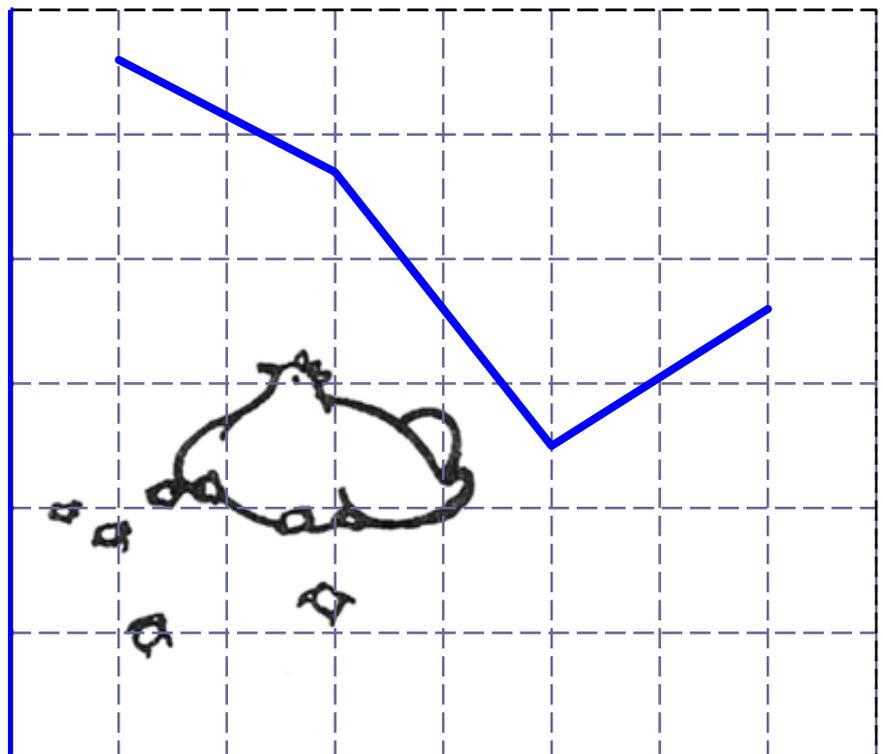


Recent advances in animal welfare science VI



UFAW Animal Welfare Conference

28th June 2018

Centre for Life, Newcastle upon Tyne, UK

#UFAWNCL18

UFAW
Established 1926



Welcome to the UFAW Conference

The science of animal welfare is a cross-disciplinary field of research that aims to provide a sound basis on which to build guidance and find solutions to the challenges raised by our caring for and interactions with both kept and wild animals. As part of its on-going commitment to improving animal welfare through increased scientific understanding, UFAW is holding this, the sixth of our on-going series of one day conferences, to consider '*Recent advances in animal welfare science*'.

These conferences are intended to provide a platform at which both established animal welfare scientists and those beginning their careers can discuss their work and a forum at which the broader community of scientists, veterinarians and others concerned with animal welfare can come together to share knowledge and practice, discuss advances and exchange ideas and views.

We hope that it achieves these aims and fosters links between individuals and within the community.

We would like to thank all those who are contributing to the meeting, as speakers, poster presenters and chairs, as well as the delegates from the many countries who are attending. We look forward to what we trust will be a thought-provoking and engaging meeting.

Stephen Wickens, Robert Hubrecht and Huw Golledge
UFAW

General Information

Organisers

The Universities Federation for Animal Welfare (UFAW) is an independent registered charity that works with the animal welfare science community worldwide to develop and promote improvements in the welfare of farm, companion, laboratory, captive wild animals and those with which we interact in the wild, through scientific and educational activity. To this end, UFAW:

- Promotes and supports developments in the science and technology that underpin advances in animal welfare, including the funding of research through its programme of [grants, awards and scholarships](#).
- Promotes education in animal care and welfare.
- Provides information, organises symposia, conferences and meetings, publishes books, videos, technical reports and the international quarterly scientific journal [Animal Welfare](#).
- Provides expert advice to governments and other organisations and helps to draft and amend laws and guidelines.
- Enlists the energies of animal keepers, scientists, veterinarians, lawyers and others who care about animals.

UFAW is an independent organisation, and throughout its history its work has primarily been funded by [donations, subscriptions and legacies](#).

UFAW's philosophy: The importance of science to animal welfare

Ensuring good welfare is about more than ensuring good health. Animal welfare is about the quality of animals' lives: their feelings. It is now widely agreed, although it is not yet possible to prove absolutely, that many species are sentient - they have the capacity to feel pain and distress, they can suffer and, conversely, be aware of pleasant feelings - and that this matters morally. But how do we assess, from the animal's point of view, what matters to them and how much?

"Science informs, motivates and facilitates advances in animal welfare by providing a strong evidence base for changing attitudes and practices, and by creating practical and effective solutions to welfare problems."

UFAW promotes and supports a scientific approach aimed at finding ways to gain insight into what matters to animals, assessing their welfare and improving the quality of their lives through practical developments in all aspects of their care.

Change for the better depends on knowledge, understanding and practical solutions. UFAW believes that good science can inform, motivate and facilitate that change - whether through developments in legislation, professional 'best practice' or the actions of other organisations and individuals.

In promoting and supporting this scientific approach to improving welfare, UFAW's work is wide-ranging and undertaken with many other organisations and individuals - enlisting and informing the energies of animal keepers, scientists, veterinarians, lawyers and others who care about animals.

For more details visit: www.ufaw.org.uk



Information about the conference

Venue:

The conference is being held in Newcastle upon Tyne, in the city's [Centre for Life](#) building (Times Square, Newcastle upon Tyne, NE1 4EP, UK). Located within a two minute walk from Newcastle Central Railway Station, the venue includes an award-winning Science Centre, a 4D Motion Ride and planetarium.

Travel information and downloadable maps of Newcastle can be found [here](#) and a map of the area surrounding the Centre for Life [here](#) and [here](#).

Newcastle has a Metro system, which runs directly to and from the airport (13 stops). Central Railway Station is the nearest train and Metro station to the Centre for Life. A map of Newcastle Metro can be found [here](#).

The nearest car parking is at Times Square (Sat Nav reference NE1 4AD). This car park is open 24 hours a day, 7 days a week, with CCTV in operation and personal assistance available at all times.

Registration:

Registration will take place in the Meetings and Events foyer of the Centre for Life from 8.30am on Wednesday 28th June. The entrance to this is from Central Parkway, which is the road to the left of the main Centre for Life building.

On registering delegates will receive a delegate list, a timetable, a list of poster presentations and a badge, which allows access to the meeting and to lunch and refreshments. Please ensure you wear your badge at all times.

Please note that only delegates that are registered can attend the scientific programme and that registration is for an individual, not an institution, and is not transferable, unless this has been agreed in advance with UFAW. Failure to agree such may result in individuals being denied entry to the meeting.

Talks will take place in the Scotswood suite, next to the foyer, with the poster session, lunch and refreshments being held on the Mezzanine at the times indicated in the timetable.

Delegates with any general questions or queries should address these to the staff at the registration desk, in the foyer, in the first instance. Cloakroom facilities are available on request.

The conference programme is a very busy one and delegates are requested to take their seats in plenty of time before the start of each session. These will start promptly at the time indicated in the programme.

Catering:

Tea, coffee and lunch will be served on the Mezzanine, on the first floor of the Centre, which can be accessed through a corridor behind the Scotswood suite, at the times indicated in the timetable.

Internet access:

The Centre for Life has a free wi-fi network for those who wish to access it. Search available networks and choose 'Life' and follow the instructions.

Safety:

In the event of a fire or other emergency, please follow the instructions given over the public address system – and leave via the nearest emergency exit.

The Scotswood suite where the conference is being held has three exits, clearly sign-posted. Delegates should turn right on exiting the building and gather at the muster point at the barrier at the bottom of the road (Central Parkway). A check that everyone attending the conference is present will then be made. Do not return to the building unless authorised to do so.

Twitter:

The hashtag for the symposium is **#UFAWNCL18**

Accommodation:

Delegates are responsible for booking their own accommodation. There are a large number of hotels eg Holiday Inn Express, Jurys Inn within 5 minutes walk of the venue. Links to these can be found by visiting this <https://www.newcastlegateshead.com>

Information on Presentations

The conference language is English. All oral presentations must be English as must the majority of the information contained in a poster.

Delegates are kindly requested to not take photographs or record talks during the conference as this is distracting for others. Speakers have been asked to provide a .pdf of their presentation that registered delegates will be able to access on-line after the event.

- **Oral presentations**

For all talks, unless notified otherwise, the first author listed in the submitted abstract will be presenting the talk. As part of the time allocated for each talk, speakers have been asked to ensure that at least 5 minutes are allowed for questions from delegates.

All speakers must ensure that they have loaded a copy of their presentation on to the PC being used for the meeting in advance of the session in which they are to talk. This PC will be at the front of Scotswood suite. As a guide, we would expect anyone speaking in the morning to have uploaded their talk during initial registration, which is from 8.30am, and the remaining speakers to upload their talks during the subsequent refreshment and lunch breaks.

The conference will use a PC based computer system running Office 2016 to run all PowerPoint presentations, so speakers need to ensure presentations are formatted for such. Presentation should be brought on a USB Memory stick. Presentations should be named such that the speaker surname and the session in which the talk is taking place is clear eg 'Smith 2 Stress and welfare'.

If video/audio clips are to be used as part of the presentation, speakers must ensure that the entire folder containing the PowerPoint presentation and video/audio files, are loaded (this will ensure all links within the presentation are maintained). Embedding these in the presentation is not sufficient.

Important note for Macintosh users

To ensure that a presentation prepared on a MAC will be compatible with a PC computer, please note the following: Use a common font, such as Arial, Calibri, Times New Roman, Verdana etc. (special fonts might be changed to a default font on a visible on a PC computer running PowerPoint).

Insert pictures as .JPG files (and not .TIF, .PNG or .PICT – as these images may not be visible on a PC computer running PowerPoint).

- **Poster presentations**

Posters will be displayed on the Mezzanine floor of the Centre for Life. Access to set up a poster is from 8.30am and all posters should be in place before the start of the conference at 9.10am. All must be taken down before the end of the conference at 17.30pm and preferably by the end of the afternoon refreshment break

The poster boards that will be used for the conference will accommodate A0 portrait size posters (ie 1189mm high x 841mm wide) and will be mounted on these using Velcro hook and loop fastenings. Spare velcro will be provided for those who need it on the day

During the poster session, which is scheduled to begin at 13.20pm, authors have been asked to make themselves available to answer questions about their work. Accordingly those contributing posters are asked to ensure that at least one of the contributing authors is standing nearby their poster during this session.

Please note: UFAW is are not responsible for loss or damage to any posters that are not removed by authors by 17.00pm on the 28th June. Any posters left behind will be automatically destroyed.

Badges:

Delegates with a special role to play in the symposium have been allocated a coloured badge, as follows:

Blue	Organisers and helpers
Yellow	Speaker
Pink	Poster presenter

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Centre for Life, Newcastle, UK, 28th June 2018



SCIENTIFIC PROGRAMME:

Timetable and Speaker Abstracts

Timetable:

8.30 – 9.10 Registration and poster set up		
9.10 – 9.20 Introduction to meeting		
	Hubrecht R UFAW, UK	Welcome and Introduction
9.20 – 10.40 Session 1 Chair: Arnott G (Queen's University Belfast)		
9.20	Telkanranta H, E Paul and M Mendl University of Bristol, UK; University of Helsinki, Finland	Measuring animal emotions with infrared thermography: How to realise the potential and avoid the pitfalls
9.40	Andrews C, S Desire and M Bateson Newcastle University and Scotland's Rural College, UK	Time flies when having fun: Could time perception offer a window on affective state?
10.00	Sandercock DA, JE Coe, MW Barnett, TC Freeman, P Di Giminiani and SA Edwards Scotland's Rural College, University of Edinburgh and Newcastle University, UK	Co-expression analysis of dorsal root ganglia from tail amputated pigs at different ages reveals long-term transcriptional signatures associated with wound healing and inflammation, and neuropathic pain pathways
10.20	Kittelsen KE, EG Granquist, AL Aunsmo and E Tolo The Norwegian Meat and Poultry Research Centre, Norwegian University of Life Sciences and Norsk Kylling AS, Norway	An evaluation of two different methods to manually catch broilers prior to transport and slaughter
10.40- 11.20 Break: Refreshments		
11.20 – 12.40 Session 2 Chair: Smulders T (Newcastle University)		
11.20	O'Neill D, J Summers, D Church, L Collins, D Sargan and D Brodbelt Royal Veterinary College and Universities of Cambridge and Leeds, UK	New era of evidence-based, comparative welfare-scoring for canine disorders using veterinary clinical record data
11.40	Clegg ILK, HG Rödel, B Mercera and F Delfour Université Paris 13 and Parc Astérix, France	Anticipatory behaviour as a welfare measure? Cognitive bias linked to anticipatory behaviour in captive dolphins
12.00	Sinclair ARL, RB D'Eath, PJ Brunton, A Prunier and DA Sandercock Scotland's Rural College and University of Edinburgh, UK; Institut National de la Recherche Agronomique (INRA) Saint Gilles, France	Long-term effects of piglet tooth resection on molecular markers of inflammation and pain in tooth pulp
12.20	UFAW and HSA Award Presentations	UFAW Medal for 'Outstanding Contribution to Animal Welfare Science' / UFAW 'Young Animal Welfare Scientist of the Year' HSA Humane Slaughter Award
12.40 – 14.20 Lunch – poster session from 13.20		
14.20 – 15.35 Session 3 Chair: Hockenhull J (University of Bristol)		
14.20	Green J and C Witham Newcastle University and Medical Research Council Centre for Macaques, UK	Developing new techniques to assess mental wellbeing in captive primates
14.40	Williams DL University of Cambridge, UK	Using the Extended Welfare Assessment Grid to evaluate welfare in clinical settings
15.00	Osthaus B, L Proops, S Long, N Bell, K Hayday and F Burden Canterbury Christ Church University, Universities of Portsmouth and Sussex and The Donkey Sanctuary, UK	Weathering the weather: Effects of the environment on donkey, mule and horse welfare
15.15	Petow S, B Eusemann, A Patt and L Schrader Friedrich-Loeffler-Institut, Germany	The influence of age, egg production and 17 β -estradiol on keel bone length and fractures
15.35– 16.10 Break: Refreshments		
16.10 – 17.30 Session 4 Chair: Poirier C (Newcastle University)		
16.10	Packer RMA, F Fletcher and MJ Farnworth Royal Veterinary College, Universities of Edinburgh and Plymouth, UK	"Could not live without one". Factors driving repeated purchase and recommendation of brachycephalic dog breeds
16.30	Khoo SY-S Concordia University, Canada	Local anaesthetic refinement of pentobarbital euthanasia reduces abdominal writhing without affecting immunohistochemical endpoints in rats
16.50	Hewson CJ The Pet Loss Vet, UK	"Come back when it's time": The A-B-C yardstick for veterinary euthanasia decision-making
17.10	Roughan JV and T Sevenoaks Newcastle University, UK	Welfare versus scientific costs of mouse identification methods
17.30 End		

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MEASURING ANIMAL EMOTIONS WITH INFRARED THERMOGRAPHY: HOW TO REALISE THE POTENTIAL AND AVOID THE PITFALLS

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Infrared thermography, also known as thermal imaging, is expected to yield some of the next major steps in improved monitoring of animal welfare. As a non-contact technology enabling rapid measurements on large numbers of individuals, it holds considerable future potential for automated monitoring and handheld assessment tools (eg for farms, zoos and laboratories). In this review, we give an overview of the current body of knowledge; highlight areas requiring further research for practical applications; and offer technical and methodological hints on how to avoid pitfalls and to succeed in thermographic research on animal welfare.

Infrared thermography involves the use of a thermal camera to measure subtle differences and changes in animals' skin or eye temperatures. These reflect variations in blood flow and muscle contraction, some which are linked to emotions. Thermographic studies on animal emotions have so far mainly focussed on the sympathetic nervous system (SNS). Activated during emotional arousal, the SNS causes vasoconstriction in peripheral blood vessels (eg in the skin and behind the eyes). A pattern of change in eye temperature over time, consisting of a reduction and a subsequent increase, have been physiologically validated in cattle to be triggered by acute sympathetic activity. Another consequence of SNS activity is a temperature reduction in peripheral body parts, and this has been investigated, using thermography, in a number of species, including measurements of the ears of rabbits and dogs, the combs of hens, and the noses of cattle and several species of primates including humans. We review these studies and highlight the emotional and physiological processes that have yet to receive extensive investigation, including measurement of facial expressions, long-term emotional/mood states and interactions between valence and sympathetic arousal.

When investigating emotional effects on thermographic recordings, other factors also have substantial effects on animals' surface temperature distributions. Recent exercise, metabolic activity, diurnal rhythm, ambient temperature, humidity and nearby heat-reflecting surfaces are some of the most important. Systematic measures of these, and development of new methods to standardise and correct their effects on thermal images, will be a crucial component of developing thermographic techniques for measuring animal welfare, and improving the quality and reliability of future research. A key component in future success in developing thermographic measures for animal welfare will be interdisciplinary collaboration involving expertise in animal welfare, cognition, physiology and physics.

TIME FLIES WHEN HAVING FUN: COULD TIME PERCEPTION OFFER A WINDOW ON AFFECTIVE STATE?

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Considering animals' emotional experiences is an important aspect of evaluating their welfare, yet is challenging because animals cannot provide subjective reports of their affective state. Instead, affective states can only be inferred using physiological, behavioural and cognitive measures. A number of cognitive measures of animal affective state, such as judgement biases and sensitivity to reward losses or gains (contrast effects), have arisen from consideration of the cognitive signatures of human emotions or emotional disorders. Human perception of time is often distorted rather than perceived veridically, being modulated by emotional experiences and altered in psychiatric disorders such as anxiety and depression. Here, I aim to stimulate consideration of whether time perception could offer novel measures of affective state in animals. I start by reviewing evidence concerning how emotion and emotional disorders influence time perception in humans. Next, I consider current models of time perception, such as the Pacemaker-Accumulator model, and how they account for emotional influences on time judgements. I then explore whether distortions of time perception could be used to assess animal affective states, and whether such measures might theoretically distinguish emotional arousal from emotional valance. I explore the potential of paradigms such as peak interval procedure, temporal bisection or temporal discrimination to be applied for elucidating time perception in non-human animals in a welfare context. Briefly, I review how pharmacological manipulations of the dopaminergic system alter timing behaviour in animal models. Lastly, I present pilot work in European starlings (*Sturnus vulgaris*), a common passerine animal model, examining associations between timing ability and current or past experiences shown to induce depression-like or anxiety-like behaviour.



CO-EXPRESSION ANALYSIS OF DORSAL ROOT GANGLIA FROM TAIL AMPUTATED PIGS AT DIFFERENT AGES REVEALS LONG-TERM TRANSCRIPTIONAL SIGNATURES ASSOCIATED WITH WOUND HEALING AND INFLAMMATION, AND NEUROPATHIC PAIN PATHWAYS

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Concerns exist that docking and biting injuries may be a cause of long term pain in the remaining tail stump during the pig's lifetime. The potential for long-term pain has been linked to sustained cellular and molecular changes in peripheral sensory neuronal activity. The aim of this study was to conduct a transcriptome analysis of caudal dorsal root ganglia (DRG) gene expression profiles from pigs subjected to tail amputation, in particular examining genes known to be associated with inflammation and neuropathic pain. Microarray analysis was performed on caudal DRG from sham (control) and tail amputated pigs 1, 8 and 16 weeks after tail treatment at either 3 days (neonate) or 63 days (juvenile). Tail amputation injury induced highly significant gene expression changes (both up and down) compared to sham-treated intact controls at both ages (518-2,794 genes, FDR < 0.05) that were still evident 16 weeks after tail amputation. Network correlation analysis using the Markov clustering (MCL) algorithm to define expression modules revealed two highly correlated (PCT $r^2 = \geq 0.75$), interrelated transcript expression clusters related to (A) neuronal function (759 genes) and (B) wound healing (273 genes). In cluster A, gene ontology (GO) and pathway enrichment analysis identified genes with significant GO terms for *voltage- and ligand-gated ion channel activity* linked to *regulation of membrane potentials, neurotransmitter levels and synaptic signalling*. In cluster B significant gene expression was associated with *receptor binding, protein transcription activity and regulation*, linked to processes such as *response to wounding, regulation of response to wounding, inflammatory response and activation of immune response*. Cross-reference against an integrated database of known genes involved in the regulation of inflammatory and neuropathic pain revealed 124 and 61 pain-associated genes in clusters A and B, respectively. Key functional families of ion channels and receptors were significantly down-regulated in cluster A, in particular *voltage-gated potassium channels* and *GABA receptors* which are linked to increased neuronal excitability. Up-regulated functional gene families in cluster B were mostly linked to *inflammation, macrophage activity, neurohormone and opioid peptide activity*. DRG gene expression profiles appear to be linked to sustained tissue inflammation and remodelling (ca. 4 months) and pain perception modulation consistent with adaptive, compensatory responses to injury induced increases in peripheral sensory neuron excitability in the injured tail stump. Tail amputation causes acute and sustained changes in peripheral somatosensory nerve function involving inflammatory and neuropathic pain pathways which have implications for pig welfare.

AN EVALUATION OF TWO DIFFERENT METHODS TO MANUALLY CATCH BROILERS PRIOR TO TRANSPORT AND SLAUGHTER

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The first step in the pre-slaughter chain of broiler chickens is the catching. It may be performed manually or by machine. Regardless of method, catching is a well-known risk factor for trauma and mortality. One of the most common non-fatal traumas associated with catching, is wing fractures. Due to this, catching evokes concern about compromised welfare. This pilot study was designed to evaluate two different methods to manually catch broiler chickens prior to slaughter. Method one was to catch the broilers in two legs and carry them upside-down. Method two was to catch the broilers under the abdomen and carry them in an upright position to the transport container. The aim was to investigate selected welfare parameters for broilers caught with the two different methods. The study sample consisted of 3951 broilers; 2010 caught by method one and 1941 by method two. The broilers were caught two subsequent nights, at two different barns, by the same four catchers. The flocks were of different hybrids; a conventional fast-growing type, slaughtered at the age of 33 days and 1328 g (mean slaughter weight) and a slower growing hybrid, slaughtered at the age of 44 days and 1539 g. Both catching methods were tested in each flock. The catchers had not been trained in the different methods prior to the study. The broilers of the first four containers in each flock were caught by method one. After a break, the broilers of the next four containers in each flock, were caught by method two. The containers were marked according to catching method. The time to fill each container was recorded. Immediately after the containers arrived at the abattoir, the broilers were investigated for wing fractures in lairage, meaning prior to stunning and shackling. In addition, the number of animals per drawer were noted along with broilers DOA and broilers on the back. The results showed that mean crating time was shorter for the containers where the catchers caught the broilers by method two ($P = 0.025$). There was a tendency that wing fractures were observed more often in the containers where the broilers had been caught by method one ($P = 0.06$). Regardless of catching method, no broilers in the study were found DOA or on the back in the crates. The results indicate that catching and carrying the broilers under the abdomen, in an upright position may be better for broiler welfare in terms of wing fractures and faster catching time. The sample size in this pilot study however, allowed us to detect only eight fractures from 128 containers. In further studies to improve catching techniques more welfare indicators, like bruising and leg fractures, should be included.



NEW ERA OF EVIDENCE-BASED, COMPARATIVE WELFARE-SCORING FOR CANINE DISORDERS USING VETERINARY CLINICAL RECORD DATA

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Welfare in the estimated population of 8 million UK pet dogs is affected by many different health disorders. Without a robust, evidence-based strategy to quantify and compare disorder-specific, population-level welfare burdens in these dogs it is difficult to identify particular disorders where strategic targeting of stakeholder resources could achieve maximum welfare improvement. The concept of Welfare Impact (WI) combines measures of disorder frequency, severity and duration to reflect the holistic welfare importance of individual disorders at population level. WI offers a quantitative, welfare-centric basis for objective disorder prioritisation but application to date has been limited by a dearth of reliable evidence on contributory factors in individual canine disorders. The VetCompass™ Program holds clinical electronic patient record (EPR) data from 4 million dogs attending 500 primary-care clinics UK-wide, and thus is well placed to fill these information gaps.

