to resume incubation following release (range 14-319 minutes), and in most of these treatment nests, the eggs were exposed to low ambient temperatures for a considerable amount of time following capture of the female. In contrast, it was rare for nest temperature to fall to ambient in control nests, and such periods were significantly shorter (Wilcoxon test;  $Z = -2.366$ ,  $N = 8$  matched pairs of nests,  $P = 0.016$ ). These results reveal that catching and handling wild birds often has behavioural and energetic consequences, and I suggest ways in which these impacts can be minimised by researchers.

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## A NOVEL METHOD FOR AUTOMATICALLY QUANTIFYING RESOURCE REQUIREMENTS OF PASTORAL LIVESTOCK IN NATURALISTIC SETTINGS



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From a welfare perspective, there is an increasing interest in quantifying the resource requirements of pastoral animals. The application of behavioural economics provides a useful means to achieve this. Ideally, these methods should be applied so as to realistically reflect the pastoral environment, the timescales (i.e. 24h/d) over which livestock make choices, and behaviour typically used in executing choices. There is no suitable technique for conducting behavioural economics studies in this way. Our aim was to develop and test such a method. The device consisted of an outdoor arena in which cows live 24h/d, and access to selected resources (e.g. grass silage) was made available via a micro-computer-controlled moving electric fence that allowed and prevented access to the resource. When the fence retreated behind the resource area, silage was available. Entry of an animal into the resource station was detected electronically and after a preset (programmable) interval had elapsed (reward duration), an auditory stimulus was activated and the fence automatically moved forward, guiding the animal 20m from the feeding area and then automatically retreated again to allow a further period of access. Locomotion (walking) is the operant response. Variation in cost of access was arranged by changing the duration of the reward (20, 30, 60 and 120s). Six cows at each of two condition scores (4 and 5) worked to obtain all their food requirements at each reward duration. Demand for silage was inelastic and similar for both condition scores ( $P > 0.05$ ). The apparatus could be modified readily to measure the requirements of livestock for a range of other resources (e.g. shade) in a naturalistic setting.

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## AUTOMATIC RECORDING OF SOCIAL BEHAVIOUR IN DAIRY COWS



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Recording social behaviour in dairy cows, such as threats, displacements or social licking is time-consuming especially as they occur rarely. We asked (1) whether the occurrence of these interactions correlated among themselves and with spatial association and (2) whether a system for local position measurement (LPM) could automatically detect proximity and social interactions, e.g. displacements, based on individual positions and relative movements. To correlate social behaviour patterns, three herds (15-30 cows) were observed for 45-81h (15-26d). The data of the LPM was from two test runs with 15 cows for 12/48h: It was validated regarding displacements by comparison with simultaneous direct (6h) and video (12h) observations and regarding spatial proximity (9h). The LPM recorded one coordinate per second and individual. Matrix correlations were calculated. Spatial association correlated well with socio-positive interactions but also with socio-negative interactions ( $\tau \approx 0.1-0.25$ ). The latter were most strongly correlated among themselves ( $\tau \approx 0.1-0.6$ ) indicating that detection of displacements by the LPM might represent socio-negative interactions more generally. However, only 1 out of 16 displacements which were observed directly in the 6 hour period was detected by the LPM. For ten of these displacements which occurred at the feeding rack, more than half of the position recordings throughout the interaction were erroneous due to interference of the metal rack and the radar frequency of the LPM. During the complete 12h run of the LPM, 3 out of 4 automatically detected displacements corresponded to actual displacements as seen on the video. Spatial proximity recorded by the LPM correlated well with data from direct observations ( $\tau \approx 0.2-0.6$ ). In conclusion, LPM is a promising tool to record automatically spatial association of dairy cows in a herd. Detection of displacements might be possible if coordinates are continuously available. However, due to technical problems accuracy of displacement detection is not yet satisfactory.

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Oral Paper: Tests, methods and models (II)  
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## BEHAVIOURAL RESPONSES TO NOVEL AND STARTLING STIMULI IN DAIRY CALVES



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Emotionality and other aspects of behavioural development in cattle are typically measured with open field, novel object, startle, and learning tests. The variables sampled in these tests may share common underlying dimensions. The aim in this study was to identify these common factors, if any, in 2 and 6 week old Friesian dairy calves (N=114), and to determine if the nature of the dimensions change with age using principal components analysis (PCA) with orthogonal rotation. Satisfactory six factor solutions were found at each age. Second order PCA was then used to determine whether any of the underlying behaviours identified by the PCA were common across the two ages. All first order factors shared loadings from the same variables measured at each age, suggesting that the same six dimensions may underlie responses across the two ages. Second order factor analysis showed that the 'response to novelty' factors identified at 2 and 6 weeks of age in the first order analysis measured the same underlying behaviour. The same was true of the 'response to startling' factors identified at 2 and 6 weeks of age. The results have important implications for the use of standard behavioural tests in measuring behavioural development and long-term welfare in dairy calves. Behavioural responses to the same tests may not measure the same underlying dimensions at different ages. Second, a battery of tests is required to fully assess developmental changes, if any, in emotional, exploratory and learning behaviours. Third, the startle and novel object tests appear to measure two different aspects of fear. Finally, it may be possible to measure such aspects as changes in fear responses with age using a few factor scores instead of a large number of raw variables.

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USING GPS ANIMAL TRACKING, GRAZING  
BEHAVIOUR RECORDING AND VEGETATION  
MAPPING TO ESTIMATE DIET  
SELECTION IN CATTLE GRAZING  
SEMI-IMPROVED PASTURES



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The development of environmentally sustainable grazing management strategies for domestic livestock requires an understanding of the complex dynamics of plant/animal interactions, which in turn requires precise measurement of the animal's foraging behaviour, including spatial and temporal patterns and diet selection. This study investigated a novel approach that combined measurements of the animals' foraging locations (from automated recording of Global Positioning System [GPS] location and jaw movement data) with a vegetation map. The study used eight groups of two beef heifers. Each group grazed a 1.5ha paddock of semi-improved pasture. The animals were fitted with a Trimble GeoXT sub-meter GPS receiver programmed to record their position every second and an IGER Behaviour Recorder to record their jaw movements. Data were collected between 14:00-22:00 and between 06:00-14:00. Concurrent manual observations were made using scan sampling at five minute intervals, and three aspects of the forage being grazed were recorded using the following categories: community (rush, grass), height (tall, short) and bite type (grass, grass+clover, grass+forb, grass+clover+forb). The vegetation was mapped using the GPS at approximately 4m intervals, with vegetation being characterised using the same categories as was used to record grazing. The jaw movement and position data were processed to determine the locations that eating occurred. These data were combined with the vegetation map in ArcGIS to determine the proportion of grazing in each of the plant categories. This was compared with the manual observation data. A regression analysis showed a significant interaction between categories ( $F_{4,109}=8.0$ ,  $P<0.001$ ), and consequently separate lines were fitted for each. Lin's concordance correlation coefficients for the categories were: community 0.93; height 0.57; the four bite types 0.72, 0.61, 0.24, 0.24 respectively. The low concordances in some of the categories between the manual and GPS/grazing/map approaches probably reflect the relatively crude scale of the vegetation map.

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## SPRINKLERS AND SHADE COOL DAIRY COWS AND REDUCE INSECT-AVOIDANCE BEHAVIOURS



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In pastoral dairy systems, cows experience peak body temperatures in the afternoon, particularly in summer. Shade and/or sprinklers can be used at the milking parlour to reduce body temperatures during this time. In addition, farmers anecdotally report that the use of sprinklers reduces irritation from insects while cows are waiting to be milked. We assessed the effectiveness of shade and/or sprinklers for cooling cows and reducing insect-avoidance behaviours in a pasture-based dairy system. Forty-eight dairy cows were divided into 12 groups (4 cows/group). Three groups were exposed to 1 of 4 treatments: 1) shade, 2) sprinklers, 3) shade and sprinklers, or 4) control for a period of 90 min before afternoon milking. We measured respiration rate, tail flicks, and hoof stamps during the treatment period for 34 days in summer. Body temperature was measured over 24 h for a subset of 25 days. Treatments were compared with ANOVA and groups served as the experimental unit. Provision of shade alone reduced respiration rate by 30% compared to controls while sprinklers reduced respiration rate by 60% compared to controls (shade: 54 breaths/min, control: 78 breaths/min; sprinkler: 30 breaths/min; SED: 2.3 breaths/min,  $P < 0.01$ ). Sprinklers reduced the number of tail flicks and hoof stamps by half compared to control and shade treatments (control: 12.6 flicks/min, 4.4 stamps/min; sprinkler: 6.6 flicks/min, 2.2 stamps/min; SED: 2.4 flicks/min, 0.5 stamps/min;  $P < 0.01$ ). Cows provided with shade had lower body temperatures during the treatment period (shade: 38.6°C, control: 38.9°C; SED: 0.09°C;  $P < 0.01$ ). Sprinklers reduced body temperatures for at least 2 hours after milking (sprinklers: 38.7°C, control: 39.2°C; SED: 0.10°C;  $P < 0.01$ ). Shade cooled cows immediately, reducing both respiration rate and body temperature before milking. Sprinklers reduced respiration rate more markedly than shade alone, cooled cows for several hours after milking, and reduced insect-avoidance behaviours.

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## EFFECTS OF SPACE ALLOWANCE ON THE WELFARE OF PREGNANT SOWS HOUSED IN DYNAMIC GROUPS



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The minimal legal space allowance for grouped pregnant sows in the EU is 2.25 m<sup>2</sup>/sow. But what would be the effect of a higher value on agonistic behaviour and social stress of animals living in dynamic groups? Two groups of 34 sows living in adjacent pens ("H":3.0 m<sup>2</sup>/sow vs. "L":2.25 m<sup>2</sup>/sow) and using electronic sow feeders, were observed during 30 weeks. Twelve sows were replaced in each group every 5 weeks. Welfare measurements were salivary cortisol on 6 "resident" ("R") and 6 "introduced" ("I") randomly selected sows, aggressive behaviour (2h continuous observation sessions) on all sows, and injury score on the introduced sows. All data were analysed using the GLM procedure. The available area had no effect on performance (sows' weight gain, back fat thickness and prolificacy). Salivary cortisol values were not different before mixing. Two hours after, they were higher for "I" (402±645 ng/ml) than for "R" (172±164 ng/ml) (P<0.01), and for "L" (368±653 ng/ml) than for "H" (205±178 ng/ml) (P=0.06). However, the difference between "I" and "R" sows disappeared 24h later, whereas values for "H" (243±348 ng/ml) were then contrarily higher than for "L" (130±114 ng/ml) (P<0.01). No difference in fighting behaviour was observed between the two pens. However, one-way aggressions were more frequent for "L" than for "H", only 3 and 8 days after mixing (26.0±8.0 vs. 15.5±4.5, P<0.01 and 20.0±12.0 vs. 9.9±5.9, P<0.001). Higher injury scores were also noted in "L" group from the second week after mixing (12.62±13.12 vs. 5.33±6.98 in "H" group, P<0.001), and also later during the third (9.93±12.85 vs. 4.48±7.62, P<0.01) and fourth weeks (4.13±7.20 vs. 2.12±4.82, P<0.05). An available area 33% higher than the EU minimum reduced agonistic behaviour and social stress, and thus induced better welfare conditions for sows living in dynamic groups.

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## AGGRESSION, STRESS AND IMMUNE RESPONSES OF GESTATING SOWS IN STALLS AND IN LARGE GROUPS ON DEEP LITTER



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The on-going welfare debate on stall housing for gestating sows has led to the search for alternative housing options to improve sow welfare. This study used some aspects of behaviour and physiology to assess the welfare of sows housed in conventional stalls ("Stalls") and in large groups on deep litter ("Hoops") during gestation. Each of the 8 replicates included 18 sows per treatments of parity 1, 2 and 3 or more, in an equal proportion, randomly selected from within a group of 85 sows or from a weekly batch of about 250 stalled sows. Behaviour (aggression) was recorded by observing the animals 10 min each hour between 0800 and 1200 and saliva cortisol measurements were taken at weeks 1 and 9. Measurements on haematology and immune response were taken at week 15 of gestation. Data were analysed by ANOVA (using group means values). There was a strong tendency for higher ( $P=0.06$ ) saliva cortisol concentrations in week 1 in sows in the Hoop treatment (6.29nM vs 4.03nM,  $SED=1.037$ ), suggesting greater stress at this time, which may correspond with the observed aggression in these sows. No significant differences in saliva cortisol concentrations were observed at week 9. Sows in the Stall treatment had a higher ( $P<0.05$ ) percentage of neutrophils (46% vs 41%,  $SED=2.090$ ) and a lower ( $P<0.05$ ) percentage of lymphocytes (41.6% vs 46.5%,  $SED=1.833$ ) than the Hoops treatment, suggesting greater stress in sows in stalls at week 15 of gestation. No significant differences were found in cell phenotype and lymphocyte proliferation (immune response). The results suggest that sows in the Stalls treatment were less stressed early in gestation and more stressed later in gestation than sows in the Hoops treatment at the comparative times.

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## BEHAVIOUR AND STRESS PHYSIOLOGY OF GESTATING SOWS IN A COMBINATION OF STALL AND GROUP HOUSING



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About 26% of sows are stall housed in Australia for most of their reproductive cycles. Confinement of breeding sows is a controversial welfare issue. This experiment examined the welfare of gestating sows housed in conventional stalls ("Stalls") with that of gestating sows housed and introduced to large groups of 85 on deep litter at either mating ("Hoops 0") or day 35 of gestation after previous housing in stalls ("Hoops 35"). The major measurements were conducted on 18 focal sows in each of the 8 replicates of each treatment and the group of 18 focal animals was the experimental unit for comparisons between treatments. Observations on aggression were conducted and saliva and venipuncture blood samples were collected and analysed for cortisol and various haematology measures, respectively. Mixing sows in the Hoop treatment at day 35 of gestation rather than day 0 resulted in less aggression on the day of mixing (427 vs. 226 bouts over 4 h,  $P < 0.05$ ,  $SED = 74.6$ ). Sows in the stall treatment had higher neutrophil differential count (50.4 vs. 43.8 and 45.0% of WBC,  $P < 0.05$ ,  $SED = 2.05$ ) and a lower lymphocyte differential count than those in the two Hoop treatments at days 55 and 104 of gestation (35.7 vs. 44.6 and 42.2% of WBC,  $P < 0.05$ ,  $SED = 1.82$ ). Sows in the Stall treatment had lower ( $P < 0.05$ ) salivary cortisol concentrations than sows in the Hoop 0 treatment at day 0 (after mixing) and 35 (2.59 vs. 5.75 nM,  $SED = 1.074$  and 1.57 vs. 3.91 nM,  $SED = 1.074$ ), but higher ( $P < 0.05$ ) concentrations at day 42 of gestation (4.39 vs. 2.45 nM,  $SED = 1.074$ ). The practice of housing sows in stalls immediately after mating and delaying mixing in large groups until pregnancy is confirmed, by reducing aggression at mixing, may provide some distinct welfare advantages over housing sows either in stalls or in large groups for the entire gestation.

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Oral Paper: Husbandry systems and husbandry procedures (II)  
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## THE EFFECT OF DIFFERENT HOUSING CONDITIONS ON THE WELFARE OF TWO-YEAR OLD HORSES



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In the life of the domesticated horse there are several periods when its management may change dramatically, for example, at the time when they are being stabled individually as two or three year olds, after being in groups at pasture or in group housing. Horses need to be able to cope with such management changes and when they do not, stress related behaviours may result, such as stereotypies. To study the effect of two typical housing systems on horses that are being stabled, we used 36 two-year old horses, 18 geldings and 18 mares. Half of the horses were stabled in individual stables (10.5 m<sup>2</sup>) and the other half in pair housing (48 m<sup>2</sup> for two horses). Horses in both groups were fed the same diets. Behaviour was recorded using continuous recording (total of 50 minutes a horse a day) in the first week after stabling, and a scan sampling method (interval 5 minutes) during the following two weeks. Behaviour was recorded between 9:00 and 17:00 hours. Differences between treatments were calculated using ANOVA. During the first week there were negligible differences in time-budgets (as percentage of total time) between treatment groups. Yet in the following two weeks horses in individual stabling spent more time being alert compared to the pair stabled horses (P=0.002). Furthermore, significant differences between treatment groups were found for stress related behaviours that were sampled as frequencies. While the pair housed horses used the space availability for play behaviour, the individually stabled horses showed a higher incidence of neighing (P<0.001), snorting (P=0.006), pawing (P=0.001), nibbling wall (P=0.006) and weaving (P=0.015). Because of the occurrence of significantly more stress related behaviours and the performance of stereotypies we conclude that stabling horses individually is more stressful than stabling them in pairs and therefore constitutes a threat to welfare.

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## USING SELECTIVE ATTENTION STRATEGIES TO UNDERSTAND THE IMPORTANCE OF THE SUBJECTIVE "PAINFUL" EXPERIENCE IN FISH



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Freedom from pain is essential for the welfare of any animal yet it is difficult to understand what an animal directly experiences. Questions regarding the capacity of fish to suffer have been fiercely debated particularly concerning pain perception. We used selective attention strategies from psychological theories to understand how important the experience of a painful event was to fish by attempting to divert their attention away from the pain. Rainbow trout were given an acutely acting noxious stimulus (0.1% acetic acid injected subcutaneously) and then examined in different contexts. Since pain is an attention dominating state we used strong aversive stimuli that are relevant to variable environmental conditions in nature. These treatments consisted of either novel object presentation or placing the fish in a novel social situation or a novel environment (total N = 60). Behaviour was recorded before the treatment and at subsequent intervals along with measurement of respiration rate and blood cortisol levels obtained via caudal venipuncture after humane killing. When compared to non-noxiously stimulated controls, fish did not show an appropriate fear response by avoiding the novel objects, therefore, pain was the imperative in this context (within 5cm;  $H = 32.3$ ,  $P < 0.001$ ). In a familiar social situation, fish experiencing pain did not show a rise in respiration rate ( $F_{1,10} = 0.45$ ;  $P = 0.52$ ) or cortisol ( $T = 1.51$ ,  $P = 0.165$ ) yet did show a behavioural impairment with reduced aggression ( $F_{1,10} = 7.98$ ;  $P = 0.02$ ). In a novel social situation, however, there was no suspension in aggressive behaviour ( $F_{1,10} = 0.25$ ;  $P = 0.6$ ). This suggests that exerting dominance over unfamiliar fish takes priority and attention is diverted away from the pain. In a novel environment, fish were more willing to show responses to noxious stimulation than in a barren environment ( $T = 3.13$ ;  $P = 0.004$ ). These data provide new evidence that fish are able to prioritise responses depending upon context.

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## THE IMPORTANCE OF EXTERNAL VALIDITY IN WELFARE STUDIES: FARMED MINK AS AN EXAMPLE



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On commercial farms juvenile mink are housed in male-female pairs. Nonetheless many welfare studies in juvenile mink have been conducted with singly housed animals to ease data collection. This may, however, impair the external validity of the studies. Therefore we investigated the effects of these different social conditions on stress reactions in farmed mink. The experiment was carried out during the growing season (August-December) with eighty juvenile female mink. The experimental design was a 2x2-factorial model. The factors were social conditions (single vs. pair) and stress treatment (stress vs. control). Because farmed mink are known to value their nest-boxes highly, nest-box deprivation on four days in each week was used as the intermittent unpredictable stress treatment. The amount of stereotyped behaviour (mainly pacing) was assessed as a behavioural indicator of stress at the outset and end of the study. The behavioural analyses (instantaneous sampling with 4-6 min sampling interval) were based on 24-hour video-recordings. Body temperature response to acute handling and restraining was measured in October. Furthermore, an ACTH-challenge test was performed and the weight of the adrenals was measured at the end of the study. The stress treatment did not have effects on any measured parameter ( $P > 0.1$  for the main and interaction effects, two-way ANOVA), whereas the social conditions had: singly-housed animals had more stereotyped behaviour in the beginning ( $P < 0.05$ ) and at the end ( $P < 0.005$ ) of the study and a higher body temperature as a response to acute stressor ( $P < 0.05$ ) than the pair-housed animals. Neither function nor mass of adrenals were affected by the treatments ( $P < 0.1$ ). The fact that only the social conditions revealed effects on the mink indicates that single housing is a serious threat to the external validity of welfare studies in juvenile mink.

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## THE ANALYTIC NETWORK PROCESS - A PROMISING TOOL IN ANIMAL WELFARE ASSESSMENT?



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In evaluating husbandry conditions with regard to animal welfare various measures concerning animal health, behaviour, physiology and performance need to be considered and combined in a comprehensive assessment. For such a setting multi-criteria analysis (MCA) is often used to analyse and evaluate alternative systems or courses of action. MCA is recommended when (i) there is a need to structure a complex decision problem, (ii) the problems are multi-objective or include multiple criteria to be considered, (iii) different alternatives are to be compared across a set of indicators measured on different scales, (iv) there is a need for a more rational, transparent and comprehensive analysis. Such criteria often apply to animal welfare assessments. Within animal welfare research, several approaches have been proposed to aggregate individual measures into a comprehensive assessment. However, the potentials of more rigorous methods from MCA have been rarely used. We introduce the Analytic Network Process (ANP) by Saaty (1996) as a promising decision analysis tool in animal welfare assessment. The ANP is a generalization of the Analytic Hierarchy Process and has been explicitly designed to consider feedback and interplay among components of the analysed system. It allows one to structure the evaluation model into a network of clusters and to consider inner dependencies (within-cluster relationships) as well as outer dependencies between clusters. The performance of alternatives can be evaluated in relative terms or by means of preference functions including external benchmarks. As an example, the application of the ANP will be demonstrated by comparing the effects of different milking systems (herringbone milking parlour, automatic milking system) on animal welfare. The example integrates indicators of animal health, behaviour and stress. Data for the demonstration are provided by an integrated experimental study.

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Oral Paper: Tests, methods and models (III)  
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## FROM BOIDS TO SHEEPOIDS



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We are in the process of developing a model combining an experimental with an agent-based approach, with sheep as subjects, to study the impact of individual personality on the behaviour of groups. Our “Sheepoids” model is based on the “Boids” model of flocking birds, which supposes that animal movements and flocking behaviour can be simulated by using a small set of simple rules determining the behaviour of each individual. The overall behaviour of the flock is an emergent property of the actions of the individuals within it. This link, between decision rules applied by an individual and the emerging behaviour of a group, makes the model an ideal tool for studying the effect of individual personality traits on group behaviour. At an early stage in the model development, with individuals still using identical rules, a comparison with field observations has already shown an important difference between boids and grazing sheep in the degree of alignment between neighbouring animals. Using the Sheepoids model, we found that a weighted average, in which the component provided by each neighbour decreases with the square of the distance to the neighbour, resulted in a better fit with the field-observations than either the average heading (as in the original Boids model) or a simple inverse-linear distance weighting (a Kolmogorov-Smirnov goodness of fit test on Averaged,  $1/D$  and  $1/D^2$  model weightings gave  $D_{\max}$  values of 0.489, 0.233 and 0.034 respectively, with critical value for  $P < 0.05$ ,  $D_{\text{crit}} = 0.038$ ). Thus, it may be that, for sheep, the area occupied by a neighbour in the field of view is more important for making positional decisions than the linear distance between them. This example demonstrates the importance of early testing of the model against real data, and shows how the process can provide insights into the behaviour itself.

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## EFFECT OF MILKING FREQUENCY AND NUTRITIONAL LEVEL ON GRAZING AND LYING BEHAVIOUR OF DAIRY COWS



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The aim of this study was to evaluate the effect of milking frequency (MF) at two nutritional levels (NL) on grazing and lying behaviour of dairy cows. Animals (N=48) were randomly assigned to one of four treatments in a 2X2 factorial design for an entire lactation: Once (ODM) or twice (TDM) daily milking at high (herbage allowance: 30.9kg DM/cow/day) or low (18.8kg DM/cow/day) NL. Grazing behaviour was recorded using IGER grazing behaviour recorders over 3X24h periods during June, August and September. Standing/lying was recorded every 5 min using modified voltage dataloggers (Tinytag Plus, Chichester, UK) over 2X24h periods during August and September. Data was analysed using the Mixed procedure of SAS. The model included terms for MF, NL, time, block and all 2 and 3 way interactions. ODM animals spent more time grazing than TDM animals (F=4.87, P<0.05), due to a higher number of grazing bouts (F=10.95, P<0.01). The initial grazing bout after morning milking tended to be longer in low NL than high NL (F=2.9, P=0.09) animals, and was longer in TDM animals than ODM animals (F=6.41, P<0.05). MF and NL had no effect on time spent ruminating, or on total lying time. ODM animals had longer lying bouts than TDM animals (F=8.66, P<0.01), and low NL animals tended to have longer lying bouts than high NL animals (F=2.99, P=0.09). However, high NL animals had more lying bouts (F=8.49, P<0.05) and lay down sooner after morning milking (F=4.49, P<0.05) than low NL animals. Prolonged grazing and standing after morning milking indicates inadequate feed allowance for low NL cows. Extra time at pasture resulted in increased grazing time by ODM animals, indicating that daily lying time is not compromised by TDM. However, increased lying bout duration in ODM may reflect a more normal behaviour pattern due to reduced disturbance.

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Oral Paper: Husbandry systems and husbandry procedures (III)  
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## COMPARING STRESS IN TWO TYPES OF AUTOMATIC MILKING SYSTEMS OPERATED WITH EITHER PARTIALLY FORCED OR FREE COW TRAFFIC: DAILY PERIODICITY IN MILK CORTISOL CONCENTRATION



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Physiological measures used to assess stress such as cortisol show a circadian periodicity. In addition to comparing absolute values, a comparison of the circadian secretion pattern may be useful, as shifts or reductions of peaks can be interpreted as deviations from a 'natural' pattern. In this study, milk cortisol concentrations (MCC) were measured on 8 farms each with one of two types of automatic milking systems (AMS) which were operated with either partially forced (de Laval) or free (Lely) cow traffic. Data from 345 cows (26-54 per farm) and 1008 milkings (1-7 per cow) were collected. Mixed effects models were conducted to account for repeated measures of individuals nested within farm and milking system. Daily periodicity of cortisol concentration was modelled using natural splines. The pattern of cortisol secretion in the AMS with partially forced cow traffic showed an early morning peak and a weaker elevation in the afternoon whereas no clear periodicity was visible in the AMS with free cow traffic (interaction type of AMS x time of day), which potentially indicates a disrupted daily periodicity of cortisol secretion. As MCC reflects events of the past 2 to 4 hours, more general differences between the two types of AMS than the milking process per se are needed to explain the patterns. The disrupted periodicity of cortisol secretion coincided with reduced values of heart rate variability during rest which suggests that the cows were less relaxed. In conclusion, the two types of AMS differed in the pattern of daily periodicity though the biological relevance of this difference remains currently open. Nevertheless, we suggest that a disrupted secretion pattern can be used to assess general strain in a dairy cow housing system.

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## LET SLEEPING RATS LIE: DOES THE TIMING OF HUSBANDRY PROCEDURES COMPROMISE LABORATORY RAT WELFARE?



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Research has indicated that chronic stress can reduce sleep quality and quantity. Yet there has been little investigation into whether husbandry procedures carried out during an animal's normal sleeping period affect subsequent sleep behaviour and welfare. We housed 48 male Wistar rats in enriched cages containing four rats, in either a light phase treatment (LP) (N=6 cages) or a dark phase treatment (DP) (N=6 cages) for five weeks on a 12h:12h light cycle with lights on at 0600. Rats in the LP cages were exposed to husbandry procedures (e.g. weighing, cleaning) 3.5h into the light phase when we would expect them to be inactive/sleeping, three times every week. DP rats experienced the same procedures, but 3.5h into the dark phase when we would expect them to be active/awake. After five weeks, behaviour for all cages was sampled over 12 hrs of both the light and dark phase. General health measures (e.g. body weight, weight gain and chromodacryorrhoea) were collected over the five weeks housing period, and organ weights (e.g. adrenal, thymus, spleen and testes) were recorded post-mortem. Principal component analyses yielded four factors each explaining over 10% of the variance. Two factors revealed treatment differences. For one, loading positively on chromodacryorrhoea score and negatively on sleep, self-grooming and enrichment directed behaviour, LP rats scored higher than DP rats ( $t_{10} = 3.47$ ,  $P < 0.01$ ). The other loaded positively for relative thymus weight and activity and negatively for aggression and social interaction. DP rats scored higher on this than LP rats ( $t_{10} = -3.42$ ,  $P < 0.01$ ). LP rats thus displayed indicators of reduced welfare (e.g. less sleep, elevated chromodacryorrhoea, lighter thymus glands, higher aggression) relative to DP rats. Therefore, husbandry procedures applied in the dark rather than the light phase might improve the welfare of laboratory rats.

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## EARLY EXPERIENCE OF CAGE-CLEANING DOES NOT AFFECT ADULT RAT ANXIETY, BUT IDENTIFICATION TAIL-MARKING DOES



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Adult rodents briefly handled daily before weaning are less anxious than unhandled controls. Under non-experimental circumstances, laboratory rat pups are only handled during cage-cleaning. Cage-cleaning rates vary between institutions, potentially contributing to differences in anxiety previously observed between rodents from different suppliers. Therefore we investigated whether more frequently cage-cleaned rat pups were less anxious as adults. At a commercial rodent supplier, 92 breeding pairs and their litters were cleaned twice weekly, weekly or fortnightly. Rats were pair-housed at weaning and one from each pair was tail-marked for identification, with marks reapplied every 2-3 weeks. One male from each litter underwent four anxiety measurements when adult: behavioural and chromodacryorrhoea response to handling; baseline faecal corticosterone; elevated plus-maze behaviour; and a novelty test. Neither cage-cleaning frequency, nor age at first cleaning, affected test outcome (e.g. corticosterone was 499+/-54 (twice weekly), 495+/-43 (weekly) and 505+/-49 ng/g (fortnightly) [mean+/-SE]). This could be because our cleaning/handling regimes, encompassing the normal range used by suppliers, were less intensive than early handling treatments in previous work. Alternatively, prenatal stress from frequent cage-cleaning might counteract anxiolytic effects of early handling. Similarly, frequently cage-cleaned pups might more strongly associate humans with stressful environmental change, potentially antagonising early handling effects. Whatever the mechanism, early cage-cleaning regimes do not affect adult rat anxiety, despite their different early handling frequencies. However, unexpectedly, the tail-marked rats ventured into the open arms of the plus-maze more than unmarked ones (Marked: 20.9+/-2.9 % time on open arms; Unmarked 7.5+/-1.4 %;  $F_{1,81} = 23.44$ ;  $P < 0.001$ ), suggesting reduced anxiety, but had higher chromodacryorrhoea responses to handling (Marked: 0.79+/-0.13; Unmarked: 0.31+/-0.15;  $z = 2.07$ ;  $N = 66$ ;  $P = 0.039$ ), suggesting increased aversion. Identification methods are little considered in experimental methodologies, but these results show that they can affect rodents' anxiety in a complex manner.

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## BEHAVIOUR PROBLEMS IN HORSES - FACTORS ASSOCIATED WITH CRIB BITING AND WEAVING



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This study investigated factors influencing weaving and crib-biting by horses. Observations were made in two experiments, first on 7 weaving horses and 14 control horses, and second on 6 crib-biting horses. It has been suggested that a weaving horse can affect the behaviour of neighbouring horses, therefore, the time budgets of weaving horses, neighbouring horses and distant horses were compared. In addition, crib-biting horses were observed to determine whether a change in straw material reduced the frequency or duration of crib-biting. The horses were from different equine yards in the middle and south of Sweden, and were stabled in boxes with daily out-door housing. The behavioural observations were direct observations with instantaneous sampling for all behaviours except the weaving and the crib-biting. Weaving and crib-biting were observed with continuous sampling throughout the observation periods. The observations were conducted one hour before and one hour after feeding, twice per day, when most abnormal behaviours are performed. The results showed that the weaving horses had a lower percentage ( $P < 0.05$ ) of the total observed time resting ( $0.16 \pm 0.09$ ) and foraging ( $0.60 \pm 0.12$ ) compared to the neighbouring horses ( $0.18 \pm 0.10$ ;  $0.64 \pm 0.15$ ) and the distant horses ( $0.17 \pm 0.09$ ;  $0.68 \pm 0.10$ ). The neighbouring horses did not have a similar time budget to the weaving horses, rather, the two groups of non-weaving horses had a more similar time budget. The crib-biting horses responded to a change in straw material. The horses performed more crib-bites per minute ( $P < 0.05$ ) when there was straw ( $2.05 \pm 0.88$ ) compared to sawdust ( $1.37 \pm 0.75$ ), contrary to most other studies where it is shown that straw reduces crib-biting. The present study showed an increase soon after introducing straw, persisting for at least three days from the change in straw material.

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Oral Paper: Stereotypies  
Saturday 12/8/06 – The Great Hall



## OPIOID CIRCUITRY AND THE AETIOLOGY OF EQUINE ORAL STEREOTYPY



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Increased dynorphin/enkephalin ratios in the dorsal striatum of high (compared to low) spontaneous stereotypy deer mice suggest that stereotypy manifests from an imbalance between the direct and indirect pathways of the basal ganglia, leading to enhanced efferent neural transmission from the dorsal striatum to cortex (Presti and Lewis, 2005). In horses performing oral stereotypy (crib-biting), neural alterations in dopamine receptor density have been recorded in both dorsal and ventral striatal regions (McBride and Hemmings, 2005) suggesting that ventral projections may also be altered in the stereotypy phenotype. Indeed, if stereotypies are considered to stem from highly motivated appetitive behaviours, it seems probable that ventral elements of the basal ganglia involving motivational circuitry should also be involved (i.e. mesoaccumbens pathway). To further address the issue of dorsal versus ventral striatum involvement in the equine oral stereotypy phenotype, opioid receptor ( $\mu$  and  $\delta$ ) densities were quantified post-mortem in the brains of stereotypy (crib-biting) (N=8) and control (N=8) horses already designated for slaughter. Using homogenates of the following brain regions: caudatus, putamen, nucleus accumbens [NA], ventral tegmental area [VTA], substantia nigra and globus pallidus, homologous competitive radioligand binding methods were employed. Results revealed that stereotypy horses had significantly higher densities (mean Bmax values [fmols bound ligand / mg]  $\pm$ SEM) of  $\mu$  receptors in the VTA (430 $\pm$ 85 Vs. 217 $\pm$ 47;  $t=2.13$ ;  $P<0.05$ ), NA (392 $\pm$ 69 Vs. 211 $\pm$ 43;  $t=2.08$ ;  $P<0.05$ ) and caudatus (709 $\pm$ 50 Vs. 423 $\pm$ 48;  $t=3.82$ ;  $P<0.001$ ) regions compared to controls. No significant results were recorded for either  $\delta$  receptor densities nor binding affinity (Kd) values for either opioid receptor subtype. The increase in  $\mu$  binding to the caudatus supports the idea of direct/indirect pathway imbalance within the dorsal striatum for stereotypy individuals. However, the increased  $\mu$  opioid binding in the NA and VTA also suggests a role of ventral striatum in this behavioural condition.

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## TO STEREOTYPE OR NOT TO STEREOTYPE?



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Over 50% of captive-born striped mice, *Rhabdomys pumilio*, develop stereotypy but, as in other animals, the behaviour is rare in wild-caught individuals. Since a complex environment during ontogeny protects against stereotypy development later in life by reducing emotional reactivity and/or increasing behavioural flexibility, could early, environmentally-mediated neuroprotection explain why wild-caught animals stereotype less than captive-born individuals? If so, will age at capture, and thus duration of exposure to the complex wild environment, predict susceptibility to stereotypy? We tested this hypothesis by retrospectively analysing data for *R. pumilio* from four grassland populations (juveniles, N=103; adults, N=101). Mice were live-trapped during various behavioural studies between 1994-2003, and thereafter singly housed under standard laboratory conditions. Three to four weeks after trapping, we observed no difference in stereotypy prevalence among populations ( $P=0.3960$ ;  $\chi^2_3=2.968$ ) or between sexes ( $P=0.1463$ ; Fisher's test). However, age at capture significantly ( $P<0.001$ ; Fisher's test) affected the proportion of animals developing stereotypy, with 55% of juveniles showing stereotypy compared with only 19% of adults. Although it is tempting to conclude that rearing in a complex (wild) environment is neuroprotective, and thus welfare enhancing, other findings suggest that wild-caught *R. pumilio* are not immune from the frustrations of captivity: they show reduced reproductive success (e.g. number of successful pairings;  $P<0.001$ ; Fisher's test) and appear to develop a passive/reactive behavioural strategy compared to the proactive strategy observed in juveniles (pers. obs). This passive strategy possibly precludes the development of stereotypy in many old-caught mice by limiting the expression and repetition of source behaviours, but too indicates compromised welfare as it may be equivalent to human depression. We term these age-dependent alternative strategies, with divergent behavioural phenotypes but convergent poor-welfare outcomes, the "wild-caught-22".