This project aimed to develop a clinical-data-driven strategy to assess and compare WI in common disorders of UK pet dogs, then apply it to highlight conditions of major population-level welfare concern.

VetCompass™ EPR data were explored to establish a set of robust direct and proxy measures covering three major aspects of WI: disorder frequency, severity and duration. Measures consistently extractable from EPRs and relevant across disorder types were developed into objective assessment tools. Applied within a standardised study design, these tools generated comparable welfare metrics for individual disorders based on case data from a fixed annual period (2013). Simultaneous presentation of these metrics, individually and combined into a WI score, across multiple disorders produced a 'Prioritisation Matrix', that facilitates transparent, evidence-based decision-making. The proposed strategy was tested in eight of the most common breed-related conditions in dogs presented to UK VetCompass™ clinics, highlighting which are priorities for welfare improvement.

This proof of concept has demonstrated that the proposed assessment criteria are applicable across a spectrum of conditions, and supported utility of the overall strategy for evidence-based comparison of potential priority disorders by population-level WI. The 'Prioritisation Matrix' format allows stakeholders to base prioritisation decisions on relative WI but with flexible emphasis on individual contributory factors. This approach is directly applicable using VetCompass™ data in any number of disorder prioritisation scenarios (eg common disorders within-breed, disorders with high media profile). Disorder severity scoring and/or WI assessment tools developed could also be incorporated into studies gathering canine health data prospectively, providing unique or complementary perspectives on welfare effect both within and between disorders.

ANTICIPATORY BEHAVIOUR AS A WELFARE MEASURE? COGNITIVE BIAS LINKED TO ANTICIPATORY BEHAVIOUR IN CAPTIVE DOLPHINS

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Many animals show an increased level of vigilance and/or activity in preparation for predictable events, termed 'anticipatory behaviour'. Anticipatory behaviour can occur before positive and negative events, but the responses seen before predictable, rewarding events have been suggested as a cross-species measure of welfare as it is thought to indicate the balance of the reward-sensitivity system. This is based on the hypothesis that the extent to which a certain reward is valued depends on the presence of other rewards, or lack of them, in the surrounding environment: when less rewards are available, each becomes more valuable. Recently, studies in some species have indeed shown that animals in poorer welfare situations perform higher or excessive levels of anticipation before positive events. Another tool for measuring animal welfare used in current research is cognitive bias testing, and especially judgement bias paradigms, where more optimistic decisions are reflective of positive welfare states. Cognitive bias testing is often time-intensive but is well-established as it allows accurate welfare assessments in many species; conversely, measuring anticipatory behaviour requires much less time and effort to conduct, but the links with affective state are not so well-supported. One study previously attempted to correlate the results of anticipatory behaviour and cognitive bias tests, in order to validate each of these tests further, but found no link. Bottlenose dolphins (*Tursiops truncatus*) in captivity show anticipatory behaviour, such as surface-looking and spy-hopping, before training sessions during which food is provided. Here, we measured anticipatory behaviour frequency in bottlenose dolphins prior to positive reinforcement training sessions, and assessed whether this was correlated to cognitive bias test results. We adapted a spatial judgement test using Positive (herring) and Less-positive (applause and eye contact) reinforcements for the extreme cues. We found that higher frequencies of anticipatory behaviour were significantly associated with more pessimistic judgements in cognitive bias tests. These findings agree with the reward-sensitivity theory and support previous work linking excessive anticipatory behaviour with negative affective states. Further work is needed on other groups of dolphins, as well as investigations regarding the anticipatory behaviour frequency thresholds in relation to welfare. However, anticipatory behaviour is an easily measurable activity and could represent a welfare indicator in dolphins as well as other animals in captive environments. Our results highlight a potential relationship between anticipatory behaviour and cognitive bias tests, and this association could be used as a future validation tool for both welfare tests.



LONG-TERM EFFECTS OF PIGLET TOOTH RESECTION ON MOLECULAR MARKERS OF INFLAMMATION AND PAIN IN TOOTH PULP

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Resection (ie part removal) of piglet needle teeth is a common procedure aimed at minimising injuries sustained by piglets and sows during feeding competition which can lead to infections and productivity losses. However, negative consequences such as local inflammation and infection have been reported, making tooth resection a potential source of pain and distress. Long-term effects of two methods of tooth resection (clipping and grinding) on tooth integrity and markers of inflammation and pain were investigated. Forty-eight female piglets from 8 replicates (litters) were assigned to one of three treatments (SHAM, GRIND, CLIP). Tooth integrity was scored post-mortem at 1 or 6 weeks after tooth treatment (n=8/treatment/time-period). Pulp was extracted from 384 teeth (8/pig), pooled and processed at the pig level to quantify relative changes in gene expression of C-X-C motif chemokine ligand 8 (CXCL8) and calcitonin related polypeptide beta (CALCB) as neuropeptide markers of inflammation and pain using RT-qPCR. All CLIP and GRIND piglets exhibited pulp exposure. Mean percentage numbers of needle teeth with exposed pulp were 0.8%, 65.8%, and 85.8% in SHAM, GRIND, and CLIP respectively. CXCL8 gene expression was significantly increased ($p<0.001$) by both resection methods at both time-periods (mean fold-changes relative to SHAM (MFC) were 333-fold and 483-fold at 1 week and 330-fold and 558-fold at 6 weeks for GRIND and CLIP treatments respectively). CALCB expression was downregulated at both time-points for CLIP (MFC=0.29- and 0.13-fold at week 1 and 6 respectively ($p<0.001$)), but only at week 1 for GRIND (MFC=0.55-fold ($p<0.05$)). These findings indicate that tooth resection by both clipping and grinding induces a prolonged localised inflammatory state lasting up to 6 weeks after injury as evidenced by increased mRNA expression of the pro-inflammatory cytokine CXCL8 within the injured tooth pulp. The two resection methods differentially reduced CALCB expression in the injured tooth pulp suggesting both methods may have implications for dental pain in piglets. Tooth clipping had a greater impact on CALCB mRNA expression which was still present at 6 weeks post-injury. CALCB downregulation may reflect differences in neurogenic responses by dental pulp cells to different severities of tooth damage, although this has yet to be confirmed or otherwise in this study. In summary these findings suggest that tooth clipping and grinding in piglets has differential and detrimental effects on tooth integrity which have implications for sustained inflammatory tooth pain in piglets up to 6 weeks after tooth resection injury.

UFAW MEDAL FOR 'OUTSTANDING CONTRIBUTION TO ANIMAL WELFARE SCIENCE' UFAW 'YOUNG ANIMAL WELFARE SCIENTIST OF THE YEAR'

The **UFAW Medal for Outstanding Contributions to Animal Welfare Science** is a prize that recognises the exceptional achievements of an individual scientist who has made fundamental contributions to the advancement of animal welfare over a number of years. The award is open to individuals whose research, teaching, service and advocacy has had international impact and significantly benefited the welfare of animals. Previous winners have been:

- [2017 Professor Sandra Edwards \(Newcastle University, UK\) and Professor Jeff Rushen \(University of British Columbia, Canada\)](#)
- [2016 Professor Donald Broom \(University of Cambridge, UK\) and Professor Christopher Wathes \(The Royal Veterinary College, UK\)](#)
- [2015 Professor David Mellor \(Massey University, New Zealand\) and Professor Georgia Mason \(University of Guelph, Canada\)](#)
- [2014 Professor Mike Mendl \(University of Bristol, UK\) and Professor David Fraser \(University of British Columbia, Canada\)](#)
- [2013 Professor John Webster \(University of Bristol, UK\) and Professor Peter Sandøe \(University of Copenhagen, Denmark\)](#)
- [2012 Professor Christine Nicol \(University of Bristol, UK\) and Professor Marian Stamp Dawkins \(University of Oxford, UK\)](#)
- [2011 Professor Ian Duncan \(University of Guelph, Canada\)](#)

The **UFAW Young Animal Welfare Scientist of the Year Award** is a prize that recognises the achievements of young scientists who have made significant contributions to improving the welfare of animals. The award is open to students who are currently studying for a doctoral degree and to individuals who are within six years of the end of their PhD work.

Previous winners have been:

- [2017 Dr Pol Llonch \(Universitat Autònoma de Barcelona, Spain\)](#)
- [2016 Dr Rowena Packer \(The Royal Veterinary College, UK\)](#)
- [2015 Dr Jasmeet Kaler \(University of Nottingham, UK\)](#)
- [2014 Dr Lisbet Pluym \(Ghent University, Belgium\)](#)
- [2013 Dr Nuno Franco \(Institute of Molecular and Cell Biology, Porto, Portugal\)](#)
- [2012 Dr Charlotte Burn \(The Royal Veterinary College, UK\)](#)
- [2011 Dr Lucy Asher \(University of Nottingham, UK\), Dr Emma Baxter \(Scottish Agricultural College, UK\) and Dr Lisa Collins \(Queen's University Belfast, UK\)](#)



HSA HUMANE SLAUGHTER AWARD

The HSA Humane Slaughter Award is a prize for individuals or organisations (anywhere in the world) whose work has resulted in significant advances in the welfare of livestock (eg cattle, sheep, pigs, other mammals, poultry or fish) during transport, marketing and slaughter, or killing for disease control.

Previous winners have been:

- [2017 Mr Peter Kettlewell and Professor Malcolm Mitchell \(Scotland's Rural College, UK\)](#)
- [2016 Professor Neville Gregory \(AFRC Institute of Food Research, UK\)](#)
- [2015 Danish Meat Research Institute \(Denmark\)](#)
- [2014 Dr Bert Lambooij \(Wageningen University, the Netherlands\)](#)
- [2013 Institut de Recerca i Tecnologia Agroalimentàries \(IRTA\) / Universitat Autònoma de Barcelona \(UAB\) Animal Welfare Research Group \(Spain\)](#)
- [2012 Stunning and Slaughter Group, University of Bristol \(UK\)](#)
- [2011 Jeff Lines \(Silsoe Livestock Systems, UK\) and John Ace Hopkins \(Ace Aquatec Limited, UK\)](#)
- [2010 Dr Craig Johnson and colleagues \(Massey University, New Zealand\)](#)

DEVELOPING NEW TECHNIQUES TO ASSESS MENTAL WELLBEING IN CAPTIVE PRIMATES

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A crucial part of advancing animal welfare science is developing novel methods to assess welfare and detect suffering. It is important to remember that suffering does not only refer to an animal's physical health, mental health is an important component of welfare too. This is especially pertinent for highly sentient animals like primates. Current techniques for monitoring psychological health in captive non-human primates focus on behavioural observations during the day time period from animal technician staff and veterinarians. Despite sleep and rest taking up over half of the lives of these animals, the nocturnal period is very rarely considered and little is known about what sleep behaviour could indicate with regards to welfare. In order to advance our understanding of when these animals are suffering we need to assess their experiences throughout a wider time period to give a more comprehensive insight in to their lives overall.

Using high definition camera recording and infra-red lighting equipment the nocturnal patterns of a colony of Rhesus macaques (*Macaca mulatta*) housed at a breeding centre facility have been monitored over a two year period. The patterns of behaviour have been analysed, with focus on how patterns fluctuate in relation to the animals experiencing stressful events. This data is the first insight in to the relationship between sleep behaviour and mental health in captive monkeys.

This research aims to advance animal welfare science by including a greater portion of the animal's lives in assessments of their welfare. I will address whether monitoring sleep could be an effective method to detect suffering and whether it should be used in conjunction with current behavioural measures of welfare.



USING THE EXTENDED WELFARE ASSESSMENT GRID TO EVALUATE WELFARE IN CLINICAL SETTINGS

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Wolfensohn's work on developing an Extended Welfare Assessment Grid (EWAG) (1) has shown value for use in assessing laboratory animal welfare. Here we use the EWAG to assess welfare in veterinary patients in clinical hospital settings. The EWAG allows visualisation of the welfare impacts of the clinical condition, the environment in which the animal is required to be kept during clinical care, behavioural deviations experienced by the animal and clinical interventions required to be used on the animal. The shape and volume of the quadrilateral resulting from the deviations along the four axes noted above provides a valuable method of visualising the welfare impact of the disease itself, the environment in which the animal is housed from kennel to critical care unit, the behavioural changes noted in the animal resulting from the disease and finally the interventions required during treatment. Seeing the changes in the resulting quadrilateral over time allows steps to be taken to reduce the impact of welfare compromise in these different areas. In an environment where many individuals are contributing to the care of the animal, plotting such a grid optimises discussion between these different carers (veterinary staff, nursing staff, veterinary students, lay staff) over ways of minimising the welfare impact of the disease and the clinical interventions required. It shows over time how steps taken are impacting on the welfare of the animal. Plotting the EWAG does take time which some consider inappropriate in a busy clinic and some complain that plotting the EWAG is somewhat arbitrary and subjective, but the focus achieved on the welfare of the animal, which can be rather lost with the emphasis on clinical treatment, can optimise steps taken to improve the welfare of the animal. Seeing whether a clinical intervention which may have a negative short-term welfare impact on the animal actually improves welfare in the longer term is facilitated by keeping a plot of the EWAG but probably more importantly plotting the EWAG focuses the clinical staff's attention on these four different aspects of welfare which can too easily be missed if physical changes are the only aspects of improvement concentrated on during the duration of the clinical patient's stay on the hospital.

- (1) Reported in **Honess and Wolfensohn** 2010 'The extended welfare assessment grid: a matrix for the assessment of welfare and cumulative suffering in experimental animals.' *Altern Lab Anim*: 38, 205-212

WEATHERING THE WEATHER: EFFECTS OF THE ENVIRONMENT ON DONKEY, MULE AND HORSE WELFARE

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It is widely believed that donkeys are less adapted to wet, temperate climates than horses. To date there has been no scientific study assessing the shelter needs of donkeys. Our research addressed this important welfare area through three studies conducted in Devon, UK: (1) a comparison of hair coat properties between horses, mules and donkeys over the four seasons, (2) a behavioural study of shelter use (man-made and natural), and (3) a study of heat loss using infrared thermography. In study 1 hair samples were taken from 42 animals, 18 donkeys, 16 horses and eight mules, in March, June, September and December. The weight, length and width of hair were measured as indicators of the hair coat insulation properties. The donkeys' coats properties did not differ much across the seasons, unlike the horses', indicating that donkeys do not grow a winter coat. The donkeys' coats were significantly lighter, shorter and thinner than that of horses and mules in winter. In study 2 the shelter seeking behaviour of 75 donkeys and 65 horses was observed over a period of 18 months. Results showed that donkeys' and horses' behaviour was differentially affected by environmental factors. When it rained there was a 54% increase in the number of donkeys in shelters and only a 14% increase in horses seeking shelter. Most donkeys stayed inside when the temperature was below 10°C and they came outside as temperatures increased. Horses preferred to be outside in temperatures up to 20°C, above which they started to seek shelter. In study 3 we used a thermoimaging camera to take photos of donkeys and horses at different temperatures. In addition to the rate of overall heat loss, the amount of heat lost from specific body areas was assessed (ears, neck, torso, rear and legs). In concordance with the findings of study 1 we found that in cold temperatures donkeys lose more heat than mules and horses, and also that their heat loss is higher through their ears and their rear. These findings provide valuable scientific evidence that can inform future guidelines on the welfare and shelter needs of equines and support the idea that donkeys are less well adapted to temperate climates and may require additional protection from the elements (in the form of man-made shelters) when compared to many horses.



THE INFLUENCE OF AGE, EGG PRODUCTION AND 17 β -ESTRADIOL ON KEEL BONE LENGTH AND FRACTURES

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Keel bone damage is a serious and widespread problem in laying hens which is likely to be painful. It is considered to be a multifactorial disorder. One factor could be egg production because calcium is mobilized from the skeleton for egg shell formation.

The aim of this study was to investigate the influence of age, egg production and 17 β -estradiol on the keel bone.

100 laying hens were divided into 4 treatment groups: "S" (n=38) and "SE" (n=12) were hindered to lay eggs by a subcutaneous implantation of a gonadotropin-releasing hormone agonist. Additionally, "SE" was given subcutaneously a 17 β -estradiol implant. "E" (n=12) only received the 17 β -estradiol implant, whereas "C" (n=38) was control hens.

The keel bone of each laying hen was radiographed 7 times: in the 12th, 20th, 26th, 32nd, 39th, 49th and 60th week of age. The digital radiographs were analyzed for fractures and the length of the keel bone was measured.

Data were analyzed using linear mixed models. Only weeks 32 to 60 were included in the model for fracture prevalence because none of the hens had a fracture before.

Fracture prevalence was significantly influenced by treatment ($p < 0.001$) and age ($p < 0.001$). It was lower in groups S (2%) and SE (8%) compared to C (68%) and E (59%). It increased from the 32nd (33%) to the 39th (41%) and 49th (48%) week of age but slightly decreased from the 49th to the 60th (44%) week of age.

The length of the keel bone was significantly influenced by the interaction between age and treatment ($p < 0.001$). It increased from the 12th (Mean and standard error; C: 9.1 \pm 0.08 cm; E: 9.11 \pm 0.17 cm; S: 9.23 \pm 0.12 cm; SE: 8.92 \pm 0.17 cm) to the 32nd week of age (C: 12.29 \pm 0.08 cm; E: 12.11 \pm 0.17 cm; S: 12.53 \pm 0.12 cm; SE: 12.51 \pm 0.16 cm) in all groups. Afterwards, it remained constant in S and SE while it decreased in C (60th week of age: 11.84 \pm 0.09 cm) and E (60th week of age: 11.97 \pm 0.19 cm).

These results show that egg production seems to play an important role in the etiology of keel bone fractures. The decreasing length of the keel bone in groups C and E could indicate a loss of bone mass. Moreover, keel bone fractures increase with age, but apparently only until about 49 weeks of age.

**“COULD NOT LIVE WITHOUT ONE”
FACTORS DRIVING REPEATED PURCHASE AND RECOMMENDATION OF BRACHYCEPHALIC
DOG BREEDS**

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The popularity of brachycephalic dogs is increasing internationally, despite growing concerns over the numerous, severe health problems associated with their conformation. In 2016, 39663 Pug, French Bulldog and Bulldog puppies were registered with The Kennel Club (UK). If effective interventions aimed at reducing the popularity of brachycephalic breeds are to be developed, a greater understanding of ownership experiences that promote repeated purchase or owner-owner recommendation is required. A cross-sectional survey of current brachycephalic dog owners was conducted using an availability sampling method on an online platform.

A total of 2168 valid responses were received from owners of Pugs (n=789), French Bulldogs (n=741) and Bulldogs (n=638). Respondents were predominantly from the UK (72.0%) and the median age of study dogs was 2.17 years. Nearly one third of owners (29.5%) had spent >£2000 on their dogs' veterinary care to date, and one fifth (19.2%) of dogs had undergone one or more conformation-related surgeries.

The majority of owners indicated they would own their chosen breed again (93.0%); however, fewer would recommend their breed to a first time dog owner (66.5%). In generalised linear models, several factors were associated with an increased likelihood of recommending their breed to a first time dog owner^(a) and/or a desire to re-purchase their chosen breed^(b): breed (owning a Pug)^(a), being a first time dog owner^(a,b), higher emotional closeness^(a,b) and lower perceived costs of ownership with their own dog^(a,b), fewer owner-perceived health problems^(a,b), fewer conformation-altering surgeries^(a), their dog behaving better than they expected for their breed^(a, b), considering their own dog's health to be better than average for their breed^(a,b) and rating their own dog's health more highly^(a,b) (p<0.05).

Free-text responses to the question “What would you recommend most about your breed?” revealed that some owners perceived health problems positively, eg “*I love how dependent my Bulldog is upon both myself and my partner*” or were compensated for by other traits, eg “*He is just perfect and despite some health issues we wouldn't change him for the world!*”; and “*Loving, loyal, owning a Bulldog is like having another child. They are higher maintenance and need regular cleaning. Rewards of owning a Bulldog outweigh the cons*”. These novel data highlight the complex relationships between brachycephalic dogs and their owners. Although negative health experiences may discourage some owners from purchasing or recommending these breeds, in the face of powerful dog-owner relationships, this appears insufficient to halt their increasing popularity.



LOCAL ANAESTHETIC REFINEMENT OF PENTOBARBITAL EUTHANASIA REDUCES ABDOMINAL WRITHING WITHOUT AFFECTING IMMUNOHISTOCHEMICAL ENDPOINTS IN RATS

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Sodium pentobarbital is a commonly used agent for euthanising laboratory rats but its solubility depends on a high pH that can cause abdominal discomfort after intraperitoneal injection. Previous studies suggest that the addition of a local anaesthetic may alleviate this discomfort, but the practice has not been widely adopted despite inclusion in some guidelines for laboratory animal euthanasia. We theorised that this may be due to the absence of adequate evidence of efficacy in the formal scientific literature, as well as concerns that adding to the euthanasia solution might affect experimental endpoints such as immunohistochemical staining for newly expressed proteins which may be affected by choice of anaesthetic. To address the first issue, we examined the effect of combining lidocaine with pentobarbital on abdominal writhing, defecation, ultrasonic vocalisations and the rat grimace scale. Additionally, we performed immunohistochemical staining for c-Fos in the nucleus accumbens and basolateral amygdala of the brain to determine whether this refinement would affect immunohistochemical staining for a protein that is expressed during strong neural activation. We also compared the amount of abdominal writhing following intraperitoneal administration of pentobarbital combined with lidocaine with that of pentobarbital combined with bupivacaine to test whether these results are specific to lidocaine or may be produced by other local anaesthetics. Our results show that lidocaine reduces abdominal writhing and defecation without affecting immunohistochemistry for c-Fos or latency to loss of posture. However, scores on the rat grimace scale were low in both conditions and almost no ultrasonic vocalisations were recorded. Additionally, we found that bupivacaine did not significantly differ from lidocaine in the amount of abdominal writhing. Our findings are consistent with previous work that indicates that pentobarbital-induced euthanasia can be refined with the addition of lidocaine or other local anaesthetics. We have implemented local anaesthetic refinement of pentobarbital euthanasia in other experiments without any apparent effects on immunohistochemical endpoints, suggesting that this approach to refinement does not affect immunohistochemistry. Although we cannot rule out effects on other biomarkers, our study suggests that laboratories using pentobarbital for euthanasia can be further refined using local anaesthetics in a manner that is unlikely to affect experimental results.

“COME BACK WHEN IT’S TIME”: THE A-B-C YARDSTICK FOR VETERINARY EUTHANASIA DECISION-MAKING

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Full-time, small-animal veterinarians each euthanase ~100 owned animals annually. However, systematic criteria for discerning when euthanasia is likely to be in an animal’s interests are still not defined, discussed or taught. That striking absence has avoidable, negative consequences for some animals. For example:

- Anecdotal evidence from the emerging veterinary fields of animal hospice and dedicated at-home euthanasia indicates some owners of sick animals are told, or perceive their first-opinion vet as having told them: “Come back when it’s time [for euthanasia]”. The owners are given appropriate palliative treatments for their animals, but no clear guidance about how to anticipate or recognise “when it’s time”. The anecdotal evidence is that some of those animals suffer very significantly, including from a lingering and distressing natural death.
- When vets recommend euthanasia is now best, theirs is not always a fully informed opinion: it can rely too heavily on physical indicators without taking into account the owner’s expert knowledge of what makes life worthwhile for the animal. Thus, some animals’ lives may be ended prematurely, which—while humanely done—falls short of the unspoken contract by which humans help their non-human animal companions to flourish.
- Conversely, with sophisticated advances in veterinary medicine, the “Supervet” effect, and societal unease with mortality, both veterinarians and owners may avoid discussing euthanasia. Some may instead burden animals with life-prolonging treatments that do not enable the animals to continue to enjoy positive benefits from life.

This situation contrasts with parallels in human medicine, where the question of how proxies of non-verbal human patients might be supported in matters of consent for end-of-life decisions continues to be a matter of close research, education and debate. Likewise, the discourse about farm animal welfare includes notions of “the good life” and “a life worth living”, with attempts to systematically discern and deliver those.

To help resolve these matters for ailing companion animals, their owners, and their veterinarians, I have created The A-B-C Yardstick. A simple discussion tool, it draws on applicable thinking and findings from animal hospice, high-mortality human medical fields, and the notion of animals needing to be “Healthy” (the vet’s piece”) and “Have What They Want” within limits (the owner’s piece).

This talk will briefly review pertinent background research, outline the development and content of The A-B-C Yardstick, and present preliminary data about its utility and efficacy.



WELFARE VERSUS SCIENTIFIC COSTS OF MOUSE IDENTIFICATION METHODS

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Laboratory mice are normally group-housed so choosing a method of individual identification is essential. On welfare grounds ear-notching/tagging are generally considered less costly than tattooing. However, unlike a tattoo, reading ear notches or tags can be difficult and often requires repeated potentially stressful handling. This can increase statistical noise, but because ear-marks can be difficult to read, misidentification may occur such that concerns over scientific integrity could surpass those related to welfare. This study was to gauge the relative costs of ear-tagging or tattooing; but considering their relative impacts from both a scientific integrity and welfare perspective. Tunnel and tail-handling methods were used to determine if the apparent anxiolytic effects of tunnel handling could reduce the welfare cost of tattooing. Male and female BALB/c mice (n=32) were acclimated to each method for 7 days before tattooing or restraint in a 'The Labstamp' tattooing machine. The restraint-only group were ear-tagged 2 weeks later (to minimise numbers). The Mouse Grimace Scale (MGS) and manual and automated behaviour analyses were used for pain assessment, and light-dark, open-field and hand approach-avoidance tests were used to determine anxiety. Misidentification rates by 13 volunteer tattoo/ear-tag readers were used to estimate the potential scientific costs of each identification method. Mice struggled more during tattooing than restraint, and showed more pain-related activity than after either restraint or ear-tagging; suggesting tattooing was more painful. However, not according to the MGS, and by 24h the tattooed mice behaved similarly to those that had been ear-tagged. All groups showed a similar post-procedural depression in active behaviour, increased grooming, and comparable changes in light-dark preference and open-field behaviour. There was therefore little indication of differentially greater anxiety regardless of the procedure experienced. Tattooed mice were as willing to interact during approach-avoidance testing as those that were restrained or ear-tagged, but only if they had previously been tunnel-handled. All tattoos were correctly identified without handling, but all ear-tagged mice had to be lifted, and ear-tag misidentification rates exceeded 30%. Although tattooing may be more painful than ear-tagging or restraint, probably only briefly. This initial welfare cost should be offset against the potential scientific benefits of tattooing in mice; ie true permanency, reading ease and accuracy, and subsequent stress-free identification. Tunnel handling mice was found to be a general refinement that in the absence of contrary evidence should be incorporated into standard husbandry practices.

**SCIENTIFIC
PROGRAMME:
Poster Abstracts**



Posters:

- **Alabi OM, SO Akinoso and FA Aderemi** (Bowen University and University of Lagos, Nigeria)
Blood levels of cortisol and differential leukocytes as measure of stress among egg-type chickens on alternative housing systems
- **Akinoso SO and OM Alabi** (University of Lagos and Bowen University, Nigeria)
Mathematics as an important tool in animal welfare assessments: A review
- **Allen G** (Wild Welfare, UK)
Is a compensation climate in zoos preventing the use of more appropriate animal welfare measures?
- **Al-Rubaye ZR, AH Al-Sherbaz, WD McCormick and SJ Turner** (University of Northampton and Anglia Ruskin University, UK)
Identifying lameness movements in sheep via sensor data analysis
- **Andrews C, J Dunn, M Waddle and M Bateson** (Newcastle University, UK)
How much weight loss is too much?
- **Armstrong E, C Rufener, M Toscano, J Eastham, JH Guy, T Boswell and TV Smulders** (Newcastle University, UK; University of Bern, Switzerland)
Are keel bone fractures associated with suppressed adult hippocampal neurogenesis in laying hens?
- **Bains R, C Witham, H Cater, D Sneddon, P Nolan, S Wells and D Farningham** (MRC Harwell Institute and Newcastle University, UK)
Monitoring social interactions as indicators of health and welfare in mice and macaques
- **Bamford LA and K Snape** (University Centre Myerscough, UK)
Changes in canine skin surface temperature during hydrotherapy using infrared thermography
- **Bell L and S Holmes** (University Centre Myerscough, UK)
Puzzle solving behaviour and vocalisations of African grey parrots (*Psittacus erithacus*)
- **Berteselli GV, L Arena, L Candeloro, P Dalla Villa and F De Massis** (Istituto Zooprofilattico Sperimentale di Abruzzo e Molise "G. Caporale" and University of Teramo, Italy)
Risk factors' evaluation for dogs' welfare housed in long-term shelters
- **Berthelsen C and C Douglas** (Newcastle University, UK)
Why do owners purchase brachycephalic dog breeds with inherently compromised welfare?
- **Binding S, K Cronin and H Farmer** (European Association of Zoos and Aquaria, The Netherlands; Lincoln Park Zoo, USA; Whitley Wildlife Conservation Trust and Paignton Zoo, UK)
The challenges, opportunities and status of animal welfare research in zoos and aquaria
- **Brod S** (National Centre for the Replacement, Refinement and Reduction of Animals in Research, UK)
NC3RS: An update on our work in animal welfare
- **Bushby EV, SC Cotter, A Wilkinson, L Asher, K Griffin, K Stevens, NE O'Connell, M Friel and LM Collins** (Universities of Lincoln, Newcastle, Nottingham Trent, Portsmouth, Leeds and Queen's University Belfast, UK)
Early-life factors and their impact on welfare and health scores in pigs
- **Campos Luna I, F Wemelsfelder, A Miller, A Beard and M Leach** (Newcastle University and Scotland's Rural College, UK)
A method to develop an effective animal welfare protocol: Laboratory mice
- **Cecchi F, G Carlini, L Giuliotti and C Russo** (University of Pisa, Italy)
Inbreeding depression on morphological traits in an Italian population of the Basset hound dog
- **Chapman A, E MacLeod, Y Kane and A Thiam** (World Horse Welfare and University of Edinburgh, UK; Ecole Inter-Etats des Sciences et Médecine Vétérinaires, Senegal)
Investigating the welfare and socio-economic role of working equids in Rufisque, Senegal
- **Clark B, LA Panzone, GB Stewart, I Kyriazakis, J Niemi, T Latvala, P Jones, R Tranter and LJ Frewer** (Universities of Newcastle and Reading, UK; Natural Resources Institute, Finland)
Production diseases and farm animal welfare: What do the public think?
- **Clarkson JM, MC Leach, PA Flecknell and C Rowe** (Newcastle University, UK)
Handling method alters laboratory mice's sensitivity to reward loss and gain

Posters (continued):

- **Clifton R, MC Reeves, J Kaler and LE Green** (Universities of Warwick and Nottingham, UK)
Development of an online learning resource about lameness in sheep
- **Collins LM** (University of Leeds, UK)
Systems within systems: Individual variation through the looking glass
- **D'Eath RB, M Jack, A Futro, D Talbot, Q Zhu, D Barclay and EM Baxter** (Scotland's Rural College, University of Edinburgh and Innovent Technology Ltd, UK)
Using technology to improve animal welfare: 3D cameras can detect lowered tail posture and give early warning of tailbiting in pigs
- **Deckers J** (Newcastle University, UK)
A proposal for an evolutionist animal welfare science
- **Dhoolappa M, KT Lakshmishree, S Sundareshan, RV Prasad, HD Narayanaswamy and A Shanbhag** (Karnataka Veterinary, Animal and Fisheries Sciences University and Manipal Academy of Higher Education, India)
Welfaregraphy: Designing of non-invasive device to monitor animal welfare
- **Di Giminiani P, J Guy and S Edwards** (Newcastle University, UK)
Application of infrared thermography for the evaluation of porcine tail injury
- **Dolman SJ, P Brakes and NK Hodgins** (Whale and Dolphin Conservation and University of Exeter, UK)
Bycatch: What future for marine mammal welfare post-Brexit?
- **Douglas CE, L Eastwood and A Smith** (Newcastle University, UK)
Piloting cognitive bias as a method of welfare assessment in cats
- **Douglas CE, K Redgwick, L Tilley and M Velazquez** (Newcastle University, UK)
The effect of irresponsible dog breeders on dog fear and aggression
- **Edgar JL, G Richards and CJ Nicol** (Universities of Bristol and Oxford, UK)
Socially-mediated arousal within domestic chick broods
- **Eusemann B, A-K Reinhard, L Schrader and S Petow** (Friedrich-Loeffler-Institut and Georg-August-Universität Göttingen, Germany)
Better foot health and fewer keel bone deviations in laying hens displaying a reduced laying rate after treatment with deslorelin acetate
- **Fontani S, L Bryant, J Billingsley, S Courtney, A Lott, A McAuley, DJ Sheppard, HD Swain and S Vaglio** (Universities of Wolverhampton and Durham, UK)
The sensory enriched primate
- **Franchi GA, MS Herskin, CB Tucker and MB Jensen** (Aarhus University, Denmark; University of California Davis, USA)
Use of a feed thwarting test to assess hunger in dairy cows during drying-off
- **Giersberg MF, B Spindler and N Kemper** (University of Veterinary Medicine Hannover, Germany)
A new method of assessing plumage and integument condition in laying hens at flock level
- **Gould L, N Boyland, B Dixon, P Brooke and K Wojtas** (Compassion in World Farming, UK)
Towards humane slaughter for fish in the EU
- **Hammond TJ, SM Brown, SL Meddle, V Bombail and AB Lawrence** (University of Edinburgh and Scotland's Rural College, UK; Université Paris-Saclay, France)
Relationships between responses to tickling, play behaviour and physical condition in male juvenile rats
- **Herskin MS, A Hels, I Anneberg and PT Thomsen** (Aarhus University, Denmark)
Livestock drivers' knowledge about dairy cow fitness for transport – A Danish questionnaire survey
- **Hewitt B, J Hockenhull, C Bunce, J Wilson, J Remnant and HR Whay** (Universities of Bristol, Edinburgh and Nottingham, UK)
Development of a multivariate analytical system to identify lameness in dairy cows
- **Hockenhull J, B Hewitt and HR Whay** (University of Bristol, UK)
Working towards an agreed definition of chronic lameness in dairy cows



Posters (continued):

- **Hockenull J, SM Mullan and DCJ Main** (University of Bristol, UK)
“It’s an independent eye”: Pig farmer perceptions of the value of the welfare outcome assessment element of their farm assurance scheme
- **Howarth ERI, A Engelhardt, CS Wilding, CL Witham and EJ Bethell** (Liverpool John Moores and Newcastle Universities, UK)
Attention bias: A new tool for welfare assessment in captive rhesus macaques
- **Jackson P, A Nasirahmadi, JH Guy, B Sturm, SJ Bulland and SA Edwards** (Newcastle University, UK; University of Kassel, Germany)
Using CFD modelling to assess thermal comfort and welfare in sustainable housing systems for finisher pigs
- **Laws GC, M Craven, H Brearily-Bayliss, K-A Thompson, D Smith, E Whittle, EA Armstrong, J Roughan, T Boswell and TV Smulders** (Newcastle University, UK)
Adult hippocampal neurogenesis as a marker of chronic stress in a mouse model of chronic liver disease?
- **Lee CJ, CR Tyler and GC Paull** (University of Exeter, UK)
Does change matter? Creating stimulating environments for fish in captivity
- **Lopez Salesansky N, D Wells, L Whitfield and CC Burn** (The Royal Veterinary College, UK)
Olfactory effects of husbandry on laboratory mouse welfare: Preliminary findings
- **Mazlan NH, CC Burn and D Wells** (The Royal Veterinary College, UK)
Marking mice: The humanness of ear punching and ear notching versus ink marks on the tail
- **Norman C, J Stavisky and C Westgarth** (Universities of Liverpool and Nottingham, UK)
Imported rescue dogs: Reasons, methods and welfare
- **O’Sullivan JS, C Ladha, Z Belshaw and L Asher** (Universities of Newcastle and Nottingham and VetSens, UK)
Rhythm of the night: Circadian rhythms in activity as a potential welfare indicator in dogs
- **Owles C, C Stevenson and J Harris** (University of Nottingham, UK)
Pain and inflammation associated with pig knee joint osteochondrosis
- **Oxley JA and VT Montrose** (University Centre Hartpury, UK)
Restraint of dogs in vehicles in the UK
- **Oxley JA, AP Wills, VT Montrose, J Bowen and A McBride** (University Centre Hartpury, The Royal Veterinary College and University of Southampton, UK)
Owner perceptions of the effects of fireworks on rabbits and guinea pigs
- **Poirier C and M Bateson** (Newcastle University, UK)
Welfare and biomedical implications of stereotypic pacing in laboratory macaques
- **Quintavalle Pastorino G, E Mercugliano, MS Mazzola and C Spiezio** (Università degli Studi di Milano and Parco Natura Viva – Garda Zoological Park, Italy)
Personality and behaviours of zoo lions (*Panthera leo*) and zoo visitors: Are they linked?
- **Raffle J, JK Bizley and CC Burn** (University College London and The Royal Veterinary College, UK)
Ferret fun: A preliminary study into playtime effects on signs of boredom in ferrets
- **Rauterberg SL, M Fels, N Kemper and M Schmicke** (University of Veterinary Medicine Hannover, Germany) Cortisol and dehydroepiandrosterone as endocrine biomarkers for chronic stress in pigs?
- **Rayner EL, I Otter, H Bacon, L Gamble, H Walters and F Langford** (University of Edinburgh, Scotland’s Rural College and Public Health England, UK; Worldwide Veterinary Service, India and UK)
Assessment of an educational intervention on the knowledge of Indian vets to animal welfare and euthanasia
- **Reese L, G Haase, L von Fersen, M Ladwig-Wiegard, H Will, R Merle, D Encke, H Maegdefrau, K Baumgartner and C Thöne-Reineke** (Freie Universität Berlin and Tiergarten Nürnberg, Germany)
Deflighting zoo birds in the 21st century
- **Russo C, MN Benvenuti, F Cecchi, N Scampuddu and L Giuliotti** (University of Pisa, Italy)
Preliminary study on animal welfare index in sheep farms in Grosseto District

Posters (continued):

- **Smith LM, T Kartal, A Rowan, S Hartmann, A Munteanu, R Quinnell and LM Collins** (University of Leeds, UK; Humane Society International, UK and USA; FOUR PAWS International, Austria)
Investigating the impact of a catch-neuter-vaccinate-release method on the free-roaming dog populations in Asia
- **Spiezio C, C Sandri, C Sammarini and B Regaiolli** (Parco Natura Viva – Garda Zoological Park, Italy)
A six-year story of success and fidelity of zoo Greater flamingos
- **Stirling J** (Edinburgh Napier University, UK)
Does the cage-trapping of corvids cause unnecessary suffering? A behavioural study of trapped magpies
- **Studer BHP, J Volstorf, MF Castanheira, JL Saraiva and P Arechavala-López** (fair-fish international association, Switzerland; Mediterranean Institute for Advanced Studies, Spain)
Assessment of fish species' potential for welfare in farming
- **Su B and P Martens** (Maastricht University, The Netherlands)
How ethical ideologies relate to public attitudes toward animals
- **Tarantola M, E Valvassori, CM Mastrazzo, A Visconti, C Bellino and E Valle** (University of Turin and ASL TO5, Animal Health, Italy)
Horse breeding for meat production: critical aspects and horse welfare
- **Valle E, A Visconti, CM Mastrazzo, D. Bergero and M Tarantola** (University of Turin, Italy)
Reflection on the communication of the equine welfare: The “5F principles” proposal
- **Venis B and CE Douglas** (Newcastle University, UK)
Comparing differences in health and behaviour of newly recognised cross breed dogs (Cavapoo) and parent breeds
- **Yngvesson J, M Wedin, S Gunnarsson, L Jönsson, H Blokhuis and A Wallenbeck** (Swedish University of Agricultural Sciences, Sweden) Let me sleep! – Welfare of disturbed broilers (*Gallus gallus domesticus*)



BLOOD LEVELS OF CORTISOL AND DIFFERENTIAL LEUKOCYTES AS MEASURE OF STRESS AMONG EGG-TYPE CHICKENS ON ALTERNATIVE HOUSING SYSTEMS

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Chickens under different housing systems show diverse responses in terms of performance, sentience, emotions and pain. Egg-type chickens being housed in battery cages are under bad welfare condition hence the recent global shift on to the use of alternative systems for chickens to eliminate stress. With this shift, methods of measuring chicken's response to good and bad welfare still remain inconclusive with various techniques being reported. Changes in levels of many blood metabolites and enzymes have been reported as good indicators of stress among chickens but their reliabilities and reproducibility still remain controversial. Therefore, an investigation was carried out to establish changes in blood levels of cortisol, total white blood cell counts, differential leukocytes and heterophil-lymphocyte ratio as reliable ways of measuring stress in egg-type chickens on different housing systems in humid tropics. 225; 8-weeks old each of Nera Black pullets (NBpx) and Lohman Brown pullets (LBpx) were randomly allotted into three housing systems; Conventional Battery Cage (CBc), Deep Litter System (DLs) and Deep Litter System with outside run (DLr) in a Randomized Complete Block Design (RCB). Each housing system constitutes a treatment group with seventy-five chickens in three replicates for each strain. Routine management practices were strictly observed. Blood collection via wing web veins started at age of 12 weeks and bi-weekly thereafter while the experiment lasted for 24 weeks. Blood sample were analyzed for concentrations of serum cortisol, total white blood cell counts (TWBc), differential leukocytes such as lymphocytes, heterophils. Data generated were subjected to analysis of variance statistically while heterophil-lymphocyte ratios were calculated for each of the experimental groups. The TWBc of the hens were not significantly ($p>0.05$) affected by the housing system and strain. The values for this ranged from 5.05 ($10^3 /ul$) for NBpx on CBc to 5.10 ($10^3 /ul$) for LBpx on DLr. However, the heterophils, lymphocytes and cortisol levels were significantly ($p<0.05$) affected by the housing systems only. Hens on CBc had highest levels of heterophils and cortisol but lowest levels of lymphocytes than others. Hens on Cbc also had the highest values for H/L ratio with the lowest from the hens on DLr. The results of this experiment suggest that these blood indices except total white blood cell counts can be used to measure the stress response of egg-type chickens on different housing systems alternative housing systems with good reliability.

MATHEMATICS AS AN IMPORTANT TOOL IN ANIMAL WELFARE ASSESSMENTS: A REVIEW

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Stress is the major indicator of bad animal welfare which can open doors to other manifestation such as poor growth, poor productivities, diseases and death. Stress can come as a result of poor housing, poor transportation, poor general handling or husbandry of the animal. Emphasis is being laid from animal welfare angle to ensure minimum and maximum floor space, feeding, watering spaces per animal and also stocking densities to make them comfortable within their pen or stall. These efforts are meant to ensure good welfare for the animals and also for maximum productivities. All these are achievable with a good knowledge of mathematics. Stress is an indication of bad animal welfare and measuring the magnitude of stress often means measuring the degree of adaptation through assessment or monitoring of changes in some bio-indices to make meaningful interpretation. These measurements are necessary to ascertain the impact of bad or good practices on animals in order to agree with or jettison theories and or science of animal welfare on. Activities such as data collection, collation and interpretations are done with good knowledge of mathematics. Also mathematical and or statistical models are very useful in laboratory procedures to analyze and interpret data collected on animals. Many mathematical models have been developed to interpret data on general well being of animals and also with predictive values. Multilinear models, regression analysis, polynomial model and calculus are some of the useful tools to assess animal welfare parameters. Efficient, effective and good animal husbandry must be welfare conscious and mathematics is a good tool needed to achieve these most especially precise detection and measurement of animal's response to good and bad welfare.



IS A COMPENSATION CLIMATE IN ZOOS PREVENTING THE USE OF MORE APPROPRIATE ANIMAL WELFARE MEASURES?

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Wild animals have evolved specific skills and behaviours to survive in the wild. Captivity for non-domesticated animals can limit an animal's ability to carry out natural and normal behaviours and without this opportunity, animals will become frustrated. So why do these limitations exist in the first place? Captivity places a restriction on spontaneity and autonomy, and some species behaviours are impossible to accommodate within these confines, for example, animals predisposed to migrate yearly. Zoos and aquariums simply cannot accommodate for every behaviour, but where natural behaviours can be provided for, the captive environment still fails to always provide.

Zoos create environments that must meet a multitude of needs. Health care has often taken precedence in measuring animal welfare and as such, environments are created that allow for easy access, maintenance, intervention, training, and bio-security measures. Sometimes visitor needs are considered over animal needs, ensuring 360 observational access and "pretty" environments that look natural, but don't meet the animal's specific needs. Any limitations brought about by conflict between these needs, are compensated for through management practices such as animal training or environmental and behavioural enrichment. This compensation climate within the zoo culture is self-perpetuating – an unsuitable environment requires the need for intervention, which results in an improvement in animal care and welfare and encourages even further intervention. As such, numerical measures such as the number of health checks or amount of enrichment provided, continues to take precedent over potentially more accurate outcome-based welfare measures that can better quantify the affective states of an animal.

A captive environment can never replicate the spontaneity of life in the wild; or the adaptive behaviours that arise from this extemporaneity, and some form of behavioural and health intervention will always be needed. And zoos cannot provide all the desired or evolved behaviours from every species so must mitigate this by providing stimuli that mimics these behavioural drives and outcomes. So, it may be impossible to create the perfect enclosure, but this cycle of compensation is potentially a barrier to more innovative and up to date measures of welfare being used by zoos and aquariums.

In this presentation, I consider the consequences of prioritising numerical measures in determining enclosure design and animal welfare; reflect on what a "perfect" zoo enclosure environment would look like, and how a more considered approach to animal welfare measures could mitigate the need for compensation management to promote positive animal welfare.

IDENTIFYING LAMENESS MOVEMENTS IN SHEEP VIA SENSOR DATA ANALYSIS

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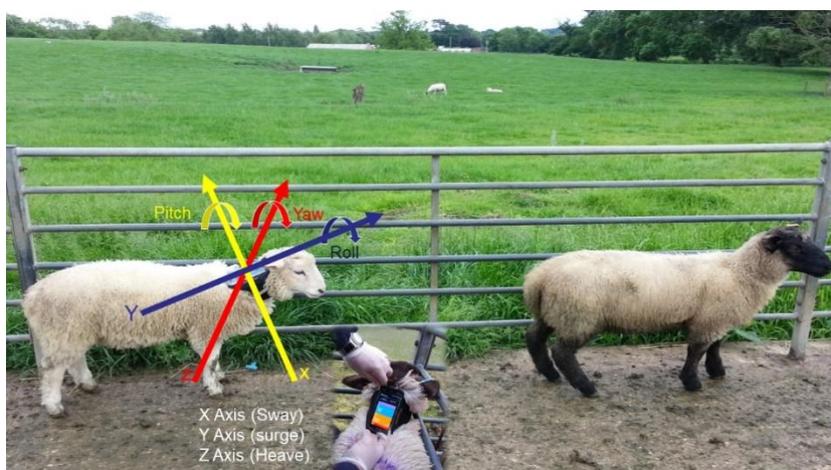
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Lameness is one of the most significant issues for sheep well-being in the UK. Climate changes bringing mild winters and wet summers create muddy soil that is a good place for the *Dichelobacter nodosus* bacteria to survive and transmit easily to the sheep foot and cause footrot; which is one of the common causes for sheep lameness in the UK. According to the report from ADAS (Vickers and Wright, 2013), each lame ewe costs approximately £89.80 because of the decline in its performance alongside the extra labour and treatment costs that are needed. Although lameness is an endemic disease, it could be controlled from being spread within the whole flock. Previously, lameness can be spotted by a trained veterinarian or experienced shepherd either using a visual Locomotion Scoring (LS) or Gait Scoring (GS) system. It was a very time-consuming approach, took many efforts, and tended to be subjective. Therefore, an objective method to monitor the flock via sensor technology has been developed to collect data about the behaviour or gait of the animal to be analysed.