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Oral Paper: Stereotypies  
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## ARE STEREOTYPIES LESS INTERRUPTIBLE THAN NORMAL BEHAVIOUR?



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Anecdotally, stereotypic behaviours are relatively hard to interrupt. We tested this idea, and investigated the role of traits suggested to correlate with 'establishment' (e.g. subject age; the predictability of and/or time spent in stereotypic behaviour). Two experiments used brief auditory stimuli. In Expt. 1, 20 2-year old farmed mink were exposed to a bell. Subjects were less likely to pause if stereotyping during the stimulus rather than locomoting normally ( $z=-2.07$ ,  $P<0.05$ ), but their pauses were no briefer. Individuals with more time-consuming stereotypies paused for longer, whatever the on-going behaviour ( $z=2.07$ ,  $P<0.05$ ); but behavioural predictability had no effect. In Expt. 2, 23 sun- and Asiatic Black bears of varying ages, in a Thai sanctuary, were exposed to a buzzer. They paused more briefly if stereotyping (e.g.  $t=3.41$ ,  $d.f.=36$ ,  $P=0.0016$ ); no other effects emerged. Two additional experiments used lasting distracting stimuli, to encourage a switch to new behaviours. In Expt. 3, 28 1-year old mink were exposed to water-jets that left droplets on the cage. This always interrupted on-going behaviour. If stereotyping, mink showed shorter pauses ( $F_{1,15}=16.16$ ,  $P<0.001$ ) and were more likely to resume on-going behaviour ( $\chi^2=13.7$ ,  $d.f.=1$ ) cf. normal locomotion. However, unlike Expt. 1, pause length was unrelated to how stereotypic the subject was. In Expt. 4, 10 bears were presented with a reward-delivering apparatus. Approach latency, plus number of operant responses (similar to pause-length), were measured. If animals were stereotyping, they tended to take longer to approach ( $F_{1,8}=4.82$ ,  $P=0.059$ ), but the number of operant responses was unaffected. Approach latency was longest in bears with very predictable stereotypic behaviours ( $F_{1,6}=8.91$ ,  $P=0.024$ ), but bear age had no effect. Overall, for reasons still unknown and in ways that vary between experiments, stereotypic and normal behaviour patterns do differ in how interruptible they are.

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## WE'VE GOT TO GET OUT OF THIS PLACE: FRUSTRATION, ENRICHMENT AND THE DEVELOPMENT OF STEREOTYPIES IN LABORATORY MICE (*MUS MUSCULUS*)



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Stereotypies arise from frustrated motivations combined with behavioural perseveration. Experiments have shown that enriched rearing-environments can either protect animals from developing repetitive behaviours when moved to barren enclosures (perhaps by normalizing CNS development and reducing perseveration), or have the opposite effect (perhaps by altering animals' expectations, thence increasing the frustration experienced in impoverished environments). We investigated what would happen if laboratory mice were reared with enrichment before transfer to standard cages, and the mechanisms underlying observed effects on stereotypic behaviour. 48 ICR CD-1 mice were reared in standard or enriched cages, and at 3 months, all were transferred to standard cages. Stereotypies and urinary corticosterone were assessed before and after this move. Mice were screened for perseveration at 12 months via an extinction task (involving learning a spatial discrimination, followed by an extinction phase during which mice were not rewarded for previously rewarded responses), and for strength of motivation for enrichment (by assessing the maximum weight pushed to reach enrichments) at 18 months. At 19 months, home cages were enriched and stereotypy and urinary corticosterone were again assessed. Enriched-housed mice stereotyped less than standard-housed mice ( $P_{1.40} < 0.001$ ). However, after transfer to standard cages, enriched-reared animals exhibited the highest levels of stereotypic behaviour ( $P_{1.40} = 0.011$ ). Stereotypies included bar-chewing, food-manipulation, route-tracing digging and somersaulting. Enriched-reared mice were more motivated to access enrichments ( $P_{1.39} = 0.013$ ), but their perseverative tendencies did not differ from standard-reared mice ( $P_{1.39} = 0.854$ ). Furthermore, mice with the highest re-housing-induced corticosterone responses were most likely to be high stereotypers later in life ( $P_{1.20} = 0.011$ ). These results broadly support the second theory, that enhanced stereotypies in enriched-reared then standard-housed animals stem from frustration - although there were inconsistencies that need further explaining. This research adds to evidence that frustration plays a key role in laboratory mouse stereotypic behaviour, and highlights the importance of not withdrawing animals from an enriched environment.

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Oral Paper: Husbandry systems and husbandry procedures (IV)  
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## ASSESSING THE WELFARE, HOUSING AND HUSBANDRY OF ELEPHANTS IN UK ZOOS



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The welfare of zoo elephants may be sub-optimal: reduced life expectancy, obesity and a variety of health and behaviour problems can be consequences of captive living. No study has previously evaluated the effects of housing and husbandry on the health and welfare of elephants in UK zoos. Thirteen UK zoos and safari parks house 40 Asiatic (*Elephas maximus*) and 36 African (*Loxodonta africana*) elephants. Seven collections hold Asiatic elephants, five African and one has both. Group sizes range from 2 to 13, often unrelated, individuals and life histories can be complex. We devised a study to examine the welfare of elephants in UK zoos in relation to their housing and husbandry. Detailed information was recorded on housing, husbandry and the history of each elephant. Welfare was assessed using direct and videotaped observations of day-time and night-time behaviour, a standardised health-check procedure, and measurement of faecal cortisol metabolite levels. Initial day-time observations showed that when indoors, elephants spent 56% of time eating, 9% standing, 7% walking, 7% interacting with the keeper, 2% performing stereotyped behaviour and 2% physically interacting with other elephants. Outdoors, 50% of time was spent eating, 12% walking, 7% standing, 4% performing stereotypies and 3% interacting with other elephants. Mean cortisol levels between the zoos ranged from 153 to 835 ng/g faeces. There was a significant effect of zoo (3-way ANOVA;  $F=7.4$ , 12 d.f.,  $P<0.001$ ) but not species or sex on mean cortisol. There was a significant correlation between age and cortisol in Asiatic ( $F=9.2$ ; 1, 36 d.f.,  $P=0.004$ ) but not African elephants ( $F=0.54$ ; 1, 29 d.f.,  $P=0.467$ ). Data will be collected twice more from each collection to balance for any seasonal effects. A welfare-profile of each elephant will be constructed, and data analysed to identify risk-factors in housing and husbandry related to poor and good welfare.

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## POSITIVE REINFORCEMENT TRAINING AND HUMAN INTERACTION REDUCES THE STRESS OF CAPTURE



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Capture is a potential source of stress to laboratory-housed animals. Animals are often captured frequently, and therefore techniques to reduce the impact should be sought. The use of positive reinforcement training may be one way of reducing this stress by allowing animals to cooperate with their capture. Fourteen pair-housed common marmosets (*Callithrix jacchus*) were allocated to one of two training/interaction groups; positive reinforcement training (T1) and positive human interaction (T2). T1 marmosets were trained to hold onto a detachable panel and remain there whilst they were removed from the cage whilst T2 marmosets were given food and positive interaction without any training. Behaviour and saliva samples were collected prior to the commencement of any training/interaction as a baseline (B), after a standard capture as a capture baseline (BC) also prior to training/interaction. Further samples were collected immediately after the first and tenth training/interaction session, following a standard capture once all training/interaction was completed (SC) and after a trained capture for T1 marmosets (TC). The saliva samples were subsequently assayed for cortisol. Data were analysed using repeated measures ANOVA followed by post-hoc planned comparisons on the predicted means. For both T1 and T2 groups cortisol levels were lower after both the first and tenth training/interaction when compared to B ( $P < 0.01$ ). Cortisol levels for both T1 and T2 groups were also lower at SC than B ( $P < 0.05$ ). The four marmosets in T1 who were successfully trained showed lower cortisol levels following TC than B ( $P < 0.01$ ) and BC ( $P < 0.05$ ). Although trained capture using a detachable panel may have additional benefits, positive interactions with humans also reduce stress and are a useful means of improving marmoset welfare.

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## GROUP VERSUS MULTIPLE INDIVIDUAL BEHAVIOUR, CAN WE DISTINGUISH BETWEEN THE TWO?



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In summer piglets spread out to allow heat dispersal and in winter huddle in close proximity to conserve heat. This behaviour was used to assess piglet response to transport temperatures. Six groups of 16 Cotswold piglets were weaned ( $17 \pm 1$  d) and transported for 24h during summer (S), winter (W) or spring (SP). Average transport temperatures varied (S:26.5°C, SP:16.4°C, W:0.9°C; SEM-2.24,  $P < 0.01$ , Mixed Procedure). Thermoregulatory behaviour was videotaped and a simple assumption was utilized: Piglets exposed to view were exposed to the air. Scan sampling (20/h) during the mid h in each 6-h period allowed piglets to be classified as exposed for 0-25% (C1), 25-50% (C2), 50-75% (C3) or 75-100% (C4) of the observations. Chi square analyses, based on number of piglets, were performed. However, percentages have been provided for ease of comparison. A summer and a winter pattern emerged. During summer more piglets were observed in category C4 (85.7%) than in C3 (9.8%), C2 (2.7%) or C1 (0%) ( $P < 0.01$ , chi-square = 235.6). In the winter pattern no differences were observed (C4, 10.9%; C3, 28.1%; C2, 28.7%; C1, 31.1%, chi-square = 6.88), although the number of piglets in C4 tended to be lower. In spring, during the two day-time periods the summer pattern was apparent (C4, 68.8%; C3, 18.8%; C2, 12.5%; C1, 0%). However in the two night-time periods the winter pattern was apparent (C4, 18.8%; C3, 29.7%; C2, 17.2%; C1, 34.4%). The discrete nature of these patterns is interesting and possibly indicative that the behaviour measured was an emergent property of the group rather than a composite of individual behaviour. Emergent behaviours have been observed in insect colonies and hypothesized to exist in mammalian groups. It is important to be able to distinguish between emergent and composite behaviours and yet we currently have no clear mechanism for doing this.

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## EFFECT OF DURATION OF ROAD TRANSPORT ON BEHAVIOUR AND PHYSIOLOGY OF CATTLE



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The aim of this experiment was to quantify the impact of transport duration on behavioural and physiological indicators of cattle welfare. Two replicates of four transport duration treatments of 6, 12 and 30 and 48h were examined. *Bos indicus* x *Bos taurus* heifers (N=480; 383.5 ± 35.3kg) were transported from one property to a feedlot using single trailer trucks (60 cattle/truck). On arrival, the cattle were allocated to pens with hay and water. Liveweight, blood chemistry and haematology were measured on 15 focal animals per vehicle pre-transport, and at 0, 24 and 72h after arrival. Rectal temperature was logged during transport and for 72h afterwards. Behaviour was recorded for 6h post-arrival for the 12h and 48h transport duration treatments. After 72h, the cattle were regrouped and finished in the feedlot over 43 days. The thermal environment was monitored during the journeys and the THI ranged from 50 - 80. A significant ( $P<0.05$ ) interaction of transport duration x replicate x sampling time was observed for the majority of the blood measurements and liveweight. The greatest difference between treatments was observed immediately on arrival, although this was not large for some measurements and generally still within normal physiological values. There was a direct association between transport duration and liveweight loss but by 72h post-transport, the cattle had recovered more than 95% of their pre-transport weight. Compared to the 12h transport group, the cattle transported 48h spent significantly more time lying and less time eating during the initial 3h post-transport phase. The difference in lying time was less consistent and an opposite trend was observed for eating time during the second 3h period. The results of this study generally indicate that healthy cattle that have unrestricted access to food or water prior to transport can be transported with best practice for 6, 12, 30 and 48h duration without major compromise to their welfare.

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Oral Paper: Husbandry systems and husbandry procedures (IV)  
Saturday 12/8/06 – The Reception Room



## SUPPLEMENTATION OF PREGNANT EWE DIETS WITH DOCOSAHEXAENOIC ACID REDUCES LAMB SUCKLING LATENCY



Katie L. Gentle, Emer Scott-Baird, Ruth M. Pickard, Andrew P. Beard,  
Gillian Butler, Sandra A. Edwards

University of Newcastle upon Tyne, UK

The probability of survival of newborn lambs is strongly influenced by their latency to stand and suckle, and their subsequent ability to maintain contact with their dam and achieve regular nutrition. This study investigated the effects of supplementing the maternal diet with the essential fatty acid, docosahexaenoic acid (DHA), in late pregnancy on neonatal behavioural development. 64 twin-bearing mule ewes were used in two concurrent experiments. Ewes received either 12g (expt 1, N=12 per treatment) or 6g (expt 2, N=20 per treatment) of DHA per day from an algal biomass supplement for the last 6 weeks of pregnancy. Controls received an equal lipid supplement from maize oil. Neonatal and maternal behaviours were continuously recorded from the time of birth until first suckling, or until two hours post parturition when unsuccessful lambs were assisted to suckle. Data were analysed by two-way ANOVA using experiment, DHA supplementation and their interaction as factors. For censored suckling latency data, the nonparametric Scheirer-Ray-Hare test was used. No significant effects of DHA were found on the latency to first standing attempt, successful standing, or first udder contact. However there was a significant DHA effect on latency to first suckling ( $P=0.017$ ), with no effect of experiment or interaction between DHA and experiment. Median latencies were 84 and 59 minutes in experiment 1, and 81.5 and 68 minutes in experiment 2, for control and DHA lambs respectively. Maternal behaviours of licking, vocalisation or lamb rejection did not differ between treatments. Subsequent cognitive development was assessed at 5 weeks of age, and the time taken by lambs to negotiate a maze in order to rejoin their dam was unaffected by DHA supplementation. It is concluded that maternal supplementation with DHA during the last 6 weeks of pregnancy offers an important means to enhance lamb survival through improved neonatal vitality.

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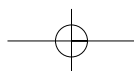
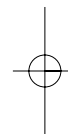
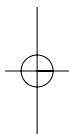
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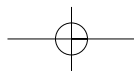
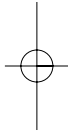
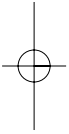


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POSTERS  
WEDNESDAY 9th – THURSDAY 10th  
AUGUST 2006

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## THE IMPACT OF TWO DIFFERENT MILKING SYSTEMS ON COW BEHAVIOUR AND PHYSIOLOGICAL PARAMETERS



Anna-Maija Aisla<sup>1</sup>, Jutta Kaihilahti<sup>2</sup>, Matti Pastell<sup>1</sup>, Mikko Hautala<sup>1</sup>,  
Outi Vainio<sup>1</sup>, Satu Raussi<sup>2</sup>, Jukka Ahokas<sup>1</sup>

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Automatic milking has become a common practice in the modern dairy industry but little is known about its effect on animal welfare and behaviour. In order to find out the impact of modern technology on animals wellbeing, both physiological and behavioural factors need to be studied. In automatic milking systems the human animal interaction is minimal but on the other hand the robot performs every milking in a similar manner. The aim of this study was to find out whether there is a difference in animal behaviour and physiological parameters between cows milked in a milking robot and in a herring bone parlour. Two groups of five cows were studied (groups 1 and 2), both groups were milked in both milking systems for a one week recording period. The respiration rate, heart rate and stepping activity were measured. All of the milkings were recorded with a digital video camera and the cow behaviour was analyzed from the recordings. The research was conducted on a farm which has both of the milking systems installed in the same barn. No major differences in cow behaviour or between the milking systems were observed as a whole. Preliminary data shows that the respiration rate of the cows in group 1 was higher in a milking robot than in a milking parlour, and was also higher than the respiration rate of the cows in group 2 in both milking systems. There was no difference in the respiration rate of the cows in group 2 between these two milking systems.

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Posters  
Wednesday 9/8/06 – Thursday 10/8/06



## APPLYING ANIMAL SENTIENCE TO HUMAN MORALITY



Jonathan P. Balcombe

Physicians Committee for Responsible Medicine, USA

This theoretical paper argues that what we now know about the behavior of sentient animals requires a profound reorganizing of our relationship to them. Mammals, at least, are acutely sentient—they express a wide range of emotions, and show awareness of past and future events. Improving animal welfare is a key facet of applied ethology, yet we are failing to keep pace with knowledge. Animal husbandry conditions in laboratories illustrate this failure. Preference studies, stress data, behavioral stereotypies, our understanding of the animals' natural history, and common sense all tell us that depriving animals opportunities to perform highly motivated natural behaviors severely compromises welfare. Yet, to this day, tens of thousands of monkeys languish behind metal bars in artificially-lit rooms, and tens of millions of rats and mice shuffle about in tiny shoe-box cages, with little to no opportunity to forage, explore, burrow, hide, nest, escape, choose social partners, or otherwise exercise control over their environments. Instead of conducting another study comparing animals' responses to some environmental enrichment, or worse, to different restraint apparatuses, moral consistency demands that we make substantive, meaningful changes now. Beyond welfare reforms, we ought to ask the question: What is it about a monkey or a rat that makes it okay to use them in research and testing that is clearly not in their best interests, when it is unethical to do so in human subjects? If our ethics are founded on sentience—as I argue they are—then we are wrong to confine, hurt and kill them.

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## ONTOGENY OF THE NURSING VOCALIZATION IN DOMESTIC PIGS



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The grunting vocalization that lactating sows emit during nursing is not only species-specific (e.g., it contains an increase in the grunting rate 25 s before the milk ejection) but also individually specific in established lactation. That is, each sow has its own grunting rate. It has not been examined yet (i) how early after parturition does the grunting pattern appear and (ii) whether the pattern is repeatable within sows already during the first days after parturition. The nursing vocalisation of ten sows was video-taped at the end of the first 24 hrs, on Day 2, on Day 3 and on Day 7. For every sow 3 nursings were always analysed 50 sec before milk ejections at each day. The peak grunting rate during a 5 sec interval, the total number of grunts during 50 sec and the grunt rate increase 25 sec before milk ejection were analyzed. The first analysis showed: (i) The peak grunting rate (Proc Mixed;  $F_{3,27}=2.59$ , NS) and the grunt rate increase (Proc Mixed;  $F_{3,27}=0.94$ , NS) were nearly the same on all days. The observation days had a significant influence on the total number of grunts (Proc Mixed;  $F_{3,27}=4.53$ ,  $P<0.05$ ). The highest grunting number was on Day 2. (ii) The repeatability in individual sows between the first 24 hrs and Day 7 were high for the peak grunting rate ( $N=10$  sows,  $r_s=0.78$ ;  $P<0.01$ ), the total number of grunts during 50 sec ( $N=10$  sows,  $r_s=0.77$ ;  $P<0.01$ ) and for the grunt rate increase ( $N=10$  sows,  $r_s=0.84$ ;  $P<0.01$ ). These results indicate that the grunting pattern is already developed during the first 24 h and the individual grunting pattern is already highly repeatable during early ontogeny.

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Wednesday 9/8/06 – Thursday 10/8/06



## CAN BEHAVIOURAL OBSERVATIONS GIVE AN EVALUATION OF WELFARE? THE TIME BUDGET AND SOCIAL BEHAVIOUR OF ARAB MARES IN A PADDOCK



Haifa Benhajali<sup>1</sup>, Marie-Annick Richard-Yris<sup>1</sup>, Marine Leroux<sup>1</sup>,  
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A unstable herd of 44 Arab mares was observed in a 2500m<sup>2</sup> paddock in summer in Tunisia. Fifteen-minute focal animal samples and scan sampling were used to determine the time budget of the mares during the period from 9am to 3pm and to study their social behaviour. A total of 42 hours of observations were performed. The behavioural states recorded were feeding, drinking, alert-standing, stand-resting, self-grooming, locomoting, rolling and social interactions. Locomotion was the most frequent activity at  $27.9 \pm 19.47\%$  (mean  $\pm$  SD), followed by feeding, and standing resting. The mares spent  $14.88 \pm 18.83\%$  of their time alert-standing,  $1.03 \pm 3.51\%$  self-grooming,  $4.75 \pm 7.19\%$  drinking and  $0.83 \pm 2.64\%$  interacting socially. 269 agonistic interactions were noticed. Retreat and avoidance represented the most frequent agonistic interactions (65% of total interactions). Almost 60% of all aggression consisted of threats to bite. Threats to kick (27%) were next in frequency of occurrence. Rolling was observed only once and mares were never observed allogrooming, lying down, urinating, defecating nor vocalizing. Social behaviour was restricted to agonistic interactions and preferential associations that could be determined were very rare. The tendency to stay away from other mares (percentage of time spent at more than 3 horse's body length) differed largely between mares and was unexpectedly high given the high density of animals ( $8.28 \pm 15.37\%$ ). The data obtained in this high density situation therefore reveals restricted behavioural repertoires, unusual time budgets with a high frequency of active walk that constitutes the most frequent activity, and a low level of social interactions that were almost entirely restricted to agonistic interactions. These results are discussed in relation to other similar studies on domestic horses and questions of welfare assessment.

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## USING SIMPLE BEHAVIOURAL SCORINGS TO IDENTIFY SOWS WHO CRUSH PIGLETS



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Piglet crushing by the sow is one of the main causes of piglet mortality before weaning. This study aimed to develop and validate simple behavioural scores performed during standard management practices which could describe and predict sow behavioural patterns that increase piglet survival. Two behavioural scores were developed: a) easiness of moving (EM: from 0 "moving without human intervention" to 3 "very difficult to move"), b) sow's reaction to piglets handling (RH: from 0 "no reaction" to 5 "high level of restless"). Behaviour from 76 sows was scored by an "expert" using these two scales through direct observation. Some sows were also video recorded to be observed by 47 "non-experts". Each "non-expert" watched and noted 7 sows for both behavioural scores EM and RH (including one video repeated without observer's knowledge). Reproduction performances were also recorded. Direct observations of the sows were repeated by the "expert" on the following litter (N=60). Data were analysed using non-parametric tests and analysis of variance. Intra-observer (non-expert) repeatability was highly significant for both behavioural scores (EM:  $r=0.84$ ,  $P<0.0001$ ; RH:  $r=0.89$ ,  $P<0.0001$ ). Panel observers agreed significantly together about EM and RH notations. Mean "non-expert" scores were highly correlated with "expert" notations (EM:  $r=0.88$ ,  $P<0.0001$ ; RH:  $r=0.91$ ,  $P<0.0001$ ). Scorings and number of piglets born alive were highly related within two consecutive litters of the same sow (EM:  $r=0.48$ ; RH:  $r=0.45$ ; number of piglets born alive:  $r=0.6$ ;  $P<0.0001$ ). The higher EM the fewer stillborn piglets they had ( $H=9.1$ ;  $P<0.05$ ). No significant relation was established between EM and RH scores and the number of crushed piglets respectively, due to low level of crushing. Both behavioural scores could be used as simple, repeatable and consistent indicators of sow behaviour. Their relation with maternal abilities should be confirmed on a larger number of sows.

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## ANIMAL WELFARE MEASURES IN BROILER PRODUCTION AND THEIR ECONOMIC, ECOLOGICAL AND SOCIETAL CONSEQUENCES



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Research has shown that animal welfare problems in conventional broiler production are associated mainly with the fast growth of the birds and a high stocking density. Changing over to slow growing broilers kept in a lower stocking density will solve, therefore, most of the welfare problems. Such a change, however, has economic, ecological and other societal consequences. In this study, we compared a conventional fast growing (FG) with an organic slow growing (SG) broiler production system managed by one full time employee for economic, ecological and societal issues. For each issue indicators - measurable parameters that give the state of an issue - were selected. Indicators were quantified based on scientific literature and national data sets. The SG production system performed better for all indicators related to the societal issue animal welfare such as behavioural time budget, cardiovascular and leg abnormalities, and mortality. Regarding another societal issue food safety, meat from the SG production system contained less medicine residues and less Salmonella contaminations but more Campylobacter contaminations. Regarding ecological issues, the SG production system emitted more ammonia and had a higher indirect energy use, the latter because of a lower feed conversion. Direct energy use tended to be lower in the SG production system. The FG production system performed better for the economic indicators cost price/kg meat and slaughter yield/bird, whereas labour income per full time employee was higher for the SG production system. This study showed that changing over to a SG broiler production system has much more consequences than only for animal welfare. Although it is difficult to compare different indicators for each issue, it is necessary to study the contribution to sustainability of all relevant issues. In this way a production system can be developed that is acceptable for society, economic profitable and ecological in balance.

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## ADAPTATION OF PREGNANT SOWS TO AN ELECTRONIC FEEDING SYSTEM: THE EFFECT OF LEARNING AND HIERARCHY



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Electronic sow feeders (ESF) may be a good option when group-housing is adopted for pregnant sows. Although pigs are known to perform accurately in operant feed intake tasks, some individuals may have adaptation problems. This could be due to social factors or difficulties in learning. The aim of this study was to evaluate the adaptation capacity of group-housed pregnant sows to ESF through two consecutive gestations and its relation to the social rank. Twenty pregnant sows (LW x LD) from first to eighth parity were group-housed in a pen with ESF from day 29 of gestation to 1 week before parturition. In the next gestation, fifteen sows repeated the experience (although group size was maintained). Sows were subjected to a training program from the fifth to the eighth day of the study in order to assist those sows which showed adaptation difficulties. Aggression was recorded to determine the social rank index (RI) of each sow (Nielsen et al., 1995). One inexperienced gilt had to be removed during first gestation once the training program finished because she failed to adapt to the system. In the first gestation, only 20% of the sows finished their feeding ration the first day of the study, and it was not until the second week that all these animals finished their whole rations. In the second gestation, 100% of the animals that repeated the experience finished her feeding ration the first day. RI was negatively correlated with the number of days that took the sows to start feeding ( $r_s = -0.58$ ,  $P < 0.05$ ). It can be concluded that previous experience on ESF is very important to assure a good adaptation of group-housed sows. Experience through one gestation would be enough to maintain the learning process until the next gestation. Our results support the hypothesis that problems in adaptation may be a consequence of social factors.

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## THE NEAREST NEIGHBOUR DISTANCE OF MALE EUROPEAN BISON AT THE PRIOKSKO-TERRASNIY NURSERY



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Our goal was to analyse nearest neighbour distance for male bison. We tested the following influencing factors: 1) rut, 2) time of day (morning, noon, afternoon), 3) antropogenic and natural factors, 4) social behaviour (friendliness, aggression). We observed 3 herds, which consisted of one male and a few (3-5) females. These herds were in isolated enclosures, of 36-70ha, 9-12ha per animal. We measured distances between bison every 5 minutes, 2-4 hours during the day, from April to October 2005. Our results were sorted by different types of activity: walking, foraging, feeding, easy lie, restless lie. About 1300 distances were taken for each male. Bison had two feeding times every day at a feeding point. We used SPSS 10.0 to analyse our results (one-way ANOVA, Kruskal-Wallis Test). At the non-rut period, all the males had equal nearest neighbour distances for feeding of 8-10m (95% all of distance,  $P < 0.05$ ). Two males had equal distances for easy lie of 1-2m ( $P < 0.05$ ) and restless lie of 2-6m ( $P = 0.05$ ), and one had different distances for both easy lie 23-39m, and restless lie 52-213m. Distances for walking (55-98m, 4-8m, 6-10m) and foraging (40-60m, 8-10m, 11-14m) were different for each male. One of the males had very long distances compared to the other males. At the rut period, nearest neighbour distances became equal for all males: foraging 8-10m, feeding 3-6m, easy lie 1-3m and restless lie 0.1-6m ( $P < 0.05$  for all distances). Two of the males had equal distances for walking 2-4m ( $P < 0.05$ ), whereas one had a distance of 6-23m. At the rut period nearest neighbour distance declined for all the males ( $K = -0.52$ ,  $P < 0.05$ ). Aggression from focal males during the whole observation period increased nearest neighbour distance ( $K = 0.3$ ,  $P = 0.5$ ), and friendliness decreased distance ( $K = -0.1$ ,  $P = 0.05$ ). Time of day, antropogenic and natural factors did not influence nearest neighbour distance for males.

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## EFFECTS OF MICROFLORA CHANGE ON SOCIAL BEHAVIOUR IN GROUPED WEANER PIGS



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Sickness is known to cause behavioural changes in an animal as a means to aid in the combat of illness, but little is known about how sickness alters social dynamics in animal populations. The objective of this study is to determine if an intestinal microflora change in an individual leads to behavioural alterations by the individual and its penmates. Weaned pigs were housed in 21 groups of three pigs, over three replicates. In 11 treated groups, one pig received three doses of 250 mg/kg ampicillin orally and penmates received placebo doses. In 10 control pens, all pigs received placebo doses. Pens were video-recorded and analysed for three 10-minute active periods randomly selected from a four-hour time window per day on days -1, +1 and +3 relative to dosing. Frequencies and durations of social (aggression, oral-nasal contact), abnormal (belly-nosing, tail-biting) and non-social (feeding, drinking) behaviour were statistically analysed as a repeated measures mixed model. Frequency data was analysed as a Poisson distribution with a log link. Fecal samples were collected directly. Treatment was not associated with clinical signs of diarrhea. However, microbiological analysis of the fecal samples revealed a significant microflora change on day +3 for treated pigs ( $P=0.006$ ). Overall aggression levels were low in all groups (mean frequency/min  $\pm$  [95% CI]:  $0.0741 \pm [0.0427, 0.128]$ ), but on day +3 treated pigs ( $0.197 \pm [0.119, 0.326]$ ) performed a significantly higher frequency of aggressive behaviour compared to pigs in the control pens ( $0.071 \pm [0.030, 0.167]$ ;  $P=0.006$ ) and its untreated penmates ( $0.105 \pm [0.055, 0.20]$ ;  $P=0.039$ ). Oral-nasal social contact, abnormal and non-social behaviour did not differ between groups. The cause of this aggression is yet unknown, however, this study shows for the first time, that an intestinal microflora shift can alter social behaviour in the absence of clinical signs of disease.

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## PRE-LAYING BEHAVIOUR AND NEST-BOX USE BY HENS



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The view that nest-boxes are important for hen welfare has resulted in their incorporation in modern cages for laying hens. However, in recent research we found only 62% of eggs were laid in nest-boxes in 8-bird furnished cages, suggesting a lack of understanding of what hens perceive as important cues for nest-site selection in furnished cages. The present experiment investigated pre-laying behaviour and nest-box use and utilised 18 hens from our larger experiment. The hens were aged 45 weeks and occupied three cages containing a nest-box and no other furniture (neither dust-bath nor perch). Records for these cages showed half the eggs were laid in the nest-box, suggesting only half the hens were nest-layers. Pairs of hens were selected at random from these cages, transferred to an identical observation cage and video-recorded over 3 days. As expected, 9 hens laid in the nest-box (nest-layers) and 9 laid outside the nest-box (floor-layers). The behaviour of each hen was captured on day 2 or 3 using the Observer VideoPro (Noldus Information Technology) and analysed *post-hoc* for differences due to oviposition site. In the hour before oviposition, nest-layers occupied the nest-box during 70.3% of the time compared to 5.6% for floor-layers ( $P < 0.01$ ). Nest-layers were less active than floor-layers (4.8 vs 21.3%;  $P < 0.01$ ), particularly due to more time spent squatting (56.9 vs 26.5%;  $P < 0.01$ ), although bout frequency was similar (22.1 vs 22.8 bouts/hen). Most hens were consistent in their oviposition sites between days suggesting an established pattern of nest-site selection. These data raise questions such as: Does age/experience have an effect? Are hens frustrated by their inability to access a preferred oviposition site? Is consistency of nest-site selection associated with a preference for that site? Does group size affect consistency of oviposition site selection? Clearly further research is required to answer such questions.

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## DEVELOPMENT OF SEXUAL BEHAVIOUR IN COMMERCIALY HOUSED BROILER BREEDERS



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Male broiler breeders behave aggressively towards females during mating. However, it is not known what causes this abnormal sexual behaviour. The development of the sexual behaviour has not been described yet and may give insight into possible causes and the role of the hen. We observed the frequency of sexual, courtship and aggressive behaviour in males and females on eight commercial broiler breeder farms (Ross parent stock) at 20, 22, 24, 26 and 28 weeks of age. Direct observations were performed in two units per farm, by scoring male behaviour and female responses in 18 males during 5 min per male per unit per age. In addition, behaviour was recorded on videotape and analysed in detail for 1 h in one unit per farm per age. All observations were performed between 4 and 0.5 h before lights off. Effects of age and comparisons between frequencies at the same age were performed using the Wilcoxon matched-pairs test. At least 86% of the matings were forced and at least 55% of the matings were not successful, confirming earlier studies. Males behaved more aggressively towards females than towards other males ( $P < 0.05$ ) from 22 weeks of age onwards. Only 20% of the matings were preceded by courtship behaviour and some elements were hardly observed. For the hens from 24 weeks of age onwards, frequency of 'no-response' or 'going away' was significantly higher than 'approaching the male' ( $P < 0.05$ ). Hens fled from the males during at least 40% of the matings. In conclusion, females showed little response to male approach. This may be caused by the aggressive male behaviour. However, it also may suggest that both males and females do not show normal sexual behaviour. This may be caused by separate rearing of males and females (hampering correct learning of sexual behaviour), large groups (resulting in a reduction of individual recognition) and a high stocking density.

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## EFFECTS OF RACLOPRIDE ON AGGRESSION AND STRESS IN DIVERSELY SELECTED CHICKEN LINES



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Lines of White Leghorn chickens were divergently selected for high (HGPS) and low (LGPS) group productivity and survivability. The selection resulted in two distinct genetic lines which have been previously characterized as having different mechanisms for coping with social stress as evidenced by differential cannibalism, flightiness and immunocompetence. HGPS birds have a superior survival strategy when compared with LGPS birds or birds of Dekalb XL (DXL), a commercial strain. The line's unique characteristics in stress response, as determined previously, and the changes in behavior and production could be reflected in the selection-induced different expression of dopaminergic system. We examined whether the diversely selected chicken lines differ in the role of dopamine (D2) receptor activities in aggressiveness. At 65 wk of age, birds of the same strain were housed in pairs; the dominant bird was treated with raclopride (a D2 antagonist) injections (or saline) for ten consecutive days to determine the differential role of stress coping ability in aggressive responsiveness. Following treatment with raclopride, dominant birds of all strains showed a reduced frequency of aggressive pecks ( $P < 0.05$ ;  $N = 15$ ), while untreated subordinates paired with raclopride injected birds increased pecking frequency ( $P < 0.05$ ). Two days after treatment, LGPS and DXL birds returned to pre-injection levels of aggressive threats ( $P > 0.05$ ), while HGPS birds maintained a depressed frequency of threats ( $P < 0.05$ ). In addition, strain differences in aggressive responsiveness coincided with an increase in epinephrine in raclopride treated LGPS birds ( $P < 0.05$ ) relative to control LGPS birds, but not exhibited by HGPS and DXL birds ( $P > 0.05$ ). Our findings suggest a functional linkage between the genetic basis of stress coping ability and the dopamine system regulating aggressive responsiveness.

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## SIZE OF ENTRANCE THROUGH WHICH FORMOSAN SQUIRREL (*CALLOSCIURUS* *ERYTHRAEUS*) CAN PASS



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In recent years, Formosan squirrels have been causing damage to farm products and houses. They can enter houses through a narrow space. The aim of the study was to determine the size of entranceway that Formosan squirrel could pass through. Nine squirrels (3-5 years), which were born in the wild, were studied in captivity. Three experimental boxes (125x40x30 cm) were divided into 5 rooms which each had an entrance of a certain size. One box (SE) had 5 square entrances (1.0, 1.5, 2.0, 2.5, 3.0 cm square), and 2 boxes (WE, HE) had rectangular entrances (WE: 25 cm width x 1.0, 1.5, 2.0, 2.5, 3.0 cm, HE: 30 cm height x 1.0, 1.5, 2.0, 2.5, 3.0 cm). Feed was put in each room. The arrangement of the entrances was changed randomly across individuals. Behavior of squirrels to each box was recorded by video camera from 9:00-13:00 for 3 days. Each box was changed per 3 days by latin square method. Squirrels visited all entrances. The visiting frequency to the entrances that squirrels could pass (68.7%) was greater than that of the entrance that they could not pass through (31.3%,  $P < 0.01$ , Wilcoxon signed-rank test). Five squirrels and 1 squirrel could pass through the entrance of 3.0 and 2.5 cm width respectively in HE. Six squirrels and 1 squirrel could pass through an entrance of 3.0 and 2.5 cm height respectively in WE. No squirrels could pass through the all square entrances in SE. Squirrels appeared to determine whether they could pass or not without touching entrances. The diameter of squirrel's head was 3.0 cm or less. However, they could not pass through the 3.0 cm square entrance. Squirrels have to pass through narrow spaces with nest material in their mouths. It is thought that this behavior may have influenced results in this study.

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## EFFECTS OF CHRONIC SOCIAL STRESS ON CIRCULATING LEVELS OF HORMONES IN THREE GENETIC STRAINS OF LEGHORN HENS



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Social stress in Leghorns is a serious welfare concern in the egg-laying industry. To address this issue three genetic strains of White Leghorn hens were housed in a low (4 birds/cage, 213 cm<sup>2</sup>/bird) and high (10 birds/cage, 175 cm<sup>2</sup>/bird) density cage system at 17 weeks of age. Genetic strains included high group production and survivability (HGPS), low group production survivability (LGPS), and a commercial strain Dekalb XL (DXL). Each strain was housed in groups of 4 and 10 to form six treatments; HGPS10, HGPS4, LGPS10, LGPS4, DXL10, and DXL4. At 30, 45, and 60 weeks of age, blood samples were taken (N=12 per treatment). Plasma catecholamines (dopamine, epinephrine, and norepinephrine), serotonin and tryptophan levels were quantified using High Performance Liquid Chromatography. There were no significant differences found for catecholamines at 30 weeks of age. At 45 weeks of age, LGPS10 had significantly higher levels of norepinephrine (P<0.05), and tended to have greater levels of epinephrine (P<0.10) and dopamine (P<0.10) than LGPS4. Dopamine levels were significantly greater in HGPS10 than LGPS10 and DXL10 (P<0.05) at 60 weeks of age. At 30 weeks of age, serotonin levels were significantly higher (P<0.05) and tryptophan tended to be greater (P<0.10) in LGPS4 compared to LGPS10. At 45 weeks LGPS4 had significantly higher levels of serotonin than LSPS10 and DXL4 (P<0.05) and tryptophan tended to be higher in HGPS4 than HGPS10 (P<0.10). At 60 weeks of age LGPS4 had significantly greater levels of serotonin than HGPS4 (P<0.05) and LGPS4 tended to have higher levels of serotonin than DXL4 (P<0.10). No other differences were evident. In conclusion density affected catecholamines and serotonin up to 45 weeks. There is no evidence for genetic line x density interactions at 30 weeks, however at 45 and 60 weeks of age genetic line in high density cages are more stressed.

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## SPATIAL VARIATION OF ACCESS TO FOOD AFFECTS MATERNAL BEHAVIOUR, BUT HAS NO LASTING EFFECTS ON OFFSPRING FEARFULNESS IN MICE



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Rats were found to adjust their stress reactivity and fearfulness in response to environment-induced variations in maternal behaviour. To study the effects of variations in maternal environment on maternal behaviour and offspring fearfulness in mice, we housed pregnant C57BL/6-dams in systems made of a nest cage (NC) and a foraging cage (FC) connected by a tunnel, with food provided ad libitum either in the NC (NC-dams) or FC (FC-dams; N=7-8 dams each) until postnatal day 14 and then kept in standard cages until weaning. Maternal behaviour was scored during postnatal weeks 1 and 2, and fearfulness in the offspring was tested in an open-field and on the elevated O-maze at 10 weeks of age. Preliminary statistics are based on nonparametric Kruskal-Wallis Tests. Dams with access to food in the FC spent significantly more time in the FC and less time in the NC, than dams with access to food in the NC ( $P<0.001$ ). This difference had no effect on total time spend in contact with the pups (in the nest; NS). However, even though NC-dams showed significantly higher levels of active maternal care during postnatal week 1 ( $P<0.05$ ), this difference had disappeared in week 2 (NS), and total levels of maternal care during week 2 tended to be higher in FC-dams ( $P<0.2$ ). Since weaning weights of FC-offspring were significantly higher both in males ( $P<0.05$ ) and females ( $P<0.05$ ), it is likely that FC-offspring may have received more maternal care throughout the postnatal period. These results are consistent with studies in rats showing that moderately challenging maternal environments induce higher levels of maternal care. However, there was no clear treatment effect on measures of fearfulness in the offspring, suggesting that the difference between these two maternal environments, and their effects on maternal behaviour, were too subtle to induce lasting effects on offspring fearfulness.

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## THE EFFECTS OF THE PRESENCE OF AN OBSERVER, AND TIME OF DAY, ON WELFARE INDICATORS FOR WORKING POLICE DOGS



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Behaviour plays a major role in the assessment of welfare, but is likely to be altered if the subject is aware of the presence of a human observer. This may apply especially to kennelled working dogs, many of which actively seek human companionship. Behaviour may also change depending upon the time of the observation, and within the kennelled environment husbandry usually occurs at specific times, so this may have a further effect upon the behaviour observed. We therefore aimed to investigate whether the presence of an observer and the time of day did affect the behaviour of working kennelled dogs. Two populations of working police dogs were studied at 16 sites. Population 1 (WPD1, N=47) were worked during day and night; population 2 (WPD2, N=45) were worked only at night. Behaviour was recorded by a visible observer for two minutes (morning), and by remote video for two five minute periods when no staff were present (midday and evening). The presence of the observer, and the time of day, both affected behaviour. For example, in both populations, proportion of time panting, a behavioural indicator of compromised welfare in the dog, was greater at midday (Wilcoxon tests WPD1,  $z=-2.6$ ,  $P=0.009$ ; WPD2,  $z=-2.0$ ,  $P=0.05$ ) than with an observer present, and duration of sitting was greater at midday than in the evening (WPD1,  $z=-3.0$ ,  $P<0.002$ ; WPD2,  $z=-2.3$ ,  $P<0.02$ ). However, many other effects of observer and time of day were significant in one but not both populations, probably reflecting differences in diurnal patterns of working and human contact. Therefore when using behaviour to assess the welfare of kennelled dogs, observations should be recorded both in the presence and absence of an observer, at different times of day and taking the working pattern of the animal into account.

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## THE EFFECTS OF AROMATHERAPY OILS ON THE BEHAVIOUR OF STABLED HORSES



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These two replicated trials investigated the behavioural effects of aromatherapy oils on 12 stabled horses, divided into three groups according to stable design. In trial 1, 12 aromatherapy oils were separately presented as drops of oil on wooden blocks. Behaviour was videoed and the mean duration of olfactory investigation of the blocks used to construct a mean attractiveness order for the 12 oils. The three most attractive oils, Rose (*Rosa damascena*), Roman Chamomile (*Anthemis nobilis*) and Peppermint (*Mentha piperita*) were used in trial 2. In trial 2, these three oils and Sunflower oil as a control, were each presented individually for five days. On days 1, 3 and 5 behaviour was recorded for 30 minutes using wall-mounted video cameras. Data was harvested from tapes according to a nine mutually exclusive behaviour ethogram using the Observer v.5 package and analysed using SPSS v.12. Freidman's analysis showed a significant effect of treatment on duration of movement ( $P < 0.05$ ,  $df 3$ ,  $\chi^2 9.92$ ) and standing alert ( $P < 0.05$ ,  $df 3$ ,  $\chi^2 9.01$ ), while differences in dozing behaviour approached significance ( $P < 0.1$ ,  $df 3$ ,  $\chi^2 6.36$ ). Wilcoxon Signed Ranks Tests for treatment differences found that Rose ( $P < 0.05$ ,  $Z -3.242$ ) and Roman Chamomile ( $P < 0.05$ ,  $Z -2.462$ ) resulted in a significant reduction in movement behaviours. Differences between Peppermint and the control were not significant. Using Freidman's analysis a significant difference was found between the three groups in mean duration of behaviours ( $P < 0.005$ ,  $df 2$ ,  $\chi^2 11.31$ ), suggesting that stable design influences equine behavioural responses to aromatherapy oils. In these short-term trials the horses demonstrated increased attraction to Peppermint, Rose and Roman Chamomile aromatherapy oils. Rose and Roman Chamomile oils resulted in behaviour suggesting increased relaxation. Published studies have shown the stimulating effects of Peppermint oil on dogs, however this study did not demonstrate similar effects in horses.

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## BEHAVIOR AND STRESS LEVELS OF COWS IN HANDLING STOCKYARDS IN THE DRY TROPICS



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To evaluate the behavior and stress level of cows of different genetic type under conditions of stockyard handling in tropical dry climate, twelve cows of two genetic types, Brahman x Simmental-Charolais (N=5, Br) and Brown Swiss x Brahman (N=7, F1) (550-610 kg body weight, 4-5 years old, 2 to 3 parities, 6 to 7 months pregnant) were used in this study. Cows' behavior was observed during 24 consecutive days, making 12 observations every other day, in order to determine the number of times a cow displaced others (index of displacements, ID) and number of animals a cow could displace (index of success, IS). Each day behavioral observations and scan sampling with continuous recording were made from 8 to 12 and from 14 to 18 h, with intervals of five minutes between each scanning. The ACTH challenge technique was carried out in all cows after calving. A multivariate analysis of principal components was made, using PROC MANOVA. Data were grouped into new components PC1 (months of pregnancy, calf body weight, levels of progesterone) and PC2 (blood sampling time: 30, 60, 90 minutes). Cortisol data were analyzed with PROC MIXED according to a completely randomized design with repeated measurements. There were differences ( $P<0.05$ ) between the two genetic types for ID and IS: 0.17, 0.36 for Br and 0.60, 0.66 for F1, respectively. Cortisol levels increased ( $P<0.01$ ) during the two hours after ACTH injection, reaching a maximum at 90 minutes after application and then began to fall. Mean cortisol levels were different ( $P<0.01$ ) for Br: 286.5, 288.8, 298.3, and F1: 171.0, 165.2, 167.3 nmol/L at 30, 60 and 90 minutes, respectively. The results obtained in this study showed that F1 cows had a higher rank than Br, whilst Br had a higher adrenal activity than F1.

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## THE BEHAVIOUR OF COWS AND CALVES DURING THEIR REUNION AFTER 7 WEEKS OF SEPARATION FOR WEANING



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Bonds between dams and their offspring have been claimed to remain intact even after artificial weaning. We observed pairs during staged reunions for behavioural indicators of recognition or a persistent bond. Sixteen beef cows and calves (225±5 d of age) were weaned by separation within audible range. Seven weeks later 10-min reunions were staged in an alleyway (4m×25m). Cows and calves entered from opposite ends. Using a balanced cross-over design, each cow was observed for 10 min with her own calf, and 10 min with a familiar calf. Calves were observed with their mother and also with a familiar cow. Familiar animals were from the same herd. Familiar calves were the same sex as the dam's offspring. The behaviour of each individual under the two pairing conditions was compared by Wilcoxon-signed rank tests. Dam-offspring pairs were observed to be closer together than familiar pairings (5.0 vs. 7.7m, P<0.05). Cows sniffed their own calf more often (2.2 vs. 0.8, P<0.05) and for more total time (6.8 vs. 1.8s, P<0.05) than the familiar calf. Calves also sniffed their dam more frequently (5.4 vs. 2.4, P<0.05) and for longer (68.3 vs. 26.4s, P<0.05) during the 10-min reunion, than the familiar cow. When calves were with their dam they vocalized less frequently (2.1 vs. 5.3, P<0.05). The frequency of vocalizing by cows was similar under both conditions. Two cows allowed their own calf to nurse. No grooming was observed. Only mild behaviour differences were observed to suggest recognition between cow-calf pairs. This may be due to the length of time spent apart or the specific comparisons made, as control pairings were still familiar and perhaps also recognized. Without detailed observations and analyses it was not apparent by the behaviour of cows and calves, which pairings were dam-offspring and which were merely familiar.

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## A PRELIMINARY INVESTIGATION INTO VERBAL CUE – COLOUR ASSOCIATION LEARNING IN HORSES (*EQUUS CABALLUS*)



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Studies investigating linguistic skills in apes, marine mammals, a grey parrot and, more recently, the domestic dog have indicated that these species can acquire certain aspects of human language; in particular they can learn verbal cues (“words”). Relatively little scientific attention has been devoted to experimental research on equine cognition, although the possibility that horses could learn to comprehend at least some aspects of human language has considerable application for their welfare and use. The present study was designed to investigate learning of verbal cues and colour discrimination abilities in a group of 6 horses by using a co-operative teaching approach. The co-operative learning strategy was adapted from work with human infants, in which words, gestures, and primary as well as secondary positive reinforcement were applied to facilitate learning. The horses had to learn the association between the name of a colour and the colour, by touching it from a board containing three and four coloured plastic cards. A blind experiment tested the subjects' ability of solving the discrimination problem by touching the named colour in visual absence of the experimenter. The results indicate that the horses were able to recognize the colours on verbal command. They responded above chance level (33.3%) to the colours and reached the learning criterion of 60% correct responses for two consecutive teaching sessions. The horses showed no significant decrease in performance when tested in absence of the experimenter (yellow:  $T=0.51$ ,  $P=0.632$ , blue:  $T=2.39$ ,  $P=0.062$ , green:  $T=1.10$ ,  $P=0.322$ ). It is concluded that a co-operative learning regime can be successful in facilitating learning of verbal cues and colour discrimination abilities in horses. Implications for handling and teaching equines are discussed.

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## THE EFFECT OF ACUTE STRESS ON BEHAVIOURAL AND HORMONAL RESPONSES IN SUPPOSEDLY CHRONICALLY STRESSED MILITARY WORKING DOGS (MWD)



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Though MWD's well being has rarely been tested, a recent survey of 303 MWD suggested chronic stress among these dogs. The present study aims to investigate these findings further with behavioural and physiological measurements. MWD (N=27) were submitted twice to separate challenges (acute stress 1 and 2) composed of visual (mobile toy car) and auditory (air blast) stimuli. To test MWD's response to the acute stress, plasma cortisol and ACTH levels and behavioural measurements were assessed. Logarithmic and square root transformations were applied for data normalization and for homogenisation of variances. Analysis of variance, followed by pairwise comparisons between groups (Tukey's studentized range test), were computed. During visual stress 1 and 2, MWD were more active, barked less, paced less and manipulated their environment less than at baseline ( $P < 0.001$ ). The only behavioural habituation concerned the posture: half low posture was observed during the first but not during the second visual stress situation ( $P < 0.001$ ). The auditory challenges 1 and 2 did not appear to stress the dogs ( $P > 0.05$ ). Although cortisol levels showed a habituation towards the second visual challenge (basal level:  $39.27 \pm 4.91$  nmol/L; stress 1:  $64.23 \pm 6.19$  nmol/L ( $P < 0.05$ ); stress 2:  $43.16 \pm 7.51$  nmol/L ( $P > 0.05$ )), ACTH values remained unchanged after the challenges (basal level:  $1.01$  pg/ml  $\pm 0.23$ ; stress 1:  $1.64$  pg/ml  $\pm 0.39$  ( $P > 0.05$ ); stress 2:  $1.48$  pg/ml  $\pm 0.39$  pg/ml ( $P > 0.05$ )). The only indication of an inability to cope was shown by low ACTH values. More research with these MWD needs to be carried out.

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## OUTCOMES ASSESSMENT OF AN ONLINE ANIMAL WELFARE ASSESSMENT COURSE



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'Animal Welfare Assessment' is an online course developed by Michigan State University (<http://msu.edu/~siegford/MSUOnlineWelfare.htm>) to help address the global paucity of science-based instruction in animal welfare. International collaboration and technology allow leveraging of expertise across disciplines/institutions to provide state-of-the-art information on applied ethology and welfare science to graduate and veterinary students. It also provides educational opportunities to industry professionals and assurance scheme inspectors. It was first offered during Autumn 2005 to 19 students from 4 institutions. Despite the convenience of taking online courses and facilitation of distance learning, online courses can suffer from sub-optimal reviews. Students may feel disengaged or put off by technology. We aimed to offer an online course that would enhance understanding, yet perform competitively against traditional courses in student assessments. One tool utilized to assess student's knowledge of applied ethology and welfare science, and the ability to integrate these into a critical thinking situation, was the use of hypothetical assessment scenarios, similar to those used in welfare judging competition. These scenarios are a novel tool used in this course and were standardized by a scientific panel. 82% of respondents believed scenarios were important for integrating welfare concepts into a critical thinking paradigm. Content and delivery assessments were given throughout the semester. 91% found course material easily accessible. 90% found the instruction team accessible and helpful. 50% of students preferred the current format over traditional formats. We encouraged students to participate in online discussions and 93% said they found it easy and comfortable to communicate with peers. Perhaps our most important benchmark was "this course improved my understanding of animal welfare and ability to assess it"; 100% of respondents agreed. 93% found the course to be enjoyable. Our findings indicate that online courses can serve an important role in leveraging animal welfare expertise to reach a continuously expanding audience.

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## EFFECT OF RESTRICTED SUCKLING ON BEHAVIOUR, FEED INTAKE AND GROWTH OF DAIRY CALVES



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There are some benefits to keep the calf and the cow together after parturition. However, concern rises about weaning stress when a calf and cow are separated after bonding is established between them. In this experiment the calves suckled their dams restrictedly. In treatment 1 (N=6) calves suckled for five weeks twice a day, two hours after morning and evening milking. After five weeks they were abruptly weaned. In treatment 2 (N=6) they suckled during five weeks like calves in treatment 1 but after five weeks were still allowed to suckle three weeks after morning milking. Calves and cows were video-recorded the day before weaning, on the day of weaning and the day after. The data was analyzed with ANOVAs for repeated measures with day (before, on, after weaning) and treatment as factors. For behavioural analysis the data was recorded for 3 calf and cow pairs in treatment 1 and 5 in treatment 2. Treatment 3 (N=5) was the same as treatment 2, but the data was collected when calves were totally weaned at the age of eight weeks. The calves suckled 8.4 kg milk/day in treatment 1 and 7.4 kg in treatment 2 on the 5th week. Consumption of dry feed was low after weaning and growth decreased for a while, especially when weaning was at the age of five weeks. Calves and cows were restless after weaning and changed activity more frequently ( $P < 0.05$ ). Calves also spent less time lying and more time standing on the day after weaning and vocalized more on the weaning day and the day after weaning than they did before weaning. When calves are weaned at a very young age growth can decrease if calves are not eating enough dry feed. A strong bond is established between calf and dam also during restricted suckling and weaning increases calves' and cows' restlessness.

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## EFFECTS OF PEN FLOOR HEATING ON PIGLET'S USE OF HEATED AREA 0-120 H POSTPARTUM



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Early piglet mortality is a highly relevant problem in pig production. A heated area for the piglets has been used by pig farmers aiming to reduce piglet mortality by providing heat away from the sow and the risk of crushing. Under natural conditions, however, the piglets stay in close proximity to the sow's udder for heat as well as colostrum the first days postpartum. We investigated whether floor heating in farrowing pens for loose housed sows affected the piglets' use of a heated piglet area. Twenty-two 2nd parity sows were housed individually in 7.5m<sup>2</sup> pens. Half of the sows (N=11) were exposed to pen floor heating (33.5 °C) from 12 h after onset of the nest building and until 48 h after birth of 1st piglet (HEAT), whereas the other half (CONT) (N=11) received no floor heating (21.2 °C). A heated piglet area (32 °C) with piglet access only was included in all pens. The percentage of piglets lying in the heated piglet area was affected by an interaction between floor heating and day postpartum ( $F_{4,80}=5.7$ ;  $P<0.001$ ). e.g. the mean percentage of CONT piglets lying in the heated piglet area on day 3 was higher compared to HEAT piglets ( $27.2\pm 2.3$  vs.  $0.7\pm 0.4$ ;  $P<0.001$ ). There was no effect of floor heating on mean percentage of piglets lying at the udder. However, the day postpartum affected the percentage of piglets lying at the udder ( $F_{4,84}=21.7$ ;  $P<0.001$ ). On day 3 postpartum the mean percentage of piglets lying at the udder was reduced compared to day 2 ( $71.7\pm 1.8$  vs.  $56.3\pm 2.0$ ;  $P<0.001$ ). In conclusion the piglets preferred to lie at the udder the first two days postpartum, but the CONT piglets started to use the heated piglet area away from the sow earlier and more than the HEAT piglets. We suggest that the HEAT piglets were less motivated to search for an additional heat source, as compared to the CONT piglets born on unheated floor.

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## VALIDATION OF SALIVARY CORTISOL AS AN INDICATOR OF HPA ACTIVITY IN HORSES



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The validity of cortisol as a measure of stress depends upon methods of sampling that are not in themselves stressful, and assays that provide true indicators of hypothalamic-pituitary-adrenal (HPA) axis in the target species. Here we report the validation of an enzyme-immunoassay for horse saliva cortisol, and demonstrate that salivary cortisol provides an index of HPA axis activity in this species. Saliva was swabbed every 30 minutes between 0900 and 1600 hours over three days in N=12 crossbred riding school horses. Serial dilutions of pooled saliva gave a displacement curve parallel to the curve of commercially prepared cortisol standards ( $F_{1,12}=1.127$ ,  $P=0.309$ ), demonstrating lack of interference from other substances in the saliva. Linear recovery of increasing additions of cortisol standards showed its accuracy (mean recovery  $86.55\pm 7.98\%$ ), and low intra-plate (CV35 1.80%) and inter-plate (CV6  $6.55\pm 0.22\%$ ) variation between replicates indicated its high precision. The immunological validation therefore showed the assay to quantify salivary cortisol with a high degree of specificity, accuracy and precision, and had sensitivity down to 0.156 ng/ml. Biological validity was demonstrated by a predicted decline in mean hourly salivary cortisol throughout the day ( $F_{4,1,56.8} = 2.58$ ,  $P=0.023$ , 1-tailed after Huynh-Feldt correction) and a predicted increase in the half hour post-exercise than before ( $t = 3.452$ ,  $P=0.011$ , 1-tailed). The biological validation therefore showed the assay to accurately mirror reported blood plasma diurnal patterns and post-exercise elevation. Together, these show the assay to be a valid non-invasive measure of HPA axis activity in the domestic horse. However, large individual variation in absolute cortisol concentration, sensitivity of HPA axis activity to environmental influences, and a time lag of 30 minutes from stressor to cortisol peak, restrict its use to measures of acute stress when within subject base-line comparisons can be made with appropriate sampling protocols.

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## AGE AT INTRODUCTION TO THE GROUP AFFECTS DAIRY CALVES' USE OF A COMPUTER-CONTROLLED MILK FEEDER



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Use of computer-controlled milk feeders often implies large group sizes and continuous introduction of new calves, which may cause welfare problems for especially young calves. The effect of age at introduction on milk feeder use was investigated including ninety-eight dairy calves. Calves were paired (one 6-day-old and one 14-day-old) and introduced into an existing group (group size median 18 (interquartile range 16-24)). During the first seven days the stockman guided the calves to the feeder if they had consumed less than half of their daily allowance. As the group structure was dynamic, blocks of calves introduced in succession were defined and uneven and even blocks within pen were defined so that, for instance, calves of an uneven block had all left the pen before the calves of the next uneven block entered. Data was first analysed including the complete dataset, but subsequently additional analyses were made including uneven and even blocks, respectively. The analysis of the complete data suggested that the larger the group size, the higher the risk of calves requiring guidance to the feeder (Odds ratio 1.09 (95% confidence limits 1.03-1.16);  $\chi^2$  (df=1)=6.40;  $P<0.01$ ), but the analyses of the uneven (NS) and the even blocks ( $P<0.10$ ) did not confirm this. Calves introduced at 6 days of age had a higher risk of requiring guidance than calves introduced at 14 days of age (Odds ratio 2.34 (95% confidence limits 1.58-3.42);  $\chi^2$  (df=1)=13.04;  $P<0.001$ ), which was confirmed by the analyses of uneven ( $P<0.01$ ) and even blocks ( $P<0.05$ ). The results show that the youngest calves had more difficulties in getting access to the feeder during the first week after introduction and required more guidance by the stockman. It is suggested that 6-day-old calves are too young to compete for milk feeder access in large groups.

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## FARMERS' PERCEPTIONS OF ANIMAL WELFARE: UTILITARIAN AND MORALISTIC VIEWS



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Farmer's attitude and behaviour towards farm animals are crucial factors affecting animal welfare. We studied Finnish farmers' attitudes and welfare of their farm animals to see if they are related, to motivate farmers to improve animal welfare, and to increase the mutual understanding between different interest groups working around animal welfare. We used a qualitative attitude interview method on 9 cattle farms and 9 pig farms, including large and middle-sized, organic, and corporate farms. We were interested in knowing how farmers define farm animal welfare, how they perceive their possibilities to improve welfare and if they have intentions to do so. In addition to the interview, on each farm we made a rough estimate of animal welfare by scoring locomotion, lying area, social contacts, air conditioning, feeding, and stockmanship. Farmers conceptualized animal welfare in two different ways. Most of them perceived animal welfare in utilitarian terms as productive business. They were interested in the productivity of the whole farm where a single unproductive animal could be replaced with a productive one. The second view perceived animal welfare in moralistic way: animals were conceived as individuals and the most important issue was to provide an animal with a good life. These two attitudes were frequently overlapping: most farmers mentioned them both. When comparing farmers' attitudes to welfare scores (chi-square test), we found no connection between farmers' moralistic and utilitarian conceptualizations and animal welfare scores. This could be due to measurement errors in animal welfare estimates based on arbitrary environmental welfare indicators and small data. However, our qualitative interview analysis suggests that despite farmers' different perceptions of animal welfare, their interest in and means of improving animal welfare may be the same for both "moralistic" and "utilitarian" farmers. Improving productivity may as well work as a tool for improving farm animal welfare.

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## THE EFFECT OF LATENCY TO EJACULATION ON CONCEPTION IN THOROUGHBRED HORSES



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In order to investigate the effect of differences in mating management on behaviour and success of conception in Thoroughbred horses, twenty-three matings across seven stallions were observed at stud A, and nineteen matings across three stallions were observed at stud B. Both studs used general mating management practices typical of Thoroughbred breeding in the UK: an upper-lip twitch, bridle and felt boots were applied to all mares, and all stallions wore bridles. Three handlers were present at each mating; one to control the stallion, another to restrain the mare, and a third to hold the mare's tail aside and assist intromission. Before mating, mares were judged to be in full oestrus through their behaviour on presentation to a stallion and veterinary examination of ovarian follicle size and cervical dilation. Conception rate across stallions at 16 days post-mating was highly variable at both studs, indicating an effect of stallion on success of breeding. However, the overall conception rate on stud A was 70%, much greater than that on stud B, 53%. At both studs, stallions in matings where mares conceived took around the same time to ejaculate,  $18.9s \pm 3.5$  (stud A) and  $18.3s \pm 2.7$  (stud B). In matings which did not result in conception, stallions exhibited longer latencies to ejaculate at stud A ( $22.5s \pm 5.0$ ) and shorter latencies to ejaculate at stud B ( $16.0s \pm 2.8$ ). Mean latencies to ejaculation in matings where mares did not conceive were significantly different across studs ( $P < 0.05$ ,  $\chi^2 = 9.0$ ,  $22.5s \pm 5.0$  vs.  $16.0s \pm 2.8$ , Kruskal-Wallis test). These studies suggest that 18-19 seconds is the optimum latency to ejaculation for conception to occur. In terms of application of these findings to managed horse breeding, it is clearly not possible to manipulate latency to ejaculation. It is, however, possible to suggest that 'rushing' of the process by handlers, observed at stud B, is clearly counter-productive, and the observed lack of such rushing may account for stud A's superior conception rate.

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## EFFECTS OF YEAR-ROUND NESTBOX AND TEMPERAMENT ON WELFARE IN BLUE FOXES



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This study was designed to evaluate the long-term effects of nestbox and temperament traits on welfare-related parameters in juvenile and adult blue foxes (*Alopex lagopus*). Fearful and confident animals were raised with and without nestboxes during the growing and breeding seasons. Experimental groups formed at weaning were: 1) confident, no nestbox available; 2) confident, with a year-round nestbox; 3) fearful, no nestbox available; and 4) fearful, with a year-round nestbox. Each group was comprised of 60 females housed singly. The results showed that foxes without nestboxes grew significantly ( $P=0.01$ ) better than those with nestboxes. Temperament had no effect on final body weights. Confident foxes were more explorative ( $P<0.01$ ) than fearful ones, and foxes without nestboxes were more explorative than those with nestboxes ( $P=0.06$ ). Capture tests revealed that access to a permanent nestbox significantly ( $P<0.001$ ) increased fearfulness in the long run. Foxes with nestboxes more frequently showed an escape reaction to human presence than foxes without nestboxes. No significant differences were detected between temperament or nestbox availability groups in the frequency of stereotypical behaviours, the cortisol:creatinine ratio or reproductive success. The fur coat of foxes with nestboxes was dirty, which significantly ( $P<0.001$ ) reduced the quality of fur. It can be concluded that year-round access to nestboxes increases fearfulness in farmed blue foxes.

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## VALIDATION OF SCAN SAMPLING METHODS FOR AGGRESSIVE BEHAVIOR OF WEANED PIGS



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Different ways to measure behavior include continuous observation or scan sampling. Continuous observation is accurate but time-consuming. Scan sampling techniques require less time to collect but their accuracy has not been demonstrated. No standard of accuracy for sampling method has been published for post-weaning aggressive behavior in pigs. The objective of this study was to validate scan sampling methods of aggressive behavior of newly-weaned piglets. Sixty-four weanling piglets were grouped in 8 pens. Aggressive behavior was defined as a fight (shoulder press, biting the head, ears or body). Video tapes were watched continuously for 24 h at 0.8 frames/second. For scan samples, aggressive behavior was scored during a freeze frame every 5, 10, 15, 20 and 30 minutes. The time (%) engaged in aggressive behavior was recorded. Percentage data were transformed for analysis. The sampling methods were significantly different ( $P = 0.0591$  for overall model): the continuous observation ( $0.089\% \pm 0.017$ ) was significantly different ( $P = 0.0482$ ) from 15 min scan samplings ( $0.083\% \pm 0.017$ ); 30 min scan samplings ( $0.083\% \pm 0.017$ ) was significantly different from continuous observation ( $P = 0.0077$ ) and from 5 ( $0.095\% \pm 0.017$ ,  $P = 0.0165$ ) and 10 min scan samplings ( $0.10\% \pm 0.017$ ,  $P = 0.0366$ ). Regressions on percentage of aggressive behavior with each scan sampling interval revealed an  $r^2 = 0.91$  for 5 min ( $P = 0.0003$ ),  $r^2 = 0.70$  for 10 min ( $P = 0.0099$ ),  $0.68$  for 15 min ( $P = 0.0118$ ),  $r^2 = 0.56$  for 20 min ( $P = 0.0316$ ) and  $r^2 = 0.22$  for 30 min scans ( $P = 0.2348$ ). Even though aggressive behavior is a temporary event and not a long-lasting state, measuring aggressive behavior in weaned piglets by 5 min scan samples is relatively accurate. Any increase in inter-scan interval (beyond 5 minutes) results in progressively less accurate estimates of pig aggressive behavior.

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## MANAGEMENT IMPLICATIONS OF BEHAVIOURAL STUDIES IN THE INDIAN HONEYBEE



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The behavioural patterns of the Indian Honeybee *Apis cerana indica* kept in an artificial hive in Mannampandal, Tamilnadu, southern India *viz.*, brood rearing, population fluctuations, colony storage and foraging activity pattern, were studied in different biological seasons ('major flow' i.e., flowering season for most of the bee forage plants in the study area, 'minor flow' i.e., flowering in lesser number of bee forage plant species 'major dearth' i.e., flowering absent in most of the species and 'minor dearth' i.e., flowering in very few plant species) in three years. The population size of the colony was estimated by counting the bees in randomly selected squares of a grid placed over each comb. The population varied between 2117 and 6301 and significantly between months, biological seasons, and years of the study period. Swarming was invariably in the last week of February. This indicated that for successful colony manipulations of this colony, January-February is the best period. The colony storage of pollen, honey, brood and empty cells were estimated as proportions of each type in randomly selected rows of cells in each comb. The pollen storage was highest in May indicating that May is the most suitable month for migratory bee keeping to obtain better crop yields. Honey storage was more in January, April and August. So, it is inferred that these months are most suitable for honey harvest from this colony. The activity pattern of the worker bees were recorded by counting the number of forager bees with pollen loads (pollen forager) and without pollen loads (nectar foragers) arriving at the hive entrance in a prescribed time interval. Both the pollen and nectar foraging are less in the major dearth period i.e., November to December (the number of foraging trips (mean $\pm$ 1.S.D.) being 8059 $\pm$ 2295 and 7530 $\pm$ 1776 for these months, respectively; F=6.990; df=11; P<0.001). So, additional care should be taken by providing supplementary artificial pollen and nectar food during this period to maintain this colony.

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## PROBLEM-SOLVING ABILITIES OF DOGS IN HIDDEN FOOD TASKS



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This study aimed to investigate retrieval of hidden food as a learning- and frustration-task for dogs. The longer the tasks went on, the higher the probability that the tolerance level of stress and frustration would be detected. Sixteen dogs were tested. In the first three test elements, food was hidden inside objects (plastic cone; “Knepig”™ and “Klurig”™, wooden toys for dogs) and in the next two test elements by the experimenter's hand or foot. Each test element was repeated five times. The main measures were the preferred strategy and latency to reach the food, as well as the duration of looking at humans, which was interpreted as initialization of communicative interaction. The dogs used either their feet or their mouths as their preferred strategy to get the food. The latency to reach the food in the first three test elements ranged from 1 s to 3.41 min and in the last two test elements from 2 s to 3.36 min. The correlation between mean time of reaching the food and trial number was significantly negative for the test elements “plastic cone” and “hand” (Spearman: “plastic cone”  $\rho = -1.0$ ,  $P < 0.01$ ; “hand”  $\rho = -0.9$ ,  $P < 0.05$ ). Looking at the experimenter was observed in the first three test elements on average for 20-25% of the trial time. In case of the last two test elements, the dogs stared directly at the experimenter 15-20% of the time and performed positive affiliation behaviours towards their owners 20-25% of the time. Attention directed by the dog at the owner reflects the tendency of dogs to look at a familiar human when they encounter difficulties in a problem-solving task. The schedule of the five experiments was considered an appropriate method for testing the tolerance level of stress and frustration of dogs in problem-solving tasks.

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## BEHAVIOURAL TESTS IN SHEEP – WHAT ARE WE REALLY MEASURING?



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Research in farm animals to measure their behavioural abilities for adaptation is commonly conducted using a variety of testing situations without knowledge of the coherency between them. The current study aims to determine in sheep the core behavioural components measured in learning and challenge situations based on social attraction, isolation, novelty or forced contact with humans. The study utilised 198 Merino x Romney sheep (94 wethers, 104 ewes). At 3 months of age, lambs were individually subjected to 3 tests involving agitation response to isolation and novelty (box test), conflict between avoidance of a human and social attraction to familiar flock mates (arena test), and the response to social isolation and repeated approaches by a human (corridor test). At 12 months of age, individual sheep were subjected to a spatial learning test on each of 3 consecutive days (maze test). Finally, their cortisol response to shearing was measured by sampling blood 15 minutes post-shearing. Data were analysed by principal component analysis using SAS. The first two components explained 24% of the total variability calculated from 19 original variables. The first component was mostly loaded by vocal responses in the arena and corridor tests. The second component related to locomotor responses to the box, arena and corridor tests. These two components were negatively correlated with performances in the maze test as sheep with high behavioural agitation or vocal responses to the challenge tests displayed poorer learning performances. Finally, there was no relationship between post-shearing cortisol and any other tests.

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## BEHAVIOUR AND REACTION TIME OF DAIRY BULLS DURING SEMEN COLLECTION



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The aim of this study was to investigate how the behaviour and reaction time (RT) of dairy bulls at an artificial insemination station was affected by the handling staff and other factors during semen collection. The behaviour of 18 bulls, 13 Swedish Red and White and 5 Swedish Holstein, was recorded during preparation and semen collection once or twice per week from one to 17 times. At each semen collection 5-9 bulls were collected and two bull handlers (A: leading the bull, B: holding the teaser/moving around) and one collector worked together. There were totally 7 different persons handling the bulls at different days. The bulls were divided into four age groups: 5, 6, 7 and 8 years. Statistical analysis was done with the Analysis of Variance, Mixed linear model for reaction time and with the generalized linear mixed model for behaviours. The effect of age group, number of days collected per week, order (1-9), handler A, handler B or collector was tested. The RT was 253.8 s. to first mount, 91.1 s. to first semen collection and 110.0 s. to second semen collection. There was a significant effect of handler B and day on RT to first ejaculation ( $P < 0.05$ ). Walking, sniff teaser and vocalize tended to be affected by handler A ( $P < 0.1$ ). There were significant negative correlations between RT and concentration of semen ( $P < 0.01$ ,  $r = -0.21$ ), and RT and TSC (Total Sperms Collected,  $P < 0.05$ ,  $r = -0.14$ ) in the first semen collection (Pearson correlation). A higher number of sperms per ejaculate were collected from the bulls being collected once a week. It was concluded that reaction time and some behaviours were affected by the presence of different handling persons in the semen collection hall.