This research aimed to utilise sensor devices to detect the early signs of lameness by collecting the movement measurements of the mounted sensor around the sheep's neck. The collected data were analysed to classify the sheep into the lame and sound classes via machine learning approaches. However, collecting data on behaviour to study the gait changes for the sake of lameness detection in sheep is not a straightforward procedure.

Firstly, the data were collected from Lodge Farm, Moulton College in Northamptonshire from several sheep. The data measurements involved movements of three axes around the neck. The y-axis was positioned to correspond with surge movements (forwards and backwards), the x-axis with sway motion (right and left), and the z-axis with heave (up and down) as shown in the figure below. Then, the raw data such as acceleration and orientation were tested by a range of machine learning classifiers.

The initial results indicated that decision tree was the best machine learning classifier for the sheep sensor-based data. Moreover, the orientation of the surge axis is the best indicator of early signs of lameness; in this context orientation means the value of the angle around the axis which is the roll angle (y axis-surge). The figure shows the deployment of a mobile sensor which is used as a prototype sensor in this ongoing study.



Vickers M And Wright N 2013. Economic Impact of Health and Welfare Issues in Beef Cattle and Sheep in England. Available at <http://www.eblex.org.uk/wp/wp-content/uploads/2013/04/Economic-Impact-of-Health-Welfare-Final-Rpt-170413.pdf>



HOW MUCH WEIGHT LOSS IS TOO MUCH?

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UK legislation (the Animals (Scientific Procedures) Act 1986) requires that all regulated procedures performed on animals have a severity limit, with the objective of setting an absolute maximal limit to any suffering experienced by experimental animals. But in order to achieve this, and to implement humane endpoints, we must be able to assess severity. Guidance from the Laboratory Animal Science Association applies weight loss criteria as part of severity assessment; beyond these limits a laboratory animal's welfare is considered to be excessively compromised, meaning that veterinary intervention or euthanasia be recommended. For example, this limit currently stands at 25% loss of body mass over a seven-day period for 'moderate' severity. These guidelines were developed based on mammalian biology, in particular that of laboratory rodent models. Yet in practice, such limits are often applied across a broader range of animal species used in scientific research, including birds. Here, we consider whether such figures are appropriate for species of small passerine birds commonly used as laboratory models, such as starlings (*Sturnidae*), tits (*Paridae*) or zebra finches (*Taeniopygia guttata*). We first highlight pertinent differences in avian and mammalian biology. Aspects of avian ecology such as flight select for adaptive patterns of weight regulation in birds which are less prominent in mammals. In particular, diurnal, seasonal and ecological changes in body weight can be large in avian species. We briefly review evidence for a range of factors known to influence body mass regulation in small passerine species. Next, we present long-term data on the magnitude of body weight variations among captive colonies of European starlings (*Sturnus vulgaris*) and describe factors affecting it. In addition, we present fine scale temporal data on diurnal mass variation in captive starlings. We compare this to typical body weight variation among laboratory rodents. Based on this evidence, we evaluate the current criteria as inappropriate for small passerines. Our aim is to stimulate further data collation and sharing among avian researchers with the objective of informing and refining future guidance concerning weight loss thresholds across species, to the benefit of laboratory animal welfare.

ARE KEEL BONE FRACTURES ASSOCIATED WITH SUPPRESSED ADULT HIPPOCAMPAL NEUROGENESIS IN LAYING HENS?

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Objective markers which integrate experiences over a long time period and in a valence-specific manner would contribute considerably to animal welfare assessment. In mammals, adult hippocampal neurogenesis (AHN) is suppressed by cumulative chronic stress and persistent pain, whilst being increased by experiences associated with improved mood, such as exercise, environmental enrichment and antidepressant treatment. These responses are largely restricted to the ventral hippocampus, which coordinates emotional behaviours and provides negative feedback to the HPA stress-axis, whilst the dorsal region is involved in spatial memory and cognition. Recent findings in our group indicate that AHN in poultry is similarly sensitive to cumulative chronic stress, and suggest that the caudal pole of the avian hippocampus may be homologous to the stress-responsive ventral region in mammals. Whether AHN similarly reflects the prolonged experience of pain in poultry is yet to be determined.

Keel bone damage in laying hens is prevalent in commercial flocks (>50%), individually variable and likely associated with chronic pain and consequent poor welfare. In an existing longitudinal study, 11 radiographs were taken from Lohmann Brown laying hens housed in a commercial multitier aviary at regular intervals between the ages of 21 and 60 weeks. Each X-ray was taken following 6 days of mobility data collection, which utilised a custom designed infrared tracking system to record transitions between aviary zones. Following scheduled post-mortem, hippocampal tissue was collected from 12 hens with multiple and/or severe fractures linked to a decrease in their activity levels, and 12 hens with no or only minor fractures. As expression of the protein doublecortin (DCX) provides a marker of immature neurons arising from AHN, immunohistochemistry was used to stain DCX-positive cell bodies for stereological quantification in serial sections.

Hens suffering from keel bone fractures had lower densities of DCX-positive multipolar ($p < .001$), large bipolar ($p = .010$), small bipolar ($p < .001$) and tiny ($p < .001$) cell types in the hippocampus as a whole than hens without fractures. In hens with fractures, fewer tiny cells were present at the caudal pole than in the rostral region. These findings indicate that AHN is suppressed by chronic pain in laying hens, as in rodents, and support the potential application of AHN as a marker of lifetime subjective welfare in commercial poultry. Relationships between individual cell counts and both scored fracture severity and mobility data will also be explored.



MONITORING SOCIAL INTERACTIONS AS INDICATORS OF HEALTH AND WELFARE IN MICE AND MACAQUES

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In recent years there has been a considerable advance in our ability to study animal behaviour within the home cage environment through a number of monitoring technologies designed to study specific behavioural ontologies in animal models of disease. Increasingly the focus of such technologies has been to monitor welfare and behaviour so providing an evidence base to advance refinement and improve experimental design. These tools may also help define humane endpoints and facilitate scientific outcomes by providing a greatly enriched data set through continuous assessment of multiple biologically-relevant phenotypes over long periods on individuals, as well as social interactions within the group. One of the key indicators of ill health can be a reduction in time spent on positive behaviours such as grooming and socialising. In hierarchical species social harmony is also essential to controlling aggression and maximising welfare. In this poster we describe two concurrent developments in technologies which are being used with two very different laboratory species (mice and rhesus macaques) to track individuals and study social interactions between individuals. We finish by discussing the potential of such techniques for acting as early warning systems for signs of ill health and poor welfare.

CHANGES IN CANINE SKIN SURFACE TEMPERATURE DURING HYDROTHERAPY USING INFRARED THERMOGRAPHY

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Animal hydrotherapy is commonly utilised therapeutically for treatment of musculoskeletal conditions but has recently gained popularity as a measure of enhancing fitness, controlling obesity and as recreational exercise, particularly in canine and equine industries. The use of hydrotherapy allows for a range of exercise intensities with reduced concussive force on the musculoskeletal system, which is particularly beneficial for injury recovery and limiting negative effects of high-intensity exercise regimes often associated with preparation for competition. Underwater treadmills are popular in canine hydrotherapy as water depth is subject to change dependent on the reason for hydrotherapy, thus anticipated therapy outcomes can be achieved rapidly in comparison to methods such as swimming and static immersion. Differing water levels influence normal locomotion in relation to limb movement, stride length and frequency, and overall gait of the animal. This can have beneficial outcomes in improving locomotion post-injury or surgery, but may have negative consequences if the musculoskeletal system is overexerted, thus affecting welfare. During hydrotherapy skin surface temperature (SST) is a reliable indicator of muscle activity, and therefore exercise intensity, with key muscles facilitating locomotion such as the semitendinosus yielding the most reliable correlations. Physiological changes in response to hydrotherapy in equines are well documented however, the canine response is not well studied thus the current study investigated canine hind limb SST changes in response to water treadmill hydrotherapy utilising a variety of water depths. A Bianco underwater treadmill was used to monitor six healthy canines during hydrotherapy over a period of nine weeks. All animals were subject to three water depth treatments; Treadmill Dry (TD), Depth to Hock (WH) and Depth to Stifle (WS) each repeated once per week, for three weeks at 0.8 kilometres per hours for eight minutes. A FLIR T420bx Thermal Imaging camera recorded the SST temperature over the *semitendinosus* and *gracilis* muscles in the hind limb at pre-determined stages of exercise; pre-exercise, four two-minute intervals during exercise, and post-exercise. A significant difference ($P < 0.001$) was observed for *animal* and *stage of exercise* in both muscles studied, but not ($P > 0.05$) for *week of program* or *water depth*. Findings suggest SST correlates with muscle activity over time however, this seems to be influenced by the individual animal, rather than water depth as previously suggested. During hydrotherapy, consideration of individual animal characteristics should be paramount over achieving therapy objectives to ensure good standards of welfare during recreational and therapeutic programs.



**PUZZLE SOLVING BEHAVIOUR AND VOCALISATIONS OF AFRICAN GREY PARROTS
(*PSITTACUS ERITHACUS*)**

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The *Psittacus* genus are known to be a complex and highly cognitive functioning group of parrots that possess a complex ability to problem solve. Captive environmental enrichment is often used to highlight cognitive function as well as reducing abnormal behaviours and prevent boredom within a captive environment. Four captive reared African grey parrots (*Psittacus erithacus*) were observed in their home environment to determine changes in vocalisations when presented with three problem solving devices varying in complexity named 'easy', 'medium' and 'advanced'. Each puzzle was tested five times per parrot in a random order within 2 h observation sessions totalling 120h over the study. Behavioural responses, latency and time to solve and vocalisations were recorded. Results determined no significant difference between the puzzle type, latency and time to solve despite individual differences in their interaction with the puzzle. 'Age' and 'individual' variables reflected a significant difference ($P < 0.01$) and whether they were 'singularly' or 'pair' housed ($P < 0.05$). Vocalisation and 'parrot' was found to be highly significantly different ($P < 0.05$) with 'whistle', 'accent changes' and 'reward/frustration' behaviours and 'mimic sounds', '1 word' and '2 word' phrases significant ($P < 0.05$). Vocalisations and puzzle type showed no significant difference although individual responses could be noted ($P > 0.05$). Despite interesting findings in this study, further research is needed to be able to fully understand the effects of cognitive environmental enrichment on behaviourally complex species such as parrots, to maximise the benefits of such devices and thus, improve captive welfare.

RISK FACTORS' EVALUATION FOR DOGS' WELFARE HOUSED IN LONG-TERM SHELTERS

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The introduction of no-kill policy for Italian sheltered dogs has resulted in their permanent detention in long-term facilities, if they are not returned to the owner or adopted. In this scenario sheltered dogs can be exposed to many stressors such as poor environment, social deprivation, spatial confinement and changes in their routine. For this reason the welfare of sheltered dogs is an important topic for the scientific community as well as for public opinion.

The aim of this study was to identify the risk factors which affected mostly the welfare of sheltered dogs through the application of the Shelter Quality protocol (SQP) in Italian long-term shelters by linking input/outcome variables.

The SQP was applied in 64 Italian long-term shelters which took part to the study voluntarily. Logistic regression analysis was carried out on data collected to identify the main factors which affect the welfare of dogs in shelter environment.

Management factors such as feeding regimen *ad libitum* (β 0.59; $P < 0.05$) and type of diet with cooked food (β 2.27; $P < 0.001$), the impossibility to access daily to outdoor area (β 0.93; $P < 0.001$) showed a significant association with inadequate BCS. The probability to observe skin lesions was influenced by bedding inadequacy (β 0.54; $P < 0.01$) and bedding type (β -1.0501; $P < 0.05$). The presence of clean bedding materials was significantly associated with lower probability to observe dirty/wet dogs (β -0.86; $P < 0.001$) as well as the presence of one bed per dog (β -0.49; $P < 0.001$). The inadequacy of shelter from adverse weather conditions (β 1.52; $P < 0.001$) and bedding materials (β 1.16; $P < 0.05$) were significantly associated with manifestation of polypnoea. The absence of training activities with dogs (β 0.30; $P < 0.05$), the impossibility to outdoor areas' access (β 0.44; $P < 0.01$) and to walk on leash (β 0.26; $P < 0.05$) increased significantly the probability to observe fear and aggressive dogs' reaction toward humans. The probability to observe signs of diarrhoea increased significantly when the feeding regimen is one/day (β 1.56; $P < 0.01$) or *ad libitum* (β 1.31; $P < 0.05$), and when the access to outdoor areas was not allowed (β 0.72; $P < 0.05$).

The SQP has confirmed its usefulness in identifying most welfare hazards in the shelter environment and management. The identification of critical aspects can also permit to plan strategic interventions in order to minimize the risks and improve the welfare of dogs housed in long-term shelters.



WHY DO OWNERS PURCHASE BRACHYCEPHALIC DOG BREEDS WITH INHERENTLY COMPROMISED WELFARE?

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Brachycephalic (BC) dogs such as Pug, British bulldog and French bulldog are examples of breeds with extreme conformation which is frequently associated with disorders such as brachycephalic airway obstruction syndrome (BOAS). Due to the shortened skull, breathing difficulties negatively impact welfare, yet the breed is increasing in popularity.

Our study furthered recent research into why owners purchase breeds with known welfare issues (we hypothesised children and media may be influential) and to examine the prevalence BOAS in a wider population, some studies used breed populations post-diagnosis. By on-line questionnaire (n=670) we compared the above breeds with similar-sized, non-brachycephalic breeds ("NBC" Border terrier, Miniature schnauzer and West Highland white terrier).

Analysis found BC owners were significantly younger than NBC, but fewer BC were first time dog owners; 83% BC knew their breed's health issues pre-purchase vs. 62% NBC. When asked where they first discovered the breed, more NBC owners stated friend/relative/public arena and more BC had forgotten. Few suggested social media (BC 6%; NBC 3%); advertisement (BC 3%; NBC 5%) or TV/film (BC 2%; NBC 2%). When asked who suggested the breed, more BC replied "me". Only 5% (BC) and 3% (NBC) suggested children. Owners had statistically significant different rankings for breed choice: BC: good breed for children, good companion, childhood experience, temperament and personality; NBC preferentially rated: encourage me to exercise, breed size, dog's exercise requirements, working ability, long life expectancy and trainability.

BC appear to have more signs of BOAS (wheezing/snoring during normal activity, ability/length of walk and recovery time from summer walks). Sleep-related problems (only able to sleep with head elevated / sitting; apnoea) were recorded in 21% BC vs 5% NBC. More BC had veterinary-diagnosed health problems (43% v 22% $p < 0.05$) including diagnosed breathing problems (12% v 1% $p < 0.05$). The average age of onset of signs leading to BOAS diagnosis was 2.2 years vs 6.4 for other conditions.

More owners would recommend NBC (99% vs BC 85%, $X^2 65.27$ $p < 0.001$) and get the same breed again (97% vs 86% BC $X^2 23.15$, $P < 0.001$).

Although BC owners are aware of health problems they acquire BC based on other perceptions, but fewer would get the same breed again or recommend BC compared to NBC. There appears to be a high prevalence of signs of BOAS in the BC population. BC breeds have more diagnosed health problems generally, including breathing-related, than NBC of similar size.

THE CHALLENGES, OPPORTUNITIES AND STATUS OF ANIMAL WELFARE RESEARCH IN ZOOS AND AQUARIA

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Zoological institutions present a suite of opportunities and challenges for animal welfare research. As centres for conservation, education and research, modern zoos and aquaria house a wide range of species; however, group sizes are often relatively small due to space constraints and involvement in captive breeding programmes. In addition, the majority of welfare assessment conducted is purely on behavioural indices, with some physiological measurement but often constrained by legislation, practicalities of data collection, movement of animals between institutions and consideration of animals' primary role in conservation programmes as opposed to research. Zoos and aquaria have the added challenge of being public facing where decisions are subject to media scrutiny. Whilst the challenges of animal welfare research within zoos and aquaria arguably contrast that of solely-dedicated research institutes, there is a rapidly increasing body of applied animal welfare research emerging from zoological institutions. This is reflective of an increasingly evidence-based approach to animal husbandry, a greater understanding of the importance of positive welfare for species conservation, unique access to a diverse range of species and increasing impetus placed on ethical and welfare-based decision making.

This talk will discuss the challenges, opportunities and status of animal welfare research in zoos and aquaria, alongside promoting the cooperative approach with research institutes to further progression in applied welfare best practice.



NC3RS: AN UPDATE ON OUR WORK IN ANIMAL WELFARE

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Promoting animal welfare is a fundamental part of the NC3Rs remit and we support this through funding research, expert working groups, online resources and publications, and organising symposia and workshops. We have made a significant contribution to improvements in laboratory animal welfare and invested over £5 million in research funding in this area. Office-led working group activities focus on specific areas (eg refinements in mammalian models of epilepsy) through to those which have a broader impact (eg refinements rodent handling and housing).

We provide an extensive library of 3Rs resources including guidelines, practical information, publications, videos and training materials. Our resources are used nationally and internationally to help welfare researchers, veterinarian and animal care staff put the 3Rs into practice. For example, the grimace scales have now been disseminated to researchers in over 50 countries.

This presentation will provide an overview of the latest NC3Rs news and updates in the field of animal welfare and discuss our recently published strategy for Improving quality of science through better animal welfare. Further information about NC3Rs activities and programmes can be found at: www.nc3rs.org.uk.

EARLY-LIFE FACTORS AND THEIR IMPACT ON WELFARE AND HEALTH SCORES IN PIGS

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Assessing and understanding an animal's welfare needs is especially important during critical periods, major life events or following a change in conditions, when needs may change or fluctuate. Such periods include early life, as previous research has shown how factors such as litter size, sex ratio and the perinatal environment can influence health and cognitive processes into adulthood, in both humans and non-human animals. In this study, our aim was to investigate sex ratio and litter size as possible early life influences on cognitive bias and physical injury scores, using pigs as a model species. After weaning all 27 Commercial crossbreed PIC337 (Large White x Landrace) pigs were placed in mixed groups in either a barren or enriched environment. Pigs remained in their assigned pen for approximately six weeks and after entering the pen pigs were individually scored depending on their injuries at three different time points; day 4, between day 8 – 17 and between day 29 – 39. As well as this, all individuals were trained to discriminate between reinforced positive and negative locations before they were tested using a spatial cognitive bias test. The findings revealed that pigs originating from a male-biased litter had significantly slower responses to reach all locations in the cognitive bias test in comparison to individuals from female-biased litters, regardless of the sex of the responder. Overall females had higher body injury scores than males, though tail injury scores were associated with the pig's relative weight and litter size showing that within individuals originating from a very large or very small litter the lightest and heaviest pigs had higher tail injury scores. Sex ratio did not influence tail injury scores. Overall, these results show that the size and sex ratio of a litter has the potential to impact on the performance and welfare of that individual into adulthood.



A METHOD TO DEVELOP AN EFFECTIVE ANIMAL WELFARE PROTOCOL: LABORATORY MICE

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In animal welfare, effective protocols are designed to assess all components of welfare including physical and psychological states as well as the environment that houses the animal.

The aim of this study was to create a laboratory mouse welfare protocol that includes all aspects of welfare. The construction of this protocol comprised 3 phases: [1] input of experts through a Delphi consultation, [2] validation of Qualitative Behavioural Assessment (QBA) for assessing the behavioural expressions (emotional states). This validation forms part of a project exploring the utility of the QBA in laboratory animals for the first time. It used free choice profiling, fixed expression validation approach and cross-validation with other welfare measures. Finally, in phase [3] the indicators derived from the Delphi consultation and QBA were aggregated into a single protocol and its reliability and practicability were assessed in different laboratory facilities.

A total of 98 participants completed the final round in the Delphi study with a consensus of 72% being reached. Hunch posture, coat condition, exhibition of normal and abnormal behaviour and usage of nesting material were chosen, irrespective of the nature of the assessment being carried out (daily assessment or welfare audit). The Free Choice Profiling data for the QBA was analysed with GPA (General Procrustes Analysis). The results show a significant agreement between participants in their assessment ($P < 0.001$). The GPA found two main dimensions that accounted for the 78% of the variation observed. Dimension 1 was characterised as 'inquisitive'/'alert' versus 'in pain'/'lethargic' and dimension 2 as 'calm'/'content' versus 'agitated'/'stressed'.

The 3-phase process used to construct the final protocol better guarantees the validity of the indicators it contains, as it encompasses all aspects of mouse laboratory welfare including a novel method of assessing psychological welfare (QBA).

INBREEDING DEPRESSION ON MORPHOLOGICAL TRAITS IN AN ITALIAN POPULATION OF THE BASSET HOUND DOG

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In the selection the inbreeding is used as a mating method because allows to fix the characteristics of the best representative of a breed. However this mating method can lead to high rates of inbreeding with disadvantageous phenomena particularly threatening small populations and those originating from a small number of ancestors. Inbreeding can increase genetic diseases, puppy mortalities and can cause inbreeding depression in terms of the animal's fitness problem and can also lead to a decrease in selection response for economic traits in livestock. As well known, dog breeders choose animals on the basis of standard characteristics, so it would be interesting to know the effects of inbreeding on morphological traits in order to estimate the changes associated with an increase in inbreeding. The aim of this study was to assess the effects of inbreeding on morphological traits in a population of the Basset Hound dog breed raised in Italy. Basset Hound belongs to Group 6 of the ENCI (Ente Nazionale Cinofilia Italiana) and over 400 puppies were registered every year. Currently in Italy there are 32 official breeders, who breed dogs mostly of American and British bloodlines. Traits were taken from 75 dogs (mean age 2.17 ± 1.545 years) (36 males and 39 females) belonging to 19 Italian breeders. For each animal the individual inbreeding coefficient (F) was estimated; the following biometrical measurements were considered: height at withers, height of chest, depth of chest, body length, length at rump, ischiatic width of rump, circumference of chest, circumference of cannon, length of ear, and length of nose. ANOVA was used to test the differences in morphological traits between sexes, among breeders and among animals with different F level. A linear regression of each trait on inbreeding coefficient was added to the model to estimate inbreeding depression. Results showed a significant effect of inbreeding on the depth of chest. The breed standard reports that chest should be neither narrow nor excessively descended. So, in this case, a reduction of the depth of chest could be a "good" inbreeding effect for animals with an excessive depth of chest that would be an undesirable feature for farmers.



INVESTIGATING THE WELFARE AND SOCIO-ECONOMIC ROLE OF WORKING EQUIDS IN RUFISQUE, SENEGAL

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Across Senegal, working equids are used by many of its poorest communities to generate income. Equids with compromised health or welfare are unable to work as efficiently as their higher welfare counter-parts, meaning that the families whose livelihoods depend on them may face adversity due to a loss of direct or potential income.

A combined quantitative and qualitative approach was used to gather socio-economic information and assess the welfare of the equid with work type, working age, general husbandry, body condition, number and severity of wounds, health and disease indicators, lameness, hoof condition and ecto-parasite burden of each equid recorded.

Although owned by only a fraction of Rufisque's population, the socio-economic role that equids play in the lives of many of the city's people is evident yet extremely complex. Almost 88% (95% CI = 81% - 92%) of owners stated that their equid provides the main or sole income for their family. The horse was classed by 97% (95% CI = 93% - 99%) of working equid families as the most important livestock species in terms of income generation.