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## MERINO SHEEP SELECTED FOR LOW VS. HIGH AGITATION DISPLAY DIFFERENCES IN SOCIAL REACTIVITY



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Selection on emotional reactivity may be of economic and welfare interest for farming productions. Two lines of Merino sheep have been selected for 15 years for low (Calm) or high (Nervous) locomotor agitation in response to confinement and human contact (i.e. composite selection index). As selection conditions involved social isolation and since sheep are notably highly gregarious, such divergent selection could also be underlied by a different social reactivity. That is what we aimed to assess. Weaned male lambs (Calm: N=91, Nervous: N=45) were individually submitted to an arena test to evaluate complementary aspects of social motivation through three successive phases: 1) attraction toward familiar flock-mates, 2) reactivity to social isolation and 3) reactivity to a conflict between social attraction and avoidance of a motionless human. A mixed model of ANOVA was performed for all data. Nervous lambs approached flock-mates ( $F=5.24$ ,  $P<0.05$ ) and tended to seek contact ( $F=3.45$ ,  $P=0.065$ ) faster than Calm animals. They also emitted more high bleats ( $F=36.24$ ,  $P<0.0001$ ) and showed a higher locomotor activity ( $F=20.22$ ,  $P<0.0001$ ). During the isolation they were still more active regarding vocalisations ( $F=24.93$ ,  $P<0.0001$ ) and locomotion ( $F=36.35$ ,  $P<0.0001$ ). Lastly despite the human presence, Nervous animals spent more time in proximity to flock-mates than Calm lambs ( $F=5.97$ ,  $P<0.05$ ). They also emitted more high bleats ( $F=11.89$ ,  $P<0.001$ ) and showed a higher locomotor activity ( $F=11.32$ ,  $P<0.0001$ ). Thus, sheep of the Nervous line seem to be more socially motivated than those of the Calm line. Since gregariousness underlie the cohesion of the flock, strengthening social motivation could be useful for improving the ability of livestock to adapt to farming productions. The true nature of the social reactivity characterising the two selected lines needs to be further examined to more precisely define the objectives of selection.

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## BEHAVIOURAL EFFECTS OF CAGE ENRICHMENT ON FEMALE MINK HOUSED IN STANDARD CAGES



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The aim of this study was to evaluate the use of different enrichments in a standard cage system and the effects on stereotyped behaviour in mink. Eight month old (black-cross colour type) females were housed individually on two farms (F1; F2) in standard cages (80 or 90x30x40 cm). On each farm 75 females were randomly allocated to one of the following treatments: wire net shelf (S), plastic cylinder (C), plastic ball (B), all three combined (ALL) or no enrichments (control). Behaviours were recorded using one-zero sampling before and after feeding from December to April. Data were analysed on separate farms due to farm having the largest effect in the initial tests. Differences were probably due to management; farm size, number of people in motion, food content at F1. The females spent 4.2% (F1) respectively 3.9% (F2) interacting with enrichments, 28.8% (F1) respectively 20.9% (F2) performing active behaviours, 11.8% (F1) respectively 9.8% (F2) performing stereotyped behaviours and 55.2% (F1) respectively 65.4% (F2) performing inactive behaviours. There were significant effects of treatment on interactions with enrichments at both farms ( $P < 0.001$ , Genmod, SAS). The total number of recorded interactions with enrichments at F1 were 966 (S), 156 (C), 43 (B) and (ALL, equals  $S=878$ ,  $C=228$  and  $B=51$ ). At F2 the total number were 593 (S), 255 (C), 32 (B) and (ALL, equals  $S=858$ ,  $C=168$  and  $B=56$ ). Interactions with enrichments decreased significantly over time at F1 ( $P < 0.001$ , Genmod), but not at F2. Stereotyped behaviours increased over time at F1 ( $P < 0.0001$ , Genmod), but not at F2. There was a significant positive correlation between activity and stereotyped behaviours (F1;  $P < 0.05$ ,  $r_s = 0.29$ , F2;  $P < 0.001$ ,  $r_s = 0.64$ , Spearman rank correlation). Our results indicate that providing female mink with different enrichments in standard housing during winter lead to shelf being used the most, but did not decrease stereotyped behaviours.

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## SURGICAL CASTRATION AFFECTS THE BEHAVIOURAL RESPONSE TO LOW-DOSE LIPOPOLYSACCHARIDE (LPS) CHALLENGE IN WEANED PIGS



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Acute stressors in early postnatal life of pigs may affect the coping mechanisms of these animals. Immunological challenges with lipopolysaccharide (LPS) can give valuable information regarding the consequences of surgical castration on the behavioural, endocrine and immune responses of pigs after weaning. At 5 days-of-age, a total of 64 male unanaesthetised piglets were randomly assigned to either undergo surgical castration or remain intact (treatment). Pigs were weaned at 28 days-of-age. One day post-weaning, pigs were injected with a dose of 0 or 5  $\mu\text{g}/\text{kg}$  BW of LPS from *Escherichia coli* (challenge). Sickness behaviour was studied by scan sampling every 5 min for 45 min at 0, 1, 2, 3, 4, 6 and 8h after the challenge was initiated. Blood samples were taken at 0, 2, 12 and 24h after injection and were analysed for plasma concentrations of tumor necrosis factor-alpha (TNF- $\alpha$ ), interleukin 1-beta (IL-1 $\beta$ ), C-reactive protein (CRP), serum amyloid A (SAA) and cortisol. Behavioural data were analysed by the non-parametric Kruskal-Wallis test using the NPAR1WAY procedure of SAS. Physiological data were analysed after log transformation using the GLM procedures. LPS provoked sickness behaviours including a reduced general activity, eating and exploratory behaviours ( $Z=-2.36$ ;  $P<0.05$ ), which were more pronounced 3h after the onset of the challenge. Significant treatment by challenge interactions showed that castration reduced the occurrence of LPS-induced sickness behaviours, such as depressed general activity ( $Z=-2.72$ ;  $P<0.01$ ), anorexia ( $Z=-2.67$ ;  $P<0.01$ ) and reduced exploratory behaviours ( $Z=-2.56$ ;  $P<0.05$ ). LPS administration increased TNF- $\alpha$  and CRP levels 2h ( $F=5.38$ ;  $P<0.01$ ) and 12h ( $F=2.80$ ;  $P<0.05$ ) after injection, respectively. LPS administration tended to increase SAA concentrations ( $F=8.30$ ;  $P<0.1$ ). Castration did not affect the response of pro-inflammatory cytokines, acute phase proteins and cortisol to the challenge. Hence, surgical castration alters the behaviour but not the endocrine and immune responses elicited by low-dose LPS challenge in weaned pigs.

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## STOCKMANSHIP AND THE HUMAN-ANIMAL RELATIONSHIP: EFFECTS ON THE HEALTH AND WELFARE OF FAMILY FARMED DAIRY CALVES



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Quantity and quality of handling of farm animals may affect performance, fear of humans and hormonal stress reactions, affecting e.g. disease resistance. Thus, measuring the human-animal relationship is important when assessing farm animal welfare. In Norway, a study is currently performed to clarify how the stockperson and the human-animal relationship influence the health and welfare of dairy calves. The study comprises two sub-studies, one focusing on stockperson attitudes and personality and the other one on the behavioural interaction between the stockperson and the individual calf. 110 dairy farms in southern Norway will be included. About 2/3 of the farms are family farms and the remaining are joint operations involving 2-5 farms. Herd size is 15-120 cows with a median of about 30. Calves are 2-6 months old and group housed. Each farm is visited once by a research technician. Fear of humans is tested through a standardized human-approach test, and calf response and stockperson behaviour in a human-animal handling situation are measured qualitatively. An extensive questionnaire is sent to each farmer before the visit. It includes questions regarding stockperson attitudes towards calves, the work with calves in general, farming style and production goals, stockperson personality, and details of housing and management. Health data are obtained from the National Animal Production Recording. A sample of calves in each herd is girth-measured twice to get an indication of growth performance. Farm visits will be completed in May 2006. Data will be statistically analysed using PCA and explorative factor analysis. Strikingly few of the visited farmers see a connection among their attitudes, their work with the calves and calf welfare. The most common environmental problems appear to be high animal density, bad air quality (high humidity and dust) and insufficient light. Calves in pens requiring regular manual cleaning display less fear of humans.

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## AN ACCELEROMETER-BASED METHOD FOR ANALYZING EQUINE OSCILLATION



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The oscillation that horses give to the rider should be understood as a basis for further studies of the physical effects of therapeutic riding. VTR-based methods combined with large equipment such as a treadmill are generally used to analyze equine oscillation. However, their use is limited for analyzing the moving horse on the ground. Accelerometer-based methods would have the advantages that they should work everywhere, and are small enough not to disturb the horse's and the rider's movements. To validate the use of the accelerometer, simultaneous measurements from the accelerometer and the VTR were needed. The purpose of this study was to compare the two oscillation waves made by the accelerometer-based and the VTR-based methods. Three horses and one rider were used. The horse walked and trotted along a straight course, 35 m long. A spherical marker 7 cm in diameter was used as a target for two panning VTR cameras, and an accelerometer was fixed in the sagittal plane between the pectoralis ascendens muscles of the horse. The VTR-derived wave was filtered by a low-pass filter after removal of very-low-frequency-components from the raw wave. The accelerometer-based wave was estimated by double integration of the acceleration and filtration by a high pass filter. In order to evaluate the similarity of the oscillation waves estimated from two methods, the cross-correlation coefficients of the two waves were calculated. The maximum of the cross-correlation coefficients in the vertical axis for walking and trotting were  $0.82 \pm 0.02$  and  $0.92 \pm 0.03$ , respectively. These results showed good agreement between the accelerometer-based and the VTR-based waves. The accelerometer-based method could therefore be applied to analyze three dimensional movement of equine oscillation.

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## THE EFFECT OF COLOUR ON TOY USE IN ADULT DOGS



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Research has shown that dogs have dichromatic colour vision, with two types of cone cells, peaking in sensitivity around the yellow-green and blue range of the spectrum (Jacobs *et al* 1992). This pilot study aimed to investigate whether colour had any effect on toy use in dogs. Seven adult Labrador retrievers were involved in the study. During each test a dog was led into the same room and presented with three identical balls that differed only in colour (red, yellow and blue). Each dog was presented with two tests each day. Balls were washed in fresh water between tests to remove any olfactory cues. The position (left-centre-right) of each coloured ball was varied between tests so that each of six possible ball positions were randomly offered to every dog. This was repeated three times during the entire study. Behaviour of the dog was video recorded while it was allowed to freely interact with the balls for a five minute period. Videotapes were analysed to identify the colour of the first ball the dog picked up in each trial. Position of the three coloured balls was not found to have any effect on behaviour. Dogs were observed to pick up the yellow ball significantly more often than the blue or red balls (52 tests (yellow) vs. 31 tests (blue) vs. 30 tests (red), (no choice = 13): Chi-square=10.72, df=2, P<0.01). These results suggest that colour may have some influence on toy selection in dogs. Further research controlling for brightness and saturation of colour is necessary to gain more complete understanding.

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## BEHAVIOURAL REACTIVITY TO SEPARATION AND REUNION WITH A SOCIAL PARTNER OR AN OBJECT IN WEANED PIGLETS



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Disruption of social links can reduce the welfare of pigs. Our study aimed to analyse the social link with a partner through separation and reunion events, and the potential impact of an object as a social substitute. Three weeks after weaning (4 wks of age), forty-eight piglets were reared either in pairs with the same partner (FP), with a movable object in the pen (FO) or isolated (SI). Thereafter each focus piglet was submitted to two successive 1h-session 1/ isolation where the partner or the familiar object was removed and then 2/ reunion where the initial partner or object was reintroduced, or an unfamiliar partner (UP) or object (UO) was introduced. Each piglet was tested twice to the paradigm, using familiar and unfamiliar partner or object in a cross-over design. Whatever the session the SI piglet remained alone. Behavioural activities were analysed by 1 min-scan on video tape. Results were expressed as percent of time of the first 30 min of recording and were analysed with ANOVA. During the isolation session, FP and FO piglets reacted similarly ( $P>0.10$ ) to the separation with significant increased pen investigation and resting (+30% and +22%; +25% and +19% respectively) compared with SI piglets exhibiting no major behavioural changes over successive sessions. During the reunion session, UP compared to FP pairs exhibited fights, lower sniffing interactions (6 vs 10% of total scans,  $P<0.10$ ) and less synchronised feeding activity (0 vs 25% of total feeding scans,  $P<0.05$ ). Less sniffing activity was observed when the object (regardless of its familiarity), was introduced to the pig than when the familiar social partner was introduced (respectively 2.5 vs 10% in FP piglets,  $P<0.05$ ). Further behavioural studies are needed on the value of a bonding partner as “security-giving” and its role in emotional reactivity in pigs.

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## THE DEVELOPMENT OF SOW AND PIGLET SKIN, CLAW AND NIPPLE LESIONS ON TWO CONCRETE FLOORING MATERIALS DURING THE LACTATION PERIOD



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Nursing piglets and lying sows frequently get lesions on contact with flooring. The aim of the study was to investigate the development of lesions of sows and their piglets when kept on two different flooring materials: concrete (N=13) and concrete covered with sand filled polyurethane (N=11). The severity of lesions was scored on scale: 1 = skin affected but not wounded, 2 = wounded skin. Nipple lesions were also recorded. Skin lesions on the sows were measured twice: pre partum and at weaning. The piglet lesions on front knees and fetlocks were measured at approximately day 9 post partum and at weaning. In addition, the number of affected piglet claw halves was recorded. There was no difference in amount of skin or nipple lesions on sows or piglets kept on the different materials. At weaning more wounded piglet claws were found on polyurethane coating than on concrete (10.23 % (0.0 - 17.05), 0.0 % (0.0 - 7.06), Mann-Whitney,  $P = 0.004$ ) possibly due to higher roughness of the sand filled coating compared to concrete. Greater litter size increased the proportion of nipple lesion on sows (GLM,  $F_{1,15} = 5.88$ ,  $P = 0.03$ ). Only 7 of 230 piglets had no skin lesions. The number of piglet skin lesions remained constant over time but the lesions healed since the number of severe lesions decreased ( $2.5 \pm 0.2$  vs.  $1.1 \pm 1.2$ , Mixed model, SPSS,  $P < 0.001$ ) and mild lesions ( $0.8 \pm 0.4$  vs.  $2.4 \pm 0.4$ ,  $P < 0.001$ ) increased over time. Mild piglet lesions were positively associated with daily gain ( $F_{1,22} = 9.94$ ,  $P = 0.005$ ) and litter size ( $F_{1,32} = 13.05$ ,  $P = 0.001$ ) and severe lesions were negatively associated with daily gain ( $F_{1,21} = 17.92$ ,  $P = 0.001$ ) and litter size ( $F_{1,26} = 4.48$ ,  $P = 0.044$ ). The amount of skin lesions did not differ between animals kept on concrete and polyurethane. However, piglets kept on the latter rougher flooring had more claw lesions. On both types of flooring the majority of the piglets had skin lesions.

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## UNDERNUTRITION DURING PREGNANCY IMPAIRS THE ESTABLISHMENT OF NON- OLFACTORY RECOGNITION OF THE LAMB BY ITS MOTHER IN EWES



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Ewes can recognize their lambs on the basis of acoustic and/or visual cues at 6 h postpartum. Preliminary results from our laboratory indicate that undernutrition during pregnancy impairs this early non-olfactory recognition (in goats). Therefore, we investigated whether undernutrition during the second half of pregnancy in ewes affect the establishment of maternal non-olfactory recognition of the lamb. Non-olfactory recognition was assessed in 2 groups of multiparous Columbia ewes at 8 h postpartum: control (N=11) and underfed ewes (N=10); these received 70% of their energy and protein requirements during the second half of pregnancy. Tests were conducted in a triangular-shaped pen; a familiar and an alien lamb were allocated one at each angle. An open barrier was situated 1 m in front of the lambs' individual pens to prevent the ewe from having access to olfactory cues from them. Latency to leave a waiting pen and to reach a lamb, time spent near each lamb, time spent looking towards each lamb, and number of visits to each lamb was recorded in a 5 minute two-choice test between their own and an alien lamb. Control ewes spent more time near their own than the alien lamb ( $121 \pm 19$  vs  $31 \pm 6$  sec., Wilcoxon,  $P = 0.003$ ). They also spent more time watching their own lamb than the alien ( $120 \pm 16$  vs  $51 \pm 8$ , sec., Wilcoxon,  $P = 0.01$ ) and more frequently visited their own than the alien lamb ( $7 \pm 0.8$  vs  $3.9 \pm 0.6$  sec., Wilcoxon,  $P = 0.01$ ). In contrast, underfed ewes did not show a preference for either lamb in any of the studied variables (Wilcoxon,  $P > 0.05$ ). In conclusion, malnutrition during the second half of pregnancy impairs the establishment of the early non-olfactory recognition of the lamb by its mother and may thus affect survival of the young. Supported by PAPIIT IN217205 and CATEDRA IN2-07 (327).

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## HISTOLOGICAL DIFFERENCES OF THE ADRENAL GLANDS AND CORTISOL LEVELS OF ENRICHED AND NON-ENRICHED LACTATING DAIRY GOAT KIDS



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The objective of this study was to evaluate the effect of environmental enrichment in suckling Alpine French male kids under confinement on histological characteristics of adrenal glands and cortisol levels. Kids were used in this study because we are studying the effects of environmental enrichment in different stages of production of dairy goats. This study came from the first stage, newborn until weaning. The animals (N=20) were randomly assigned to two treatments (enriched and non-enriched), with two replicates each. The enrichment elements were elevated sacks of henequen, trunks, tyres and coconuts. The male kids were sacrificed on this farm when their weight reached 10 kg. Blood samples were taken to measure cortisol levels and when the kids were euthanized (which was not part of the experiment) we took samples of the adrenal glands. The adrenal glands were weighed and measured and histological cuts were made and fixed. Four hundred cells were measured from each animal. Two blinded measurements were performed from each sample. Cortisol levels were measured using a commercial kit. A complete randomized design to test the effect of the treatment was used. Cortisol levels, the weight of the adrenals glands and the size of the adrenal glands did not show statistically significant differences. There was a highly significant difference for the area of the cells of the glomerular and fasciculate zones of the adrenal glands, where the non-enriched mean was larger ( $P<0.001$ ). This suggests that the non-enriched animals had more active adrenals and hence may have experienced more stress. Our results suggest that cortisol does not serve as a universal indicator of stress. In this study the secretion of glucocorticoids was not altered, however, histological differences of the adrenal glands were found. We suggest the consideration of this method as another indicator of stress.

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## EVALUATION OF "ONE STANDING ONE FEEDING" STRATEGY FOR CONTROL OF CATTLE DEFECACTION USING AUTOMATIC FEEDING STATIONS



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At the 39th Conference, we presented the possibility of decreasing defecation on deep litter in a loose housing barn by inducing heifers to visit a feeding station soon after standing. The objective of the present study is to confirm the effectiveness of our new strategy. The experimental paddock (6.5 × 9.5 m) was constructed outdoors and roofed. Half of the paddock was bedded to form a resting area. The remaining area was designated as the feeding area. The feeding area was divided into two areas by an imaginary line. In half of the feeding area, there was a feeding trough, named the silage area. The other half, named the station area, had a feeding station. Six Holstein heifers were grouped together in the paddock. A standing detection device was developed and attached to each heifer's left hind leg. This experiment included four experimental periods. During the first 28 d, the feeding station was closed (C1). During the next 29 d, heifers were allowed to obtain concentrate at the feeding station once at each standing (one standing one feeding: Sf). During the subsequent 27 d, the feeding station was closed again (C2). During the last 29 d, heifers were allowed to obtain concentrate at the feeding station once in each 6 h (6 h interval feeding: If). Visits to the feeding station were recorded continuously during experiments by a computer. Data were analyzed using Proc GLM of SAS. The rate of defecation in the station area was significantly higher in Sf (45.5%) and If (20.7%) than that of C1 (7.2%) and C2 (6.2%) ( $P < 0.05$ ). Furthermore, Sf was higher than If ( $P < 0.05$ ). The average number of rewarded visits per animal each day was significantly higher in Sf ( $9.1 \pm 0.8$ ) than in If ( $4.4 \pm 0.9$ ) ( $P < 0.01$ ).

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## FEEDING AND SOCIAL BEHAVIOUR OF GROWER-FINISHER PIGS IN LARGE SOCIAL GROUPS



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The present study was conducted to gain better insight into the feeding and other behavioural activities of grower-finisher pigs in large social groups. Two blocks, each comprising four pens of 18 pigs (SG) and two pens of 108 pigs (LG) on fully slatted floors (0.76 m<sup>2</sup>/pig) were used in the experiment. Initial body weights of pigs averaged 34.6±4.1 kg, with equal numbers of barrows and gilts in each pen. Pigs were fed from multi-space wet/dry feeders, with a pig to feeder space ratio of 9:1. Feeding and general behaviour activities were determined by continuous/scan sampling observations at intervals for a period of 10 wk following regrouping. The pigs in LG demonstrated more bouts of feeding (35 vs. 25, P<0.05) and the bouts were shorter in duration (232 vs. 301 s, P<0.05) than in SG during d3 following regrouping but no differences were found during wk 5, 7 or 10. The percentage of pigs queuing at the feeders was higher in LG than in SG during d3 (0.90 vs. 0.59, P<0.05) and this trend was also apparent d6 following regrouping (0.79 vs. 0.60, P=0.08). The 24 hr diurnal group feeding patterns during d3, d6, wk5, wk7 and wk10 and the 24 hr average percentage of feeder spaces occupied (55.7 vs. 56.2 %, for SG and LG) was similar between the two group sizes. The average amount of time spent (%/24hr) on eating/drinking (5.2 vs. 5.2 for SG and LG), standing/walking (5.1 vs. 5.4 for SG and LG) and lying (89.6 vs. 89.3, for SG and LG) did not differ between the two group sizes and the diurnal patterns of these activities were also unaffected by group size. We conclude that feeding behaviours of grower-finisher pigs were disrupted immediately following formation of large compared with small groups. However, long-term negative effects on feeding and behavioural time-budgets were not apparent.

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## HANDLING PRACTICES DURING REARING ARE LINKED TO THE COW-HUMAN RELATIONSHIP



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This study investigated the influence of different handling practices during rearing on cow-human relationship in 33 cubicle loose-house dairy herds (36±15 lactating cows) selected according to farmers' answers to a questionnaire. They were allocated to four groups: GROUP1: regular talking to/touching of calves beyond feeding (talk/touch calves) and special habituation procedure for heifers when integrated in the cow herd (habituation heifers), GROUP2: habituation heifers, no talk/touch calves, GROUP3: no habituation heifers, talk/touch calves, GROUP4: no habituation heifers, no talk/touch calves. To assess cow-human relationship, reactions to an unfamiliar experimenter were observed in three tests and herd values calculated: median of the avoidance distance of cows inside the barn (AD); percentage of lying cows that stood up when the experimenter passed behind them (LP); and reaction of cows to the experimenter walking in the alley and trying to touch them (W&T; % of cows withdrawing at distance >2m and % letting themselves be touched). The 4 groups differed in LP ( $P<0.05$ , Kruskal-Wallis-Test) with most cows standing up in GROUP4-farms (median:22%; GROUP1:6%, GROUP2:6%, GROUP3:12%). In W&T more cows allowed themselves to be touched in GROUP1 (12%) and GROUP3 (16%) than in GROUP4 (0%;  $P<0.05$ ) and less cows withdrew at a distance of more than 2m in GROUP1 (0%) than in GROUP4 (14%;  $P<0.05$ ). Differences in AD ( $P=0.133$ , Kruskal-Wallis-test) were not significant, but with comparison of farms using Mann-Whitney-U test showed AD to be significantly lower for GROUP1 (median:0.07m) than GROUP4 (0.28m;  $P<0.05$ ) and tended to be lower for GROUP3 (0.07m;  $P<0.1$ ). The results suggest an influence of handling practices during rearing on reactions of cows towards humans. Additional human contact seems to be particularly important for calves but also heifers, as a combination of both was the most effective in improving the later cow-human relationship. The present study is part of the Welfare Quality® research project.

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## VARIATIONS IN ADÉLIE PENGUIN HEART RATE AND BEHAVIOUR



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The study investigates impacts of stressors on physiological and behavioural reactions in incubating Adélie penguins, *Pygoscelis adeliae*. In a field study based in SSSI no. 13, King George Island (Antarctica), simultaneous records were obtained of variations of heartbeat and behaviour in 19 focal animals. Recordings were made during the second half of two incubation periods. Data were recorded once to twice daily, for 2d-15d (median: 6d) per penguin. The sessions in 2000 and 2001 lasted 30 min and 45 min, respectively. Heartbeat was measured using artificial eggs fitted with infra-red sensors. Elements of behaviour were recorded using a Hi8 video camera. Heart rate data were transformed into graphs and heart rate was counted for 20 s-intervals, from which beats-per-minute values (bpm) were extrapolated. Behavioural data were transcribed using focal animal sampling (continuous recording, all-occurrences). Vigilance and agonistic behaviour as well as disturbance were likewise quantified for 20s-intervals. Calculations were performed individually for each focal animal (baseline vs. disturbance reactions). Pearson-correlations (2-tailed) were calculated for the two types of disturbance (conspecific/human) and the three indicators used, as well as for the relationship between vigilance and heart rate. While heart rate responses of the majority of focal penguins did not correlate with conspecific disturbance (max  $r^2$ : 0.064;  $P < 0.001$ ), heart rate of most birds correlated with human disturbance (max  $r^2$ : 0.533;  $P < 0.001$ ). Approximately 50% of the penguins showed an increase in vigilance to conspecific disturbance (max  $r^2$ : 0.118;  $P < 0.001$ ) and the majority strongly responded to human disturbance (max  $r^2$ : 0.493;  $P < 0.001$ ). As heart rate and vigilance behaviour do not always correlate, both parameters ought to be considered when assessing disturbance impacts. Results suggest that the impact of human disturbance increases with decreasing distance as well as increasing number and "carelessness" of the visitor(s).

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## TWO-DAY-OLD LAMBS RECOGNIZE THE INDIVIDUAL ACOUSTIC SIGNATURE OF THEIR MOTHER



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In sheep (*Ovis aries*), lambs show a preference for their own dam 12 to 24 hr after birth, and this is important for their survival. The role of acoustic cues in this early preference for the mother is not clear. While acoustic recognition of the dam is clearly established one week postpartum, it is not known whether it may occur earlier or what mechanisms are involved. Therefore, we investigated the ability of lambs to discriminate between the bleats of their own mother and an alien equivalent dam in a two-choice test. In a first study, tests were conducted at 12hr, 24hr or 48hr after birth (N=19 or 20/group); both dams were hidden behind a canvas sheet and lambs were unable approach the ewes at less than 1m, thus preventing olfactory perception. Only at 48 hr lambs spent significantly more time near their mother than near the alien dam (63 sec.[29-119] vs. 4sec.[0-31], Wilcoxon, P<0.05). We then conducted a playback experiment of recorded high or low pitched bleats in the same two-choice situation to assess whether 48-hr-old lambs can recognize the bleats of their mother. Lambs showed a preference by spending more time near the loud-speaker playing low-pitched bleats of their mother 56 sec.[22-92] versus those of an alien dam at 48 hr 11 sec.[2-30], N=20; Wilcoxon, P<0.01, but not for high-pitched bleats. A final experiment investigated whether low-pitched bleats are more attractive than high pitched bleats, independently of their familiarity. Forty-eight-hr-old lambs did not prefer unfamiliar low- vs. high-pitched bleats (N=20; Wilcoxon, P>0.05). We conclude that 48-hour-old lambs can recognise an individual acoustic signature in the low-pitched bleats of their own dam, but a dialogue may be necessary between the dam and her lamb when high-pitched bleats are used.

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## PHYSIOLOGICAL AND BEHAVIOURAL RESPONSES IN DIFFERENT STOCKING DENSITY OF INDONESIAN NATIVE CHICKEN



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The aim of the research was to evaluate the effect of stocking density of Indonesian native chicken management on physiological and behavioural responses. Ninety three Merawang chicken day-old chicks fed a commercial ration containing 20% crude protein and 3000 kcalME/kg in crumble form were used in this experiment for twelve weeks. Stocking densities of the birds were (1) 8 birds/m<sup>2</sup>; (2) 10 birds/m<sup>2</sup>, and (3) 13 birds/m<sup>2</sup> with three replicates. The diet and water were offered *ad libitum* and the confinement temperature and humidity were 32.7°C and 70%, respectively. Physiological values of the blood (number of erythrocytes, haemoglobin, leucocytes and ratio of heterophils to lymphocytes (H/L)) and behavioural activities, eating, drinking, standing, resting, sleeping and pecking of object were recorded at 4, 6, 8, 10 and 12 weeks of age. The study showed that differing stocking densities of 8, 10 and 13 birds/m<sup>2</sup> significantly ( $P < 0.05$ ) affected physiological and behavioural activities. Increasing the stocking density and age of the birds caused decreasing the H/L ratio, potentially indicating stress in the birds, and the activity levels were lower at higher stocking density, especially in the afternoon. There was no significant effect on production performance, but the 13 birds/m<sup>2</sup> group had reduced body weight. This study concludes that the confinement environment for birds in a tropical climate should not exceed 10 birds/m<sup>2</sup>.

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## USE OF BEHAVIOURAL STUDIES IN WATER BIRD HABITAT MANAGEMENT – A CASE STUDY



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Diving behaviour of four species of water birds viz., Little Grebe *Tachybaptus ruficollis*, Little Cormorant *Phalacrocorax niger*, Common Coot *Fulica atra*, and Darter *Anhinga rufa*, was compared in Vaduvor lake, a water bird sanctuary in Tamilnadu, southern India. The diving patterns were studied by recording duration of diving, and preceding and succeeding surface times of a dive at different water depths and in all the months of the two year study period whenever these birds visited the lake. These birds were found in the lake only when the water depth was high. Furthermore, the Darter was found only in the deepest region and when the lake was full, indicating that water depth is a crucial factor. Their diving behaviour was recorded in 3 different regions of the lake of varying depth contours and in each region in 3 randomly selected stations of different water depth. The total number of dives recorded was 410 (comprising of 54 bouts), 262 (46 bouts), 307 (47 bouts) and 134 (37 bouts) for the Little Grebe, Little Cormorant, Common Coot and Darter, respectively. Darter was the most efficient diver with the highest efficiency value (efficiency = dive time/total surface time) (the efficiency values were  $0.57 \pm 0.28$ ,  $0.80 \pm 0.71$ ,  $0.80 \pm 0.79$ , and  $1.0 \pm 0.96$  for Little Grebe, Little Cormorant, Common Coot, and Darter respectively;  $F=15.68$ ,  $df=3.909$ ,  $P<0.001$ ) The diving efficiencies were more when the water was comparatively deeper. Further, when the data on the water depth and other water quality variables of the lake were subjected to multiple regression analysis to predict the population of these diving birds, water depth was found to be the most significant factor. So, it is suggested that in the proposed de-silting of the lake to increase its water holding capacity, the present depth variations in different regions of the lake should be maintained relatively to preserve the water bird diversity of the lake.

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## DEVELOPMENT OF A PROPENSITY TO CHEW TEST AS A PREDICTOR OF TAIL-BITING IN PIGS



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Tests of propensity to chew tail-like objects (e.g. ropes) may provide valuable information on which pigs are likely to become tail-biters. However previous tests have shown low test re-test consistency of individual performance and therefore are unlikely to have strong predictive value. This study aimed to develop a novel chew test which gave consistent results across tests. Rope-chew tests were carried out using N groups of one (N=20), two (N=20) and ten (N=8) pigs. Half of each group were tested with ropes (1 per pig) attached to the wall (TW), and half with ropes attached to a parasol base on the floor (PB). Pigs were tested 10 days post-weaning and again three weeks later to check for individual cross-test consistency. Time spent chewing on the rope (CH) and total time in contact with the rope (TC) were recorded for each pig. Pigs tested individually tended to panic and made little contact with the ropes. Pairs and groups of ten were calmer. Performance in the first test was most strongly correlated with performance in the second test for the TW test with 10 pigs (TC:  $r_s=0.570$ ,  $P=0.009$ , CH:  $r_s=0.620$ ,  $P=0.004$ ) and PB test with 2 pigs (TC:  $r_s=0.415$ ,  $P=0.069$ , CH:  $r_s=0.610$ ,  $P=0.004$ ). Scattergrams showed that in the PB test pair members behaved similarly to each other, questioning whether the test provided reliable information on each individual's chewing propensity. For the TW test with 10 pigs much variation was seen within each trial group, suggesting that pigs were expressing individual variation in propensity to chew, with some individuals chewing far more than others. Pigs thus appeared to exhibit most variation and show highest cross-test consistency when tested in the TW test in groups of ten. The predictive value of this test with respect to tail-biting is now being studied.

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BEHAVIOURAL AND HEART RATE  
RESPONSE OF DAIRY CALVES TO  
SEPARATION FROM THEIR MOTHERS:  
EFFECT OF CALVES' AGE AND  
AUDITORY/VISUAL CONTACT



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In this study we evaluated how the behavioural and heart rate response of dairy calves to separation from their mothers was affected by two factors: the calf's age at separation (1, 4 and 7 days) and the presence or absence of post-separation visual/auditory contact between the calf and its mother. We used 46 dairy calves randomly allocated to one of six treatments according to a 3x2 factorial design. Calves' behaviour was recorded during the 24 hours period after separation and the heart rate was measured during the 60 minutes before and 60 minutes after the separation. The differences between treatments were analysed using the GLM procedure (SAS). A strong influence of the calf's age was found. The calves separated on day 4 and 7 spent more time standing and moving ( $F_{(2)}=13.47$ ,  $P<0.0001$ ), they placed their heads outside a pen more often ( $F_{(2)}=6.46$ ,  $P<0.05$ ) and sniffed the walls and bedding more frequently ( $F_{(2)}=5.24$ ,  $P<0.05$ ) than those separated on day 1. The calves also tended to place their heads outside a pen more frequently when they could see and hear their mothers ( $F_{(1)}=2.91$ ,  $P=0.1$ ). The peak of activity was observed immediately after separation and then between 11-14 and 20-22 hours. The heart rate increased rapidly in all of the age treatments. Differences arose between 15-29 minutes ( $F_{(2)}=3.99$ ,  $P=0.05$ ) and between 30-44 minutes ( $F_{(2)}=3.87$ ,  $P=0.05$ ), because the calves separated on day 7 had significantly higher heart rate than the calves separated on day 1. Between 45-60 minutes the heart rate decreased in all the calves. The heart rate was not influenced by post-separation contact with the mothers. The behavioural and heart rate response of calves is more intense and lasts longer when they are separated later. Furthermore, the behavioural activity of calves is more intense when they can see and hear their mothers.

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## INDIVIDUAL URINARY CORTISOL CHANGES IN KENNELLED DOGS



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Plasma cortisol levels have often been used to measure the stress response in dogs kennelled for short periods; however, as the sampling process itself can cause plasma cortisol to become elevated, the validity and humaneness of this measure has been questioned. Therefore, in this study, we used cortisol present in naturally voided urine as an indicator of the stress response in kennelled dogs. Urinary cortisol levels (based on cortisol: creatinine ratios) were evaluated in a randomly selected sample of 81 shelter dogs (57 male), kennelled at Battersea Dogs' Home, Old Windsor. Urine was collected on days 2, 5, 10, 17, 24 and 31 (d1 referring to day of admittance). Baseline cortisol concentrations from 20 re-homed dogs (12 male) were collected for comparison. Mean cortisol concentrations rose steadily from d2 to d17, and declined thereafter. Cortisol levels were significantly higher than the baseline measures on all test days, except d31 (Mann-Whitney:  $P < 0.05$ ). No gender or age effects were detected. Despite this mean trend, a high degree of individual variation was observed on each test day. Further analysis revealed that within the first two weeks, cortisol peaked at different times for different dogs, peaking and declining steadily from d2 in 3/21 dogs, rising steadily from d2 in 7/21 dogs, increasing from d2 to d5 then declining in 5/21 dogs and declining from d2 to d5, then increasing thereafter in 6/21 dogs. The results are discussed with reference to personality and why different stressors inherent in the kennel environment may affect some individual dogs more than others. The implications for the husbandry and welfare of kennelled dogs include the identification of the most susceptible individuals, as well as the utilization of stress management techniques by kennel staff.

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## AN INVESTIGATION INTO THE USE OF STRAW RACKS BY SOWS IN LARGE DYNAMIC GROUPS



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This study assessed levels of usage of straw racks by sows within large dynamic groups, and the effects of providing the racks on post-mixing aggression. 122 sows were allocated to one of two treatments over seven replicates. Treatments were as follows: (1) access to two racks containing chopped barley straw, (2) control, with no straw racks. Treatments were applied to two separate dynamic groups (each containing 35 ( $\pm$ 3) sows). Approximately 9 sows were replaced in each group every 3 weeks (each replacement constituting a replicate). Both groups were housed in identical split-yard systems, the pre- and post-feeding yards being separated by an electronic feeder. Rack usage was observed at regular intervals over two 24-hour periods each week. Aggressive interactions between newly-introduced and 'resident' sows were assessed during the immediate post mixing period. On average over a 24-hour period, 2% of sows were observed at each rack, with a greater average percentage being observed at the post- rather than pre-feeding rack ( $P < 0.001$ ). Peak rack usage was shown between 0800 and 1200 hours, where on average 6% of sows were observed at each rack. On average over a 24-hour period, 27% of sows that were observed at the racks were newly-introduced. This percentage was significantly greater in the pre- rather than post-feeding yard ( $P < 0.05$ ). The proportion of sows which performed aggressive behaviour after mixing was greater in the straw rack rather than control treatment ( $P < 0.001$ ). The fact that approximately two sows occupied each rack during peak rack usage periods suggests that the racks were appealing to the sows, and therefore had welfare benefits. Newly-introduced sows to the group did not appear to have difficulty gaining access to the racks. However, the increased levels of aggression shown suggest that welfare benefits associated with this system are limited.

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## IS THE WAY WE FEED LAMBS IMPORTANT FOR THE DEVELOPMENT OF AN AFFINITY TO THEIR CAREGIVER?



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Artificially suckled mammals can express high affinity to their human caregivers but the mechanisms involved are not fully known. We examined the role of the way young farm herbivores are fed for the development of affinity to their caregiver. We tested the effect of two current methods: either the bottle was in the caregiver's hand or it was fixed on a stand against a pen wall. These methods were compared to simple tactile contacts (holding) and to a control without human contact. Sixty lambs were separated from their dam 12h after birth. Treatment sessions (5min) were repeated three times a day for five days and then twice a week. Animals' behaviour was observed by scan sampling every 10s. 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 caregiver, 3.alone. Data were analysed with ANOVAs. During treatments, hand fed lambs initiated more contacts with their caregiver (54% of scans  $\pm$  2%) than the "held" lambs (25%  $\pm$  3,  $P < 0.001$ ) and the last initiated more contacts than the "wall bottle-fed" lambs (19%  $\pm$  2,  $P = 0.05$ ). In the arena, all handled lambs interacted more with their caregiver than controls ( $P < 0.05$ ). We did not observe any effect of the way we fed lambs on responses ( $P > 0.1$ ): giving food to lambs did not improve the time they spent near their caregiver compared to holding them (held: 78s $\pm$ 9; "wall fed": 54s $\pm$ 9; "hand fed": 41s $\pm$ 9; control: 5s $\pm$ 3,  $P < 0.05$ ). Held lambs expressed less distress behaviours in the caregiver's presence ( $P < 0.05$ ) and more distress behaviours after separation ( $P < 0.05$ ) than the other lambs ( $P < 0.05$ ). Thus, food could focus the attention of lambs towards the caregiver but would not be necessary for the development of affinity to her/him. Holding lambs is sufficient for affinity to develop.

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## COMPARISON OF BEHAVIOUR, PHYSICAL CONDITION AND PRODUCTIVITY OF LAYING HENS IN FOUR MOLTING METHODS



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The objective of the present study was to evaluate the welfare level of hens in four molting methods by comparing behaviour, physical condition and productivity. Ninety-six White Leghorn layers (72 wks) were used. Each molting group consisted of 12 cages with two hens per cage. The four molting methods consisted of 10-d feed and first 3-d water withdrawal (WFW) and 10-d feed withdrawal (WF) followed by ad libitum access to a layer diet from d 11 which were traditional methods in Japan, and of 28-d restricted feeding (RF) and 28-d nonfeed withdrawal (NW). RF and NW hens were fed a low energy diet contained 60% wheat middings and 35% corn (12% CP and 2000 kcal ME/kg). Behavioural observations were conducted on d 1·2, 4·5, 9·10, 11·12, 27·28. WFW and WF hens showed clear two phases of behavioural change during 10-d fasting period. Explorative behaviours increased for WFW and WF hens on d 1·2, and some of the behaviour progress into stereotyped behaviour. Standing-resting sharply increased for WFW and WF hens from d 1·2 to 9·10 while lying-resting decreased sharply. Contrastively, RF and NW hens did not show such a behavioural pattern. WFW and WF hens performed more aggression on d 1·2 and 11·12 than RF and NW hens ( $P<0.05$ ). The proportion of RF hens performing aggression remained relatively higher throughout 28-d molt period compared with NW. Weight loss of NW hens was more gradual compared with the other three methods. Any productive traits showed no significant differences among the four methods during the postmolt period. In conclusion, welfare level of RF and NW hens, especially NW, was higher compared with WFW and WF hens. Not only aggression but also resting behaviours may be important behavioural indices for evaluating the welfare level of caged layer hens.

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## BEHAVIOURAL AND CARDIAC RESPONSES TO CHANGES IN THE SOCIAL AND NON SOCIAL ENVIRONMENT IN QUAIL



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Poultry are frequently exposed to changes in their social and non social environment (transport, mixing), which alters their welfare. In this study, behaviour and cardiac activity were investigated in response to social and non social changes. Female quail were housed with either a conspecific (CONS, N=12) or a ball (BALL, N=10) from the age of three weeks onwards. Adult quail were fitted with a telemetric device to collect cardiac activity. Quail were exposed to a separation from the familiar partner (i.e. the conspecific or the ball) followed by its reintroduction, and an exposure to an unknown partner (i.e. another conspecific or another ball). Stereotyped pacing observed in BALL quail before and during isolation and reintroduction periods suggested that those quail were experiencing chronic stress. Moreover, BALL quail showed behaviours suggesting that they were looking for a conspecific. Both of these results suggested that BALL quail underwent a social deficit. BALL quail were not affected by manipulations of their partner ( $\chi^2=3.36$ , NS). In CONS quail, stereotyped pacing decreased when the partner was removed and recovered its initial level when the partner was reintroduced ( $\chi^2=10.21$ ,  $P=0.006$ ), suggesting that CONS quail were more disturbed when a conspecific was present. The size of our experimental design was suspected to be too small for two quail. The introduction of the unknown partner increased behavioural investigation towards it: BALL quail pecked more the unknown than the familiar ball ( $z=-2.08$ ,  $P=0.04$ ) and CONS quail had longer contacts with the unknown than with the familiar congener ( $z=-3.09$ ,  $P=0.002$ ). Analysis of heart rate variability showed only minor changes in the sympatho-vagal balance. To conclude, changes in the social environment were more disturbing than changes in the non social environment in quail. Moreover, individual experience was shown to have a major role in the elaboration of responses to novelty.

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## PIG ENRICHMENT: LEGISLATION, SCIENCE AND REALITY



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Since 2003, the provision of appropriate environmental enrichment to pigs of all ages has been a legal requirement in the EU (Directive 2001/88/EC and 2001/93/EC). In order to gain knowledge about how farmers comply with these regulations, a brief questionnaire was sent to 21 Veterinary Officers from the British State Veterinary Service, who make regular welfare inspection visits to pig farms. Due to the small scale of the questionnaire, the results were not analysed statistically, but expressed as the proportion of respondents that answered. The results highlighted some main trends in the UK pig industry and were compared with the findings of a literature review on pig enrichment. The majority of pig farms visited provided enrichment to pigs (92%) although not all types of pigs received it. These pigs were pregnant sows in farrowing accommodation (62.5%), suckling pigs with the sow (87.5%) and weaner pigs (75%). A reason may be the widespread use of farrowing crates in the UK where substrate is provided to the piglets but that is not necessarily accessible for the sow. Weaner pigs are often reared in systems with fully/part slatted floors (flatdecks). Producers will be reluctant to provide enrichment substrates on these floors. The use of chains (91%) and car tyres (55%) was still widespread. These objects are not recommended for long-term use, as they can quickly lose their novelty factor. Although pig producers seem to comply with the enrichment legislation, some groups of pigs are overlooked. Suitable enrichment for pigs is also regularly not provided, although it is known from the literature what suitable pig enrichment is (Van de Weerd, 2006). This knowledge needs to be transferred to the pig industry. Van de Weerd (2006). A review on environmental enrichment for pigs in intensive housing systems. Defra report. This project was funded by Defra.

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## HORSES ACTIVELY SAFEGUARD THEIR SOCIAL NETWORK: THE EFFECTS OF INTERVENTIONS IN HORSE INTERACTIONS



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To what extent are social relationships important to domestic horses, and what strategies do domestic horses use to maintain their social network? This question has been studied by analysing social interventions within stable groups of horses consisting of adult females, - geldings and sub-adults. They were observed continuously (24hr/day) for several weeks. In one year two unfamiliar small groups were added to the herd in order to study 'familiarity' as an additional variable. An intervention is defined as the behavioural action of one horse (the intervener) actively interfering in an ongoing interaction of two other horses with the apparent aim of altering that interaction (verified by post-hoc analyses of disturbed and undisturbed interactions). Many interventions took place during dyadic affiliative interactions. Interventions in allogrooming (N=162) or play (N=105) were performed significantly more often when at least one member of the initial interaction was a preferred partner of the intervener (allogrooming: Wilcoxon-signed-ranks-test  $z=-5.21$ ,  $N=37$ ,  $P=0.0001$ ; play: Wilcoxon-signed-ranks-test,  $z=-3.89$ ,  $N=24$ ,  $P=0.0001$ ). The stronger the preferred association between intervener and the interacting animals in allogrooming, the higher the chance that the intervener displaces one horse and continues allogrooming with the other (Wilcoxon-signed-ranks-test,  $z=2.12$ ,  $N=31$ ,  $P=0.034$ ). Interveners from the smaller introduced groups (relatively unfamiliar with respect to the resident herd) intervened significantly more often when one of their group members allogroomed with an unfamiliar animal (tested by Monte Carlo procedure with a Bonferroni critical significance 0.005 per combination (N=9)), suggesting a strategy to safeguard reliable social relationships within the small introduced groups when introduced in a large residential group. Thus domestic horses actively take risks and spend time to safeguard their affiliative relationships. Some suggestions on the implications of these findings with respect to husbandry systems are discussed.

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## APPLYING FUNDAMENTAL DUST BATH RESEARCH IN THE EVALUATION OF POULTRY HUSBANDRY SYSTEMS



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To establish dust bath ("bath") quality, feather lipid percentages were measured (NEN3443-method) and baths were directly (except in experiment 1 where they were videotaped) observed in: 1 Broiler breeders in a traditional system. 2 Broiler breeders in furnished cages with artificial grass. 3 White layers in furnished cages with artificial grass\* 4 White layers in furnished cages with a litter box. 5 Brown layers in furnished cages with a litter box. Feather lipid percentages were compared by analysis of variance. To avoid circularity results were validated with fundamental research performed by Van Liere (1991). A difference between different types of hens was only found in head rubbing on artificial grass (broiler breeders showed this in 40%, layers in 6.9% of the baths). Except in the traditional system, bathing was not functional as shown by a too low shaking out frequency and a too high percentage of stale feather lipids. Hardly any difference between baths in a litter box and on artificial grass was found: In experiment (5), 94.7% of baths that proceeded to the "side rubbing phase" (stage II) fell back to the "shaking in phase (stage I). Unexpectedly, in experiment (3) this was the case in only 7% of such baths. The total bath duration was high due to an extremely high frequency of baths with a, according to Van Liere (1991), too short duration. This easily results in the incorrect conclusion that hens "make good use of the litter". Also on basis of other measurements (stage II in a quarter of short baths, a shortened stage I) one has to conclude that the frustration of the hens in these furnished cages was comparable to that after five month of substrate deprivation under laboratory conditions. \* Experiment performed by Wiers *et al.* using the method developed in this research.

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## FRUSTRATION OF WALKING DUE TO TETHERING IN DAIRY COWS



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Regulations to protect farm animal welfare tend to offer more possibilities to behave: rearing in groups permit social contacts; pigs and hens shall be provided with substrates to manipulate; more space allows animals to move around etc. Across Europe 20-80 % cows are tethered part of the year and this prevents them from walking. We analysed if cows are frustrated for not walking. Frustration was assessed through the higher expression of the activity when released from inhibition (Mackintosh, 1974. *The Psychology of Animal Learning*. London/New-York/San Francisco: Academic Press). We used 15 2-yrs-old Holstein cows that had never been tethered for a prolonged period beforehand. They were then tethered for 0 (controls, loose housing), 1, 3, 9 or 27 days (Latin square design) and fed similarly. Thereafter they were observed for 10 min in 8 x 10 m arena. Cortisol was regularly determined in milk and milk production was recorded to check for incidence on stress and production. ANOVAs were run including animal (random), treatment (i.e. duration of tethering) and period as factors and initial levels (before all treatments) as covariates. Tethered cows spent more time walking in the arena than controls whatever the duration of tethering (17.2 vs. 11.8% of the time, SE=1.7, P<0.001) while their speed of walking was similar (1m/s). Milk cortisol tended to decrease along tethering (-0.007ng/L.day, P=0.08). Tethered cows produced more milk than loose housed cows (+0.6kg/day, P<0.05). The results suggest that cows are motivated to walk and tethering induces frustration. Tethering should thus be limited on welfare grounds. The absence of movements may decrease basal metabolic needs, hence low cortisol release and more milk production when cows are tethered. Further work will aim at assessing if tethering induces chronic stress in cows (using pharmacological challenges) and if regular access to an exercise area (e.g. 1 h/day) can relieve their frustration.

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## BEHAVIORAL RESPONSES BY DAIRY COWS SUBJECTED TO DIFFERENT DRY-OFF PROCEDURES



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Typically, dairy cows are dried off 40 to 60 days before the anticipated date of calving. Dry off procedures are variable but usually include one or all of the following: changes in milking frequency, diet quality or the quantity of food or water provided. The objectives of this trial were to investigate the effect of diet quality during dry-off on the rate of decline in milk production and cow behaviour. Forty-two late lactation cows were randomly assigned to one of two dietary treatments, differing in digestibility, in groups of three and observed for 12 d. Cows were initially fed a late lactation total mixed ration (TMR) and then switched to either ad libitum tall fescue hay or oat hay, which had an in vitro digestibility of  $60.2\% \pm 1.8$  and  $44.3\% \pm 0.6$ , respectively. Mean dry matter intake of the TMR diet was  $18.1 \pm 0.4$  kg/cow/d but declined to  $7.0 \pm 0.1$  and  $12.9 \pm 0.2$  kg/cow/d when cows were given either the oat hay or grass hay diets, respectively. Milk production decreased the day following introduction of the two hay diets but was greater for oat hay than grass hay ( $P < 0.05$ ). During the first two days of hay feeding, the frequency of calls increased for both groups but was higher for the oat hay fed cows ( $P < 0.02$ ). Although the total number of calls had decreased in both groups after 3 d of hay feeding, vocalizations remained higher for the cows receiving the oat hay ( $P < 0.05$ ). There was no difference in total standing times. Compared to cows fed grass hay at dry off, cows fed oat hay showed a particularly pronounced reduction in intake and production, however, this was associated with a transient increase in vocalization. The increase in vocalizations may be interpreted as a signal of hunger and therefore an indicator of poor welfare.

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## WHO'S A CLEVER BOY THEN? METHODS TO ASSESS LEARNING TO EVALUATE BRAIN FUNCTION IN HORSES



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Recent emphasis has been put on the role that altered brain functioning may have in the performance of stereotypic behaviour in captive mammals, including horses. Performance in learning tasks has been recommended as a method to assess brain function in stereotypic animals. The aim of this study was to design a programme of initial training and learning tasks that would enable a more comprehensive evaluation of the learning abilities of horses, and relationships these may have with the expression of stereotypic behaviour. The initial training programme comprised three phases which allow test subjects to habituate to the apparatus and training procedures as well as providing a means of assessing initial subject performance and motivation. The programme of 4 learning tasks assess the subjects' response to reversal discrimination, discrimination based on positional cues, discrimination based on symbol cues and response to a random reinforcement schedule. The initial training programme and learning task were trained by the use of positive reward (food) for correct responses. This training programme provides a means of studying the underlying differences in responses to learning tasks displayed between stereotypic and non-stereotypic animals in more detail. This includes identification of specific types of altered functioning implicated by the response history such as prefrontal cortex dysfunction and basal ganglion dysfunction. During pilot work 10/14 horses were successfully trained to a novel operant task, and 7/10 successfully completed the first learning paradigm (reversal discrimination and extinction). The three horses which did not complete were removed from the study due to unforeseen circumstances. These preliminary results suggest that once trained, comparison of responses to learning tasks may be a viable means of assessing causes and affects of stereotypic behaviour in horses. However, care must be taken in design of learning tasks and in selection of subjects.

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## RELIABILITY OF AVOIDANCE DISTANCE RECORDING IN DAIRY CATTLE IN DIFFERENT TEST LOCATIONS



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Animal-human relationship may influence health, performance and welfare in many farm animal species. Therefore, avoidance distance assessment towards a person is often included in animal welfare assessment protocols for cattle. Earlier work has shown that avoidance distance recorded in three different on-farm locations relates similarly to milker behaviour and that these avoidance distances are correlated. It was the aim of this study to investigate inter-observer and test-retest reliability of avoidance distance recordings in these three locations. In 6 loose housed dairy herds in north-western Germany, avoidance distances towards three initially unknown observers were recorded 1) when the cows left the milking parlour, 2) at the feedbunk and 3), in the home pen. Recordings were taken by all observers on the same day and repeated on three consecutive days. Data were analyzed at herd level (herd medians) using a linear mixed model and Spearman rank correlations. Avoidance distances in the home pen and at the milking parlour were significantly affected by the observer ( $P < 0.01$  and  $P < 0.001$ , respectively;  $d.f. = 2, 28$ ), yet there was no such effect at the feedbunk. Despite of the fact that observer C differed significantly from observers A and B in the home pen and at the milking parlour, in the latter location significant correlations between observers were only found for B and C ( $r_s = 0.86$ ,  $P < 0.001$ ,  $N = 15$ ). The observation day had no significant effect on recordings in any of the test locations. Our results indicate, that observer effects in avoidance distance recording depend on the test location and that test-retest reliability is high for all test situations chosen in this study. This may be taken into account when choosing methods in on-farm assessment protocols. Avoidance distance recording at the feed bunk appears to be most robust with regard to the issues investigated.

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Wednesday 9/8/06 – Thursday 10/8/06



## THE EFFECT OF LOCATION AND VARIETY ON FORAGING BEHAVIOUR OF STABLED HORSES



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In two replicated trials we initially aimed to investigate positional foraging preferences in stabled horses presented with a standard forage. Using the same protocol we then investigated preferences for single and multiple forage sources and interactions with the effect of location. Ten stabled horses, four females and six geldings, aged from 18 months to 21 years, maintained at Writtle College Stud took part in these trials. In Trial 1 four 60 litre containers holding 2.7 kg of chopped English ryegrass were located in the centre of the front, back, left and right walls of the horses' 3.5m<sup>2</sup> Monarch-style loose-boxes. In Trial 2 three containers each containing 2.7 kg of forage (chopped Italian ryegrass, chopped timothy, chopped alfalfa) and one container containing 2.7 kg of an equal parts mixture of these three forages (i.e. 0.9 kg of each forage) were presented in the same locations according to a Latin Square design to control for location order effects. In both trials the horses' behaviour was recorded for 30 minutes using wall mounted video cameras. Data was harvested from tapes according to an 11 behaviour mutually exclusive ethogram using the Observer v.5 package and analysed using SPSS v.12. Data were analysed using Friedman's analysis. In Trial 1 a significant difference in position was found with total foraging duration greatest in the front position ( $P < 0.005$ ,  $df_3$ ,  $\chi^2 = 14.0$ ). In Trial 2 a significant difference in duration of foraging was found with highest duration recorded for single ryegrass ( $P < 0.001$ ,  $df_3$ ,  $\chi^2 = 21.4$ ). When a variety of forages were presented the effect of location was NS. In these short term trials horses showed a preference for foraging location when a single forage was presented. When a variety of forages were presented single ryegrass was the preferred forage and forage preferences overrode positional preferences.

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## COMPETITIVE INTERACTIONS IN FEEDLOT BEEF CATTLE



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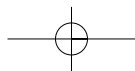
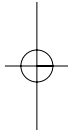
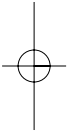
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Ruminants are social animals and interact with their social group frequently, especially when access to a resource is limited. Despite considerable interest in social behaviour of cattle, no work has focused on assessing the relationship between competition and feeding behaviour in feedlot cattle. We compared successful competitive interactions to individual feeding time (min/hour) and feed intake (DM basis; kg/hour) in beef heifers. Forty-five feedlot heifers ( $520 \pm 33$  kg BW) were randomly assigned to 3 pens of 15 animals. Each pen was fitted with two radio frequency equipped feed tubs that monitored individual animal intake and feeding duration 24-hours a day. Cattle were fed a mixture of barley silage, concentrate and mineral supplement at 0900, 1200 and 1500 and had ad libitum access to both feed and water. Animals were videotaped on three separate days and the competitive interactions observed around the feed tubs were monitored continuously from 0900 to 2200. Animals were considered successful if they displaced another animal and gained access to one or both of the feed tubs. We found significant relationships between the amount of successful interactions displayed and feed intake ( $R^2=0.43$ ,  $P<0.001$ ) as well as total time spent eating ( $R^2=0.34$ ,  $P<0.001$ ). The relationship between successful interactions and intake was even more pronounced in a comparison between an hour period immediately following the first morning feeding ( $R^2=0.76$ ,  $P<0.001$ ) and an hour period three hours after the last afternoon feeding ( $R^2=0.29$ ,  $P<0.001$ ), suggesting that motivation for feed likely impacts an animal's success. Our work indicates that the success of an animal in competitive interactions at the feedbunk plays a large role in its intake and time spent eating; however, this relationship may vary depending on the animal's motivation for feed.

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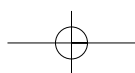
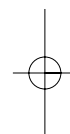
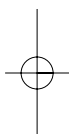






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## THE WELFARE OF CAPTIVE STARLINGS



Lucy Asher, Melissa Bateson

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The European starling *Sturnus vulgaris* is one of the most widely used birds in the study of animal behaviour and yet very little is known about its welfare. The topic of laboratory bird welfare has recently been brought to the forefront because the EU is reviewing laws regarding their husbandry and care. We feel it is vital that these laws be based on good science. To find out more about starling welfare, we conducted a classic two-by-two design, manipulating cage size and enrichment to give four possible treatment groups; small barren, large barren, small enriched and large enriched. The smaller cage size (H52 W85 D51cm) reflected those currently used at our facility, the larger (H85 W141 D84 cm) those suggested by the new draft regulations, whereas enrichment reflected the specific needs of the species (natural branches, foraging substrate and water baths). Sixteen starlings were each left in one of the four cage types for one week, and various physiological and behavioural methods were used to measure their welfare, including analysis of corticosterone, fat, foot and feather condition scores, general differences in behaviour and behavioural time budgets, in addition to scores of diversity and repetitiveness of behaviour exhibited. Small barren cages indicated the worst results in nearly all measures of welfare used: The birds spent more time sedentary in small (ANOVA:  $F_{1,12} = 8.00$ ,  $P = 0.015$ ) and barren cages (ANOVA:  $F_{1,12} = 7.08$ ,  $P = 0.021$ ), performed more behaviours specific to caged environments in small (ANOVA:  $F_{1,12} = 8.79$ ,  $P = 0.012$ ) and barren cages (ANOVA:  $F_{1,12} = 7.93$ ,  $P = 0.016$ ) and performed more repetitive sequences of behaviour. Although starlings in large enriched cages had the best measures of welfare, this was closely followed by the large barren and small enriched cages, which were approximately equivalent. Our results suggest a loss in cage space can be compensated for using appropriate enrichment.

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## AN INVESTIGATION INTO FACTORS AFFECTING INTERNAL HOOF STRUCTURE IN DAIRY HEIFERS



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Eighty-nine high genetic merit Holstein-Friesian heifers were used to assess the effects of management and genetic factors on internal hoof parameters. Heifers were allocated to one of four rearing regimes at 7 weeks of age. Treatment 1 heifers were reared to calve at 540 kg and treatments 2, 3, and 4 were reared to calve at 620 kg. Treatment 1 and 2 heifers were offered grass silage-based diets during the winter and grass-based diets during the summer; treatment 2 heifers received additional concentrates. Treatment 3 heifers were offered a straw/concentrate diet during the winter and a grass-based diet during the summer. Treatment 4 heifers received the same winter diets as treatment 3 but were housed and offered a straw/concentrate diet in the summer. Mating commenced at 14 months of age and all heifers were sired by one of 17 bulls. Heifers on this trial were slaughtered at 18 months of age for reasons unrelated to this study. The lateral claws of the hind right hooves of these heifers were cut in half in a sagittal plane. Measurements were made of the depth of fat pad and the depth of the soft tissues below the pedal bone at 5 points along the length of the bone. Effects of treatment, sire, days in calf, liveweight, and solear pressure on tissue depth were determined by regression analysis. Treatment had a significant effect on tissue depth (but not fat pad depth) at 4 of the 5 observation points ( $P < 0.05$ ). The depth of the soft tissues below the pedal bone in grass silage-fed heifers was significantly thicker than in heifers fed straw/concentrate diets. Sire, days in calf, liveweight, and solear pressure were not related to tissue depth. These results suggest that nutritional treatment during rearing can influence internal hoof structures in dairy heifers.

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## LOCOMOTORY BEHAVIOUR IN DAIRY CATTLE: THE IMPACT OF WALKING SURFACES ON CLAW LOADING AND LOCOMOTION



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New floors may promote good locomotory health in dairy cattle and in this study the impact of such floors was evaluated. Loose housed HF cows (N=63) were kept on four different floors, i.e. a conventional concrete slatted floor (SC) and floors of profiled solid cement (GC), slatted rubber (SR) or solid rubber (FR), and monitored for locomotory functions. In weeks 0, 6, 12, 18 and 24 the cows' gaits were assessed with a pressure distribution plate (RsScan International, Olen, Belgium, sampling rate of 175 Hz, sensor sizes of 0.5 x 0.76 mm). Results were analyzed with Restricted Maximum Likelihood using ASReml. Fixed effects in the model included parity and weeks on floor x type of floor. The random effects cow and leg accounted for repeated measurements. An even distribution of load across the different legs was assumed to mirror fluid locomotion. Distributions were derived from ratios of values from different legs, with similar measuring values for 2 legs resulting in outcomes approaching 0. The ratio of maximal pressures between the legs was relatively high in SC cows, e.g.  $0.17 \pm 0.01$  (predicted mean  $\pm$  se) in week 12 compared to values always below 0.1 in the other cows ( $P_{\text{time} \times \text{floor}} = 0.019$ ). Cumulative claw surface during a step increased over time for SC cows, i.e. from  $2549 \pm 213$  cm<sup>2</sup> in week 0 to  $3919 \pm 192$  in week 14, but fluctuated between  $2876 \pm 98$  and  $3640 \pm 163$  in the other cows ( $P_{\text{time} \times \text{floor}} < 0.001$ ). Visual evaluation of loading patterns during steps indicated different claw-floor interactions for the different floors. On rubber floors a distinct weight-bearing wall developed in time, meaning that load was allocated to the strongest claw areas, while the abrasive character of concrete slats causes increased growth and overgrown hooves.

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## PREFERENCES OF DIFFERENT TYPES OF FLOORING AT MODERATE AND LOW AMBIENT TEMPERATURE IN DAIRY GOATS



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Although cattle and sheep prefer soft floors with low thermal conductivity when the ambient temperature is low, such data do not exist for goats. The aim of this experiment was to investigate goats' preference for different types of flooring for lying at moderate and low ambient temperature. In each of two experiments, 9 pregnant dairy goats were assigned to a modified 2 x 3 factorial design with ambient air temperature (moderate = +10 to +12 and cold = - 8 to -12°C) and type of flooring in the lying area (three treatments with the choice between two different flooring materials) as main factors. The position in the pen was scored using instantaneous sampling at 15 minutes intervals of the last 48 h of each experimental period. The lying time was reduced from 73.2 % and 73.7 % in the moderate temperature period to 63.8 % and 65.4 % in the cold period in experiment 1 ( $P<0.0001$ ) and 2 ( $P<0.0001$ ) respectively. In the moderate temperature period, straw was the least preferred flooring ( $P<0.001$ ). Expanded metal was preferred to solid wood ( $P<0.1$ ), but there was no significant difference between solid wood and mattress or expanded metal and mattress. In the cold period, solid wood was preferred to expanded metal ( $P<0.1$ ) and straw ( $P<0.1$ ) and mattress preferred to solid wood ( $P<0.1$ ) and to straw ( $P<0.001$ ). In conclusion, dairy goats seem to avoid lying on straw both at moderate and low temperatures even if they generally shift their preference towards bedding materials with low thermal conductivity at low temperatures.

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## LAMBS' AFFINITY TOWARDS A HUMAN RESULTS FROM ATTRACTION RATHER THAN FAMILIARISATION



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Young herbivores can express high affinity towards their caretaker. We tested if such a response could be developed by familiarisation, or by attraction to a human compared to a non living object presented simultaneously in the home pen. Four groups of eight female lambs were obtained at 12h of age, reared artificially and exposed simultaneously to a human in blue overalls and a traffic cone (90 mins of daily exposure). As a stockperson is usually moving (during routine work) for the time of exposure, the experimenter changed every 15 minutes between being immobile and slowly approaching the lambs. Other human contacts were avoided. After four weeks of exposure, the lambs were individually tested in a 2 x 6m arena successively in isolation (2 min), in the presence of the familiar human or the object (2 min) following a cross-over design, and in isolation again (2 min). Wilcoxon tests and Spearman correlations were used to analyse the results. During each daily exposure, lambs spent more time in contact with the motionless human than with the object (208.0+/-105.4s vs. 80.6+/-67.7s,  $W_{32}=220$ ,  $P<0.001$ ). During the arena test, no difference was observed when lambs were tested in isolation ( $P>0.1$ ). Lambs spent more time close to the human than to the object (72.3+/-39.2s vs. 51.6+/-29.0s,  $W_{29}=105.5$ ,  $P<0.05$ ) and vocalised less (19.1+/-8.6 vs. 24.2+/-9.2,  $W_{29}=-129.5$ ,  $P<0.001$ ) than with the object. The vocalisation frequency when with the human ( $r_s=0.4$ ,  $P<0.05$ ) or after human departure ( $r_s=0.48$ ,  $P<0.05$ ) was related to the time in contact with the human during the daily exposure phase. No significant relationship was observed between variables related to the object. Attraction to the human rather than a simple exposure seems to explain lambs' affinity to the familiar human. Vocalisations can be influenced by the animal's motivation to make contact with their stockperson.

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## THE EFFECT OF EXTENDING LACTATION ON THE WELFARE OF SOWS POST- WEANING USING QUANTITATIVE AND QUALITATIVE BEHAVIOUR ASSESSMENTS



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The impact of three weaning ages (4, 6 and 8 weeks, 4ww, 6ww, 8ww) on the behaviour and welfare of 27 sows (nine per replicate) was investigated in response to proposals within the European Community to increase the weaning age beyond 4 weeks. Sows were filmed two hours immediately after being weaned into fully-slatted accommodation. Two-minute clips were used to assess the sows' response to weaning (using qualitative assessment, N=17). Two-hour clips were used to quantitatively assess sow behaviour using continuous observations. Feed intake during lactation was recorded. Generalized Procrustes Analysis was used to identify qualitative sow scores. Data were analysed using ANOVA. The qualitative sow scores were correlated to continuous measures of behaviour, using Spearman Rank correlations. Two dimensions were identified for the qualitative assessment of the sows' behavioural style, dim1 describing this style as 'relaxed/calm' and dim2 as 'investigative/exploratory'. The 4ww-sows had significantly higher mean scores for dim2 than 6ww and 8ww-sows (0.056, -0.033, -0.029,  $P=0.013$ , 4ww, 6ww, 8ww, respectively). The 8ww-sows were observed feeding more often than the 6ww-sows ( $P<0.05$ ) and tended to feed more than the 4ww-sows (NS,  $P=0.107$ ), (mean frequency; 15.78, 9.50, 21.56,  $P=0.037$ ). This greater incidence of feeding did not appear to be due to nutritional requirements, as mean feed intake during lactation (kg) did not differ between treatments (6.75, 7.43, 6.94,  $P=0.260$ ). The higher dim2 score for the 4ww-sows suggests they may be spending more time investigating/exploring, possibly associated with searching for their piglets. The negative correlation between dim2 and the frequency of feeding ( $r_s=-0.526$ ,  $P<0.01$ ), may suggest that animals were feeding less often because they were behaving in an explorative way. Therefore, the 8ww-sows may have been calmer about the weaning process as they were observed feeding longer. The data suggest that later weaned sows may react better to weaning than earlier weaned sows. Project funded by Defra.

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## THERMOGRAPHY OF CAPTIVE CETACEAN RESPIRATORY ACTIVITY



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This paper evaluates thermography of the thermal energy in the cetacean exhaled air ('blow'). Using a thermographic camera sensitive in the infra red spectral band 7.5 - 13  $\mu\text{m}$  we have explored the thermal energy of the emissions from the respiratory blow of captive cetacea held at the Sea World facility in San Diego, USA. Two pilot whales (*Globicephala melas*), 2 beluga (*Delphinapterus leucas*) and 3 killer whales (*Orcinus orca*) were observed at night and in the very early morning in their pools. Thermography of the spout was carried out as the animals swam, and close range thermography of the eye, and use of an infra red thermometer was carried out when the animals came to the poolside following the commands of their trainers. A Flir systems thermaCAM™ E4 camera was used to make thermal image movies by capture direct onto the hard disc of a laptop computer. The thermal recordings were used to provide colour enhanced images and the time base provided with the images was used to record the duration of the blow, the interval between blows and to provide an estimate for the swimming speed of the animal. The temperature of the surface of the eye (TE) was recorded with a Raytek ST remote sensing infra red thermometer and the mean eye and skin (TS) temperature differential (TD) ( $= \text{TE} - \text{TS}$ ) determined for the pilot whales was 5°C, killer whales 7.3°C and beluga 6.5°C. Analysis of the results shows that thermography has the potential to; 1) Allow remote measurement of respiratory frequency in cetacea. 2) The potential to add information to the decision making process as to whether a hunted animal is vital, or if it is dead.

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## EFFECTS OF VISUAL EXPOSURE ON BODY WEIGHT, CHROMODACRYORRHEA SECRETION AND BEHAVIOUR OF LABORATORY RATS



Sylvie Cloutier, Ruth C. Newberry

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Laboratory rats are often housed individually in polypropylene (opaque white) or polycarbonate (clear) cages placed on shelves at varying heights, thus varying in degree of visual exposure. We hypothesised that the welfare of individually housed rats is affected by the degree to which they can see from, and be seen in, their cage. Adult male Sprague-Dawley rats (N=54 cages placed in adjacent pairs with the same visual cover) were randomly assigned to one of three cage cover types: (1) No cover (clear plastic); (2) Solid (clear plastic covered with white cardboard); (3) Partial (clear plastic covered with discontinuous vertical bands of white cardboard), and three shelf heights: (1) Top (143 cm high); (2) Middle (82 cm high); (3) Bottom (21 cm high). Body weight was measured weekly over a 3-week period. Chromodacryorrhea (stress indicator) was recorded following body weight measurement and cage cleaning. Behaviour during a Cat Odour Test (CAT) was measured during week 4. Treatments did not affect body weight ( $P > 0.05$ ). In week 1, rats housed on bottom shelves produced more chromodacryorrhea after cage cleaning than those on middle shelves (GLM,  $F_{2, 18} = 4.43$ ,  $P = 0.03$ ). Rats on bottom shelves in partially covered cages or on top shelves in solidly covered cages produced more chromodacryorrhea following weighing than those housed on top shelves in partially covered cages (GLM,  $F_{4, 18} = 4.25$ ,  $P = 0.01$ ). Rats in clear cages on bottom shelves performed less risk assessment behaviour in the CAT than those on top shelves and those in solid cages on top shelves showed less risk assessment than those on middle shelves ( $F_{4, 18} = 3.91$ ,  $P = 0.02$ ). The results suggest that individually housed rats may be least fearful when provided partial visual cover and located on top or middle shelves, thus providing a good view of the surrounding area while also enabling rats to take cover.

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INTRACRANIAL FAT BODIES AND MOTOR  
INCOORDINATION IN CRESTED DUCKS  
(*ANAS PLATYRHYNCHOS*) - AN ANALYSIS OF  
THEIR RELATIONSHIP AND IMPLICATIONS  
FOR ANIMAL WELFARE



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Crested ducks are widely bred by poultry fanciers and occasionally show behavioural abnormalities such as motor incoordination, resulting in poor welfare for affected individuals. Their crests are formed from fat and connective tissue on the cranium. Occasionally, this tissue invades the brain, forming intracranial fat bodies. With the goal of eliminating incoordination in crested ducks, we aimed to investigate its link with intracranial fat bodies. Brains of 10 crested ducks with fat bodies were compared with those of two uncrested domestic duck breeds without fat bodies (10 Pommeranian, 10 Hochbrutflugenten). Duck brains were dissected, sectioned and stained. We used a new computer program (NucleoScope) to assess body size, brain size, total brain volume and volume of 15 brain structures. The relationship between total brain volume, brain structure volume and body size was described by a regression line. Indices were calculated expressing the distance of data points from this line, and differences between the focus breed and the pooled reference breeds were investigated with t-tests (SigmaStat). Fat bodies of crested ducks varied from 113.48mm<sup>3</sup> to 3891.65mm<sup>3</sup>. Total brain volume of crested ducks was significantly larger ( $t=-3.399$ ,  $P=0.002$ ) but brain volume minus fat body volume, and cerebellum volume, were significantly smaller compared to reference breeds ( $t=2.315$ ,  $P=0.028$  and  $t=2.742$ ,  $P=0.011$ ). Additionally, cerebellum and fat body volume were negatively correlated ( $r=-0.65$ ;  $P=0.039$  Pearson test), showing that fat bodies are associated with a reduced cerebellum. This explains motor deficits in at least some individuals. However, previous work showed that some ducks with fat bodies have no motor deficits, suggesting that something other than cerebellar volume, such as cerebellar structure or fat body topography, is responsible. Tests should be developed to identify individuals with problematic fat bodies early in ontogenesis, and brain anatomy considered in breeding programmes, in order to remove this welfare problem from crested ducks.