The main factors found to compromise the welfare of working equids in Rufisque were related to the hours/days worked, the initial working age of the equid and the number of injuries observed. Equids were found to work approximately six hours per day (St Dev 1.08), seven days per week (St Dev 0.96) and they typically start their working lives under the age of two years. Injuries/wounds were found on 86% (95% CI = 81% - 90%) of working equids in Rufisque with the equipment used being the main cause of the injury.

Ownership of an equid provides access to a social network that is difficult to quantify. There is no doubt that the equid-human partnership is a powerful bond, with the vast majority of owners displaying pride in the fact that they work alongside their equid. For many, this type of working life is a choice not a last resort.

World Horse Welfare has been running a community based programme in Rufisque since 2013 focussing on the training of owners, veterinarians and other service providers in the area to improve their knowledge and skills in caring for equids. It is important for this type of support to continue to further improve the welfare of the working equids and also maintain resilience within these communities.

PRODUCTION DISEASES AND FARM ANIMAL WELFARE: WHAT DO THE PUBLIC THINK?

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The sustainable intensification of production is an increasingly common feature of modern farming, with intensive animal production being particularly susceptible to certain production diseases (PD) which can have negative consequences for farm animal welfare (FAW). The public are an important stakeholder at the end of the food chain yet are largely unknowledgeable and unfamiliar with how food is produced including modern animal production systems. Although there is a considerable research focused on public attitudes towards improved FAW, this does not specifically relate to PD or their related interventions. This research therefore seeks to establish public attitudes towards FAW with a specific focus on PD, and whether the incidence of PD and associated interventions represent a barrier to their increased use.

An online survey was distributed in 5 European countries (Finland, Germany, Poland, Spain and the United Kingdom) with a total of 2,330 responses, and explored the risks and benefits associated with and acceptability of PD and associated interventions within intensive pig and poultry production systems. Data was analysed by means of Kruskal-Wallis ANOVA, exploratory factor analysis and structural equation modelling.

Results highlighted that the public have concerns over intensive production systems, including in relation to FAW, naturalness and the use of antibiotics and anti-microbial resistance. The most preferred interventions across all were those that can be viewed as most proactive, namely housing and hygiene measures, with the least preferred interventions relating to the main concerns and risks identified, namely medicine based interventions that raised both humane animal care and food safety concerns.

Whilst legislation will ensure that interventions will deliver safe food the results highlight the need for effective communication of the risks and benefits of the management practices within these systems. Results also highlight the influence of the identified concerns, perceived risks and benefits on attitudes and subsequent behavioural intention, and the importance of including these in subsequent communications with the public.



ESTIMATING THE PREVALENCE OF SELECTED ANIMAL-BASED WELFARE INDICATORS IN RUMINANTS AT ABATTOIRS

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As the majority of ruminants are slaughtered in abattoirs they are potentially an efficient and population-representative location for assessing animal welfare. Currently, severe welfare non-compliances (eg dead on-arrival) are reported to the Food Standards Agency (FSA) and can trigger inspections to farms, markets, and hauliers. Observations of less severe indicators of poor welfare, originating before arrival at an abattoir, could also be used to monitor welfare on farm, at markets, and in transit. The data could provide information for farmers, market owners, and hauliers to improve welfare, as well as to enforce legislation, and be used to benchmark prevalence of welfare indicators nationally.

We investigated the viability of collecting animal based welfare indicators in abattoirs. The occurrence of 12 valid animal-based welfare indicators, feasible to observe in an abattoir, was recorded in 18,084 sheep and 6,490 cattle at 44 visits to 10 abattoirs in Great Britain over 14 months. All but one (bruising) were ante-mortem measures (eg dull demeanour, lameness, injuries, skin irritation/parasites). The origin of animals (farm, market) was determined using abattoir records.

Most sheep had few of the 12 welfare indicators; bruising was the most prevalent indicator (8.5%), followed by lameness (2.2%). The majority of cattle had bruises (68.9%), the next most prevalent indicator in cattle was poor body condition (4.2%). Mixed-effects binomial logistic regression models were used to determine factors associated with bruising in cattle. Bruising was more prevalent in females than males, dairy than beef breeds, and in cattle with injuries and with poor conformation. Tracing animals' origin was not always possible. Abattoirs did not record individual sheep identification and batches were not linked precisely ante- and post-mortem. Individual cattle identities were recorded but it was not always possible to determine whether they had arrived from a farm, collection centre or market.

In conclusion, whilst abattoirs are potentially a valuable location to monitor animal welfare, improvements in the ability to follow the identity of individual animals throughout the production line and link to complete movement records would be needed to ensure accuracy, consistency, and traceability. Whilst the prevalence of welfare indicators was low, if multiplied by the population at risk this is a considerable number of animals affected per year and the inability to link ruminants to farm, market or transit could mask situations where a high proportion of animals had poor welfare. The number of bruised cull dairy cattle is also a cause for concern.

HANDLING METHOD ALTERS LABORATORY MICE'S SENSITIVITY TO REWARD LOSS AND GAIN

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Mice are the most commonly used species for scientific research and millions are housed in laboratories worldwide. The standard method used to handle laboratory mice is known as tail handling and involves the capture, elevation and restraint of mice using their tails. Although widely used as standard practice, tail handling increases anxiety in standard behavioural tests, such as the elevated plus maze, when compared to mice handled using alternative methods, such as in cupped hands or a tunnel. In addition, we have found that tail handling can increase anhedonia, a core symptom of depression relative to mice handled with a tunnel. However despite this evidence, tunnel handling remains to be implemented across research institutions, perhaps because the welfare benefits of this handling refinement have not been fully evaluated and understood.

How an animal responds to both negative and positive stimuli (such as reward) or events can help reveal their underlying affective state. In human patients with negative affective states, such as depression, alterations in how they process and evaluate information can be measured by their responses towards reward gains or losses. Typically, individuals in negative affective states are more sensitive to reward loss (ie show greater disappointment), and less responsive to reward gain (ie show less elation). Therefore, measuring how animal's respond to reward losses and gains offers a useful technique to understand their underlying affective state.

Our experiment investigated if the method used to handle laboratory mice produced changes in their sensitivity to both reward loss and reward gain. We explored how handling method, either using the tail or a tunnel, affected mice's perceptions of rewarding sucrose solution following a shift in reward value. We used two standard protocols where mice initially receive a sucrose solution, and then the sucrose concentration is subsequently reduced (a successive negative contrast or SNC) or increased (a successive positive contrast or SPC). We measured the changes in hedonic responses of the mice by assessing the total amount of sucrose that they consumed and their detailed licking patterns when drinking. These measures suggest that handling method may differentially affect mice's responses to reward loss and gain, and provide insight into how both the positive and negative valence of emotional states is affected by handling method.

We discuss the implications of our findings in relation to animal welfare and for scientific data collection for a wide array of in vivo paradigms, especially those that investigate or involve reward.



DEVELOPMENT OF AN ONLINE LEARNING RESOURCE ABOUT LAMENESS IN SHEEP

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Lameness is a major concern for the welfare of sheep worldwide. In England, footrot is the most common cause of lameness in sheep, and is present on over 90% of sheep farms. Recent research has highlighted the importance of prompt antibiotic treatment, and the avoidance of foot trimming, as key to control of footrot.

Since 2006 there have been a number of initiatives communicating evidence for best practice to manage lameness to farmers. During this time there have been changes in the way farmers treat and control footrot, with fewer farmers using foot trimming and more using antibiotic treatment. However, there have been no initiatives focused on young farmers studying at agricultural colleges. The aim of the current study is to develop a freely available online learning resource about lameness in sheep for students and lecturers at agricultural colleges.

Semi-structured interviews lasting around 30 minutes were carried out with 10 lecturers from different colleges across England. Lecturers were asked about the course structure, their beliefs around lameness management, preferred teaching methods, and what they felt would be useful from an online resource. Focus group discussions lasting around 45 minutes were carried out with groups of 5-8 students on further education courses. There were 8 groups from 5 colleges across England. Discussion topics included student beliefs around lameness management and preferred learning methods. Students were given 6 example resources which led to discussion around their preferences for learning materials. The data from interviews and focus groups were analysed using thematic analysis.

Key findings from the lecturer interviews were that lecturers focused on practical teaching, and reported that better access to high quality images would be valuable. Key findings from the student focus groups were that students preferred images and videos to text, and enjoyed interactive resources. Students reported that they enjoyed practical learning, and that hearing evidence from farmers made them more likely to take on board new recommendations.

The online resource will be made available during spring 2018. Feedback from lecturers and students will be used for ongoing development, and to illustrate the impact of the resource with regards to increased implementation of best practice recommendations for footrot in sheep. This resource will ultimately reduce lameness prevalence and improve the welfare of sheep on UK farms.

SYSTEMS WITHIN SYSTEMS: INDIVIDUAL VARIATION THROUGH THE LOOKING GLASS

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The propensity of individuals to suffer is central to our understanding and quantification of welfare issues. The scales of the systems studied in animal welfare science can differ greatly – from individual dogs presenting with behavioural problems at a clinic, to welfare hazards impacting an entire species, breed, or line that can add up to billions of animals worldwide. Whichever scale we are operating at, be it at the level of the gene, the animal, the farm, country, or the globe, the issue of individual variation continues to muddy the waters of animal welfare science, and potentially thwarts the translation of findings into real-world practice.

But is this individual variation just caused by inappropriate sampling, measurement, human and random errors, or is it that we are missing key pieces of the puzzle? In this presentation, I will discuss recent and emerging evidence on individual variation that shows it can be explained at least in part with an understanding of the how the various underlying pieces of the system fit together and interact. These underlying pieces, include sex, *in utero* and postnatal ontogenetic processes, physiology, epigenetics and the microbes that inhabit the bodies of the animals we are investigating. Findings from these varied fields of research demonstrate clear associations between health, welfare, performance, and development that are all of relevance for captive animal populations. Indeed, we are only just starting to uncover the myriad ways in which these factors alter our understanding of how animals experience the world around them. Appropriate measurement of such factors may allow a more personalised approach to welfare, and will allow us to achieve higher levels of statistical predictive power in our experiments, which could ultimately result in greater validity of welfare measures and further translation of science into practice.



USING TECHNOLOGY TO IMPROVE ANIMAL WELFARE: 3D CAMERAS CAN DETECT LOWERED TAIL POSTURE AND GIVE EARLY WARNING OF TAILBITING IN PIGS

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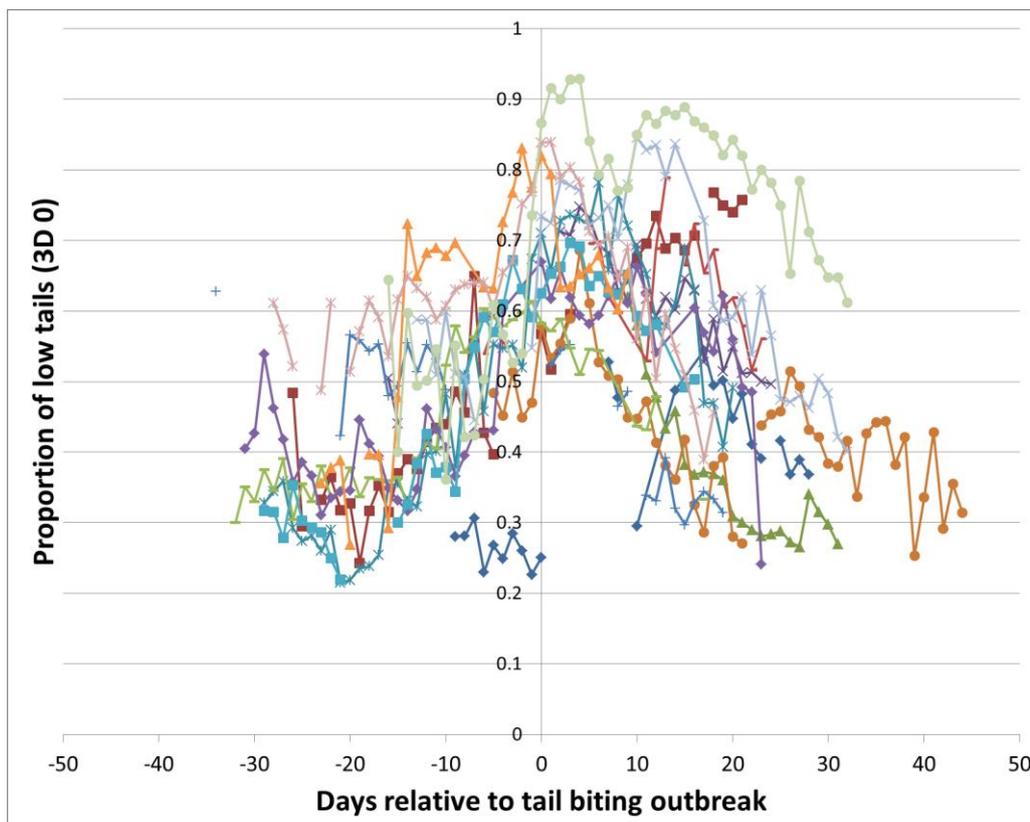
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Tail biting is a major welfare and economic problem for pig producers worldwide. Low tail posture is an early warning sign which could reduce tail biting unpredictability. Based on this, we developed a precision livestock farming approach, using Time-of-flight 3D cameras to automate the measurement of pig tail posture. Commercial partner Innovent Technology Ltd processed raw 3D 'point cloud' data with machine vision algorithms to find pigs and measure tail posture. Validation of the 3D algorithm found it to be reasonably accurate, particularly at detecting low vs. not low tails. 23 groups of 29 pigs per group were reared with intact (not docked) tails under typical commercial conditions over 8 batches. 15 groups had tail biting outbreaks, following which enrichment was added to pens and biters and/or victims were removed and treated. 3D data from outbreak groups showed the proportion of low tail (3D angle = 0°) detections increased pre-outbreak and declined post-outbreak (see figure). Pre-outbreak, the increase in low tails occurred at an increasing rate over time, and low tails was higher one week pre-outbreak (-1) than 2 weeks pre-outbreak (-2). Within each batch, an outbreak and a non-outbreak control group were identified. Outbreak groups had more low tail (3D = 0°) detections in weeks -1, +1 and +2 than their matched controls. Comparing 3D tail posture and tail injury scoring data, a greater proportion of low tails was associated with fewer pigs with uninjured tails and with more injured pigs. Low tails might indicate more than just tail biting as tail posture varied between groups and over time and low tails increased when pigs were moved to a new pen. The use of 3D machine vision to automate tail posture detection has considerable potential for commercial application as an early warning of tail biting. More generally, the automatic collection of behavioural data from either 2D and 3D video has considerable potential in animal welfare science, including applications in research and for various real-world settings such as on farm.



A PROPOSAL FOR AN EVOLUTIONIST ANIMAL WELFARE SCIENCE

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Many laws are based on the assumption that there is a fundamental difference between vertebrates and invertebrates, where this difference is based on the assumption that the latter are, with some exceptions, insentient. This paper explores recent evidence that suggests otherwise, for example by drawing on research with crustaceans and annelids, and provides an answer to the question what moral relevance should be attributed to this controversy. To develop an adequate theory of animal welfare, the presenter will evaluate, in particular, the work of Richard Haynes, who developed a critical stance towards the positions of scholars in the 'animal welfare science community' in his book 'Animal Welfare. Competing Conceptions and Their Ethical Implications' (Springer, 2010). Haynes argued that the concept of welfare has been narrowed down inappropriately, and that a proper definition of the term would go some way to overhauling the moral theories of scholars in the 'animal welfare science community'. It is then argued that animal welfare remains crucial in our relationships with animals, but that most animal welfare theories are inadequate by discarding speciesism and its close relative, evolutionism, the idea that we should attribute more moral regard towards animals the more closely they are related to us in evolutionary terms. At the same time, it is argued that, whilst speciesism is discarded theoretically, many animal welfare theories are, in practice, based on a strong speciesist stance that cannot be maintained. To redress the balance, an evolutionist moral theory will be developed with the aim to give every animal due recognition, where this theory is then applied to the moral controversy around the use of animals for biomedical science. To conclude, a sketch is provided of what this theory would imply for the law on the use of animals in biomedical research, with due recognition to the fact that the political value of this theory would depend on the adoption of a fair and just legal process.



WELFAREGRAPHY: DESIGNING OF NON-INVASIVE DEVICE TO MONITOR ANIMAL WELFARE

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Rising civic concern regarding animal wellbeing and consumer demand for humanely produced products have placed pressure on the livestock industries to improve and confirm the welfare status of their animals. This has increased the need for reliable methods of assessing animal welfare during profit-making farm practices experimental laboratory animals. The measurement of the stress caused by commercial farm practices and animal experiments is a major component of animal welfare assessment. However, a major issue for animal welfare science is that many of the techniques used to measure stress involve invasive procedures, such as blood sampling, which may themselves cause a stress response and therefore affect the measurement of interest. To reduce this problem, a number of non-invasive or minimally invasive methods and devices have been developed to measure stress. These include the measurement of cortisol concentrations in saliva and faeces, and remote devices for recording body temperature, heart rate and the collection of blood samples. Few reports focus on recent advances and current research in the use of infrared thermography (IRT) for measuring stress. Specific applications for IRT in the animal welfare activities are also described including an automated, non-invasive system for early diagnosis of discomfort in animals. The main objective of our study is to design a user-friendly tool which even an uneducated farmer or animal attendant can easily handle and will be able to easily monitor the stress level of an animal. All our field visits exposed that people neglect our fail to notice near the beginning signs of discomfort related problems of their animals. This device monitors the physiological parameters, such as body temperature, and heart beat rate with surrounding temperature. It is essential that non-invasive measures of acute and chronic stress are developed for reliable assessment of animal welfare during standard farm management practices and animal experiments and IRT may be a useful tool for this purpose. IRT may offer advantages over many other non-invasive systems as it appears to be capable of measuring different components of the stress axis, including acute sympathetic and hypothalamic-pituitary-adrenocortical responses. The unique advantages of the device are to overcome low cost, low power consumption device capable of providing real-time communication.

APPLICATION OF INFRARED THERMOGRAPHY FOR THE EVALUATION OF PORCINE TAIL INJURY

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Infrared thermography (IRT) has achieved promising results in detecting injuries and diseases in animals, in particular in the context of lameness in cattle, horses and sows. Superficial skin temperature directly reflects the underlying circulation and tissue metabolism and its alterations may be indicative of inflammatory responses induced by injury or disease. A total of 32 female pigs were exposed to either surgical tail resection (n=16) or sham-resection (n=16) at the age of 17 weeks. One week post-surgery, all animals underwent quantitative sensory testing (QST), which consisted of the delivery of a total of 9 individual mechanical stimuli in three equidistant regions of the tail via a pressure algometer. Three thermographic images of the dorsal surface of the tail were collected from each animal before and immediately following QST. A region of interest (ROI) was delineated in the middle section of the tail and maintained constant for both treatments. Additionally, IRT images were collected pre- and post-QST testing in 17-week old female pigs exposed to neonatal tail docking (n=7) or sham-docking (n=7). The difference pre- and post-testing in mean ROI temperature was compared statistically with a paired t-test. The mean superficial skin temperature was significantly lower in intact tails (pre: 32.13 ± 0.11 vs. post: 29.96 ± 0.43 ; $P < 0.05$) following mechanical challenge. In contrast, a significant increase in mean temperature (pre: 34.79 ± 0.15 vs. post: 35.09 ± 0.14 ; $P < 0.05$) was observed in tails subjected to tail resection. While mean temperatures recorded in intact tails 17-weeks post-docking significantly decreased following QST (pre: 31.44 ± 0.28 vs. post: 28.20 ± 0.75 ; $P < 0.05$), docked tails exhibited no change (pre: 32.25 ± 0.46 vs. post: 32.28 ± 0.60 ; $P = 0.876$). To the best of our knowledge, this is the first attempt to quantify the change in superficial skin temperature of pigs exposed to tail injury. The observed increase in temperature one week following resection may be attributable to the expected increase in vascular activity in response to inflammation. However, differences in superficial skin temperature observed in 17-week old pigs exposed to neonatal tail docking may suggest a long-term effect of the injury on the vascular activity of the affected region, with implications for the physiological pain response. Due to the novelty of this application, further research is fundamental to understand whether the observed response is a feature typical of painful conditions, such as neuropathy observed in humans, and what this means in terms of the overall pain experienced by the animals.



BYCATCH: WHAT FUTURE FOR MARINE MAMMAL WELFARE POST-BREXIT?

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The incidental entanglement of marine mammals in fishing gear (bycatch) is an important welfare issue in UK and international waters. More than 2,000 marine mammals (mainly harbour porpoises, common dolphins and seals) are estimated to die in UK gillnet fisheries alone and thousands of common dolphins die in pelagic trawls in the English Channel each year. Although data are limited, there are indications that humpback whales in Scottish waters might not be recovering from historic whaling, due to the number of creel entanglements. There are clear differences in the types and degree of injury bycaught cetaceans receive, and these vary with species and with age. Pathological data indicate that the majority of bycaught cetaceans asphyxiate in the nets. Other bycaught cetaceans can suffer a variety of injuries and high levels of stress during incidental capture. Documented effects, for those that escape or are released from fishing gear, include behavioural alterations, physiological and energetic costs, such as associated reductions in feeding, growth, or reproduction (ie fitness), leading to reduced long-term survival. Further, mitigation efforts may lead to displacement from important habitats, with unknown welfare implications. The impacts of bycatch upon individuals can only be understood with dedicated observations and reduced with effective mitigation. Despite this, effort has been based upon European regulations implemented in 2004 that are not entirely fit for purpose. New legislation and policy that is likely to result from the UK leaving the European Union should provide an opportunity to improve measures to reduce levels of marine mammal bycatch and associated welfare implications. To improve welfare, the following considerations should be included in a UK bycatch strategy, to ensure that it is fit for purpose for the fishery and species in question: a) providing incentives for fishermen to reduce bycatch will produce the best results (encouraging them to implement best practise – such as reporting all incidences, requiring e-monitoring and adaptive management, resulting in moving away from areas where marine mammals are seen); b) further development of the evaluation of welfare impacts on bycaught marine mammals (post-mortems from landed and stranded individuals) should be undertaken; c) transparency; and d) a multi-taxa approach to monitoring and mitigation, wherever possible. Further, in addition to population concerns, investigation into the sub-lethal effects of bycatch-related injury and stress on fitness are required, including improved understanding of the injuries suffered, the length of time to asphyxiation and the social implications of individuals dying.

PILOTING COGNITIVE BIAS AS A METHOD OF WELFARE ASSESSMENT IN CATS

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Cognitive bias tasks, originating in human psychology, have been used to indicate welfare in rats, pigs, rabbits and dogs, but not cats. It is an expanding research area as it can also measure the presence of positive emotional states. Cats can be relatively undemonstrative so measuring welfare can be difficult.

Our aims were to investigate:

- 1) whether cats could be trained for cognitive biases tasks using locations
- 2) tests of cognitive bias in circumstances likely to be more or less stressful (study 1: a quiet environment in the rescue shelter vs noisy environment in the rescue shelter next to barking dogs; study 2: cats housed in their own homes vs cats in a rescue shelter)

Food preference tests were performed to maximise individual cat participation. Cats were trained in their home environment in a go/no-go task to discriminate between a “positive” location rewarded with food (hidden in a cardboard box) or a “negative” location (box, no food [lemon slices used in study 2]) approximately 1m apart. Once the cats had successfully completed the training (16 correct responses of 20 trials), a test of cognitive bias was performed by placing the empty box in the middle “ambiguous” location. The cats’ responses (go/no go within 30 seconds and latency to go) was recorded.

The cats could be trained to discriminate between locations and the pragmatic cognitive bias protocol could be conducted by one person.