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## FAMILIARITY OF THE FEEDER SMELLING DOES NOT IMPROVE POST-WEANING FEEDING BEHAVIOUR IN PIGLETS



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Weaning in piglets is stressful because of changes in rearing and social environments, mother's departure and sudden modification in food composition, presentation and distribution. Since the sense of smell is highly developed in pigs and because chicks increase novel food acceptance when presented in a familiar feeder, we investigated the consequences on weaned piglet behaviour of supplying piglet food either in a new clean feeder or in the same feeder as during suckling. At d15, one feeder was introduced in each farrowing pen of eight (or six) different litters. After weaning at d28, each litter was divided in two homogeneous groups (5-6 piglets/group): standard piglet diet was supplied either in the familiar non-washed feeder used during the suckling period (F: Familiar feeder group) or in a similar but cleaned feeder (C: Control group). Piglet growth, food consumption and piglet behaviour (time spent feeding, lying, lying near the feeder for 12h/day and number of food intake, feeder sniffing and jumping over feeder for 1 h/day) were measured from d27 to d32. Data were analysed using non-parametric tests. Behavioural and animal production data did not differ significantly between groups. However, piglets tended to increase (C:  $P=0.07$ ) or increased significantly (F:  $P<0.05$ ) feeder sniffing occurrences between d27 and d28. F piglets tended to be lying more often near the feeder than C piglets on d32 ( $P=0.1$ ). F piglets decreased significantly jumping over feeder frequencies with time ( $P<0.05$ ) and had a higher mean daily growth rate on d32-36 than on d29-32 ( $P<0.05$ ). Familiarity (F) or novelty (C) of the feeder smell did not affect piglet feeding behaviour. However, treatment induced slight effects on growth rate and development of activities directed to the feeder, suggesting that a controlled and artificial odour sprayed in the suckling and weaning environments could be tested to improve feeding behaviour.

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## DAIRY CATTLE EXPLORATORY AND SOCIAL BEHAVIOUR: A COMPARISON OF CLONED AND CONTROL HEIFERS



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The behaviour of cloned animals is largely overlooked. However, such behavioural studies are of great interest to protect the well-being of cloned animals. The present study aimed at characterizing social behaviour (agonistic and affiliative behaviours, hierarchical index) of cattle in a mixed stable herd composed of 10 same-age heifers, half of them being issued from somatic cell nuclear transfer and the other half, controls, was produced by artificial insemination. Each heifer was observed during three 5-minute periods per day for a total of 960 individual samples. The type of social behaviour and its frequency were recorded as well as the identity of the social partner. We also recorded individual exploratory behaviour and locomotion of heifers isolated in an unfamiliar environment. Social behaviour of cloned and control heifers as well as their behaviour in an unfamiliar environment were compared using the Mann-Whitney U-test. According to their hierarchical index, 3 clones out of 5 were ordered in the first highest ranks and the two remaining in the lowest ranks. The hierarchical index was correlated positively with body mass and age of heifers ( $\rho=0.78$ ,  $\rho=0.84$ ,  $N=10$ ,  $P<0.01$ , respectively). Both cloned and control heifers showed more affiliative behaviour ( $U=698$ ;  $P=0.01$ ) and less agonistic behaviour ( $U=669$ ;  $P<0.01$ ) towards individuals belonging to the same category than towards other class individuals. In a new environment, clones exhibited a similar level of locomotion than did controls but more exploratory behaviour ( $U=2.5$ ;  $P=0.03$ ). According to the limited number of individuals of each category and to the structure of the herd it was not possible to detect any behavioural differences between cloned and control heifers. However our mixed stable herd presented a social organization, based on affiliative interactions, that presents two subgroups of heifers. Welfare consequences of this social organization are discussed as well as possible underlying recognition mechanisms.

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## EFFECTS OF MATERNAL ENVIRONMENT ON MATERNAL BEHAVIOUR AND OFFSPRING FEARFULNESS IN MICE



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Rats adjust their fearfulness in response to environment-induced variations in maternal behaviour. To study the effects of variations in maternal environment on maternal behaviour and offspring fearfulness in mice, we housed pregnant C57BL/6-dams in systems with a nest-cage (NC) and a foraging-cage (FC) connected by a tunnel, with food provided ad libitum in the FC. Dams were randomly assigned to four treatment groups (N=7-8 each) according to a 2x2 factorial design. Treatments differed in presence or absence of a stressor (rat odour; factor 1) and a shelter (Mouse house; factor 2) in the FC, and lasted until postnatal day 14. Then, dams and their litter were kept in standard cages until weaning. Maternal behaviour was scored during postnatal weeks 1 and 2, and fearfulness in offspring was tested on elevated O-mazes when 10 weeks old. Preliminary analyses used Kruskal-Wallis tests followed by post-hoc U-tests. While the presence of the stressor did not affect time spent in the FC, dams without access to a shelter made significantly less excursions in the FC compared to dams with access to a shelter ( $183.4 \pm 10.1$  vs.  $222.6 \pm 12.4$ ;  $U=69$ ,  $N_1=15$ ,  $N_2=16$ ,  $P<0.05$ ). However, dams exposed to rat odour in the FC tended to show a higher total number of licking/grooming episodes across both weeks (mean:  $49.1 \pm 3.0$  vs  $42.0 \pm 3.9$ ;  $U=81$ ,  $N_1=15$ ,  $n_2=16$ ,  $P<0.1$ ), and a higher total number of active nursing episodes in week 2 (mean:  $31.8 \pm 3.7$  vs  $25.4 \pm 2.3$ ;  $U=79$ ,  $N_1=15$ ,  $N_2=16$ ,  $P<0.1$ ), whereas presence or absence of shelter had no effect on maternal care. Offspring of dams exposed to rat odour, who had consequently received more active maternal care, were less fearful, as the percent of time spent in the unprotected sector of the O-maze was higher ( $18.6 \pm 1.6\%$  vs  $14.4 \pm 1.4\%$ ;  $U=215.5$ ,  $N_1=25$ ,  $N_2=26$ ,  $P<0.05$ ). These results provide the first evidence that moderately challenging maternal environments can downregulate fearfulness in offspring, possibly through increased levels of active maternal care.

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## AVERSION TO THE INHALATION OF DIFFERENT GAS MIXTURES TO STUN PIGS



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At concentrations above 30% carbon dioxide by volume in atmospheric air, CO<sub>2</sub> is known to be aversive to pigs. Pigs are routinely stunned using 90% CO<sub>2</sub>. The objective of this study was to assess aversion to the inhalation of 90% argon (AR), 85% nitrogen and 15% CO<sub>2</sub> (85N15C), or 70% nitrogen and 30% CO<sub>2</sub> by volume in atmospheric air (70N30C) using aversion learning tests and behavioural studies to investigate whether these mixtures were less aversive to pigs. 36 slaughter-weight female pigs were exposed to each gas mixture in three separate trials of 12 pigs each, with exposure to the gases for 60, 40 and 30 seconds, respectively. Each pig was allowed to enter the stunning crate and be lowered into a pit with the gas mixture. Each trial consisted of 3-4 training sessions where the pit contained atmospheric air, and 9-12 treatment sessions, where the pit was supplied with the different gas mixtures randomly. The following behavioural parameters were recorded: time to enter the crate, presence and time taken to perform the first retreat attempt, escape attempts, gasping as sign of breathlessness and loss of posture as sign of unconsciousness. Pigs were removed after loss of posture and allowed to recover. Proc MIXED and Proc GENMOD statements of SAS were used for the variable time to cross the raceway and ordinal data, respectively. When exposed to AR the incidence of pigs showing retreat and escape attempts, and gasping was lower ( $P < 0.05$ ) than when exposed to 70N30C and 85N15C. The incidence of animals that lost posture was higher ( $P < 0.05$ ) when pigs were exposed to 70N30C (95%) than 85N15C (72%) and AR (55%). Exposures to gas mixtures with nitrogen and either 15% or 30% CO<sub>2</sub> are more aversive to pigs than 90% argon by volume in atmospheric air.

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## BEHAVIOUR OF BITCHES WHILE NOT NURSING PUPPIES



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In the literature, the study of bitches behaviour is restricted to nursing puppies (i.e. duration of suckling or frequency of urination and defecation stimulation). This work aimed to identify the behaviour of bitches while not nursing and potential differences between them to explain puppies behavioural differences. Five bitches from 5 breeds were videorecorded in our laboratory rearing cage (3.75m<sup>2</sup>) from week 4 to week 7 after birth of their puppies, 5x15 minutes/day (total= 8h45/animal). The collected variables were the Location of the bitch (cage, platform, nest), her Position (sit, stand, lie down), her Activity (active alone or with a pup, inactive alone or with a pup) and Contacts with puppies. The results were expressed in minutes/15 minutes per week ANOVA (F tests) followed by post-hoc analysis (LSD tests). The Situation, Position and Activity variables were considered as repetitions as no week effect was observed. The bitches stayed significantly more in the cage than in the nest or on the platform (respectively 62%, 25%, 13% of time, P<0.001). They were lying down significantly more than standing or sitting (respectively 71.5%, 20%, 8.5% of time, P<0.001). They were significantly more inactive and in contact with one pup (54% of time, P<0.001). A significant interaction was observed (P>0.001) between the bitches and each of the 3 variables indicating that bitches behaved differently. To what concern the Contacts with puppies, differences between bitches (P<0.001) and between weeks (P<0.001) were highlighted but no puppies sex effect (P=0.8). The bitches showed significant individual variability (2.6 min. to 6.7 min./15min with their pups) that could be responsible for behavioural differences in pups but, to our knowledge, this has not yet been demonstrated.

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## EFFECT OF TWO DIFFERENT ROUGHAGE SOURCES ON BEHAVIOUR OF LACTATING DAIRY COWS



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The aim of the study was to compare the behavioural responses of cows fed 2 TMR differing only for sources of roughage: grass hay (H) vs. maize silage (MS). The diets had similar proximate composition (% on DM basis): CP, 15.0; NDF, 36.2 (ADF, 22.4); NSC, 37.3 for H diet and CP, 14.5; NDF, 35.8 (ADF, 21.4); NSC, 38.3 for MS one. Fourteen Holstein cows (28.5±6.4 kg/d milk yield; 21.2±99 DIM) were divided into 2 groups according to a cross over experimental design with 28 d periods. Data collection took place during the last week of each experimental period. Each group of cows was housed in a separate straw-bedded pen and it had free access to 7 weighing manger stations. DMI throughout the period was similar between H and MS (20.3±3.8 vs. 20.0±3.8 kg/d). Behavioural observations were carried out for 24h using an individual scan sampling technique (5 minutes). We observed the following behaviours at each scan: location (in the pen /out at feed stations), position (lying/standing) and activities in which the cow was engaged (TMR eating, ruminating, sleeping, drinking, inactivity). Cows were defined as sleeping when lying with turned head and closed eyes, and inactive when not engaged in any of the listed activities. Data were analyzed with a logistic regression using LOGISTIC procedure of SAS (SAS/STAT, 2002). The probability to find cows in or out of the pen, eating, ruminating or drinking was not related to the diet. H-diet fed cows were more likely to spend time standing (+17.1%, P=0.0013) or sleeping (+22.3%, P=0.02), while they are less likely to be inactive (-17%, P<0.01). It is known that different roughages are able to affect productivity and health status of dairy cows: the present study shows that there could also be an effect of roughage source on their behaviour.

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## AN EXPLORATION OF BEHAVIOUR PROBLEMS IN RACING STANDARDBRED HORSES



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Behaviour problems, such as aggression, avoidance and stereotypies, may be indicative of negative states such as frustration, fear and anxiety. The objectives of this study were to collect data on the prevalence of behaviour problems in Standardbred racehorses and to identify some of the risk factors for these problems. A questionnaire was administered at 14 harness racetracks in Ontario to collect information on stereotypies, aggression and undesirable reactions to common handling procedures. Data on age, gender, and husbandry of horses were gathered. Mixed modeling was used to explore associations between independent variables and the behaviour problems and solutions. Response rate was 70%, with data collected for 1295 horses. The most common problems found in Standardbred racehorses in Ontario were wood-chewing (41.5%) and pawing (44.9%). Biting and kicking were each found to be approximately 10%. Levels of common equine stereotypies were low: 4.1% weaving, 2.9% cribbing and 4.7% boxwalking. Although risk factors varied between behaviours, horse age had a significantly positive relationship (Odds Ratios (OR) 1.06-2.35 per year,  $p < 0.05$ ) with a number of behaviours. Stallions were most likely to show territorial aggression both towards people (OR 2.34, vs. geldings; 2.07 vs. mares,  $P < 0.05$ ) and horses (OR 2.03 vs. geldings,  $P < 0.05$ ) and to bite (OR 3.42 vs. geldings; 2.58 vs. mares,  $P < 0.05$ ). Mares were more likely than geldings to stall kick (OR 1.36,  $P < 0.05$ ) and threaten handlers (OR 1.79,  $P < 0.05$ ). The study is the first to investigate aggression specifically directed towards handlers, and the prevalence of this type of behaviour is notably high. Levels of stereotypies were similar to those found for other stabled performance horses, but were higher than those previously reported for other Standardbred populations.

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## CUMULATIVE EFFECT OF ENVIRONMENTAL ENRICHMENT ON BEHAVIOUR AND PRODUCTIVITY OF DAIRY GOAT KIDS AFTER WEANING



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The objective of this study was to evaluate the cumulative effect of environmental enrichment on behaviour and productive performance of weaned Alpine female kids. Thirty-two female kids were randomly assigned from birth to two treatments (enriched (E) and non-enriched (NE)), with two replicates each (N=8). The enrichments were ears of corn, broccoli, carrots, apples and henequen bags with alfalfa hanging in different areas of the pen; logs and wooden cubes; hemp rope and brushes; coconut shells stuffed with a mixture of minerals, molasses, and corn meal. Scan sampling was used every 5 minutes for 4 hours per day until completion of 150 hours of observations of individual time budgets from weaning (10 kg) until the onset of first estrous. The kids were weighed every 15 days. A complete randomized design and multivariate analyses for repeated measures were used to assess the effect of enrichment on the variables studied. The kids in the enriched group had a lower average frequency of agonistic encounters ( $P<0.01$ ), exploration ( $P=0.05$ ) and tended to spend less time in body care ( $P<0.07$ ) than the non-enriched ones (E:  $21.7\pm 3.01$ ,  $38.7\pm 5.1$  and  $35.1\pm 3.05$ ; NE:  $3.6\pm 3.01$ ,  $4.7\pm 5.1$  and  $17.05\pm 3.05$ , respectively). The difference in weight gain between the two groups was significant ( $P<0.05$ ), the enriched group gained more weight ( $108.8\pm 5.9$  g) than the non-enriched one ( $87.9\pm 5.9$  g). This study suggests that simple and low cost changes for environmental enrichment from birth have significant effects on the behaviour and weight gain of goat kids after weaning. Explorative behaviour of the non-enriched group was directed towards the enclosure, affecting facilities, which can increase costs to the producer. The increase in agonistic encounters in the same group can be an indicator of poor welfare. Increase in weight gain in the enriched group may be decisive factor for adopting this practice.

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## VOCALISATIONS ASSOCIATED WITH FEAR CONDITIONING IN THE DOMESTIC PIG



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This study is part of a project focusing on emotional correlates of pigs' (*Sus scrofa*) distress calls. We hypothesised that a pig's vocalisation indicates the emotional and/or motivational state of the animal. In this particular experiment we measured vocalisations in 10 week-old pigs during a classical conditioning paradigm, where a neutral light stimulus (conditional stimulus, CS) was associated with a following short (500 ms) electric shock (unconditional stimulus, UCS). The anticipation of an aversive event can be regarded as mental stress, in contrast to the physical stress elicited by the UCS, which should result in a different vocalisation. A total of 20 pigs underwent three training sessions comprising five stimulations with CS+UCS (delay: 2 sec), followed by three "trained" sessions, i.e. once CS+UCS and four times CS only. The elicited vocalisations of responses towards both electric shock (UCR) and light after learning (CR) comprised harmonic as well as noisy elements. We distinguished three periods: 1. unanticipated UCS (physical stress), 2. anticipated UCS as indicated by reactions during CS before onset of UCS (physical and mental stress), and 3. anticipation of UCS (mental stress only). Statistical analysis is limited to the harmonic elements of vocalisations of those subjects clearly responding in all periods. They were analysed using a LPC procedure, extracting 12 LPC-coefficients (corresponding to the resonance frequencies of the vocal tract) constituting one LPC-vector per 92.88 ms time window. Calls were classified regarding the period on the basis of these LPC-vectors using a non-parametric discriminant analysis using the k-nearest-neighbour method (k=2) and cross-validation option in SAS. The mean percentage of correct classification of the calls was above 75% for all three periods indicating a reliable differentiation between them. We suggest that the vocalisation elicited during fearful situations differs depending on whether they are caused by mental or physical stimulation.

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## IT IS POSSIBLE TO DEFINE THE AVERSIVENESS THRESHOLD OF STRAY VOLTAGE WHEN ANIMALS ARE ALLOWED TO AVOID IT



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Stray voltage (<10V) caused by a faulty connection between the electrical circuit and the earth can occur in farms and may impair animal welfare. In order to use an appropriate methodology to study its potential aversiveness, we tested if the threshold voltage at which avoidance behaviour starts is different if the animal is given the possibility to avoid it or not. Six-month-old lambs fed *ad-libitum* were trained to eat concentrate from one (N=13) or two metallic feeders (N=13) isolated from the rest of the metallic structure and situated at the end of an experimental corridor. Stray voltage was then applied during a 2min test to either the single feeder (1FEED), or the first feeder in which the lamb started to eat (2FEED) every day, in steps of 0.5V (AC, 50Hz), from 0.5V up to 9V. This allowed the 2FEED lambs to change to the non-electrified feeder if they wanted to. The lamb was earthed via a metal floor-plate. At 5V and upwards, 2FEED lambs spent less time eating in the electrified feeder compared to the non-electrified feeder (respectively 31,1±6,4 and 49,6±5,8 % of time at 5V, Student t-test, P<0.05). In 1FEED lambs, no threshold voltage for the time spent eating or quantity of concentrate eaten was observed. However, more 1FEED lambs urinated during or just after the test than 2FEED lambs (respectively 24 urinations/196 tests (0-9V) vs 6/192, chi-square test, P<0.01). Heart rate was not modified by treatment. Even if 1FEED lambs experienced stray voltage as a stressful event (higher incidence of urination), they continued eating. However, when lambs had the opportunity, they avoided the stray voltage starting at a threshold of 5V. It is possible to obtain a more precise indication of the level of aversiveness of a negative treatment when the opportunity to avoid the stressor is given.

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## SENSORY ECOLOGY AND ANIMAL WELFARE - THE EFFECT OF FLICKER FROM FLUORESCENT LIGHTS ON THE WELFARE OF EUROPEAN STARLINGS



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Animals' sensory capabilities are frequently tuned to the characteristics of the habitats in which they evolved. However, if animals are brought into captivity, the environmental parameters that surround them are changed, often negatively impacting upon their welfare. As a case study, we present a series of experiments examining how the flicker emitted from conventional, low-frequency (LF; which flicker at 100Hz) fluorescent lights affects the welfare of captive European starlings (*Sturnus vulgaris*). We found that starlings show a significant preference for high-frequency (HF; which flicker at 100kHz, a level imperceptible to any animal) over LF fluorescent lights (GLM, using the constant term:  $t_{20}=3.38$ ,  $P=0.001$ ), indicating they can detect a difference between these two lights and find HF light the less aversive condition. Starlings also experience higher incidence of myoclonus (mild muscular spasms) when housed under LF lights (mixed-model ANOVA:  $F_{8, 64}=2.65$ ,  $P=0.014$ ). In addition, short-term exposure to LF light affects both activity and foraging levels (mixed-model ANOVAs:  $F_{8, 64}=2.65$ ,  $P=0.014$ ;  $F_{8, 64}=2.15$ ,  $P=0.043$ ) and physiological indicators of stress (mixed-model ANOVA:  $F_{1, 7}=7.16$ ,  $P=0.032$ ). Long-term exposure also has a significant effect the birds' activity and foraging behaviours (mixed-model ANOVAs:  $F_{8, 104}=2.33$ ,  $P=0.024$ ;  $F_{1, 12}=11.18$ ,  $P=0.006$ ). Further experiments studied the effect of flicker rate on visually mediated tasks. During mate choice, females ranked males consistently under HF (one-sample t-tests:  $t_7=2.88$ ,  $P=0.024$ ), but not under LF conditions ( $t_7=0.21$ ,  $P=0.843$ ). In foraging experiments, birds differed in their foraging habits under the two lighting types, consuming more food under LF light (GLM:  $F_{1, 15}=7.17$ ,  $P=0.017$ ). Together, these experiments indicate that European starlings can detect a difference between HF and LF lights, with LF lights negatively impacting upon the birds' welfare, and significantly affecting their visual discrimination abilities.

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## USING ECOLOGICAL THEORY TO TEST THE NATURE OF INDIVIDUAL TRAITS: IMPACT OF FEARFULNESS ON THE RESPONSES TO PAIN



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Theoreticians hypothesize that individual variation or degree of boldness is vitally important in understanding the different strategies adopted by individuals within populations. Bold individuals are extroverted, and take more risks compared with introverted shy or fearful individuals suggesting the degree of boldness is fixed throughout different contexts. In captivity, individuality results in divergent stress coping styles with selective breeding for bold, low stress responsive individuals yet the welfare consequences of this is unknown. We used current ecological theories to test whether individuality was fixed or plastic depending upon prior experience. Rainbow trout were given emboldening or negative experiences and tested to examine if their response to novel stimuli were altered by winning or losing or by observing bold and shy fish, respectively (N=20). Bold individuals that watched shy demonstrators responding to novel stimuli displayed a more fearful approach to novelty when re-tested. Success and failure in fights significantly decreased fearfulness to novelty in shy subjects. Shy winners and losers decreased their latency to approach a novel object, with winners also making more physical contact with the object. Bold winners remained bold and their behaviours were unchanged whereas bold losers became shyer in response to a novel object. Fearfulness in rainbow trout appears to be context specific and is affected by prior experience and this has implications for selective breeding programmes. To understand the welfare consequences of boldness, bold and shy fish were subject to pain as a cause of poor welfare since fish are subject to invasive procedures during fishing and farming. The noxious stimulation consisted of a subcutaneous injection of 0.3% acetic acid from which fish completely recover within 3 hours. Shy fish took much longer to recover compared with bold fish (N=10). This suggests that shy fish may “suffer” relatively more and is relevant to their wellbeing.

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## IMPROVED HOUSING AFFECTED ACTIVITY IN GOLDEN HAMSTERS



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The potential for improving laboratory animal welfare through modified housing, with consequent scientific implications, has been the subject of recent research. Increasing the depth of bedding has been shown to improve welfare in golden hamsters by reducing stereotypies. However, such changes can influence the activity rhythm. In order to investigate this effect, we allocated a group of forty-five singly housed male golden hamsters (cages: 95x45cm) to three treatment groups of 15 animals each that differed in the depth of their bedding: 10, 40 or 80 cm of raw sawdust. A wooden shelter, carton and wood for gnawing, a sandbath and a running-wheel were also supplied. Light-dark cycle was 12:12h with a twilight period of 30 min each. Dawn began at 0100h, dusk at 1300h. Magnetic diodes connected with a computer program (The Chronobiology Kit, Stanford Software Syst.) recorded wheel-running activity continuously. The hamsters in the lowest bedding group (10 cm) synchronised well with lights-off, i.e. activity onset was shortly after lights-off. This synchronisation decreased with increasing bedding depth. Taus (measure for rhythm length) between the groups were significantly different (10 cm:  $23.99 \pm 0.065h$ , 40 cm:  $24.07 \pm 0.067h$ , 80 cm:  $24.55h \pm 0.079$ ; Fisher's Exact Test:  $N = 44$ ,  $P = 0.0223$ ) and correlated negatively with wheel running activity (Spearman Correlation:  $r_s = -0.328$ ,  $P < 0.005$ ). Synchronisation of the daily activity onset with lights-off is usually found in golden hamsters under normal light-dark conditions. In our data the activity rhythms of the non-synchronised hamsters resembled free-running rhythms, which occur usually under constant dark conditions or when the photic zeitgeber is not strong enough to entrain the rhythm. The effects of these improved welfare conditions on chronobiology have to be considered when comparing earlier studies on golden hamsters. The correlation between running-wheel activity and other activities under these housing conditions is being examined.

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## LIGHT TYPE PREFERENCES IN LAYING HENS



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Natural light is compulsory in organic egg production during the laying period but not during rearing. The effect of early exposure to natural light may have an effect on the later light type preference and on the behaviour of the birds after being transferred to the laying facilities. The aim of this experiment was to study the light type preference in laying hens reared in either artificial (incandescent) or natural light. 126 newly hatched LSL-chicks were divided into 3 light treatments (in total 18 pens): 8 hours artificial light + 16 hours dark (A8), 16 hours artificial light + 8 hours dark (A16) and 8 hours natural light + 16 hours dark (N8). At 14 weeks of age, the birds' light type preference was tested on a group level by connecting two previously unfamiliar pens with a tunnel. Temperature within the connected pens was equal during the testing. Birds were video recorded for 4 hours before reversing the sides of light types and recording for another 4 hours. Data were scored using scan sampling (5-min interval) and it was analysed using ANOVA. A8- and A16-chicks spent higher proportion of their time in artificial light than N8-chicks [A8:  $73.6 \pm 7.4$  %, A16:  $87.8 \pm 1.8$  %, N8:  $55.2 \pm 10.1$  %,  $P=0.096$  (A8 vs. N8),  $P=0.007$  (A16 vs. N8),  $P=0.191$  (A8 vs. A16)]. The light type during rearing appears to influence chicks' later light type preferences. These results suggest that chicks for organic egg production (where they will have access to natural light) should be reared with access to natural light, but there is a need for longer-term studies. The results may also imply that birds reared with access to natural light are more adaptable to a changing light environment.

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**SUPPLEMENTATION WITH FLAKED MAIZE  
DURING LATE GESTATION AND  
RECOGNITION OF THE KID AT 4 H  
POSTPARTUM IN GOATS GRAZING UNDER  
EXTENSIVE CONDITIONS**



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The objective of the present study was to determine if feed supplementation during late pregnancy can facilitate the early recognition of kids by their mothers in goats maintained under extensive conditions. A Control group of 12 pregnant mixed-breed goats were maintained under traditional extensive management, where the animals grazed the available natural vegetation. Another group of 18 pregnant goats (Supplemented mothers) were managed in the same conditions as above, but 12 days before the mean expected date of delivery, females of this group were supplemented daily with 0.6 kg of flaked maize/mother. At 4h postpartum the ability of the mothers to recognize their kid without the help of olfactory cues was assessed during 5 min in a two-choice test between their own and an alien kid of approximately the same age. Perception of olfactory cues was prevented by preventing the mothers approaching their kids closer than 1 m. Control mothers did not spend more time near their own kid than the alien kid ( $75 \pm 15$  s vs  $50 \pm 14$  s; Paired t test,  $P>0.05$ ) whereas Supplemented mothers did ( $93 \pm 16$  s vs  $39 \pm 10$  s;  $P<0.05$ ). Nonetheless, the differences between the two groups in the time mothers spent either near their own kid or near the alien kid, did not reach significance (Independent t test;  $P>0.05$ ). These results suggest that supplementation with maize for a few days before parturition might improve the recognition of the kids by their mother. Given the relation between recognition and neonate survival existing in sheep, the consequences of supplementation on kid mortality would be worth investigating. With support of Fernando JA Medrano, Intervet Mexico.

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## DOES PUNISHMENT WORK? RIDER RESPONSES AND BEHAVIOUR PROBLEMS IN RIDDEN HORSES



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Traditional horse training is largely based on negative reinforcement, together with positive reinforcement to reward desired responses and punishment to discourage undesired responses. Riding instructors rarely highlight the importance of continuity, contiguity or schedules of reinforcement and riders may fail to apply the principles of learning adequately. The resulting frustration may lead to harsh application of rider aids, leading to poor physical and psychological welfare in ridden horses and the development of behaviour problems. We tested the relationship between behavioural problems in horses whilst ridden and rider tendency to use positive reinforcement of desired behaviour and punishment of undesired behaviour. Using self-report via an Internet survey, we asked riders to describe their response last time their horse displayed behaviour described in eight common riding scenarios: four where the horse made efforts to respond to accepted norms of behaviour, and four where the horse responded inappropriately. Rider responses across the four scenarios were coded into an overall score of probability of responding with punishment through neutral to positive reinforcement. An index of ridden behaviour problems was made from the sum of self-reported frequency of common behaviour problems in the last week that the horse was ridden. There was no correlation between the probability of using punishment for undesired behaviour and ridden behaviour problems. However, there were fewer ridden behaviour problems in horses with riders who described a higher probability of using positive reinforcement of desired behaviour (Spearman's  $r=-0.232$ ,  $N=93$ ,  $P=0.026$ ). The correlation was not explained by overall consistency of the riders approach in reinforcing desired behaviour and punishing undesired behaviour. But there was an effect of overall probability of using positive reinforcement, even of undesired behaviour (Spearman's  $r=-0.211$ ,  $N=103$ ,  $P=0.033$ ). These data may suggest positive reinforcement is a more effective method of training horses than punishment.

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## SOCIAL INTERACTIONS AND SOCIAL HIERARCHY IN A DAIRY HERD



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The bovine's social interactions can be divided into agonistic and non-agonistic behaviours. Agonistic interactions are expressed on the dispute for social dominance. Non-agonistic interactions are more frequent in stable herds and can serve to enforce the social bonds. The objective of this study was to investigate the relationship between social interactions with contact, e.g. licking and grooming behaviour, or those considered agonistic. We studied a Holstein dairy herd with 10 dry and 6 lactating cows at the Training Centre of EPAGRI - SC/ Brazil. The herd is managed by the Voisin's Rational Grazing System with a supplementary feeding after the evening milking. Animals were identified by the ring and coat. The observations were made during 8 days, in an 8 h day period. With 15 minutes interval, we observed all the social interactions with contact during 10 minutes, identifying the actor and receiver of the action. The social hierarchy was determined through a social matrix that considered all the events when an animal instigated or received aggression. Correlation analyses were made between the Dominance Value of each cow and the frequency of the receiver and actor of all social interactions. There was no correlation between Dominance Value and grooming and licking behaviours ( $P > 0.3$ ). There was also no correlation between being the actor and receiver of grooming ( $P = 0.91$ ) or licking ( $P = 0.26$ ). There was a significant correlation between Dominance Value and frequency of instigation of aggression ( $r = 0.57$ ;  $P < 0.02$ ), but not between Dominance Value and number of aggressions received ( $r = -0.43$ ;  $P = 0.1$ ). In conclusion, non-agonistic interactions with contact were not influenced by the social status within the group.

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## ADAPTATION TO AUTOMATIC MILKING WITHIN EXTENSIVE GRAZING SYSTEMS



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A research program, the Greenfield Project, was established to investigate the viability of automatic milking technology for New Zealand's extensive dairy farm systems which are typified by all-year pasture grazing, zero housing and minimal concentrate feeding. In this study the effect of two levels of training on the behavioural adaptation of 2-year old primiparous (P, N=29) and mixed-age multiparous (M, N=37) Friesian cows to the farm which incorporated a system for remotely selecting cows for milking, was examined. Prior to calving animals received no training (NIL), some training in the AMS and on the farm (MINIMAL), or more extensive training including the exposure to typical noises and sounds of the AMS as well as the on the farm training (EXTRA). Training was carried out progressively over four sessions on non-consecutive days at least 15 days prior to calving. The effect of the pre-calving training was assessed after calving by measuring the ease of entry into the AMS unit (Entry-Time), the time before cows voluntarily visited the pre-selection unit (Time-to-SU) and days before achieving their first voluntary milking (Time-to-AMS). Data was analysed using ANOVA. Training improved Entry-time at first milking (NIL = 17.9s, MINIMAL = 1.4s, EXTRA = 6.7s, SED = 5.24, P=0.002). Primiparous animals learned to use the selection units (P = 39.4h, M = 63.4h, P=0.005) and achieved their first voluntary milking (P=3.9, M=6.9 days, P<0.001) quicker than multiparous cows. Ninety-two percent of primiparous animals achieved a voluntary milking 5 days after calving, compared to 52% of multiparous animals. The training improved aspects of the behaviour required for successful adaptation to automatic milking but had little impact on time to achieve a voluntary milking. Primiparous animals adapted to automatic milking in a pastoral farming environment quicker than multiparous cows.

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## THE EFFECT OF BROODY HENS ON CHICKS' ACTIVITY CYCLES AND SYNCHRONY



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The aim of the present study was to investigate the effect of broody hens on chicks' activity cycles and synchrony, with the prediction that the presence of broody hens would increase the chicks' synchronization of activity. Twelve groups of 10 layer hen chicks (Lohmann Tradition) were reared in pens (2.55 m<sup>2</sup>); six pens were provided with a broody hen and six pens with heating-lamps. Day length was kept constant at 12 hours (0700-1900 h). The duration of active and inactive behaviour was recorded. A focal animal from one pen from each of the two treatments was observed continuously for 4 hours when the chicks were 1, 3, 7, 9, 14 and 16 days old. The focal animal sampling was briefly interrupted at 5 min intervals by a scan sample of the activity of all the chicks in the pen. The duration of the active phases of the brooded chicks was four times as long as for the non-brooded chicks (treatment  $P < 0.0001$ ; age  $P = 0.09$ ), and the inactive phases were three times as long for the brooded chicks as for the non-brooded chicks (treatment  $P < 0.0001$ ; age  $P = 0.14$ ). There was no difference between the two treatment groups in the proportion of time spent active to the total time budget ( $P = 0.23$ ). The activity of brooded chicks was found to be significantly more synchronized than that of non-brooded chicks ( $P < 0.0001$ ). In conclusion, the broody hens resulted in an increased synchrony of activity among the chicks and in an approach of the chicks' activity cycles to the brooding cycles found by other scientists in more natural environments. Previous work has shown that inactive chicks are more often the target of severe feather pecking than active chicks. Synchronizing activity in groups of chicks is consequently assumed to reduce severe feather pecking.

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## AMBULATORY TOOL FOR CARDIAC ACTIVITY MEASUREMENTS IN ANIMAL RESEARCH



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Both behavioural and physiological reactivity are often studied when assessing the welfare status of an individual animal. In certain situations, heart rate (HR) and heart rate variability (HRV) are used as potential indicators of stress. However, the majority of devices used for heart rate recording are originally designed for human sports purposes, often with limitations in terms of use on animals (presence of wires, loss of signals, small data storage capacity). Recently, a cardiac activity (ECG) measuring device, "Black-box" (BB), has been developed with the possibility for long-term recordings (24 hours). The Black-box registers ECG-data on a memory card from which data can be transferred to a computer. Software can detect R-peaks, perform motion analysis and detect artefacts. To test the device, cow behaviour was recorded simultaneously and the results were analysed in relation to the ECG-data. Preliminary data on testing the device with 20 milkings is presented. The quality of ECG-data was controlled by processing the whole recorded data by using the r-r-analysis software. With this software the whole cardiac activity (ECG-curve, heart rate) from each milking was followed beat by beat, and r-peaks were detected. By using this software, the artefacts were detected and removed. It was shown that the new Black Box, ECG-device is able to register cardiac activity on animals and ensures high quality of heart rate data required for research purposes. The software was able to detect r-peaks, and subsequent analysis of heart rate data.

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## EXPOSURE OF CALVES TO NOISE IN DAIRY FARMS



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In Northern Europe, calves are usually housed in same stalls as dairy cows. Noise levels in modern highly automated stalls are increasing, which may be a risk to animals' welfare. Young calves rest for 70-80 % of their time. Noise may affect sleep and increase nervousness and inappetance. Scientific knowledge and Finnish legislation suggest that farm animals should not be exposed continuously to noise over 65 dBA. We measured the noise exposure of 1-3 months old dairy calves at modern production environments. The study was conducted in ten randomly selected free stalls of 40 to 80 cows. A calibrated microphone noise analyser was installed into a calf pen at 90 cm height. Exposure to noise was measured periodically (1s, 10s, 1min, 10min) by using the third bands (20 Hz - 20 kHz). Results were weighted both on the basis of cattle's audio frequency (LC) and human's audio frequency (LH). The occurrence of high frequency sounds (>20 kHz) were also studied. Most parts of noise bouts lasting ten seconds were between 60 - 65 dBA. The average background noise levels were 62.1 dBLH and 58.7 dBLC. The levels were 59.3 dBLH and 56.5 dBLC for ventilation, 87.3 dBLH and 80.8 dBLC for feeding, 61.4 dBLH and 62.4 dBLC for milking, and 59,0 dBLH and 58,0 dBLC for manure removal. At high frequencies (2 - 10 kHz) LH gives lower sound level compared to LC. Calves were exposed to noise of over 65 dBA for 30 % of the day. The spectra of sounds decreased sharply close in high frequencies. Noise level in calf pens was so high that noise control should be put into action. The occurrence of high frequency noise was rare in the stalls.

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## KEEPING CHILDREN SAFE: HOW RELIABLE ARE CHILDREN AT INTERPRETING DOG BEHAVIOUR?



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There is little rigorous research relating to why children are more likely to be bitten by dogs and on how the situation differs between countries. This study investigates if there are differences between the way children of different age groups and countries interpret dog behaviour. The study was carried out in public nurseries and primary schools the UK, Italy and Spain and involved 430 children of the following ages: 4, 6, 8, 10 years old. Each child was shown 12 short video clips of dogs performing normal behaviours (e.g. greeting, fear) and asked how the dog was feeling (i.e. happy, sad, scared, angry) and to explain what led them to think that the dog was feeling that way (e.g. body actions, behaviours). Parents were asked to fill in a form which included questions on whether the child had been bitten by a dog in the past. Approximately 10% of the children had been bitten by a dog out of which 50% were between the ages of 3 and 5 years old, 15% below 2 years old and 33% between 6 and 9 years old. Irrespective of nationality, children under 4 years of age were found to be less good at interpreting the behaviour of the dog than the other age groups (chi-square =137.829, df=6,  $P<0.001$ ) especially friendly (chi-square =47.449, df=3,  $P<0.001$ ) and fearful (chi-square =31.174, df=3,  $P<0.001$ ) dogs. They looked more at the face of the dog to make their decisions and less at the movements and postures. Because the body language of dogs is not the same as humans, by looking more at the dogs' facial expression young children may be more at risk from misinterpreting a dog's intent and so getting bitten. This suggests that younger children may require dog behaviour awareness training in order to ensure that they are kept safe.

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## HORSE'S TEMPERAMENT AND SUITABILITY FOR RIDING ACTIVITY CAN BE PREDICTED FROM 8 MONTHS OF AGE



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This study investigated the predictability from a young age, of the adult horse's temperament and its suitability for riding. This study was conducted with 110 horses regularly tested from birth to 2.5 years of age. The first aim was to examine if fearfulness, social motivation, responsiveness to humans and locomotor activity can be considered as temperament traits in horses. For each of these potential traits, we developed several standardised behavioural tests involving novelty, suddenness, human presence, and presence or absence of conspecifics. The results show that within traits, the responses to tests developed to characterise that trait were well correlated (suggesting stability across situations), and were correlated over time from weaning (8 months of age) to 2.5 years of age, but not from birth. For example, the frequency of neighing recorded when the horse was alone (a situation developed to characterise social motivation) was significantly correlated between 8 months and 2.5 years (Spearman correlation:  $R=0.61$ ;  $P<0.01$ ). We concluded that fearfulness, social motivation, responsiveness to humans and locomotor activity can be considered as traits of temperament, and can be predicted from weaning. The second aim was to identify the relationship between these four temperament traits and the horse's suitability for leisure or sport. At 3 years of age, the horses were broken in to score the ease with which they could be handled and led outside (important for leisure activities), as well as their performance during lunging and a jumping test (important for sport activities). Results show that the horses which seemed more suitable for leisure activity had previously been found to show low levels of fear, of reactivity towards humans and of social motivation. The horses best suited for sport activity had been found to be more fearful, to have a high reactivity towards humans and a high social motivation.

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## COMPARISON OF METHODOLOGIES TO MEASURE FEAR OF HUMANS IN SOWS



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Interactions between animals and their carers can influence both welfare and productivity. The aim of this study was to evaluate 3 different methods of determining the level of fearfulness of people in sows under commercial conditions. 55 sows and gilts, housed in pens in groups of 4/5 of different parities, were each subject to 3 tests: A: an approach and contact test on sows in stalls; B: an open field test with a stationary human; and C: response of a free-moving sow to approach and contact from a human whilst in a group of familiar sows. Each test was repeated after a period of no more than 1 week and the sows' reactions scored according to a pre-determined scale (0-6, where 0= high fear, sows showed extreme avoidance of the observer and 6= low fear, sows showed no withdrawal response to the observer). Median (IQ range) values were: A= 5.0 (4.5-6.0), B= 4.0 (3.5-5.0), C= 5.0 (4.0-5.5). A Kendall coefficient of concordance suggested no significant relationship between the three tests ( $W=0.507$ ,  $P>0.05$ ). Rank correlations showed a significant relationship between tests A and B ( $r=0.270$ ,  $P<0.05$ ), a stronger correlation between tests A and C ( $r=0.404$ ,  $P<0.01$ ), but no significant correlation between tests B and C ( $r=0.198$ ,  $P>0.05$ ). The order in which the tests were given to the sows had no significant effect on scores for any of the tests (Kruskal-Wallis test,  $P>0.05$ ). The repeatability of tests A and C was high, as shown by rank correlations (A:  $r=0.777$ , C:  $r=0.628$ ;  $P<0.001$ ), whereas test B had poor repeatability ( $r=0.153$ ,  $P>0.05$ ). In conclusion, tests A and C were significantly related, which may be due to their similar methods since both involved actively initiating contact with the sows, and were repeatable, suggesting they are a reliable on-farm indicator of fear in sows.

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## AVOIDANCE TOWARDS HUMANS IN TWO GENETIC POPULATIONS OF PHEASANTS



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We studied whether there was genetic variability in criteria used to test bird's tendency to escape from humans. Young pheasants (N=75) from a genetic line C bred for numerous generations in aviary were compared with young pheasants (N=75) considered as "wild type" WT (originating from a wild population maintained in an aviary for one generation only and with no reintroductions for several decades). Animals were bred together from one-day old until 10 weeks of age. The first tests (test 1 and 2) were conducted on day 7 and 14 (D7 and D14 respectively) and consisted of taking the animals out of their breeding room and quantifying their reactions when they were replaced individually in this room in the presence of a man. On D35 (test 3), D42 (test 4), and D65 (test 5), animals were placed individually in a dark box and their reactions observed after they were pushed outside the box by the animal keeper (test 3) or an unknown man (tests 4 and 5). The birds escaped in a wide corridor. The behavioural patterns used to escape and bird location in the corridor were quantified. During the tests 1 and 2, WT pheasants did not go far away from the place they were put, whereas C birds walked and vocalized more than C birds. During the corridor tests (tests 3, 4, and 5), bird-human distance was larger in WT pheasants than in C pheasants. WT birds flew away more often than C birds. The latter stayed on the ground when escaping. The bird-human distance increased from test 3 to test 5 in both groups. This comparison suggests that variability in these behavioural parameters is at least partly controlled by genetic factors. This variability could be used to investigate the ontogenesis of avoidance reaction towards humans in birds.

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## EATING SEQUENCES OF GESTATING SOWS IN GROUP HOUSING WITH ELECTRONIC SOW FEEDERS



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Electronic sow feeders (ESF), a sequential feeding system, have been used in group housing of gestating sows to control individual intake and aggression during feeding. However, the effect of sequential feeding on sow eating behaviour is not clear. An experiment was carried out to study the feeding order of gestating sows in group housing with ESF. A total of 146 sows in parity 1 to 6 were studied in seven static groups. Each of the three pens used was equipped with an ESF and accommodated  $36 \pm 2.1$  (SD) sows. Space allowance was 2.1 m<sup>2</sup> per sow. Sows from two breeding groups were simultaneously moved into each pen, one group at 5 d (pre-implantation) and another at 40 d (post implantation) post breeding. All sows were limited fed according to their nutritional requirements. Feeding cycle started at 3 pm daily. Feeding order was recorded at d 3 and d 56 (wk 8) post mixing by the computer which controlled the feeding system. Weight gain during gestation and farrowing data (total born, live born, dead born) were collected. The results showed that 90% of sows entered ESF and ate their ration voluntarily on d 3 post mixing. Pre-implantation sows ate earlier than post-implantation (Chi-square = 11.68,  $P=0.01$ ), and mature sows (parities 3 to 6) ate before sows in parity 1 and 2 (Chi-square = 43.4,  $P<0.0001$ ) in feeding order. Feeding order on d 3 was positively correlated with feeding order during wk 8 ( $R^2 = 0.87$ ,  $P<0.0001$ ), indicating that feeding order established on d 3 were maintained in the late stage of gestation. Farrowing performance and weight gain during gestation were not correlated with feeding order. These results suggest that gestating sows adapt to sequential feeding systems by establishing and maintaining a feeding order.

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## CAN ENVIRONMENTAL ENRICHMENT HELP DETECT WELFARE AND ONSET OF DISEASE IN MICE?



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Genetically modified mice often develop disorders causing suffering and the modification process itself might compromise welfare: routine health and welfare assessment is essential. This typically requires intensive tests (e.g. SHIRPA) and detection of obvious clinical signs such as weight loss. We aimed to develop less intensive and invasive methods of detecting behavioural changes occurring before these clinical signs to allow the development and use of earlier humane endpoints. We proposed that mice would show less 'risky', 'luxury' and demanding behaviour as the first detectable sign of disease onset. Genetically modified R6/1 HD (Huntington's Disease) mice and wild-type controls were housed in pairs of the same genotype in conventional cages, or enriched cages allowing climbing, exploration and object manipulation. Behaviour was monitored by direct and video observation. Feed and water intake, health, and specific disease indicators, were assessed daily and mice were SHIRPA-tested twice weekly. Preliminary results revealed limb claspings (indicating disease onset) first appeared at 11 weeks of age. In SHIRPA tests, all mice became less active over time but wild-type mice remained more active than HD mice (most common activity score was 3 for all 10 week-old mice, and 0 (HD) and 2 (wild-types) at 20 weeks. Ability to manoeuvre and balance on a rod and climb up a vertical grid declined over time in all mice but to a greater extent in HD mice after limb claspings developed. In home cages, all mice initially used all enrichment devices but use of some devices apparently reduced with disease onset, eg beam running was seen in 10% of observations before the onset of limb claspings in HD mice and 1% afterwards. Wild-type but not HD mice showed a consistent change in sleeping location with time. The degree to which specific behavioural changes in enriched and conventional cages reliably preceded clinical disease is being examined using appropriate longitudinal statistics.

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## HORSE PERSONALITIES DIFFER BETWEEN BREEDS



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Recent research has demonstrated the existence of equine personality and our ability to assess it. Anecdotal evidence suggests that equines exhibit breed typical personalities and that personality characteristics differ between breeds. The present study formed part of a larger research project and aimed to explore personality differences between equine breeds. Horse owners completed a Horse Personality Questionnaire (HPQ) on their pure bred horses and ponies. The HPQ comprised 25 behaviourally defined adjectives (BDAs) rated on a scale of one (no expression) to seven (extreme expression). Questionnaires were completed for 150 Irish Draughts (IDs), 155 Shetlands, 279 Thoroughbreds (TBs), and 273 Arabs resulting in 857 questionnaires in total. BDA scores for each breed were analysed. Kruskal Wallis tests showed significant differences between all four breeds for all 25 BDAs ( $P < 0.02$ ). Post hoc Mann-Whitney-U tests identified significant differences between each of the six breed pairs. Of the 150 Mann-Whitney-U tests, 115 were significant ( $P < 0.04$ ). For example, IDs and Arabs were significantly different for 19 of the 25 BDAs ( $Z = -17.291$ ,  $P < 0.001$ , to  $Z = -2.399$ ,  $P = 0.016$ ). The BDAs that were not significantly different were curious, effective, insecure, opportunistic, playful and popular. The results indicate the existence of breed typical personalities and that there is variation between breeds but not across all BDAs. In the example provided, it is inferred that the two breeds are similarly curious, insecure, etc. and yet scores on the other 19 BDAs are significantly different. Knowledge and understanding of personality differences between equine breeds is of great interest to horse owners and has potential to be utilized by the equine industry.

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## TRAINING AND TIMING – HOW TO FACILITATE THE DAILY INSPECTION OF EXTENSIVELY KEPT CATTLE



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Increased interest and understanding for nature in combination with increased demand for ecological meat has contributed to many producers in Sweden choosing to keep their animals under extensive conditions. According to Swedish animal welfare legislation, animals should be inspected daily and more often when sick or close to calving. However, it may be difficult to find the animals and, even when found, it may be difficult to carry out satisfactory inspections of body condition and check them for injury or disease. To investigate if training and/or the timing can facilitate inspection of extensively kept animals, two experiments with 14 groups of cattle were completed on five farms. Factors investigated were provision of concentrate, time of day and regularity of routines. Time to find the animals, how close they came, time to approach within 10 m and if they allowed the experimenter to touch them, were recorded. The results showed that if the experimenter brought concentrate, more animals came towards them (77.5% vs 31.2% of occasions, ANOVA on ranks,  $P < 0.05$ ) and the time until all animals approach within 10 m was reduced ( $11.0 \pm 1.2$  min vs  $3.6 \pm 1.2$  min, ANOVA on ranks,  $P < 0.05$ ). For the two regular treatments, the larger the group size the longer time it took to approach (linear regression, with concentrate  $P = 0.028$ , without concentrate  $P = 0.01$ ). Regular routines also had an effect as the only treatment that gave a significant learning effect over time was when the experimenter brought concentrate and inspected the animals at the same time every day (the time for animals to approach decreased over the test period, regression analysis,  $P = 0.005$ ). This shows that by simple methods, the daily inspections of animals kept under extensive conditions, such as in nature reserves or on ranches, can be improved.

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## CORRELATIONS BETWEEN COW BEHAVIOUR, HEALTH AND PRODUCTION AND AN ANIMAL NEEDS INDEX (ANI 35L FOR CATTLE) IN FINNISH DAIRY HERDS



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An Animal Needs Index (ANI) has been proposed as a tool for on-farm animal welfare assessment. However, ANI concentrates on assessing features of the animals' environment and management, which does not warrant that ANI measures actual animal welfare. Therefore, validation of ANI with animal-based measurements of welfare is needed. We compared ANI assessment with some animal-based indices of cow welfare in Finnish dairy herds. Adequacy of production environment was assessed with ANI 35L/2000 on 38 dairy farms with insulated free-stall barns of 28-96 (mean 51) milking cows in January-April 2005. Cow behaviour was observed for three hours (total observation time, continuous behaviour sampling), and injuries and cleanliness of a random sample of cows (N=10/farm) was inspected on the farms during a two-day visit. At least 80% of the milking herd was gait scored to evaluate lameness prevalence. Production data was collected from the national milk and health recording database for the year 2004. Correlations between farms' total ANI-scores and animal-based parameters were analysed with Spearman's Rank Correlations test. Herd means of production parameters (annual milk production per cow, calving interval, parity) did not correlate with ANI-score (correlation coefficients between -0.28 and 0.19,  $P>0.05$ ). ANI-score correlated with an abnormal behaviour index (based on the sum of observed frequencies of tongue-rolling, bar-biting, licking objects, dog-sitting, leaning and inter-sucking:  $r_s=-0.48$ ,  $P=0.002$ ), prevalence of severe lameness ( $r_s=-0.37$ ,  $P=0.023$ ) and proportion of abnormal lying-down movements ( $r_s=-0.40$ ,  $P=0.012$ ). Proportion of abnormal rising movements, cow dirtiness and prevalence of skin lesions or swelling in hocks and knees did not correlate with ANI-score (correlation coefficients between -0.19 and 0.25,  $P>0.1$ ). Only a few animal-based parameters correlated significantly with total ANI-score, indicating that direct animal observations should not be excluded from on-farm welfare assessment. Nevertheless, a relatively short observation time might be sufficient for detecting behavioural disturbances at herd level.

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## CROSS-MODAL HABITUATION-DISHABITUATION TEST OF INDIVIDUAL RECOGNITION IN PIGS



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We investigated the ability of pigs to recognize individual conspecifics using a cross-modal habituation-dishabituation paradigm. Pigs are able to discriminate individuals using olfactory, auditory or visual cues; and therefore may hold multimodal representations of individuals and may attribute the same meaning to cues in different sensory modalities from the same familiar individual. We hypothesized that familiar pigs show continuation of the habituation response (cross-habituation) from one cue to another from the same individual in a different modality. Cross-modal representation of an individual has not been demonstrated in any non-human animal. In a series of 2-min exposures, the visual attention to a stimulus pig was measured as time spent looking through a narrow viewing slit. Auditory cues were masked with recorded pig vocalisations and the experimental chambers were pressurised to prevent olfactory exchange. Five visual exposures to the same familiar (F) or unfamiliar (U) individual were followed by a single, 2-min exposure to olfactory cues only from either the same pig (SF, SU), or a different pig, a familiar littermate (DF). Cross-habituation was expected for the same pig, but only if it was familiar (SF); hence the controls for familiarity (SU) and identity (DF). Unexpectedly, pigs habituated to visual cues from unfamiliar pigs (SU) and familiar pigs (SF, DF) at a similar rate (ANOVA;  $P=0.378$ ). Also, there was no significant dishabituation to the two controls, olfactory cues from an unfamiliar (SU) or different individual (DF), relative to the attention shown to olfactory cues from the same familiar individual (SF) (ANOVA;  $P=0.858$ ). Failure to demonstrate a capacity for individual recognition may have been due to the methodological approach; alternative social discrimination tests could prove more appropriate to the pig.

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## THE EFFECT OF INTER-ZOO TRANSPORTATION ON REPRODUCTIVE SUCCESS OF THREE FELID SPECIES



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Zoos maintain endangered felids as part of captive breeding programs which aim to preserve the genetic integrity of each species. However the welfare status of these animals and the efficacy of breeding programs have been questioned. This study examined the impact of transporting three felid species (Amur leopards *Panthera pardus orientalis*, Amur tigers *P. tigris altaica* and Sumatran tigers *P. t. sumatrae*) on reproductive success. Transportation is a stressor, it often involves sedation and may occur repeatedly during an individual's lifetime. By comparison, dispersal of wild felids to new territories occurs within a specific age range. Movement of individuals outside the natural temporal span may disrupt normal behavioural development as well as social and reproductive behaviour. Life history data were analysed for each species. Of the 110, 76 and 56 recommended pairings, 34, 26 and 30% failed to result in births for Amur tigers, Sumatran tigers and Amur leopards respectively, with 56, 66 and 68% of pairings failing to produce cubs that reached their first birthday. The number of transports experienced did not affect the number of cubs born in the subsequent breeding attempt in any species. However in Amur tigers, the age at transport of both the sire and the dam was correlated with number of offspring produced (DAM Spearman  $r_s = -0.28$   $N=77$   $P<0.014$ ; SIRE  $r_s = -0.27$   $N=85$   $P<0.011$ ). These results suggest transportation and associated stress does not necessarily affect reproductive success in big cats though age at first transport can. However, success rates could be improved. Disparity between the numbers of offspring produced and the number surviving to one year indicate that post-natal factors may have a large effect on welfare and reproductive success in these species. This will be the focus of future studies.

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APPLYING FUNDAMENTAL ETHOLOGICAL  
RESEARCH: STUDYING PREDATOR-PREY  
INTERACTIONS TO IMPROVE PREDICTIONS  
IN ESTUARINE CONSERVATION



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The Individual Behaviour Based Model of estuarine ecology that has been developed based on long term field data, using Oystercatchers (*Haematopus ostralegus*) as a model species is successful in predicting the impacts of environmental changes. At its heart is a food depletion model which assumes that consumers will tend to starve in highly depleted areas and seasons. Since Oystercatchers selectively remove thin shelled mussels (*Mytilus edulis*), starvation risk is expected to rise as feeding conditions deteriorate across the season. We assessed the prey selection strategies of Oystercatchers across the season by observing the foraging behaviour and collecting opened and live comparator mussels of different length classes (30-40mm, 40-50mm and 50-60mm). Multiple regression with higher order terms showed that the birds took large mussels in the beginning of winter but started to accept smaller mussels after October. Surprisingly, they started to select larger mussels again towards end of the winter. In parallel, mussel shell thickness increased at the beginning of the winter, attained a peak around the winter solstice, and then started to decline. We measured mussel shell strength by the number of blows required to crack the mussels using artificial Oystercatcher bill. Strength varies in relation to ventral thickness, length and width; however with these variables taken into account, shell strength still declined to a minimum around the winter solstice, and then slowly increased over the rest of the winter. So mussels are structurally dynamic with both shell thinning and thickening taking place. The net result is that despite the selective removal of thinner-shelled mussels by Oystercatchers, the density of prey available to them increases towards the end of winter. The shell thinning and weakening are probably due to reduced estuarine salinity and temperature. So including changes in these variables in the estuarine ecology model would improve its predictive power.

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PLUMAGE COLOUR AND FEATHER  
PECKING - BEHAVIOURAL DIFFERENCES  
ASSOCIATED WITH PMEL17 GENOTYPES  
IN CHICKEN (*GALLUS GALLUS*)



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Earlier studies suggest that a dominant mutation in the plumage colour gene PMEL17, causing a white phenotype (I/I) in the mutant, protects against victimization to feather pecking. F4 parents of a cross between red junglefowl and White Leghorn were genotyped and used to produce PMEL17 homozygous offspring (i/i, N=30 and I/I, N=30 respectively). Birds were raised in pens (1.2 bird per m<sup>2</sup>) and their behaviour recorded from 6 to 23 weeks of age in groups of either two dark coloured i/i (wild-type, N=10) and one white I/I, or two I/I and one i/i (N=10). In addition each female bird (N=33) was tested for feather preference, reaction to novelty, open-field activity, fear of humans, and tonic immobility. In the home-pens, i/i birds within the group were more feather pecked (Wilcoxon's match pairs: 8.21±1.94 versus 2.70±1.08 pecks per h, P=0.02) and individually had poorer feather condition (Mann-Whitney U: 1.06±0.37 versus 0.13±0.09 feather score, P=0.04) than I/I birds. No pecking preference for immobile dark coloured feathers was observed. In the open-field test i/i birds vocalized more (GLM repeated measures: F<sub>1,30</sub>=6.6, P=0.02) and earlier (GLM repeated measures: F<sub>1,30</sub>=6.9, P=0.01) than I/I birds, and in the fear of humans test I/I birds had higher activity (GLM repeated measures: F<sub>1,29</sub>=6.4, P=0.02), with most effect seen at 21 weeks of age (effect of age: GLM repeated measure: F<sub>2,58</sub>=13.8, P=0.03). Hence, genotypes of PMEL17 affected some aspects of behaviour. Such differences might be important aspects of the mechanism which predispose i/i individuals for being victims of feather pecking. However, alternative explanations should be considered and investigated in future studies.

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## A NEW TECHNIQUE TO EVALUATE THE EFFECTS OF HEIGHT OF AVAILABLE FORAGE ON SELECTIVITY AND INTAKE RATE BY CATTLE



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In native pastures in Japan, tall grasses and shrubs are major plants foraged by grazing cattle. In such vegetation, the animals have to search for their diet from different heights ranging from the ground to overhead, because available leaves of those plants are distributed from the ground to 2 m height or more. To evaluate the effects of height of available forage on selectivity and intake rate of animals, new experimental facilities were devised to set feeds at different heights (20, 70, 120 and 170 cm). The facilities are composed of 2 wooden fences (175 x 400 cm) on which 36 stationery clips (= 4 heights x 9 rows [50 cm intervals, including both ends]) are fixed to fasten feed (9-10 g of hay, 10-15 cm in length) at the individual heights. A pathway was established by putting up the fences face-to-face (120 cm in width). Seventy-two feeds in all heights (Exp. 1) and 18 feeds at each height (Exp. 2) were fastened. Five Holstein cows (mean BW 650 kg) were used after 6 hours fasting, and the time spent on the pathway (Tg) and the number of feeds taken (Nf) were measured, and feed intake rate (IR) was calculated as Nf/Tg. In Exp. 1, the cows foraged 29 (11-41) feeds during 246 (99-377) sec, when they took feeds more frequently from 70 and 120 cm than from 20 and 170 cm (one-way ANOVA,  $P < 0.05$ ). When feeds were set at each height (Exp. 2), IR was highest at 70 cm (8.1 feeds/sec) and lowest at 170 cm (4.5 feeds/sec) (one-way ANOVA,  $P < 0.1$ ). The results indicate that grazing animals more strongly select forage plants from the height with higher IR. These findings give useful information on the mechanisms of diet selection and nutritional intake of grazing animals in the native pastures.

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## VALIDATION OF A SUBJECTIVE TEMPERAMENT SCORE AND ITS CORRELATION WITH HAIR WHORL POSITION IN BEEF CATTLE



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A categorical hair whorl (HW) position scale has been proposed as a selection tool for temperament in infrequently handled beef cattle. However, the reliability of the approach may be obscured by the subjective score (SS) used to validate it. Using frequently handled cattle, the aims of the study were (1) to validate the SS used previously to assess temperament by comparison with objective observations (behaviour in a crush, flight speed (FS), interaction with a novel object (NO), (2) to validate the use of HW measures themselves against these objective observations, and (3) to investigate whether a continuous HW measure can discriminate between animals differing only slightly in HW position. Seventy-six crossbred finisher beef animals were used. With the SS approach, animals were recorded simultaneously by two observers whilst restrained in a bail and videotaped for objective recording of behaviour and FS. Inter- (Kappa coefficient 0.35) and intra-observer reliabilities ( $r_s=0.69$ ) for SS were significant ( $P<0.001$ ). A PCA ( $P<0.05$ ) showed a correlation between SS and videotaped behaviour, whilst SS also correlated with FS ( $r_s=0.41$ ,  $P<0.001$ ) indicating that restless animals exited the crush quicker. SS did not correlate with time spent interacting with a NO. Multiple facial photographs allowed continuous HW positions to be obtained and then categorised into high, medium, low locations or absent. Animals with a high HW tended to be flighty as indicated by the SS and have a high FS (REML,  $P<0.1$ ), but using the continuous scale, there was no evidence of a relationship between HW and these measures (quadratic regression). The results indicate that the SS used previously was a valid measure of behaviour during restraint. In frequently handled herds, high HW position may relate to flighty temperament, but neither categorical nor continuous HW recording can discriminate adequately between the temperaments of most animals under these conditions.

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## MATERNAL BEHAVIOUR IN *MUS MUSCULUS* – A REVIEW



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With the aim of increasing understanding of problems with reproduction in laboratory mouse strains, we reviewed the literature on maternal behaviour in commensal house mice and laboratory mice. Similar to other altricial species, female mice prepare a nest before parturition; however little is known about regulation of this behaviour. Nursing is the main part of maternal behaviour, and pups are weaned through a gradual non-aggressive process after about three weeks. Mice are social and both males and females show parental behaviour. Female mice giving birth at about the same time form communal nests, where pups are also communally nursed, a phenomenon that may confer inclusive fitness gain. However, social living may also be risky with conspecifics being the main predators of pups. A distinct aggressive behaviour pattern shown by pregnant and lactating female is thought to protect nest and pups against such attacks. Maternal aggression is influenced by the presence of pups and by litter size and composition. Communication through external stimuli from the pups contributes to maintaining maternal behaviour, thereby influencing pup growth. Handling of infants and pre- and perinatal stress affects maternal behaviour. When resources are limited, females may reduce litter size through infanticide; however the phenomenon of maternal infanticide under normal laboratory conditions is poorly understood. Many studies included in this review use only standard tests to measure maternal behaviour, and more ethological research would be valuable to understand problems with reproduction in laboratory strains as well as to understand the influence of different housing conditions.

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## RELATIONSHIPS BETWEEN THE SOCIAL RANK OF MALE GOATS AND THEIR TESTOSTERONE LEVELS, AGGRESSIVENESS, AND LIBIDO



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Social disputes are a frequent source of stress and may be a cause of physiological disturbances and economic loss in gregarious species such as goats. The aim of this study was to assess the relationships between social rank and testosterone levels, aggressiveness, and libido in male goats in two seasons. Twelve adult male goats were tested individually in September (reproductive season) and January (out season) to determine their dominance, libido and testosterone levels. Dominance tests were applied using a dyadic interaction matrix. Animals were challenged during five minutes using a source of interest (food). Dominance, aggressiveness and displacement success indexes were obtained. Males were classified according to their dominance index (low, medium and high). Libido tests were applied for 20 minutes using a female in heat. Blood samples were collected seven days before the libido test (every 30 min for 5 hours) to determine testosterone levels. Data were analysed using Kruskal-Wallis, Mann-Whitney and Spearman correlation tests. The linearity coefficient in the hierarchy ( $h$ ) was 0.75 in September and it became more stable in January ( $h = 0.82$ ). High ranking goats had higher testosterone levels than the medium and low ranking males during September ( $7.78 \pm 0.75$ ,  $1.24 \pm 0.32$ ,  $2.92 \pm 0.96$ , respectively  $P < 0.05$ ). In January, the differences in testosterone disappeared ( $1.14 \pm 0.56$ ,  $0.71 \pm 0.21$  and  $0.59 \pm 0.05$ , respectively). No relationships were found between social rank, aggressiveness and libido in both seasons. Testosterone levels were positively correlated with displacement success ( $r_s = 0.501$   $P = 0.013$ ) and with libido ( $r_s = 0.429$   $P = 0.036$ ). High ranking goat males showed higher testosterone concentrations only in the reproductive season. Displacement success and libido were related to testosterone levels. On the contrary, aggressiveness was not related to testosterone levels. Aggressiveness was not necessarily related to social rank.

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## NEW MONITORING METHODS OF DAIRY CATTLE BEHAVIOUR AND WELFARE IN FINLAND



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Behavioural changes associated with stress response are the most common indicators describing the welfare status of an animal. We present new welfare related research methods and technologies that were developed and tested in our research group in Finland. A WLAN based tracking system was set up to monitor the movement of 10 cows in a loose housing barn, the system can achieve resolution of under 1 m, but obstacles inside the barns still cause problems in systems accuracy that have to be resolved. We have tested a new Holter-type device for recording cow's ECG. The device measures cow's ECG and motion activity using two orthogonal accelerometers. As a result of preliminary measurements on cows this new device will record reliably the cow's ECG up to 24 hours per recording. Artefacts can be detected and data edited. A real time system for monitoring the respiration rate in a milking robot was also developed. The system uses a laser distance sensor to measure the movement of the cow's side and it has proven to be a reliable method for measuring the respiration rate. The respiration rate is extracted from the data with FFT with the resolution of 2 breaths /minute. A system for automatically measuring the leg health and the step and kick behaviour of dairy cows was developed. The system measures the individual leg loads and from the data also the step and kick frequency can be calculated. The aim is to bring these new methods to general awareness and discuss the possibilities that these new methods offer for behavioural research and automatic welfare monitoring on farm level.

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## THE WELFARE OF SHEEP TRANSPORTED BY SEA FROM AUSTRALIA TO THE MIDDLE EAST



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There is a significant trade in livestock, in particular cattle and sheep, conveyed by ship from areas where there are plentiful feed supplies, such as Australia, to major centres of consumption that do not have adequate feed resources, such as the Middle East. The possible stresses associated with such transport have given cause for concern for the welfare of these livestock. The major areas of welfare concern are the impact of multiple, rather than single, stresses on the animals, beginning with mustering on the property of origin and ending with feedlot finishing and slaughter in the country of destination. In between, the livestock are usually transported by truck four times, sometimes for periods in excess of 48 hours, and kept in intensive feeding units both before and after the ship transport. The first of these intensive feeding periods is pre-embarkation and serves to accustom the stock to pelleted feed and the second is in the destination country and allows the animals to gain weight before slaughter. Drawing on experience from traveling with livestock from Australia to the Middle East, and a survey of stakeholders in Australia, the major potential stressors on ship are believed to be clinical diseases (as evidenced by mortality level, clinical disease incidence and animals in hospital), heat stress (respiration rate and wet bulb temperature), high stocking density and ammonia accumulation. Sound preparation and selection of animals intended for export are important, as well as ensuring optimal conditions on board and for the disembarkation.

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## BEHAVIORAL RESPONSES OF MINIPIGS TO THE PIGTURN®: A NOVEL LABORATORY PENNING SYSTEM



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Minipigs are increasingly used in biomedical research and a system is needed that automatically and remotely collects serial biofluid and physiological data, thus refining data quality and reducing animal costs. We examined behavioral responses during the development of a novel rotating pen which counteracted the pig's rotational movement, ultimately allowing free movement of catheterized animals. Eight 9-month-old Gottingen minipigs (30kg BW) were housed individually in 1.9m<sup>2</sup> adjoining pens with rubber matting, toy, feed bowl and drinker. The PigTurn, in the same room, consisted of a 1.4m<sup>2</sup> octagonal pen with fully-slatted floor, toy, drinker and feeder. Behaviour was recorded in the home pen over 48h (HP1, HP2) after which, each pig was recorded in the stationary PigTurn for 48h (SP1, SP2). Ten days later, pigs were again observed in home pens (HP3, HP4) and then in the stationary PigTurn having been given a single 200mg caffeine tablet with feed (SC1, SC2). Finally, 10 days later, each pig was observed for 24h in the rotating PigTurn (TP1). Behaviour was recorded continually and analyzed using 10-min scan sampling to determine daily time-budgets during the nine 24-h periods. Data were analyzed using repeated measures ANOVA with Tukey's post-hoc tests. Time-budgets of minipigs during SP1 and SP2 did not differ from those in the home pen. However, during SC1, minipigs were more active ( $0.59 \pm 0.03$  vs.  $0.43 \pm 0.03$ ,  $F_{8,53}=5.11$ ,  $P<0.001$ ) and alert ( $0.098 \pm 0.041$  vs.  $0.031 \pm 0.010$ ,  $F_{8,53}=2.56$ ,  $P=0.02$ ) than during all other time periods, spending less time lying ( $0.47 \pm 0.04$  vs.  $0.64 \pm 0.04$ ,  $F_{8,53}=5.99$ ,  $P<0.001$ ) and more time standing ( $0.52 \pm 0.04$  vs.  $0.36 \pm 0.04$ ,  $F_{8,53}=5.88$ ,  $P<0.001$ ). Effects disappeared during SC2. During TP1, minipigs spent more time walking compared to all other time periods ( $0.069 \pm 0.010$  vs.  $0.010 \pm 0.003$ ,  $F_{8,53}=16.80$ ,  $P<0.001$ ), similar amounts of time inactive but more time lying ( $0.76 \pm 0.02$ ) than in the HP ( $0.60 \pm 0.04$ ,  $P<0.05$ ) and SP ( $0.65 \pm 0.05$ ,  $P<0.05$ ) periods. Overall, results indicate no adverse behavioural time-budget responses to the stationary or movement-responsive pen.

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## PRELIMINARY STUDY OF DEPENDENT RELATIONSHIPS IN DOGS



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In social species, dependence relationships provide security, mostly through the proximity maintenance towards the caretaker. In another way, it may also allow the animal to explore the environment by using its caretaker as a spatial landmark. In this work, dependence relationships are analysed through a set of experiments by using a classical procedure in psychology. This work is a pre-test of a study, which could provide more fundamental information relating to the evolutionary mechanisms underlying dependence relationship behaviour usually called attachment. It aims to categorise behavioural variables in relation to breed and gender in order to define canine patterns of attachment, then to assess the relationship between these patterns and other factors like spatial memory. Males and females differ in spatial strategies and therefore dependent relationship was analysed through a sexual differences perspective. The behaviour of 40 domestic dogs (20 males and 20 females) was assessed in a modified version of M.D.S. Ainsworth's Strange Situation Test (SST). The test lasted 28 minutes and consisted of seven four-minute episodes in a testing chamber. Mainly, situations with periods of separation and reunion between dogs and their caretaker or a stranger were analysed. Animals' behaviour was evaluated according to different modalities: frequency of contact and time spent near the owner, the stranger and the door, and also play time. Data seem to indicate that 1) males and females show different patterns of dependence behaviour; 2) during the isolation phase, a similar activity is observed in both genders; 3) during the separation phase, females show more interactions with the stranger than males. Taken together, these results seem to indicate that dogs show a dependence behaviour towards the caretaker similar to the one children show towards their mother.