In study 1, “noisy environment” cats (n=4) had higher stress scores (Wilcoxon signed rank, $H_2=5.74$ $p<0.05$), three showed pessimistic bias, one optimistic. All 4 “quiet environment” cats showed optimistic bias but this was not significant (Fishers exact $p=0.14$). The small sample size was due to cats being rehomed. However, results may suggest that cats may have a more negative affective state when housed near barking dogs.

Again in study 2, cognitive bias between cats in domestic homes (5 optimistic, 3 pessimistic) and the rescue shelter (2 optimistic, 6 pessimistic) did not differ statistically significantly (Fisher’s exact $p=0.13$).

Our study shows that cats can be trained and cognitive bias protocols are possible. Repeating these studies with a larger sample size and using products designed to reduce stress (such as herbal Pet Remedy, or synthetic pheromone Feliway) may further establish if this type of cognitive bias protocol is an effective measure of cats’ affective state and could therefore be used to assess welfare including importantly positive quality of life.

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THE EFFECT OF IRRESPONSIBLE DOG BREEDERS ON DOG FEAR AND AGGRESSION

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Puppies from puppy farms have higher morbidity and mortality. Our study explores the effects of acquiring a puppy from a less responsible breeder on later fear and aggressive behaviour. We also explored research undertaken by the owner before acquiring a puppy.

The survey questions were from the Canine Behaviour and Research Questionnaire "CBARQ TM" and about the breeder and the owners' opinion of the breeder. This was distributed to owners of three breeds online via breed clubs and social media.

Of 975 usable responses 30% were Collies; 22% Spaniels and 48% Labradors. Logistic regression showed that breed was not a significant predictor of behaviour, so analysis (Welshes ANOVA) used amalgamated data.

We categorised 9% of breeders as very responsible if the: puppy's mother was seen, accommodation was categorised as good, puppies lived in the breeder's home, puppy had been checked by a vet and wormed, only 1 litter was available, only 1 breeding female was present and a puppy contract was used. While mean scores for all fearful and aggressive behaviours were preferable for dogs from these breeders, only stranger-directed fear was approaching significance (mean 0.25; SD 0.56 vs 0.37; 0.7 $p=0.076$). Using respondents' intuitive classification of "responsible" (compared to satisfactory or irresponsible) 73%, dog-directed fear (mean 0.39, SD 0.6 v 0.68, 0.82 $p=0.000$); Stranger-directed fear (0.27, 0.58 vs 0.58, 0.89 $p<0.000$); dog-directed fear (0.56, 0.68 v 0.79, 0.91 $p<0.000$) and non-social fear (0.57, 0.57 v 0.70, 0.72, $p<0.01$) were significantly different.

There were correlations between our score (0: very responsible - 8 very irresponsible) and owner-directed aggression (0.48, $p<0.01$) and stranger-directed aggression (0.58, $p<0.01$).

While 87% of respondents did some research into acquiring their puppy, only 23% researched the breeder. These dogs were less likely to be aggressive towards other dogs, strangers, or exhibit general fear. Where the RSPCA and Animal Welfare Foundation's puppy contract was used these puppies grew into dogs that showed the least of all the above aggressive and fear related behaviours.

There were no differences in dog behaviour between first time owners and more experienced owners. However first time owners did appear to do less research on the breeder (36observed, expected 55, chi-square 12.3 $p<0.01$).

A dog showing elevated fear and aggression is a less desirable companion, but if frightened, or in a situation where it has learnt to show aggression is also likely to be experiencing poorer welfare than dogs not showing these behaviours.

There is an opportunity for prospective dog owners to improve the behaviour and welfare of their companion by taking more time to research the breeder.

SOCIALLY-MEDIATED AROUSAL WITHIN DOMESTIC CHICK BROODS

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Farmed animals are exposed to situations which may reduce their welfare and the social environment has the potential to either alleviate or magnify this effect. Indeed, for domestic chickens, both stress and unwanted behaviours may spread quickly across large groups of individuals, through socially-mediated arousal and social facilitation. In the current study, we measured the responses of 9-week old domestic chicks (n=19 broods) to the mild stress of their brood mates, who were unrelated but raised together from hatching. Pairs of observer chicks were exposed to two treatments in a counterbalanced order: AP consisted of an air puff applied to a trio of conspecifics at 30s intervals; CN consisted of an air puff directed away from the apparatus at 30 s intervals. During each test behaviour and surface eye temperature of subjects and observers were measured throughout a 10-min pre-treatment and a 10-min treatment period. Both subjects and observers responded to AP with increased freezing (Subjects; $p < 0.001$, Observers ; $p < 0.001$), and reduced preening (Subjects; $p = 0.001$, Observers; $p = 0.001$) and ground pecking (Subjects; $p < 0,001$, Observers ; $p < 0,001$). Subjects, but not observers, decreased the time they spent sitting ($p=0.009$). Both subjects and observers also showed reduced surface eye temperature (Subjects $p < 0.001$; Observers $p < 0.001$) indicative of stress-induced hyperthermia; changes which were highly correlated within broods. None of these changes were observed for subjects or observers during the control treatment. The results demonstrate that domestic chicks show social facilitation of negatively-valenced behavioural responses and associated socially-mediated arousal. Future work should examine the extent to which the presence of such social phenomena observed in response to a mild stressor has implications for the spread of stress to husbandry-relevant stressors in large groups of commercially-housed chicks.



BETTER FOOT HEALTH AND FEWER KEEL BONE DEVIATIONS IN LAYING HENS DISPLAYING A REDUCED LAYING RATE AFTER TREATMENT WITH DESLORELIN ACETATE

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Being part of a larger study investigating the effect of egg formation on bone health, the aim of this study was to investigate the effect of deslorin acetate on egg production and bone health in laying hens.

A total of 40 Lohmann Selected Leghorn (LSL) hens were kept in a floor system. At the beginning of the experiment 20 hens (Group 1) were 21 weeks old and 20 hens (Group 2) were 14 weeks old. Half of each group received by subcutaneous injection a Suprelorin® implant (Virbac, Carros, France) containing the gonadotropin-releasing hormone agonist deslorelin acetate. The hens were examined weekly; an ultrasonography of the ovary was performed and egg production was monitored. In addition, digital radiographs of the keel bone were taken at 27 and 35 weeks of age (Group 1) and at 20 and 27 weeks of age (Group 2), respectively. The radiographs were analyzed for fractures and deviations. In case of a keel bone deviation, the deviated area was measured and divided by the whole keel bone area to get the proportion of deviation.

Hens treated with deslorin acetate showed significantly fewer follicles at the ovary ($p < 0.001$, Tukey-Kramer). Egg production was completely suppressed for 6 weeks. Afterwards, 2 treated hens of Group 1 and 4 treated hens of Group 2 started to lay eggs again within the experimental period of 16 weeks. The control hens of Group 1 had significantly more keel bone deviations compared to treated hens of Group 1 ($p < 0.05$). In addition, they showed a significantly larger proportion of deviation than the treated hens of Group 1 (mean and standard error: 27 weeks of age: control hens: 4.80 ± 0.64 %, treated hens: 2.14 ± 0.64 %; 35 weeks of age: control hens: 6.34 ± 0.64 %; treated hens: 2.55 ± 0.64 %; $p < 0.05$, Tukey-Kramer). Some of the hens (Group 1: 10 control hens, 2 treated hens; Group 2: 9 control hens, 2 treated hens) developed bumble foot during the experiment. Interestingly, control hens were significantly more affected than treated hens ($p < 0.05$, Chi-squared analysis).

These findings indicate a possible relationship between egg production and keel bone health on the one hand and egg production and susceptibility to foot pad dermatitis on the other hand. This last point might indicate differences in the reactivity of the immune system between non-laying and laying hens.

THE SENSORY ENRICHED PRIMATE

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Enrichment can be defined as a dynamic process that structures and changes the captive animal environment by increasing the opportunities for expression of species-specific behaviours, by improving the psychological, physiological and behavioural wellbeing, and by decreasing the occurrence of abnormal behaviours. The induced ability to respond appropriately to stress and to cope with challenges is widely considered an important aspect of wellbeing and it is now a fundamental aspect of zoo animal husbandry. Increasing numbers of studies are investigating the impact on captive primate behaviour by environmental enrichment programmes; however, these studies have mainly focused on food and manipulative enrichments, neglecting the potential of sensory ones. This multi-zoo project aims to investigate the effects of a newly designed environmental enrichment, based on scent and acoustic stimuli, in captive groups of three primate species across all major lineages (lemurs, monkeys, apes) – Bornean orang-utan (*Pongo pygmaeus*); emperor tamarin (*Saguinus imperator*); and red-ruffed lemur (*Varecia variegata rubra*). We carried out a pilot study at Dudley Zoological Gardens (UK) and Twycross Zoo (UK), of which we will discuss our preliminary findings. We will collect further data at Twycross Zoo (UK), Tiergarten Schönbrunn (Austria) and Apenheul Primate Park (The Netherlands). This project integrates commonly used behavioural observations with established faecal hormone and innovative acoustic signal analyses, constituting a novel approach to the question of how sensory enrichment may improve primate welfare and how these enrichments can be tested empirically. It will provide findings which should also entail quantifiable impact, such as best practices adopted by target zoos and extended to other institutions through amendments in management policies released by EAZA Studbook Keepers and Taxon Advisory Group Coordinators for the study species.



USE OF A FEED THWARTING TEST TO ASSESS HUNGER IN DAIRY COWS DURING DRYING-OFF

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The dry period (DP) is an important stage of the production cycle of dairy cows as it allows for treatment of intramammary infections and renewal of udder cells before the next calving. The DP comprises management changes with likely negative effects, such as sudden cessation of milking and provision of nutrient-reduced diet impairing energy balance even when fed for *ad libitum* intake. This ongoing work proposes a behavioural test, 'feed thwarting test', to assess separate and interactive effects of two milking strategies (gradual or abrupt cessation of milking) and two different feeding strategies (lactation diet or energy-reduced lactation diet with forage-to-concentrate ratios of 51:49 and 65:35, respectively, *ad libitum*) on the degree of hunger. Healthy loose-housed Holstein cows with a milk yield of at least 15 kg/d are randomly distributed to four treatments (milking frequency x feeding level) 7 days before the last milking (dry-off day when they start being fed a ration whose forage-to-concentrate ratio is 92:08, *ad libitum*). Thwarting tests are conducted on days -5 and 2 relative to the dry-off day between the two morning feedings at 0700h and 1100h. The test is conducted in a test pen next to the cows' home pen permitting visual contact to peers. The first test day comprises of two phases, a familiarization and a testing phase. Initially, the experimental cow is offered a small portion of concentrate in an open plastic box and its task is to approach the box and eat the concentrate. In the second phase, the cow returns to the testing pen where it finds two similar plastic boxes, the same familiar box with a small portion of concentrate and an equally sized box closed with a wired-mesh lid, and full of concentrate, that can only be seen and smelled, but not reached and eaten. From the moment the cow sniffs or touches one of the boxes, its subsequent behaviours are registered for 5 minutes. On the second experimental day, only testing is conducted. Latency to approach the boxes, attempt to access the concentrate in the wired-mesh box and bites, pushes, licks and vocalizations are recorded. We expect that cows on a nutrient-reduced diet and twice-daily milking, related to a greater energy demand, will express the highest level of these behaviours during the test. The behavioural responses are interpreted as signs of hunger and possibly frustration due to not being able to access the feed.

A NEW METHOD OF ASSESSING PLUMAGE AND INTEGUMENT CONDITION IN LAYING HENS AT FLOCK LEVEL

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Feather pecking and cannibalism are major challenges and serious welfare issues in modern laying hen husbandry, particularly after the ban on conventional cages in the EU and the (future) abolition of beak trimming in many European countries. Besides time-consuming direct behavioural observations and video analyses, the assessment of plumage and integument condition provides useful information about the occurrence of these behavioural disorders. However, most scientifically established assessment methods require capture and handling of individual hens (hands-on scoring, HSc) which may be stressful for the animals when carried out in large flocks on a regular basis. The aim of the present study was to validate a mere visual scoring method (VSc) in conventional layer hybrids (Lohmann Brown plus, LB+) and dual-purpose breeds (Lohmann Dual, LD).

Therefore, a total of 1,800 untrimmed hens per genetic strain was housed conventionally in four compartments of an aviary system. VSc was carried out weekly (20th -71st week of life) in five previously defined locations of the barn. The hens' plumage and integument condition was scored on five body parts (head/neck, back, tail, wing, breast/belly) using a five and four point scale, respectively. In addition, HSc was carried out on seven study days applying the same scoring system as for VSc.

In LB+ hens, minor plumage damage started at the age of 25 weeks and increased to the 71st week, so that between 22.5% (wing) and 99.5% (back) of the LB+ hens showed feather loss to a different extent. In contrast, only 2% of the LD hens showed minor feather loss (head/neck, breast/belly) which remained constant throughout the laying period. Integument damage occurred in 0.5% of the LB+ hens in week 46, reaching a peak with 6% affected hens in week 66, and decreasing to 2.5% of injured hens at the end of the study. No injuries were found in LD hens.

Spearman's rho for the comparison of plumages scores given in VSc and HSc was >0.90 and significant for all body regions, except for breast/belly ($r_s=0.45-0.50$). However, VSc and HSc were equally valid for detecting skin injuries of all body regions ($r_s>0.86$, $P<0.01$).

In conclusion, the mere visual method presented in this study offers a sound alternative for determining the plumage and integument condition in laying hens at flock level, both when the animals were highly - as the conventional layer hybrids - and slightly - as the dual-purpose breeds - affected by feather loss and integument damage.



TOWARDS HUMANE SLAUGHTER FOR FISH IN THE EU

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Fish are the most utilised animal group on Earth. An estimated 1-3 trillion fishes are caught each year, and up to 140 billion are farmed for food. By comparison, the number of birds raised for food each year is over 60 billion and the number of mammals is over 3 billion. However, there are large knowledge gaps in our understanding of fish welfare and different species' needs compared to terrestrially farmed species. Central to the concept of welfare is that an individual has the capacity to suffer and, historically, fish have frequently been denied having this capacity. There is a substantial, and growing, body of evidence which shows that fishes are sentient, and therefore we have a moral obligation to consider their welfare. While demand for fish consumption increases, research and development to improve fish welfare has never been so important. Slaughter presents a major welfare issue for both wild and farmed fish; we have reviewed evidence into methods of slaughter for various species and found that many are killed inhumanely, without effective stunning. For example fish may be immersed into ice slurry, into water saturated with carbon dioxide, decapitated, asphyxiated in air, exsanguinated by gill cutting and even gutted alive, all whilst still conscious. In addition to the killing method, pre-slaughter handling practices present significant welfare issues. However, progress is being made; humane slaughter methods are available for some species, and for others they are currently under development. Percussive and electrical stunning equipment is becoming more widely available for different fish species, although further research is essential to confirm effective parameters are used. The OIE has published guidelines on the welfare aspects of stunning and killing of farmed fish for human consumption or for disease control purposes. We make evidence-based recommendations for improving the welfare of fish, through research, food business engagement and policy change.

RELATIONSHIPS BETWEEN RESPONSES TO TICKLING, PLAY BEHAVIOUR AND PHYSICAL CONDITION IN MALE JUVENILE RATS

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The tickling paradigm is a well-established model used to elicit positive emotional states in rats, but there is little investigation into the model's relationship with play behaviour and how pre-existing characteristics (eg physical condition) influence the response of individuals to tickling. 64 adolescent (age 28 days) male Wistar rats, (split into two batches) were housed in pairs and assigned to treatment (tickling) or control (neutral handling). One animal within each cage (n = 32, 16 per cohort) was handled. During handling, frequency modulated ultrasonic vocalisation (FM USV) production and approach behaviour in the form of hand-following (HF) was measured. Prior to handling, home cage play was recorded for 5 minutes. There were significant cohort effects in tickling responses, play and body weight. In cohort 1 (C1), tickled animals produced more FM USVs ($F_{1,89.1} = 36.18$, $p < 0.001$) and showed increased HF compared with controls ($F_{1,88.7} = 16.46$, $p < 0.001$), both measures indicating that tickled animals were in a more positive emotional state. In cohort 2 (C2), treatment had no effect on FM USVs ($F_{1,94} = 0.44$, $p = 0.508$). However, there was no difference in HF between batches ($F_{1,188} = 0$, $p = 0.948$) with tickled animals also showing increased solitary play ($F_{1,94} = 5.03$, $p = 0.027$). Compared with C1, C2 produced fewer tickle-induced FM USVs ($F_{1,94} = 6.98$, $p = 0.01$), had a lower starting body weight ($F_{1,188} = 50.25$, $p < 0.001$), reduced average daily gain ($F_{1,188} = 35.95$, $p = 0.008$) and also showed less solitary and social play (solitary; $F_{1,94} = 5.74$, $p = 0.019$; social; $F_{1,94} = 3.37$, $p = 0.069$). These results suggest some degree of dissociation between tickling responses and play behaviour; whilst solitary play was increased by tickling, social play was not. Measures of the tickling response were also dissociated as whilst USVs and HF responded to treatment, only USVs were sensitive to a cohort effect. Ultimately, this suggests that the relationship between tickling and play behaviour is more complex than previously described.



LIVESTOCK DRIVERS' KNOWLEDGE ABOUT DAIRY COW FITNESS FOR TRANSPORT – A DANISH QUESTIONNAIRE SURVEY

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Dairy cows are transported by road to slaughter after their productive life. Cull cows are vulnerable to transport stress, and can only be transported when fit for the intended journey. However, the decision, as to whether a cow is fit is rather subjective and relies on the farmer and the livestock driver. Using questionnaire methodology, we aimed to describe knowledge about, and experiences with, dairy cow fitness for transport among Danish livestock drivers. During nine days of data collection at the three largest Danish cattle slaughterhouses, 66 drivers (55% of the national population of cattle drivers) answered a questionnaire (response rate: 97%). They were Danish males (mean age: 49 years), of which 94% stated that they knew the rules regarding fitness for transport. More than half of the respondents said that physical conditions (light, space) before loading animals allowed proper assessment of fitness for transport, and 85% answered that time constraints were not a challenge for this. Thirty-five percent reported to be in doubt regarding fitness for transport of specific cows at least frequently, and given two specific questions on legislation concerning fitness for transport, only 52% of the respondents answered both correctly. The results add new knowledge about livestock drivers' approach to animal welfare. As drivers are held partly responsible for fitness for transport of animals sent to slaughter, and descriptions of fit/unfit are rather vague, livestock drivers seem to need additional education, training, assessment tools or feedback in order to optimize the welfare of animals to be transported.

DEVELOPMENT OF A MULTIVARIATE ANALYTICAL SYSTEM TO IDENTIFY LAMENESS IN DAIRY COWS

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Despite extensive research efforts, lameness remains a key welfare issue in the dairy industry. With around a third of all dairy cows in the UK experiencing lameness at any one time, it is a threat that poses serious economic losses to the farmer. While policy exists to manage the associated risk factors, such as farm management and nutrition, the problem still persists. This project hypothesises two reasons for this persistence: the varied approach to defining the issue, with disagreement among researchers about the scoring system used; and the tendency for observers to misdiagnose mildly lame cases. As the disease has the potential to cause difficult to treat, chronic pain it is important to have a universal identification system to diagnose the disease early, before the cows' experience long-term suffering. To address these issues, this project took the form of two complimentary elements: the first aimed at using historical data on dairy cows' behaviour and physiology, to develop a new multivariate analytical system; while the second aimed to determine whether there are any variables currently overlooked, which could prove advantageous to the development of the scoring system, by interviewing the experts. To conduct the first study, the commonly recorded variables; mobility score, milk yield, body condition score, fertility and somatic cell count, were normalised and combined (using MATLAB) to generate an overall lameness score. This score sat within a spectrum, allowing researchers to identify each cows' severity of lameness and also the distribution among the herd. By expanding out the definition of lameness it is more appreciative of individual differences and researcher bias. With further development, farmers will be able to electronically enter the recordings into a database, where the code will automatically calculate the lameness score; an efficient and cost-effective solution. The second study interviewed eight experts within the field to get a greater understanding of where the gaps in our knowledge of lameness were. The interviews were transcribed and analysed (using NVivo) to show reoccurring themes and variables, providing a greater insight into the biomarkers of lameness. By understanding the varied pathology of lameness, we can then better understand when the disease becomes chronic and how this long-term problem can be treated.



WORKING TOWARDS AN AGREED DEFINITION OF CHRONIC LAMENESS IN DAIRY COWS

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Lameness in dairy cows has received considerable research attention over the last twenty years resulting in raised stakeholder awareness of the problem and a greater knowledge of management measures that can reduce the risk of lameness occurring. Regular mobility scoring is now advocated by levy boards as well as being a requirement for some UK farm assurance schemes. Prompt detection and treatment is critical for the effective management of lame cows. Yet this does not happen in all cases. Less is known about what happens to cows that end up living with lameness on a long term basis. This may include cows who did not receive treatment in time to resolve the underlying pathology, those who suffer from recurrent bouts of lameness, and those who never become acutely lame but whose mobility is compromised. It is acknowledged that lameness is associated with pain in cows. In human medical literature, three months is commonly taken as the cut off between experiencing acute and chronic pain. The distinction between acute and chronic conditions in dairy cows is not so clear cut. From a veterinary perspective lameness is often considered resolved once the underlying lesion appears to have been treated effectively. However, this may not be reflected in the cows' subjective experience of pain or their mobility score. The aim of this project is to better understand how stakeholders define chronic lameness in dairy cows and how this is framed around the duration of lameness, the severity of the problem and the impact on productivity and quality of life. A shared understanding about what different stakeholders mean when they talk about chronic lameness is critical before we can begin to address this ongoing welfare issue. An iterative, qualitative methodology will be adopted, initially to gather the opinions of different stakeholder groups, most crucially dairy farmers and vets, to ascertain the array of different understandings and language surrounding cows with long term mobility issues. Subsequently, a multi-round consultation process will seek to develop a shared definition of chronic lameness that can be taken forward in future research to establish the significance of chronic lameness in the national dairy herd and how this may be addressed in practice to improve dairy cow welfare.

“IT’S AN INDEPENDENT EYE”: PIG FARMER PERCEPTIONS OF THE VALUE OF THE WELFARE OUTCOME ASSESSMENT ELEMENT OF THEIR FARM ASSURANCE SCHEME

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As part of their farm assurance scheme, UK pig farms routinely undergo welfare outcome assessments (WOA). These assessments are intended to take place 3-4 times per year to monitor welfare standards on farm, to advise and support welfare improvements where necessary, and ultimately to provide evidence of welfare standards within the pig industry to the consumer. The assessors, typically the farms usual vet, are expected to feed their findings back to the farmer, to discuss how any changes that might be needed can be implemented, and to benchmark the farm against their past performance and that of others within the industry. This mechanism for farmers to monitor and review their own farms health and welfare performance is a critical part of the process. Anecdotal evidence suggests there is considerable variation within the WOA process, particularly in the feedback the farmer receives. Semi-structured interviews with 15 pig farmers were conducted, face-to-face (n=14) or by telephone (n=1), to explore their perceptions and experiences of the WOA process. Thematic analysis of the resulting transcripts revealed three key themes around which the majority of the farmers’ discussion revolved. The WOA was favourably received by many farmers, and several spoke of the value of having “an independent eye” looking over their animals, particularly in identifying any changes since the last assessment that the farmer may not have noticed from their daily contact with the pigs. However, the perceived value of WOA was largely dependent on the specific vet involved in the assessment process and the farmer’s relationship with them. The second theme concerned the farmers’ beliefs about what animal welfare is and how they believed the public perceived and defined it. Very occasionally these two viewpoints aligned but more often the farmers’ saw them as incompatible and believed that public concern for welfare was not supported by their behaviour as consumers, which led some to question the value of WOA as part of farm assurance schemes. The third theme that emerged from the interviews was the broader value of farm assurance schemes for both individual farmers and for the industry, with a diverse range of opinions being expressed. Overall, these data provide a valuable insight into farmers lived experience of WOA, from which we can draw recommendations for good practice when conducting WOA as well as beliefs that should be addressed to promote farmer buy-in to the welfare components of farm assurance schemes.