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STEREOTYPIC BEHAVIOUR IN CAPTIVE  
AFRICAN (*LOXODONTA AFRICANA*) &  
ASIAN (*ELEPHAS MAXIMUS*) ELEPHANTS  
IN FIVE UK ZOOS



Una B. Quaid, Moira Harris, Stephen Harris, Chris M. Sherwin

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Prevalence and forms of stereotypy were recorded in 12 African and 17 Asian elephants kept in 5 zoological collections in the UK. Direct behavioural observations were made over 3 consecutive days for each collection. Mean faecal cortisol metabolite concentrations were also determined. To identify factors associated with the performance of stereotypies, each animal's history, management, and the number of visitors were recorded at each visit. Three videos of elephants at night from 2 collections were also analysed for stereotypy. Frequency of stereotypy varied considerably between individuals, even within each collection. It occurred in all collections with no significant difference between collections in the proportion of observations spent stereotyping (Kruskal-Wallis ANOVA;  $H=3.54$ ,  $df=4$ ,  $P=0.47$ ). Weaving was the most common form of stereotypy observed (49.44% of stereotypic observations; 2.51% of total observations) and was observed in all collections. Age was significantly positively correlated with stereotypy performance ( $r_s=0.565$ ,  $P=0.003$ ) and females performed stereotypies more than males ( $W=91$ ,  $P=0.03$ ). Whether elephants were captive or wild-born had no effect on stereotypy (Kruskal Wallis Multiple Comparison  $K_{diff}=14.4$ , diff ranked mean = 6.6,  $P>0.05$ ). Of elephants that performed stereotypies, Asian elephants (mean $\pm$ SD) (15.94 $\pm$ 14.04%) did so for a greater proportion of observations than African elephants (3.15 $\pm$ 4.26%) (Mann Whitney;  $W_{9,7}=40.0$ ,  $P=0.044$ ). Mean faecal cortisol metabolite concentration (ng/g faeces) of African elephants (504.0 $\pm$ 116.0) was significantly greater ( $t=2.05$ ,  $P=0.05$ ,  $df=25$ ) than their Asian counterparts (398.0 $\pm$ 144.0). There was no significant difference in the mean faecal cortisol metabolite concentration between elephants that stereotyped and those which did not. Overall, these results highlight the difficulties in using data on stereotypical behaviour in zoo elephants as the primary indicator of welfare because of the variability of the subjects in terms of species, origin, history, and differences in husbandry between and within collections.

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## DO SPECIFIC INDIVIDUALS LEAD ACTIVITY SYNCHRONIZATION IN BEEF CATTLE?



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Traditionally, the activities in a herd are thought to be led by one or more leading animals. Alternatively, a democratic mechanism is possible, with all animals having practically the same influence on the decision-making. We tested these two hypotheses using data on activity switches in a herd of 15 Gasconne cows on pasture. Observations were carried out during 10 days in 2004 and 15 days in 2005 from dawn to dusk. We recorded all times of switches between activity (animal is not lying) and resting (animal is lying) of each cow and dominance status of cows using ad lib observation method. We took as lying-down/standing-up synchronized bout when at least 8 animals changed the activity with a maximum time gap between two animals of 10 minutes. Mixed model (SAS) with year, dominance status, maternity status, dominance status\*year and maternity status\*year as fixed factors and identity of cow as a random factor was applied on the data. Dominance status did not influence relative order either in lying-down bouts or standing-up bouts or participation of cow in standing-up bouts (mixed model,  $P > 0.05$ ). Animals with high dominance status participated less in lying-down bouts (mixed model,  $P < 0.05$ ). The individuality of the cow explained only a small proportion of variability in relative order within both lying-down and standing-up bouts (range 5.9-11.5 %), thus showing that no specific animal(s) regularly lead the synchronized bouts. The results suggest that there were no leading animals that would initiate activity switches in our herd, thus indirectly supporting the democratic hypothesis. Supported by Grant Agency of the Academy of Sciences of the Czech Republic AVCR IAA 6307402 and Czech Science foundation GACR 523/03/H076.

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## DOES A SYNTHETIC PLATE IMPROVE THE QUALITY OF THE LYING AREA IN HOUSING SYSTEMS FOR FATTENING PIGS?



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Leg injuries are common in fattening pigs lying on concrete floors without litter. In order to reduce these injuries, a synthetic plate covering the lying area was used. We quantified the effects of the synthetic plate on lying behaviour and lesions on the legs of fattening pigs. The synthetic plate consisted of a plastic layer with a studded surface. Eighteen groups of 10 fattening pigs were kept in six blocks in three pens with partly slatted floors at temperatures ranging from 4°C to 28°C. The solid concrete floor was either left bare, covered with a small amount of straw, or the synthetic plate. Lying behaviour (lateral, sternal lying, huddling and lying on slatted floor) was studied using video recordings for 48 hours at weights of < 35 kg, 50-70 kg and > 80 kg. Pigs were examined for lesions at the carpal and tarsal joints at regular intervals during the fattening block. Generalised mixed-effects models were used. No differences between floor types were found in lying laterally (61 %), sternally (16 %) and huddling (3 %;  $P > 0.10$ ). At 50-70 kg, pigs in pens with the synthetic plate started to lie to thermoregulate on the slatted floor at lower temperatures (11°C) than in pens with and without straw litter (16°C, floor types x weight-class:  $P = 0.03$ ). A higher proportion of animals in pens with the synthetic plate (20 %) showed bursitis at the carpal joints than in pens with (13 %) and without straw litter (11 %;  $P < 0.01$ ). As the synthetic plate did not reduce the prevalence of injuries, and pigs moved to the slatted floor at lower weights to transfer excess heat compared to a concrete lying area, it is concluded that the lying quality was not improved by adding a synthetic plate.

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## THE EFFECT OF NEWBORN CALVES VIGOUR IN THEIR MORTALITY PROBABILITY



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The aim of this study was to evaluate the behaviour of newborn calves and its relationship with mortality rates between herds of Nelore and Guzerá breeds. The study was carried out at Estação Experimental de Zootecnia de Sertãozinho, (São Paulo State, Brazil), with 366 cows-calves pairs (254 Nelore, 112 Guzerá). The behaviours of each pair (mother and offspring) were recorded (from birth to first suckling or until five hours of observation) by direct observations using instantaneous sampling (with 5 min. sample interval). Two variables were considered for calves (LP=latency to stand up and LM=latency to suckle), and one for cows (TCC=time in contact with the calf). Two classes for LM were defined: (1) calves that successfully suckled in up to three hours after birth and (2) calves that did not suckle in this period of time. Mortality rate was calculated from birth to weaning (7 months), stillborns were not included. Mortality rate was analyzed through GENMOD procedure with PROBIT linking function, using SAS statistical package. Mortality was influenced by LM and TCC ( $P < 0,05$ ). Despite the numeric differences between breeds in the mortality rate (3.6 and 12.5% for Nelore and Guzerá, respectively), statistical differences were not found ( $P > 0.05$ ). The majority of the Nelore calves (93.8%) suckled very quickly (within three hours) compared to a lower number of Guzerá calves (53.9%). It was clear the effect of LM classes had on the mortality rate for Guzerá; there was a lower rate (4.0%) for the group that suckled faster (within 3 hours after birth) which was similar to that for Nelore (3.6%). These results lead us to conclude that it is important that calves suckle within 3 hours of birth, making it necessary to review the critical limit for the first suckling, usually defined as 6 hours.

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## A CASE-STUDY: FAECAL CORTICOSTEROID AND BEHAVIOUR AS INDICATORS OF WELFARE DURING RELOCATION OF AN ASIATIC ELEPHANT



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The aims of this study were to validate an enzyme immunoassay for measuring faecal glucocorticoid metabolites in a male Asiatic elephant, and to investigate changes in behaviour and metabolite excretion associated with a putative major welfare event. Faecal samples were taken several times daily prior to, and after transport and relocation of the elephant to a new herd. Cortisol metabolites were measured using an 11-oxo-etiocholanolone (3 $\alpha$ , 11oxo-CM) and 11 $\beta$ -hydroxy-etiocholanolone (3 $\alpha$ , 11 $\beta$ -dihydroxy-CM) enzyme immunoassay (EIA). The assays were validated by demonstrating a 365% (3 $\alpha$ , 11oxo-CM) and 515% (3 $\alpha$ , 11 $\beta$ -dihydroxy-CM) increase in cortisol metabolite excretion following transportation and relocation. The pattern of change in both cortisol metabolites was significantly correlated ( $R=0.96$ ;  $P<0.0001$ ). The mean concentrations were significantly greater during the post-transport phase compared to the pre-transport phase (Mann-Whitney test:  $U=102, 105$ ;  $Z=-4.539, -4.488$ ;  $P<0.0001, P<0.0001$  respectively). Maximal cortisol metabolite excretion occurred 2-3 days after relocation, consistent with predicted gut transit. Behavioural data were obtained by 10 min continuous observations for 5 periods during the day-time and 5 during the night. Stereotypic pacing occurred during the day-time prior to relocation, but after relocation, only at night. Prior to relocation, 30% of the time was spent sleeping, all of this at night, whereas after relocation, the maximum time spent asleep was 20% with most nights having little or no sleep. In addition, the usual sleeping position changed from 92% in lateral or sternal recumbency to exclusively sleeping whilst standing. Night-time sleeping decreased, compensated by day-time sleeping increasing by 60%. These results provide preliminary evidence that non-invasive monitoring of faecal cortisol metabolites can be useful to investigate adrenal activity in Asiatic elephants and might be used as an indicator of welfare. Furthermore, the physiological and behavioural changes reported here indicate that relocation was a stressful event for this elephant, with possible negative consequences for his welfare.

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## COMPARISONS OF BEHAVIOUR, USE OF FACILITIES AND PHYSICAL CONDITION BETWEEN DOMINANT AND SUBORDINATE HENS IN FURNISHED CAGES



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The objective of the present study was to compare the behaviour, use of resources and physical condition between the dominant and the subordinate hens in a furnished cage. At 54 weeks of age, 60 White Leghorn layers were divided into two groups. Twenty four hens were housed in six furnished cages with four hens per cage, and 36 hens with six hens per cage. The dominance hierarchy was determined by social interactions. Behavioural observations using scanning techniques at 10-min intervals were conducted at 57 and 67 weeks of age for three days each (4 h/day). Physical condition (body weight and claw length) was also measured. Data were analysed using Friedman's test with repetition. There were no significant effects of group size on the use of facilities or behaviour. The dominant hen used the dust bath more (21.0%) and the nest box less (12.3%) than the subordinate (1.5% and 23.1%, respectively) over both weeks ( $P < 0.1$  and  $P < 0.01$ , respectively). The use of the nest box decreased for the subordinate hen from 57 to 67 weeks of age ( $P < 0.05$ ). Comparing the proportions of each behaviour, the dominant performed more aggression (3.1% vs. 0.0%,  $P < 0.001$ ), dust-bathing (2.2% vs. 0.6%,  $P < 0.1$ ), scratching (0.4% vs. 0.0%,  $P < 0.1$ ) and litter pecking (4.7% vs. 1.8%,  $P < 0.05$ ) than the subordinate. Aggression decreased for the dominant, whereas eating, drinking and other comfort behaviours increased for the subordinate from 57 to 67 weeks of age. There was no significant difference between the physical condition of the dominant and the subordinate. In conclusion, the dominant hens use the dust bath more than the subordinate hens, whereas the subordinate stayed in the nest box more than the dominant. In the furnished cages, equipping the nest box was important not only for hens to perform the nesting behaviours, but also for the subordinate hens to use the facility as a 'refuge', especially immediately after introduction.

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## EFFECT OF ENVIRONMENTAL ENRICHMENT ON BEHAVIOUR AND PRODUCTIVITY OF DAIRY GOAT KIDS AFTER WEANING



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The objective of this study was to evaluate the effects of environmental enrichment on the behaviour of weaned Alpine female kids. Two treatments (enriched and non-enriched) with two replicates each (N=8), were randomly assigned to 32 female kids, never enriched before. Enrichments were provided during one period of the kid's life, after weaning, and consisted of logs to climb, hanging food, brushes, ropes and coconut shells placed on the floor filled with concentrate. Scan sampling was used every 5 minutes, for 4 hours, until completing 150 hours of observations of individual time budgets from weaning (10 kg) until the onset of first estrous. The goats were weighed every 15 days, health records were kept and age to first estrous was recorded. A complete randomized design and multivariate analyses for repeated measures were used to assess the effect of enrichment on the variables studied. The enriched kids had fewer agonistic encounters ( $P<0.001$ ) and exploration (nosing, licking, biting) was directed towards the enrichment, while in the non-enriched it was directed towards the pen. According to their health records the kids in the enriched group got sick less and were sick for a shorter period than the non enriched ( $P<0.05$ ). No significant differences were found in weight gain or age to first estrous. This study suggests that simple and low cost changes in the environment had significant effects on the behaviour of goat kids after weaning under confinement conditions. Exploration was directed towards the enclosure, affecting facilities, which can be costly to the producer. The increase in agonistic encounters, as well as the differences in health status in the non-enriched group can be indicators of reduced welfare, decreasing the benefits to the producer.

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## EFFECT OF DAY OR NIGHT GRAZING ON BEHAVIOUR AND PRODUCTION OF SWAMP BUFFALO HEIFERS



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An experiment was conducted to examine the effect of day or night grazing on behaviour and production of swamp buffaloes. A grazing trial was conducted over 42 days in the late rainy season, during September to November 2005 at Surin Livestock Research and Breeding Center, Thailand. The experimental period was divided into two 21-day periods. Twelve 2-year-old swamp buffalo heifers were allocated to four groups, each containing three heifers, with the mean group weights being as similar as possible. Each group was allowed to graze either from 06:20 to 18:00 h (treatment 1) or from 18:20 to 06:00 h (treatment 2) in four separate paddocks, each of 0.8 ha, using a cross-over design. When not at pasture the animals in each group were kept in the common corral with free access to fresh drinking water and mineral blocks. Individual animal activity was recorded by visual observation at 1-min intervals during the period at pasture. Individual groups within each period were treated as replicates. Differences between group means were tested using MIXED procedure of SAS. The buffaloes on treatment 1 spent longer ( $P<0.05$ ) grazing than those on treatment 2 (423 v 332 min). The number of meals differed ( $P<0.05$ ) between treatments, but overall mean meal durations were similar (73 min). Buffaloes allowed to graze during daylight had a tendency ( $P<0.10$ ) toward a higher bite and step rates than those grazing during the night. With the reduction in grazing activity during the night on treatment 2, the animals ruminated for longer during the period at pasture (327 and 191 min,  $P<0.001$ ). Live-weight change over periods of 20 days did not differ significantly. The difference in temporal behaviour patterns between treatments indicated that animals have to adapt foraging strategies appropriate for different situations in order to maintain feed intake and subsequently production.

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## A DEVICE AIMING AT IMPROVING WELFARE OF RATS HOUSED IN STANDARD METABOLIC CAGES



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Metabolic cages are used for housing rats for collection of urine and/or feces for up to 5 days. The small, barren area, grid floor and absence of shelters and social stimuli compromise rat welfare. Our goal was to design and test a practically applicable device which meets behavioural needs for environmental complexity, thus reducing the negative impact of housing in metabolic cages. A box-shaped enrichment device was designed and implemented in existing metabolic cages. Male Tac:SD rats were housed for five days in an enriched metabolic cage (EM; N=12) or a standard metabolic cage (SM; N=12). Data were collected on bodyweight, food consumption, open field behaviour and cage preferences. Rats in both groups gained significantly less weight when housed in metabolic cages ((ANOVA, diff. of LSM) SM:  $t=6.17$ ,  $P<0.0001$ ; EM:  $t=2.84$ ,  $P=0.0068$ ). Moreover, SM rats failed to increase their weight gain after being housed in the metabolic cage, whereas EM rats significantly increased their weight gain when returned to normal housing conditions ( $t=-3.58$ ,  $P=0.0008$ ). Food consumption was higher during housing in standard ( $138.9\pm 10.0$  g/housing period) than enriched ( $133.94\pm 5.19$  g/housing period) metabolic cages ( $\chi^2=6.56$ ,  $P=0.0104$ ). No differences were found in open field behaviour between the two groups. However, comparing activity before and after housing in the metabolic cage, only SM animals exhibited significantly lower activity (SM:  $F=3.87$ ,  $P=0.0003$ ; EM:  $F=18.77$ ,  $P=0.061$ ). In the preference test, a preference for the tunnel connecting the cages and a side preference for the left side was found in both groups. However, this side preference was eliminated, when the enriched cage was placed on the right side ( $\chi^2=1.15$ ,  $P=0.56$ ) whereas the right side was significantly avoided when the enriched cage was placed on the left side ( $\chi^2=7.2605$ ,  $P=0.026$ ). We conclude that the enrichment device improved the welfare of rats housed in metabolic cages.

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## BREEDSPECIFIC PREFERENCES OF WHITE CRESTED POLISH CHICKENS IN MATE CHOICE



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White Crested Polish chickens (WCP) are a breed of domestic chickens which has unusual characteristics such as a large brain. We observed behavioural development from the day of hatching, to examine social preferences which influence mating-mechanisms and might result in an ethological isolation leading to the speciation process of WCP. Lohmann Brown Classic (BL) served as comparative breed in experiment 1) to study preferences during imprinting in newly hatched chicks and 2) to investigate social preferences during growth. 50 WCP and 50 BL were hatched and raised together. In exp.1, all 100 WCP and BL day-old chicks were tested by presenting adult hens of the same breed, and of the comparative breed for 15 min. The duration of standing in front of each of the presentation hens was measured using the program Viewer (Biobserve). There was no significant breed preference of the chicks for either their own or the comparative breed. Exp.2 took place in an open field arena to detect whether WCP hens prefer individuals of their own breed as social partners. Three hens of each breed were observed weekly between the 1st and 24th week of life for 20 min. Hens were randomly chosen; inter-individual distances were obtained using digital fixed-images and analysed using the software 'Meazure'. Distances among WCP hens were significantly shorter than distances across breeds. Mean distances among WCP and among BL were significantly different from each other. These results demonstrate a strong breed specific preference among WCP, shown by shorter intrabreed distances than across breeds. This leads to the conclusion that WCP represent an ethological entity below the species level. Breed-specific social matings influence female choice and hence the sexual selection mechanism.

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## IN SEARCH OF THE RELATIONSHIP BETWEEN CANDIDATE GENES AND BEHAVIOUR: A COMPARISON OF PET DOGS AND POLICE DOGS



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One of the important candidate genes for studying effects of environment on the phenotypic manifestation of allelic variation is the dopamine D4 receptor gene. Importantly, dogs, similarly to humans, possess a wide set of genetic polymorphism concerning DRD4 gene. This gene is supposed to be associated in humans with hyperactivity, mother-infant attachment types, attention deficit and sensitivity to reward. To study the interactions between environmental factors, DRD4 allele polymorphism and their effects on behaviour traits, we investigated two groups of German shepherd dogs: police dogs and pet dogs. DNA samples were collected in a non-invasive way from the buccal mucosa using a piece of wad, then the dopamine D4 receptor genotypes were determined and the allele frequencies compared in the two groups. In addition, owners of the dogs filled in a 13-item questionnaire assessing attention skills, impulsivity and motor activity in their dogs. This tool was developed on the basis of a validated questionnaire used for evaluating temperament traits in children and proved to be a reliable and valid method of assessing attention skills and activity in dogs. Results show that the population was in Hardy-Weinberg equilibrium (regarding the alleles of the DRD4 gene;  $\chi^2=0.564$ ,  $df=4$ ,  $P=0.967$ ) and these alleles distributed in similar frequencies in the two groups ( $\chi^2=2.648$ ,  $df=4$ ,  $P=0.618$ ). Importantly, however, results suggest specific differences between police dogs and pet dogs. We found significant differences in police dogs' activity-impulsivity scores in terms of genotype ( $t=3.34$   $P<0.0001$ ) whilst similar differences were not found in pet dogs ( $t=0.64$ ,  $P=0.531$ ). Such investigations in dogs are especially of great importance, because they can reveal associations between allele polymorphism and behavioural traits in interaction with the environmental effects. This work has been supported by the HAS (F 031/2000) and by grant from the EU (NEST 012787).

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## BEHAVIOURAL CHANGES FOLLOWING 21 TO 57 H OF FEED DEPRIVATION IN SWINE



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The current work sought to develop a broad foundation of scientific data to determine when the adaptive capacity of an animal is overextended and welfare is compromised by a metabolic challenge and the resulting hunger. For this purpose, two separate experiments were conducted in which physiological or behavioural measures were collected from swine deprived of feed for 21 to 57 h (DEP) or fed normally (CON) (physiology, N=20/trt; behavior, N=8/trt). Proc Mixed of SAS was used to determine the effect of treatment and treatment x time interactions on the observed measures. Treatment x time interactions were found for glucagon (P=0.03), insulin (P<0.001), insulin:glucagon (P<0.001),  $\beta$ -hydroxybutyrate (P<0.001), non-esterified fatty acids (P<0.001), drinking (P=0.002), standing (P=0.01), inactivity (P=0.02), lying sternal (P=0.03), lying lateral (P=0.002), and total lying (P=0.004). Although the animals appeared to adjust appropriately to the metabolic challenge imposed as suggested by increases in alternative energy substrates, our results suggest that feed deprivation for durations greater than 45 h produced behavioural changes (increased activity, standing, and decreased total lying) that are likely related to increased sensations of hunger, although further work is required to determine whether these behaviours are indeed accurate indications. Lastly, our results suggest the value of multidiscipline research to develop a broader and more complete understanding between the interaction of various factors.

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## EFFECT OF TEMPERATURE AND FLOORING TYPE ON THE BEHAVIOUR AND PHYSIOLOGY OF WEANED PIGLETS



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To safeguard homeostasis and welfare, it is crucial that an animal's environment meets its behavioural and physiological requirements. Temperature can have a large effect on pig welfare, so the aim of this experiment was to evaluate different practical measures of thermal comfort in weaned piglets on different floor types. The experiment was designed as a 2x2x2 factorial, with 2 floor types (fully-slatted and part-slatted (53% solid)), 2 ambient temperatures (C = midpoint of thermoneutral range or H = C+4 °C), and 2 stages of growth (15 or 22 kg liveweight). Eight pens of 20 weaned pigs were subjected to each temperature regime according to a balanced crossover design. For each 7 day trial period, records were made of feed intake, temperature and air velocity at pig level and respiration rate of a sub-sample of pigs. Observations of behaviour were made during a 1-hour period on each of 5 days, using direct scan samples at 5-minute intervals, assessing the degree of physical contact, lying posture and location within the pen. Time-lapse recordings of behaviour were used to determine diurnal patterns over a 24-hour period. Data were analysed by ANOVA. During H conditions, there was a significant increase in mean respiration rate (H=59.6, C=47.6, sem 1.24, P<0.01), the frequency of pigs lying on the slatted part of the floor adjacent to the drinkers (H=0.47, C=0.36, sem 0.019, P<0.001) and in lateral (H=0.11, C=0.02, sem 0.018, P<0.01) and semi-lateral (H=0.24, C=0.10, sem 0.019, P<0.001) lying postures, and a decrease in the frequency of pigs touching (H=0.07, C=0.26, sem 0.049, P<0.05). Significant diurnal differences were observed, as pigs spent more time lying during the daytime, but not at night, under the H treatment (P<0.001). In conclusion, lying behaviour may be used as an index of thermal comfort in pigs under practical assessment conditions.

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## WELFARE OF HORSES USED IN THERAPEUTIC RIDING PROGRAMS



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Horses (*Equus caballus*) are commonly used in disabled riding programs, for training of both able and non able-bodied riders. The aim of this investigation was to explore what physiological and behavioural effects riders with learning and/or physical disabilities have upon the horse, whether this could cause welfare concerns and if there were any trends related to type, severity of disability or balance of the rider. Eight horses were each observed with three different riders with systematically varying types and degrees of disability (N=24). Saliva samples were taken from each horse before and after the experiment to measure cortisol levels, and each horse was fitted with a heart rate belt. Tail flicks and headshakes were recorded throughout the sessions, as well as some rider behaviours. The nature of the study meant that sample sizes were small and statistical results (T-tests, blocked ANOVA and lag sequential analysis) are to be viewed conservatively. Overall, walking heart rate was 56bpm on average (range 37-77bpm) and there was no obvious correlation between rider behaviour and horse heart rate or tail flicks and headshakes. Overall, salivary cortisol levels were comparable to levels measured in a similar study, and numerically lower after the sessions than before (pre-mean  $3.19 \pm 0.84$  ngml<sup>-1</sup> and post-mean  $2.98 \pm 0.69$  ngml<sup>-1</sup>), but this was non-significant ( $t=1.542$ ,  $df=23$ , NS). However, double & severe disabilities and unbalanced position of the rider on the horses showed to be slightly more demanding on the horses. These were the only groups that showed a slight rise in cortisol and higher rates of tail flicks (mean increase 0.36ng/ml, tail flicks 0.89/min). The results indicate that the horses did not appear stressed by the riding programs. However, our recommendation is to take extra care of horses ridden by unbalanced riders or riders with severe disabilities, with particular reference to the horses' back.

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## BEHAVIOURAL INDICATORS OF PAIN IN BELGIAN WHITE-BLUE CATTLE



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The Belgian Blue Beef (BBB) is a recently established double-musled beef cattle breed. The chief objection against the breed is the high rate of caesarean sections that is needed during calving, with estimates well over 90%, which is commonly believed to cause suffering. We compared several behaviours that have previously been suggested in the literature as potential pain indicators. These included quality of rumination, activity budget, reactivity and signs of nervousness. We selected a study farm where yearly a relatively large fraction (up to 50%) of the cows had natural calvings. We conducted focal animal sampling during three hours/day (morning/noon/evening) on 39 cows aged four years or more. The animals were observed about a month prior to partum, and on the first, second and fourteenth day post-partum (day 3). The animals were kept in neck-chains in indoor tie-stalls with two individuals per section. We found that after a caesarean section, cows lay significantly more often on the first day postpartum compared to cows that had calved naturally. They also showed more transitions from lying to standing and vice versa. The 'caesarean section group' reacted significantly more when the side was touched, whereas the 'natural calving group' reacted significantly more when the area around the vulva was touched. Rumination quality was significantly lower in 'caesarean section cows' than in 'natural calving cows' on the second day post-partum. Agressiveness was significantly higher in cows that had calved naturally, but only on the third day postpartum. Overall, both groups showed some clear indications of pain (at the side or vulva), but the caesarean section group showed somewhat more signs of behavioural disruption.

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## BASIC BEHAVIOURAL PATTERNS AND WELFARE IN BELGIAN BLUE BEEF: DIURNAL AND STALL-MEADOW VARIATION



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Evaluation of behavioural time budgets and quality of activities is a simple procedure in on-farm cattle welfare assessment. Duration of lying behaviour and quality of rumination have been suggested as indicators of animal wellbeing. We evaluated these aspects in Belgian Blue (BB) cattle in order to contribute basic behavioural data. The breed is of high welfare concern due to the extreme selection for hypermuscularity. Twenty-five healthy BB cattle of mixed sex (10 bulls) aged 2 to 4 were observed by focal animal sampling (30 minute focals - 41.5 hrs observation time). We assessed the duration of time engaged in different postures (lying, standing) and time spent ruminating. Contexts were “stall” versus “meadow” and “day” versus “night”. Quality of rumination was assessed by counting rates of chewing per bolus. Feed in the stall consisted of hay and corn. Observed duration of lying down per individual was significantly longer at night than during the day (Wilcoxon test  $W=61.5$ ,  $P=0.0001$ ). Animals lied down during  $48\pm 4.8\%$  (mean $\pm$ SE) of the observation time (76%: at night in stall; 16%: in stall daytime; 26%: in meadow daytime) but did not lie significantly more in the stall than in the meadow (Wilcoxon test  $W=37.0$ ,  $P=0.23$ ). Time spent ruminating did not differ significantly between day and night (Student-t =1.3289,  $P=0.19$ ), nor between the stall versus meadow context (Wilcoxon test  $W=37.0$ ,  $P=0.23$ ). Rates of chewing per bolus did not differ significantly between the stall and meadow context (1-way ANOVA  $df=1$ ,  $F=3.17$ ,  $P=0.08$ ). Overall rumination took up  $39\pm 4.1\%$  of the observation time. Sleeping was only observed at night, making up 12% of the lying time. The data might be useful for establishment of a larger data-base quantifying the normal variation in time budgets in different contexts in this breed.

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## HUNGER BEHAVIOUR IN DAIRY CALVES



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Hunger is an important affective state, but little work has documented behavioural indicators of hunger in animals. Dairy calves are typically fed only about half of their ad libitum milk intake. The aim of the current study was to describe the behaviours associated with hunger in calves, by comparing animals fed conventional amounts of milk (two milk meals weighing a total of 10% of the calf's body weight; N=12) or provided milk ad-libitum (N=12). Calves were kept in groups of four and observed from 8 to 14 days of age. Treatment was assigned within group using a computerized feeder. Ad libitum calves gained about 4-times more weight ( $P<0.001$ ) and ingested twice as much milk as calves fed conventionally ( $P<0.001$ ). Restricted calves performed on average 24 unrewarded visits/d (i.e. visited the feeder but received no milk), 12-times more than ad libitum calves ( $P<0.001$ ). Ad libitum calves visited the feeder 5 times/d and no significant difference was found for both treatments in duration of rewarded visits or number of sucking bouts. During rewarded visits, restricted calves paused less and spent twice the time sucking per visit ( $P<0.001$ ). Interestingly, restricted calves consumed the total amount of milk available, in a single nutritive sucking bout that was followed by short non-nutritive bouts. Restricted calves spent one extra hour standing per day ( $P=0.05$ ), and initiated more strong contacts with other calves ( $P<0.003$ ), 73% of which led to displacement. We found no effect of hunger on the number of vocalizations or the frequency of cross-sucking events and disease incidence. In conclusion, these results indicate that hungry calves are more active, more aggressive and spend more time occupying the feeder. These behaviours may be useful in identifying milk feeding practices that avoid hunger in dairy calves.

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## EFFECT OF MILK ALLOWANCE AND AGE ON MEAL PATTERNING OF DAIRY CALVES



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Little is known about how milk allowance affects milk feeding behaviour. The objectives of this study were to quantify the effects of age and milk allowance on meal patterns of dairy calves. Eighteen Holstein calves were randomly assigned to either ad libitum or restricted (10% BW) access to milk and were weaned at 8 wks of age. Calves were reared in a single group pen (9 calves at once) with milk provided by a computer-controlled feeder. Meal criteria were identified for each calf as the intersection point between the distributions of the bimodal frequency distribution of log<sub>10</sub>-intervals between nutritive visits to the feeder. These criteria were used to calculate meal number and duration. The effects of milk allowance and age were tested using a general linear mixed model. Up to 4 wks of age, ad libitum-fed calves had more meals ( $4.2 \pm 0.5$  vs.  $2.2 \pm 0.5$  meals/d;  $P=0.02$ ) and higher milk intakes ( $7.7 \pm 0.4$  vs.  $4.6 \pm 0.4$  kg/d;  $P<0.001$ ) than restricted-fed calves. Meal duration and size were not affected by milk allowance, averaging  $11.1 \pm 0.6$  min/meal and  $2.2 \pm 0.1$  kg/meal. Similar patterns were noted during the following 4 wks. Again, ad libitum-fed calves had higher milk intakes ( $8.6 \pm 0.4$  vs.  $5.9 \pm 0.4$  kg/d;  $P<0.001$ ). However, regardless of milk allowance, calves achieved higher intakes ( $P=0.007$ ) during this period by increasing meal duration ( $13.3 \pm 0.7$  vs.  $11.1 \pm 0.7$  min/meal;  $P=0.03$ ) and size ( $3.0 \pm 0.1$  vs.  $2.2 \pm 0.1$  kg/meal;  $P<0.001$ ) compared to the first 4 wks. Thus, when using an automated feeder, ad libitum feeding results in an increased meal frequency, and as calves age both restricted and ad libitum calves increase meal size and duration.

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## MATERNAL BEHAVIOUR IN LABORATORY MICE: THE EFFECT OF HOUSING ENVIRONMENT



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Barren, restrictive housing has demonstrated effects on neurobiology, behaviour and welfare. Furthermore, mice are very immature at birth and maternal behaviour is crucial for the survival of mouse infants. This study aimed to investigate the influence of housing environment on maternal behaviour in laboratory mice. Primiparous females (C57BL/6J; 10/treatment) housed in either barren cages (Makrolon II: sawdust litter) or in larger furnished cages (Makrolon III: sawdust litter of two grain dimensions, one chew block, half a sheet of Kleenex tissue, a MouseHouse, a cardboard nestbox) with food and water provided ad libitum, were studied. Home cage behaviour was recorded on video (dark/light-period) from day 4 prepartum but the mice were left undisturbed until day 4 postpartum when a pup retrieval (PR) test was carried out, followed by a 5-minute behaviour observation (postPR). Litter survival was 100% in furnished housing and 50% in barren housing (preliminary analysis: Chi-squared=6.107; df=1; P=0.013). No pup mortality was recorded after day 3 postpartum. PostPR, females in barren housing spent more time on the floor (62.81±8.25 vs 27.58±4.86 %; ANOVA df=1; F=15.394; P=0.003) and digging (34.26±9.63 vs 0.28±0.19 %; Mann-Whitney df=1; Z=-2.947; P=0.002). No significant differences in nest-related behaviours were found. Video recordings of home cage behaviour after the PR test and throughout the lactation period are presently being analysed. As indicated by the large difference in survival, pup welfare was strongly affected by housing treatment, and the postPR digging escape behaviour suggested that females were also negatively affected by barren housing. Further analysis of home cage recordings will provide information on differences in maternal behaviour which may explain the different survival rates. On the basis of the unexpected high percentage of litters lost in this study, we recommend the provision of nesting material to all animals in further research of this type.

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## PERCEPTIONS OF THE VETERINARY PROFESSION'S ROLE IN ANIMAL WELFARE



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Animal welfare is a globally important issue that is receiving increasing scientific, political and public attention. It is a multidisciplinary field, with the roles played by the animal welfare science community and the veterinary profession being key. As a vet with a strong interest in animal welfare, and a Masters degree in Applied Animal Behaviour and Animal Welfare, it is the author's feeling that there may be a sense of "dissatisfaction" amongst animal welfare scientists (including those with veterinary degrees) towards the role that the veterinary profession is currently playing in the field of animal welfare. This impression has been gained from comments read in the animal welfare science literature, and from comments made by welfare scientists; e.g.: "...vets tend to think they are the best positioned to address welfare. So they need to address their sense of privilege, given the absence of [welfare] teaching [in vet colleges]". Such views are perhaps unsurprising given that emphasis is placed, during veterinary undergraduate training, on the promotion of physical health, with little consideration of other key determinants of welfare (e.g. behavioural needs). A descriptive survey, using open-ended questions and coding methods to classify responses, will be administered at ISAE Bristol, in the hope that Congress delegates will share their opinions, anonymously, of the veterinary profession's current role in animal welfare. It is hoped that the results of this survey, when reported back to the profession (e.g. via the veterinary press) may stimulate dialogue on the subject, giving rise, hopefully, to more formal opportunities for the two communities (via their relevant organisations, e.g. the ISAE and the BVA) to discuss issues raised. The ultimate objective would be a greater sense of shared purpose between the two communities, so that increased harmony and co-operation could achieve greater advances in the improvement of animal welfare.

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## EFFECTS OF FEED FREQUENCY ON FEEDING PATTERN, RUMINATION AND RUMINORETICULAR MOTILITY IN SHEEP



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Feeding behaviour in a ruminant influences ruminoreticulum constancy and digestibility greatly because of the characteristic of the digestive function. In this study, the effects of frequency of feeding on the times spent feeding and ruminating, and ruminoreticular motility were investigated. Four adult sheep fitted with a ruminal cannula were used. Three feeding conditions were used, controlled feedings divided into 2 times or 4 times per day with even intervals, and ad libitum feeding. First cutting timothy hay was used and 1.8% of body weight was given per day in restricted feedings. Behaviour of the sheep was classified according to the jaw movement. Ruminal motility and the digesta pH were measured. ANOVA and Tukey-Kramer's test were used. This study conformed to the Kitasato University Ethical Code. Although there was no difference in the feed intake per day, compared with controlled feedings ( $4.0 \pm 0.6$  h), significantly long time was spent on the feeding time in ad libitum feeding ( $7.1 \pm 1.9$  h,  $P < 0.05$ ). On the other hand, in ad libitum feeding, the sheep was the tendency to spend short time on resting and ruminating ( $P < 0.1$ ). Although the number of ruminations tend to increase in the restricted feedings, no significant difference was seen in the ruminoreticular motility among three conditions. The range of the ruminal digesta pH in ad libitum feeding ( $1.09 \pm 0.34$ ) was significantly greater than in the 4 times treatment ( $0.53 \pm 0.15$ ). As a conclusion, although increasing the frequency of feeding in sheep shortened the time spent feeding, ruminating time increased to keep the ruminoreticulum environment steady. However, since the type and the level of feed can affect the environment in a ruminoreticulum, further studies are required.

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