ATTENTION BIAS: A NEW TOOL FOR WELFARE ASSESSMENT IN CAPTIVE RHESUS MACAQUES

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The way humans interpret information is associated with self-reported feelings of wellbeing and physiological changes in neuromodulatory hormones with anxiolytic functions. Laboratory-based cognitive tasks that record responses, for example, eye-movements, to emotional stimuli have revealed that biases in attention reliably map onto physiological and self-reported measures of affect. In humans, an attention bias (AB) profile can be used to identify individuals who are vulnerable to poor psychological health. These methods can be adapted to measure AB in non-human primates (NHPs), providing a new measure of welfare, an area notoriously difficult to assess. The study builds on work showing AB to be a promising new method of welfare assessment, to validate a state of the art eye tracking tool to non-invasively assess captive primate welfare. Thirty female rhesus macaques (*Macaca mulatta*) will be used and data collection will occur before and after the macaques' annual health check, an acutely stressful event. Following this, the next step in NHP AB research is to understand the underlying biological mechanisms. This is crucial for gaining a rounded understanding of the role of AB in the aetiology of affect-related disorders in NHPs. Urinary oxytocin and salivary cortisol will be measured to determine if these hormones correlate with shifts in AB. It is known that genotype influences AB, therefore, previously collected samples from all 30 macaques will be used for analysis of 5-HTTLPR and oxytocin receptor gene polymorphisms to determine if these variations also correlate with shifts in AB. Further, the changes in cortisol and oxytocin will be compared to the genetic data to build an understanding of the relationship between these hormones and 5-HTTLPR and the oxytocin receptor gene respectively.

USING CFD MODELLING TO ASSESS THERMAL COMFORT AND WELFARE IN SUSTAINABLE HOUSING SYSTEMS FOR FINISHER PIGS

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Finishing pigs tend to choose their lying location according to the most comfortable area in terms of temperature and air velocity. However, if they choose to lie within the designated dunging area or in front of the feed/water locations, this can result in unhygienic conditions and group unrest, leading to impaired welfare and reduced growth and feed efficiency. Designing improved housing systems for pigs requires understanding of the climatic needs of pigs coupled with an effective environmental control system. The aim of this research was to determine whether there was a difference in the combined velocity and temperature values, described as the effective draught temperature (T_{ED}), between the locations where finishing pigs consistently chose to lie within a fully-slatted pen and the areas that they avoided. A Computational Fluid Dynamics (CFD) model of an existing pig building in the UK, containing a room of 292 pigs at 40 kg liveweight, was constructed in a specialist software package (DesignBuilder, V.5.0.3.007; EnergyPlus 8.1, DesignBuilder Software Limited, Stroud, UK). The exact position of the pigs was taken from video recordings, selecting images from 6 am, 12 pm, 6 pm and 12 am during two test days, namely a typical summer day (29th August 2015) and a typical winter day (10th February 2015) in the UK. The external air and internal room surface temperatures were extracted from a verified dynamic thermal model, then inserted into the CFD model to produce air velocity and temperature data in three dimensional axes (X, Y & Z). The data were then used to determine the extent to which the actual lying patterns of the pigs could be reliably predicted by the CFD model, and thus whether this method can be used to assess the thermal comfort experienced by finishing pigs under different climate scenarios. A successful tool could then be used to provide the pig industry with a greater understanding of the thermal comfort of animals and so aid the development of practical solutions to improve ventilation and animal welfare in both existing and new housing systems for sustainable pork production. This methodology might also be able to provide a more reliable means of establishing the optimum position of resources and functional areas, such as drinkers, dunging and lying areas, to promote stable social groups and efficient production.



ADULT HIPPOCAMPAL NEUROGENESIS AS A MARKER OF CHRONIC STRESS IN A MOUSE MODEL OF CHRONIC LIVER DISEASE?

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Many rodents are being used in biomedical research into chronic conditions. As part of this research, the condition (or a proxy for the condition) is induced in the animals in order to study mechanisms of disease progression and/or develop treatments. Often, the animals will suffer because of this induced condition. Most of the time, the suffering itself is not part of the research, so methods to relieve suffering without interfering with the validity of the disease model would be desirable. However, to be able to evaluate the effects of such interventions, we need a way to measure the animals' suffering.

The level of adult neurogenesis in the hippocampus may be a good proxy for animals' chronic suffering, as this process is known to be down-regulated by chronic stress and chronic pain. In this study, we use hippocampal neurogenesis as a proxy for the chronic stress condition of mice with induced liver fibrosis. Experimental mice were exposed to injections of CCl₄ (carbon tetrachloride), a well-known liver toxin, every 2 weeks for 8 weeks. They were then killed to collect tissues for liver research, and we collected the brains. These mice were compared to 3 other groups to better understand the effect of CCl₄ on chronic stress/pain: a positive control group, a negative control group, and a vehicle injection group. The positive control group underwent 8 weeks of unpredictable chronic mild stress (UCMS), a procedure which reliably induces a depressive-like state in mice, concurrent with suppressing hippocampal neurogenesis. The negative control group were mice of the same strain who lived in their home cages, undergoing only routine husbandry. The vehicle control group was injected with olive oil only every 2 weeks for 8 weeks, to differentiate the potential stress of injections from the potential chronic stress of the liver disease.

At the end of the study, all animals were tested in an open field maze. Time spent away from the walls of the arena in UCMS mice was half that of the negative controls. However, CCl₄ mice spent just as much time away from the walls as the negative controls. We then processed the brains for the expression of doublecortin, a marker of newly-generated neurons in the dentate gyrus of the hippocampus. In the dorsal hippocampus, no treatment differences were detected in doublecortin staining. However, in the ventral hippocampus, which is involved in stress regulation and which is known to be more sensitive to chronic stress, there was significantly less doublecortin staining in the UCMS mice than in the control mice. Doublecortin staining in the ventral hippocampus of the CCl₄ mice did not significantly differ from the control mice, and was almost significantly higher than in the UCMS mice. The tentative conclusion from this result is that biweekly injection with CCl₄, resulting in liver fibrosis, does not induce the same level of chronic stress and anxiety as Unpredictable Chronic Mild Stress.

DOES CHANGE MATTER? CREATING STIMULATING ENVIRONMENTS FOR FISH IN CAPTIVITY

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Fish welfare is of increasing public and regulatory concern. In the rapid global expansion of facilities housing fish for research, however, most attention has been aimed at facility economics and maximising production, and welfare considerations have largely focused on water quality. The zebrafish (*Danio rerio*) is a popular model organism for scientific research. Zebrafish are native to the Indian subcontinent where they are found typically in vegetated waters. In contrast, laboratory fish are usually kept in bare aquaria for ease of maintenance and because tanks used are generally small and do not lend themselves to the addition of physical enrichment structures. Environmental enrichment is often purported as the solution to improving wellbeing in captive fish. However, many enrichments are not compatible with research facilities. It was hypothesised that significant welfare benefits may be achievable through simple practical solutions easily adapted to current practices in research laboratories. To investigate these new approaches, this study examined the effects of simple changes in the tank environment on the wellbeing of laboratory-maintained zebrafish. It was hypothesised that moving fish between tanks of identical status (bare) would provide positive stimulation equating to more complex enriched environments. Groups of zebrafish were either housed in 'stable' environments (where they were maintained in the same tanks throughout the study) or in 'changed' environments (where they were periodically moved to novel but identical tanks). Comparisons between treatments included effects on morphometry (length, weight and condition), reproductive success (egg output and viability) and aggressive behaviour. No effect of simple tank changes was found on body condition, reproductive output or aggression, for the periods of time studied, indicating that more complex scenarios in housing tank conditions are required for significant welfare benefits for captive zebrafish.



OLFACTORY EFFECTS OF HUSBANDRY ON LABORATORY MOUSE WELFARE: PRELIMINARY FINDINGS

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With a highly sensitive olfactory system, mouse physiology and behaviour is influenced by the scents of other animals and chemicals found in the environment. Some odours commonly found in laboratories could produce stress and defensive responses that might confound experimental research and impact on mouse welfare.

A UK survey showed wide variation in routine husbandry procedures requiring the use of potentially odorous personal protective equipment and sanitizing products. Following up on the results of the survey, experiments were performed to determine to what extent mouse behaviour was affected by variation in potentially odorous aspects of husbandry.

Mice had no significant preference for interacting with handlers wearing nitrile versus latex gloves, but they appeared slightly averse to bare hands. When mice were handled using gloves that had previously been used to handle conspecifics of the same or different strain or sex, mice showed behaviour consistent with social responses to the conspecific odour source, eg being attracted to gloves used to handle the opposite sex. Similarly, in an open field cleaned only with water, mice urine-marked significantly more than in open fields cleaned with detergents; they showed no significant avoidance or attraction to the different cleaning products. When gloved hands were cleaned with ethanol rub before handling, cagemates sniffed each other more than when handled with plain gloves, BALBc mice approached the hands less frequently, C57BL/6J mice showed more defensive burying and sex differences in grooming, and males of both strains showed less aggression immediately afterwards.

Understanding how common odorous substances affect mouse welfare will help refine mouse husbandry and experimental procedures, improving mouse quality of life and experimental data obtained from them.

MARKING MICE: THE HUMANNESS OF EAR PUNCHING AND EAR NOTCHING VERSUS INK MARKS ON THE TAIL

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Most biomedical research is carried out on mice. Since laboratory mice are usually housed in visually homogenous groups, individual identification is often required. Many methods are used to identify individual mice, with some methods being more invasive than the others. Our aim was to assess the welfare consequences of the most commonly used identification methods. An online survey of UK and Irish mouse units, revealed that ear punching and/or ear notching followed by marker pen marking were the most commonly used identification methods. Therefore, these were the three methods we compared.

We found that both ear punching and ear notching frequently caused a head flinch during marking, followed by significantly increased homecage ear-grooming, and freezing compared with unhandled controls. The next day, ear notched mice were significantly less likely to consume a novel food than controls were.

Turning to tail-marking with ink, a two-choice Grice box preference test confirmed suggestions in the literature that marker pen odour was aversive to mice, at least when mice are exposed to the uncapped pen itself.

A final study used pair housed mice, with one unmarked mouse and its cagemate who was (a) ear-punched, (b) ear-punched with local anaesthetic, EMLA cream, (c) tail-marked with a pen, or (d) left unmarked. Applying EMLA cream before ear punching caused significantly more ear-grooming than any other treatment. The unmarked cagemates of mice that were ear-punched, with or without EMLA cream, groomed their marked cagemate significantly more than any other mice. Mice ear-punched with EMLA cream and their cagemates were significantly less likely to consume novel food the next day compared with tail-marked or unmarked mice. With regards to tail-marking, which was repeated weekly, mice defecated significantly more at Week 1 than at Weeks 3 and 4. There were no significant treatment effects on faecal corticosterone or elevated plus-maze behaviour.

In conclusion, when considering whether weekly tail-marking could be a refinement over ear punching and/or notching, we found that mice tolerated weekly handling for tail-marking, despite their aversion to the fresh marker pen odour. No significant differences were found between tail-marked and unmarked mice. Conversely, ear punching and notching – with or without EMLA cream – increased some signs of pain and anxiety relative to controls. These findings suggest that weekly tail marking using marker pen could be a good alternative to ear punching and/or notching.



IMPORTED RESCUE DOGS: REASONS, METHODS AND WELFARE

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In recent years the phenomenon of rescuing dogs from overseas appears to be increasing in popularity. This study investigated the reasons people choose to rescue from abroad, the process they used to get the dog and potential welfare problems associated with this practice. An online questionnaire was advertised on social media and received 3080 responses from people, living in the UK, who had adopted a rescue dog from abroad in the last 5 years. Participants primarily chose to adopt from abroad based on want for a particular dog they had seen advertised and concern for its situation, however some had been refused dogs from UK rescues. Dogs came from 44 countries, primarily Romania (34%, n=1035) and most were found on the street (61%, n=1865). Predominantly adoption occurred through an organisation (92%, n=2773) and participants found the process extremely easy and felt they had sufficient support and advice. The EU Pet Travel Scheme was used to import 89% and only 1.2% of dogs were imported correctly under the Balai Directive (no=37). Many arrived with health conditions (20%, no=603). Furthermore, zoonotic parasites *Leishmania infantum*, *Dirofilaria immitis* and *Linguata serrata* had an apparent prevalence of 14.8% (79/533) 3% (12/396) and 2% (5/252) respectively. Most respondents who have rehomed their dog or considered it since adoption, did so because of behavioural problems (70%, n=218). Behaviour problems of the imported rescue dogs appears comparable to that of other rescue dogs and predominantly, participants were happy with their decision to adopt from abroad. It is important vets consider exotic diseases when seeing imported patients. Our findings emphasise the importance of clear guidelines on travel laws and stricter checks on animals imported under the EU Pet Travel Scheme to ensure compliancy with legislation.

RHYTHM OF THE NIGHT: CIRCADIAN RHYTHMS IN ACTIVITY AS A POTENTIAL WELFARE INDICATOR IN DOGS

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Modern sensor technology allows behaviour to be measured continuously over days, weeks, or even months. This means that daily rhythms in behaviour can be examined at resolutions and over durations not previously possible. In humans, circadian rhythms in behaviour alter in poor states of welfare such as stress, anxiety or pain and in response to a wide range of diseases. Here we outline why circadian rhythms in general activity could be a useful indicator of welfare in the domestic dog. We present data from dogs with and without a chronically painful disease to illustrate this point, but also provide a theoretical overview of how circadian rhythms in activity might be associated with welfare. Activity data (measured as the vector magnitude, vm^3 , from a collar-mounted tri-axial accelerometer) were collected over 7 days for 20 pet domestic dogs of various breeds with osteoarthritis and 20 healthy controls. We used a cosinor mixed model to explore the degree of fit to a 24 hour circadian cycle and examined the effect of including additional harmonic terms which accounted for shorter cycles (12, 10, 8, 6, 5, 4, 3 and 2 hours added in a stepwise fashion). Overall model fit was judged by R^2 values and individual was included in models as a random effects term. Arthritic dogs displayed heightened nocturnal activity levels and depressed daytime activity levels (Figure 1). The best fitting model for healthy and arthritic dogs included cycles of 24, 12 and 8 hours in duration. Healthy dogs' activity fitted much better to a cosinor model of circadian rhythm ($R^2=0.2$) than arthritic dogs ($R^2=0.04$). This suggests that arthritic dogs have a disruption in the normal circadian rhythm of activity. Findings fit with previous owner reports of shifting position and discomfort during sleep in dogs with arthritis. There could be a number of explanations for differences between arthritic and healthy dogs in their activity patterns. The welfare implications of these different explanations is discussed and tentative conclusions presented about the potential for circadian rhythms as a welfare indicator in dogs.

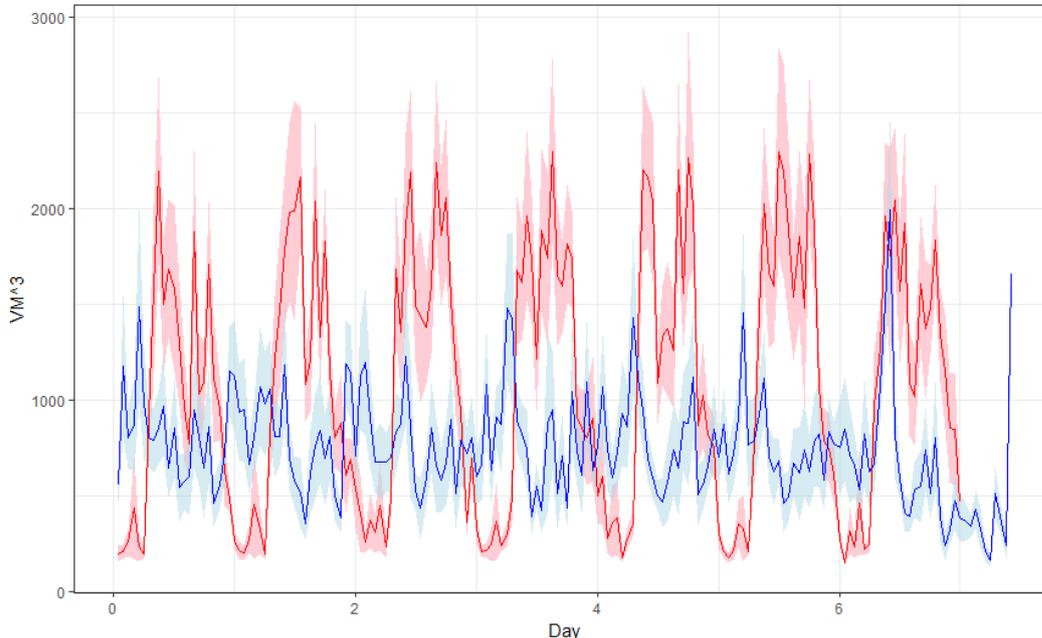


Figure 1. Activity of dogs with (blue) and without osteoarthritis (red) over 7 days. Arthritic dogs have a lack of circadian rhythm to their activity. Solid line is mean values and shaded area is standard error.



PAIN AND INFLAMMATION ASSOCIATED WITH PIG KNEE JOINT OSTEOCHONDROSIS

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An estimated 20% of the UK pig herd suffers from lameness which can be caused by a number of joint diseases. Osteochondrosis (OC), due to a degenerative failure in cartilage formation, is one of the most common diseases affecting growing pigs with an estimated incidence of over 80%. Despite its prevalence, OC is poorly understood; the subclinical nature of early OC and its ability to repair makes characterising the disease difficult. However, OC is likely to cause pain which raises animal welfare concerns and could have economic implications. Characterising the relationship between OC, inflammation and pain is an important step in understanding the disease.

'Landrace x Large White x Duroc' crossbred sows (9-months-old, weight 76-96kg [n=6] and 15-months-old, weight 124-156kg [n=6]) were assessed for pain over 7 days using a visual scoring system assessing factors such as lameness and response to human interaction. Knee joint OC was assessed post-mortem both macroscopically and histologically and synovial tissue was collected to assess synovitis (hyperplasia of the synovial membrane). The expression of matrix metalloproteinases (MMPs, enzymes involved in extracellular matrix breakdown), tissue inhibitors of MMPs (TIMPs) and inflammatory cytokines in the synovial tissue was assessed using qPCR.

Pigs showed pain ranging from absent to severe and all animals showed an altered gait at least once during the observation period. Macroscopic OC was identified in 22 knees and severity strongly correlated with lameness ($r^2=0.719$, $p=0.01$, Spearman's Rank Correlation). Synovitis ranged from absent to severe and although there was no correlation to pain behaviours or OC severity it was noted that pigs with severe synovitis had the most severe pain. Synovitis was associated with increased expression of the inflammatory cytokine interleukin-6 ($r^2=0.600$, $p=0.004$, Spearman's Rank Correlation). Synovitis was also associated with increased MMP1 and MMP3 expression ($r^2=0.549$, $p=0.006$ and $r^2=0.517$, $p=0.010$ respectively Spearman's Rank Correlation) but TIMP expression was unchanged.

These findings indicate a direct relationship between OC and pain and have identified potential inflammatory markers of synovitis. Increased expression of MMPs and the lack of a corresponding change in their inhibitors (TIMPs) during synovitis could lead to further cartilage breakdown and joint damage. However, further work is required to understand the relationship between synovitis and OC, to determine if inflammation occurs independently to, or as part of, an OC pathology. Understanding pig OC and the involvement of joint inflammation could help identify new treatment and prevention strategies, which is important for improving pig welfare.

RESTRAINT OF DOGS IN VEHICLES IN THE UK

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Within the United Kingdom, many dog owners travel by car with their dog(s). Despite guidance in the Highway Code that dogs should be suitably restrained, large numbers of dogs are thought to travel without restraint in cars. Unrestrained dogs have the potential to distract drivers and could cause an accident resulting in injury and even death. Despite the prevalence of dogs' travelling in cars, and concerns raised over the restraint of these dogs, to date, there is limited information available on the restraint of dogs in vehicles in the UK. The aim of this study was to determine the frequency of use of vehicular dog restraint devices, the methods of restraint used and the reasons for restraining, or not restraining, dogs in vehicles.

Dog owners and drivers in the UK (n=690) completed an online questionnaire providing information on how often they drive with their dog and the location of their dog when driving, as well as whether their dog is restrained whilst driving, methods used to restrain their dog and reasons for use of restraint methods. Dog owners frequently drove with their dogs, with the highest proportion of respondents (33.2%) driving with their dog between 2 and 5 days a week. The majority of respondents stated that their dog mostly stayed in the boot (42.4%), or the back seat (33.1%). Whilst a large proportion of respondents (72.2%) restrained their dog whilst driving, 5.4% stated that they only sometimes restrain their dog and 22.4% stated that they do not restrain their dog whilst driving. The most popular reasons for not restraining dogs whilst driving were that the dog was thought to be comfortable or safe in the boot (31%) or that the dog was well behaved or calm (22%). Of those respondents that did restrain their dog, a harness and tether attached to a seat belt or buckle (43.3%) was the most common restraint method used. The main reason for respondents' decisions to use a specific restraint device was that it was thought to be the best method to ensure the safety of the dog (59.6%). Overall, whilst our findings highlight that dog owners are generally aware of the need to restrain their dogs when travelling by vehicle, there is a need for further education on why this restraint is important and evidence-based guidance on the safety and suitability of different vehicular dog restraint devices.



OWNER PERCEPTIONS OF THE EFFECTS OF FIREWORKS ON RABBITS AND GUINEA PIGS

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The fear of fireworks is a very commonly reported problem amongst pet dogs and cats, and there is substantial literature on the responses of these pet species to firework exposure. Rabbits and guinea pigs are prey species that are easily disturbed by loud noises. Though these are popular UK pets that are frequently housed in outside enclosures, to date there is no research investigating their response to fireworks.

Using owner reporting via an online survey, this study aimed to determine the effect of fireworks on rabbits and guinea pigs and the preventative measures used to minimise any negative effects. Participants were recruited through social media and through pet, rabbit and guinea pig blogs and magazines. In total, 841 respondents were included in the analysis. 230 were guinea pig owners, 487 were rabbit owners and 124 owned both species. Thirty-nine percent (238/611) of rabbit owners and 41% (145/354) of guinea pig owners stated that their pet was scared of fireworks. Of those rabbits reported as scared of fireworks, the most commonly reported behaviours were thumping back legs (216/238), hiding (210/238) and shaking/shivering (62/238). For scared guinea-pigs the most commonly reported behaviours were hiding (139/145), vocalising (66/145) and shaking/shivering (50/145). Only a small percentage of guinea pig (3.8%; 13/339) and rabbit owners (7.2%; 44/609) had ever consulted vets either before or after firework periods. The most common preventative intervention used by rabbit owners to reduce fear was to provide more bedding (31.8%; 192/603) and by guinea pigs owners was the provision of extra bedding (40.5%; 136/336).

Overall, findings suggest that rabbit and guinea pig owners underestimate the fear of fireworks in their pets. This indicates the need for educational interventions to ensure that rabbit and guinea pig owners are aware of the signs of fear in their pets, and the appropriate precautions they can take during firework seasons. Further research is needed regarding behavioural and non-invasive physiological indicators of fear in rabbits and guinea pigs in response to fireworks, and to determine the efficacy of precautionary measures used by owners.

WELFARE AND BIOMEDICAL IMPLICATIONS OF STEREOTYPIC PACING IN LABORATORY MACAQUES

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Stereotypic behaviours are commonly observed in captive animals and are usually interpreted as a sign of poor welfare. Stereotypies have also been linked with brain abnormalities. However, stereotypies are a heterogeneous class of behaviours and mounting evidence indicates that even within one species different stereotypies can have different causes, and can be linked to different affective states. To better understand the mechanisms underlying stereotypies and their relation with animal welfare, it is therefore crucial to investigate each stereotypic behaviour separately. Understanding the cause of stereotypies is particularly important in laboratory animals. Indeed, beside welfare concerns, if some stereotypies are the product of an abnormal brain, the use of stereotyping animals in research might compromise the validity, reliability and replicability of scientific findings. Laboratory rhesus macaques are one of the main animal models used to understand human brain mechanisms. In research facilities, macaques are often seen displaying stereotypies, the most prevalent one being pacing, when an animal walks repetitively in the exact same pattern. During this talk, we will review what is known about pacing in rhesus macaques and will present new unpublished data on this topic. We will identify what are the potential causes of pacing supported by scientific evidence and will discuss the implications of these different hypotheses for macaque welfare and the validity of scientific findings coming from this species.



PERSONALITY AND BEHAVIOURS OF ZOO LIONS (*PANTHERA LEO*) AND ZOO VISITORS: ARE THEY LINKED?

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In the last 10 years researches have been focused on the impact of personality on welfare, health and management of zoo animals. Moreover, researches have reported effects of visitor presence on zoo animal behaviour, in particular primates and felids. The aim of this study was to evaluate the effect of the visitors' presence on the behaviour of three females and one male of lion housed at Parco Natura Viva - Garda Zoological Park and to assess the influence of their own personality on the visitors' effect. The study was run over two different periods: the first period without visitors' presence and the second one with the presence of visitors. Focal animal sampling method was used to collect the frequencies of individual and social behaviours. A survey was also completed by the two keepers of the lions. The questionnaires listed 31 traits rated on a scale from 1 (trait was never exhibited) to 12 (trait was always exhibited) by the keepers for each lion. Personality traits were defined for each individual through the questionnaires. A correlation between behaviour and the personality of each individual was done. Moreover, a comparison between two different periods of behaviours showed by each individual was done. Results underlined significant differences between lions for the following traits: curious, friendly to conspecifics, playful, solitary. In addition, significant differences between the two periods were found for individual behaviours related to specific personality traits. In conclusion, findings from this study seem to show that different personalities can differently help to cope with the presence of visitors. Studies about animal personality seems to be useful to take care and manage each individual of a zoological garden to guarantee his/her welfare.

FERRET FUN: A PRELIMINARY STUDY INTO PLAYTIME EFFECTS ON SIGNS OF BOREDOM IN FERRETS

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Prolonged inescapable boredom could be a major welfare issue for captive animals who experience highly predictable simple environments and routines each day. However, research into animal boredom to date is scarce. Behavioural manifestations of boredom are expected to include restless sensation-seeking behaviours combined with indicators of drowsiness. Here we explored the concept in ferrets, as a species known for their apparent curiosity and explorative tendencies. They are also close relatives of the American mink, a species recently shown to exhibit signs consistent with boredom when lacking in environmental enrichment, including sensation-seeking behaviour and lying awake with eyes open.

We hypothesised that daily playtimes in laboratory housed ferrets would reduce restlessness, aggression, sensation-seeking and awake drowsiness. Groups of four ferrets were housed together, regularly handled, and provided with enrichments including tunnels and shelters in their multi-level cages. For three consecutive days, two of the ferrets per cage experienced an additional 1h of playtime, consisting of exploration of a room containing a ball pool, paper bags, a ball containing a bell, and a familiar human to interact with. The following week, the remaining two ferrets experienced the playtime whilst the first ferrets stayed in the homecage, giving a paired design.

Sensation-seeking motivation is currently being tested after playtimes, via observation of the ferrets' voluntary interaction with an array of stimuli. These stimuli range from mildly aversive (bitter apple spray and peppermint, both of which we have found to cause the ferrets to shake their heads and withdraw), through neutral (an empty tea strainer), to positive (a mouse-scented bedding sample and a ball containing a bell).

Following playtime, preliminary analyses suggest that ferrets sleep more (rather than lying awake) and show less aggression than their relatively unstimulated cagemates. They also chose to interact significantly less with neutral and mildly aversive stimuli. These results are consistent with playtime reducing both drowsiness and sensation seeking, and thus possibly reducing boredom.



CORTISOL AND DEHYDROEPIANDROSTERONE AS ENDOCRINE BIOMARKERS FOR CHRONIC STRESS IN PIGS?

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Different housing conditions are supposed to affect stress levels in pigs, and thus can have long-term effects on animal welfare. In this context, chronic stress has to be differentiated from an acute activation of the hypothalamus-pituitary axis. The aim of the present study was to investigate whether the adrenal hormone dehydroepiandrosterone (DHEA) suggested as a marker to differentiate between acute and chronic stress varies between pigs kept in different housing systems. Blood and saliva samples were collected from 106 pigs of two age categories kept on three different commercial farms. Growing pigs at 9-10 weeks of age weighing 20-30 kg (n = 71) and fattening pigs at 17-20 weeks of age weighing 70-80 kg (n = 35) were investigated. They were kept either on a conventional farm with improved conditions (C+) or on a conventional farm with different welfare and health problems (caudophagia, infections) (C-) or on a farm under conditions which were aimed to enhance animal welfare according to the German "Neuland" program (unC). Cortisol and DHEA concentrations were measured and the related cortisol/DHEA ratio was calculated. Saliva cortisol was lower in unC compared to C+ and C- in both age categories (p<0.05). For fattening pigs, no more significant results were found. In growing pigs, saliva DHEA was higher in unC compared to C+ and C- (p<0.001), and in C+ it was higher than in C- (p<0.05). Saliva cortisol/DHEA ratio was lowest in growing pigs from unC (p<0.001), and in C+ it was lower than in C- (p<0.05). Serum cortisol was higher in growing pigs from C+ compared to C- and unC (p<0.001), while serum DHEA was higher in C- compared to C+ and unC (p<0.05). The cortisol/DHEA ratio in serum was higher in C+ compared to C- (p<0.001) and lower in C- compared to unC (p<0.05). Thus, different cortisol and DHEA concentrations were found in pigs from varying housing systems. Especially cortisol and DHEA measured in saliva could reflect various stressors during the housing period, while serum concentrations could be more related to an acute stress response. Measuring DHEA and cortisol together may provide a valuable tool to evaluate chronic stress in farm animals. However, to clearly assess these biomarkers further research with more samples and evaluations are needed.

ASSESSMENT OF AN EDUCATIONAL INTERVENTION ON THE KNOWLEDGE OF INDIAN VETS TO ANIMAL WELFARE AND EUTHANASIA

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India has complex associations with animals, influenced largely by culture, religion and traditions. Vets often graduate with a limited appreciation for animal welfare, ethics and the knowledge and skills to undertake humane euthanasia. There are no published data on the degree of knowledge of Indian vets of animal welfare and euthanasia, or whether an educational intervention can influence this. Therefore, current knowledge of these topics, and the effect of exposure to an educational intervention, was assessed in 84 Indian national and 49 international vets attending a two-week-long surgical training course run by the Worldwide Veterinary Service in Ooty, Tamilnadu, India. This formed part of a larger study which assessed attitudes to animal welfare and euthanasia. At the start of the course, a pre-intervention questionnaire, comprising demographics and knowledge-based questions on animal welfare and ethics, was completed by all participants. All (except for an additional course-cohort of 15 Indian participants acting as controls), were then exposed to a pre-designed lecture and case-studies that occurred during the usual teaching of the course (d6). At the end of the course (d12), a second questionnaire was completed containing identical questions. Prior to the intervention, there was no difference in knowledge of the control or intervention group of Indian participants. Indian participants had lower knowledge scores prior to the intervention compared to international participants ($p < 0.05$). Knowledge increased in both Indian and international participants after the course, with the Indian participants showing the greatest change ($p < 0.05$). The biggest improvement was observed in the knowledge of the Five Freedoms. For multiple choice questions that defined animal welfare, where incorrect answers included reference to animals having "rights", Indian participants chose these answers more frequently prior to the intervention than international vets; the frequency of correct choices increased significantly after the intervention ($p < 0.05$). The control cohort did increase their knowledge slightly over the course period but not as significantly as either of the intervention groups. Both groups' self-assessment of their understanding of animal welfare and euthanasia improved after the intervention. This study suggests that there are opportunities to improve current knowledge of Indian vets to animal welfare and euthanasia, and that post-graduation learning is useful for all veterinary graduates to help reinforce prior learning. Specifically, a targeted, culturally-relevant, educational intervention impacts on Indian vets' knowledge towards animal welfare and euthanasia, and is of interest to educational and other organisations aiming to improve standards of animal welfare in India.



DEFLIGHTING ZOO BIRDS IN THE 21ST CENTURY

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For more than a century birds have been deflighted in zoological collections in order to prevent them from escaping. Over the years, efforts have been made to improve or develop new surgical techniques, reduce the risk of complications and minimize stress and pain during the procedure. However, the procedure in question is itself a rather new phenomenon that coincides with the increased public interest in animal welfare. Since then there has been debate between zoo representatives, poultry industry lobbyists, politicians and animal welfare groups that has in turn led to a variety of adjustments to different countries' legislations. While in some countries all deflighting procedures are prohibited (eg Germany), others offer exemptions for zoological institutions (eg Switzerland) or non-farmed birds (eg U.K.), while some have no regulations at all (eg U.S.A.).

Despite having decisive effects on legislation, the debate is being carried out on a merely subjective and emotional level. There are many opinions on why deflighting should be prohibited or why it is supposed to improve a bird's living conditions; however, most of these opinions are based on assumptions, transfer performances or non-welfare-related issues. To the authors' knowledge no scientific data has ever been published on how deflighting procedures affect one of the commonly deflighted bird species' welfare (ie waterfowl, flamingos, pelicans, storks, cranes and herons).

It is for this reason the authors are currently working on a project that concentrates on the two most frequently kept species in German zoos that belong in this group, the Greater Flamingo (*Phoenicopterus roseus*) and the Great White Pelican (*Pelecanus onocrotalus*). By combining behavioral analysis and measuring Corticosterone in feather samples of irreversibly (pinioned/follicle extirpated), reversibly (feather clipped) and non-deflighted birds we will provide reliable, animal-based data on these two species and their behavioral repertoire under flight restraint. Furthermore this pilot study could potentially be used as a model for upcoming research projects with other species.

PRELIMINARY STUDY ON ANIMAL WELFARE INDEX IN SHEEP FARMS IN GROSSETO DISTRICT

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The safeguard of animal welfare represent both a responsibility and a challenge for farmers. Extensive farming systems seems guarantee high levels of animal welfare, fulfilling consumer ethical demands but anyway, it could exhibit critical points. So, the assessment of animal welfare at farm level is fundamental. Welfare checking systems can rely on either resource or animal-based criteria and must take into account objective, repeatable and easy measurable aspects. The aim of this study was to investigate on sheep welfare at farm level, in order to suggest managerial or structural corrections in the optic of animal welfare enhancement.

The study involved 11 dairy sheep farms located in the district of Grosseto (Tuscany, Italy). A checklist was filled out during farm inspections by a trained observer and a farm welfare index was calculated according to scores assigned to five macro-areas: A: management, B: farming system, C: environment control, D: feeding and water supply, E: hygiene, health and behavioural aspects. An Excel spreadsheet was created to input the data and automatically assign both a partial score to each macroarea and a total farm score. Depending on the score, macroareas and the whole farm were evaluated according to five classes: 1 = scarce; 2 = sufficient; 3 = moderate; 4 = good; 5 = excellent.

The study displays a situation characterized by an acceptable level of well-being, with none of holdings showing deficiencies that place them at the minimum level. In the 56% of the cases, the farms show a moderate level of welfare (level 3); the 27% of the sample is located at the level 2, while only the 18% of farms reached the higher score of welfare. The Macroarea A presented more deficiency (level 1), due to the insufficient attendance to technical courses, the poor level of mechanization and the lack of effective prevention of attacks by predator species (wolves, free ranging dogs).

Macroarea E showed the best situation (level 5), thanks to the presence of a health plan in almost all farms, which can contributes to improve the health and health of animals.

These results indicated that in this district some sectors of sheep farming need intervention aimed at increasing the level of animal welfare.



INVESTIGATING THE IMPACT OF A CATCH-NEUTER-VACCINATE-RELEASE METHOD ON THE FREE-ROAMING DOG POPULATIONS IN ASIA

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The worldwide population of domestic dogs (*Canis familiaris*) is estimated to be approximately 700 million individuals. Around 75% of domestic dogs are classified as “free-roaming”, referring to their ability to roam and reproduce without restriction. Where free-roaming dogs exist in high densities there are significant implications for public health, animal welfare and the environment. Asia has amongst the highest density of free-roaming dogs and, consequently, faces serious public health, environmental and social challenges. In parts of India and Bhutan, the Humane Society International has been implementing catch-neuter-vaccinate-release (CNVR) programs with the aim to reduce the overall size of the free-roaming dog population and improve their health and welfare. This study investigated the impact of high intensity CNVR programs in Jamshedpur, Haryana and Bhutan between 2009 and 2016. This study aimed to determine whether high intensity CNVR (i) impacts the health and welfare of the local free-roaming dog populations, (ii) impacts the population’s overall size, structure and reproductive potential and (iii) results differ to low intensity CNVR programs.

Data was collected through street surveys using the mobile app OSM tracker to collect information on dog age, neutering status, presence of visible skin condition, lactation status (females) and body condition. The overall size of the free-roaming dog population was estimated using a combination of mark-recapture and index counts. Baseline surveys were completed prior to the CNVR program commencing and bi-annual street surveys were carried out for the duration of the programs. In addition, clinical data was collected on various health conditions (eg rabies, mange, venereal cancer) of all dogs captured as part of the CNVR program. This included 21,077 dogs in Jamshedpur, 34,000 dogs in Haryana and 53,838 dogs in Bhutan.

This study hypothesised that (1) there is an association between CNVR and various health indices of the free-roaming dog population and (2) there is an association between CNVR and free-roaming dog population size, structure and reproductive potential (3) there is a difference between low and high intensity CNVR. These associations were tested using logistic regression statistical approaches. Analyses of the data allowed this study to assess the impact CNVR had on the health and welfare of these dog populations and the population size and structure. In this poster, we will provide results from these long-term studies. This work forms part of the STRAYS project, funded by FOUR PAWS International, which aims to investigate sustainable methods to control free-roaming dog populations.

A SIX-YEAR STORY OF SUCCESS AND FIDELITY OF ZOO GREATER FLAMINGOS

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Flamingos are highly gregarious birds and their zoo breeding colonies need to have at least 40 individuals: if a lower number is present, flamingos lose their confidence and are unable to breed. Studying the behaviour of long-living species with widespread zoo populations such as flamingos is important to improve their husbandry and breeding. This study monitored reproductive success and monogamy in a flock of greater flamingos (*Phoenicopterus roseus*) housed at Parco Natura Viva – Garda Zoological Park in Italy. To assess the reproductive success of the greater flamingo flock, data from 2012 to 2017 breeding seasons were compared, in terms of number of eggs laid, hatchling, breeding pairs and survived chicks. Egg success (N° hatchlings/ N° eggs) and pair productivity (N° hatchlings/ N° eggs) were also calculated. To investigate monogamy, information on pair composition in each breeding season was collected and compared in different years. First, an overall increase of the flock size over the study period was found. Regarding the reproductive success, the number of pairs, eggs and hatchlings increased as the colony became in greater in size. Egg success and pair productivity varied over different seasons. Monogamy was persistent in adjacent breeding seasons, but decreased with the increase of the flamingo flock size, as juvenile individuals became involved in pair formation. Our results suggested that different factors can influence the reproduction, particularly egg success and pair productivity, as well as pair composition of zoo greater flamingos. All these factors are related to animal welfare and need to be considered in developing management practices. Studies like this help to enhance the knowledge of the species characteristics and needs as well as to obtain information on optimal flock size and composition.



DOES THE CAGE-TRAPPING OF CORVIDS CAUSE UNNECESSARY SUFFERING? A BEHAVIOURAL STUDY OF TRAPPED MAGPIES

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Recent research has cast doubt on the necessity and efficacy of cage-trapping corvids for pest control. This practice is permitted in Scotland under the General Licences which stipulate that traps must be emptied within a 24 hour period but which otherwise provide few safeguards for the welfare of trapped birds. The aims of this study were firstly to ascertain if magpies do suffer in traps and secondly to identify factors which might exacerbate their suffering.

Observations were made of the behaviour of 69 magpies caught in three types of cage-trap: Larsen, Larsen Mate and Multi-catch traps, in two locations: open paddock and sheltered woodland. Variations in behaviour in relation to different factors were investigated. These factors included: the duration of time in the trap; the effect of the time of day; trap type; and trap location. Physical injuries and body weights were also recorded as were trap-specific factors including the presence of a decoy bird in Larsen traps, and perch usage and fighting in Multi-catch traps.

All trapped magpies demonstrated high levels of escape-directed exertion. The mean number of escape behaviours per minute and the mean percentage of time active (\pm SEM) over daylight hours on the first day of captivity was 36.78 (\pm 1.10) and 86.25% (\pm 1.26). Magpies in Larsen traps consistently performed the highest number of escape behaviours per minute while those in the Multi-catch traps almost always performed the lowest. Results from this study indicate that magpies do not habituate to the trap over time and the greatest stress indicated by the highest mean number of escape behaviours per minute (64.03 \pm 2.77) was experienced by magpies in Larsen traps in the open paddock at dusk.

The results from this study have implications for the practice of cage-trapping corvids and identify areas where modifications are required to mitigate unnecessary suffering.

ASSESSMENT OF FISH SPECIES' POTENTIAL FOR WELFARE IN FARMING

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Is it possible to summarise the widely dispersed ethological findings of the 450 species currently present in fish farms as ethological profiles in order to produce recommendations encouraging the practitioner to improve the welfare of his animals or even select the most suitable species?

Since 2013, a research team of the fair-fish international association has been establishing a database on the ethology of fish species (FishEthoBase - fishethobase.net) which by June 2018 already presents some 40 species in short profiles, focussing on ten core criteria, and assessing, in the form of a FishEthoScore, a) the state of fish welfare under current standard farming conditions of the species concerned, b) the potential for improving the fish welfare of this species, and c) the certainty of the findings.

FishEthoBase condenses all available studies on fish behaviour in wilderness, farming conditions, and laboratory experiments, with priority on peer reviewed publications; however, the database is open for further studies and to traceable personal communication from academia and field. Users of the database may submit criticism or additions at any time, not least within the framework of regularly conducted international stakeholder dialogues.

The short profiles produced so far show potential for improving the fish welfare of all farmed fish species in at least one criterion. Whether, with which effect, and with which cost/benefit ratio this potential can be used is the subject of consultation in practice. Such consultation will be provided by the FishEthoBase researchers based on a criteria and indicators sheet on farms around the globe certified against the international scheme "Friend of the Sea" (FOS). The aim is to identify key features of an international standard for higher welfare to encourage best practice, knowledge transfer, and continuous improvement. According to a Memory of Understanding signed with fair-fish international, FOS is determined to extend its certification scheme to fish welfare criteria drafted by the FishEthoBase team. We will present a first approach.

For good reasons, farming terrestrial animals has specialised in less than 20 species. Aquaculture will not be able to avoid concentrating on the most suitable species as well. We will present how FishEthoBase can help with this selection process.

As to research, we will present the large knowledge gaps to be covered yet, even in species that have long been farmed in large quantities, such as Common carp and Nile tilapia, the most farmed fish species ever.



HOW ETHICAL IDEOLOGIES RELATE TO PUBLIC ATTITUDES TOWARD ANIMALS

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Ethical ideologies, which include dimensions of idealism and relativism, are often involved in the process of decision-making regarding operational and economic research. However, the study of the role of ethical ideologies concerning public attitudes toward animals has been largely neglected. The present study analysed how ethical ideologies related to public attitudes toward animals in China, Japan and the Netherlands. The “Ethics Position Questionnaire” (EPQ) was used to assess respondents’ ethical ideologies, and their relationship with attitudes toward animals, which were measured by the “Animal Issue Scale” (AIS) and the “Animal Attitudes Scale” (AAS). Our results showed that public attitudes toward animals were positively associated with idealism in three countries, which parallels previous studies in the United States. This finding indicates that individuals who think their ethical behaviour will always lead to positive consequences generally have high awareness of and positive attitudes toward animal welfare. We also found a significant negative correlation between public attitudes toward animals and relativism in China and Japan. However, this correlation was not significant in the Netherlands, and this result is in line with previous findings in the United States showing that relativism failed to associate with attitudes toward animals. We assume these different findings may be related to the different culture between Asian and Western countries. Japanese and Chinese people do respect animals according to their traditional culture of Confucianism and Buddhism, yet it appears that animals are assumed to have value because they are resources to satisfy human needs. Therefore, Chinese and Japanese people are considered to be more collectivistic, focusing attention on the contextual factors when explaining their attitudes toward animals, while Western populations are more individualistic and concerned with universal rules when explaining event. Here we have shown, by comparing attitudes toward animals among individuals from different countries with different cultures, that idealism may be universally correlated to attitudes toward animals, while relativism may not.

HORSE BREEDING FOR MEAT PRODUCTION: CRITICAL ASPECTS AND HORSE WELFARE

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The highest consumption of horse meat occurs in Italy, France, and Belgium. No data are available on the welfare of the horse kept for the meat productions. This production is not subject to a welfare specific legislation. Finally, the Veterinary inspectors are often helpless when faced with this type of breeding.

The aim of this study was to apply a specific on farm protocol in order to highlight some critical aspects of this intensive farm system and asses animal welfare.

The data collection was performed in the biggest horse farm of the north west of Italy (2400 horses slaughtered per year). A total of 12 multiple pens were monitored during the spring 2017 for a total of 7 inspections. Four independent observers were trained and their agreements were checked before the study. During each on farm visit a check list was fulfill according to a designed specific score for: nutritional status (BCS and water provisions), good health (ocular/nasal discharge, injuries, fecal quality, coat cleanness), good housing and management (bedding quality, farmers educational level, light level, regular health checks), good behavior (behavior during the fixed time frame of the observation). Descriptive statistic (frequencies/range) of the most observed condition was calculated. A total of 650 animals were observed (age months min 8-20 max); males and females were mixed in the multiple pens. According to BCS the 13.98% of the animals were evaluated thin, 27 % fat; 26% of the bowls were dirty. Among the good health indicators nasal (10%) and ocular (6%) discharge, caught (4%), difficulty breathing (4%) and diarrhea (100%) were observed, most frequent injuries were mane lesions (62%) swollen legs (12%) just 18 % of the animals were judged clean, 10 % judged were very dirty. Among good housing, bedding quality (depth and hygiene) was inadequate in the 50% of the pen. Light level was lower than 17 lux in 80% of the pen. In the 50% of cases the space allowance per animal was lower than 4 m² (m²/total BW). No regular health checks were provided and farmers had no specific formation about management of the animals. The most frequent behavioural response displayed was eating (40.71%), rest (17.5%), interaction among horses were 8.6 % and no stereotypies were identified. This preliminary report is part of a biggest study; this can help to develop guidelines to improve horse welfare and raise public awareness.



REFLECTION ON THE COMMUNICATION OF THE EQUINE WELFARE: THE "5F PRINCIPLES" PROPOSAL

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Promoting strategic welfare advice is essential since people are motivated by animal welfare but often confused by how information is provided. Successful communication strategies on animal welfare necessitate more than mastering talk and research paper. Other approaches involve the use of wordplay or acronym like the well known "Three Rs example" ethic guides in animal used for science. The present abstract briefly propose an "acronym approach" to communicate science-based principles about equine welfare. We believe that methods will be able to address welfare in a meaningful way for owner according to "F principle" proposal.

- 1) F as Forage: equids are evolved as a nonstop virtual grazer with short time of fasting. Promoting a forage oriented diet is essential since BCS and water provision is not sufficient to guarantee their welfare. Researcher should focus on the minimum forage DM intake for their well-being and its provisions during the day. That will help to overcome the deleterious effect on high concentrate diet and avoid the effect of fasting.
- 2) F as Friends: underline the importance of socializations and the expression of this natural behaviour since the equids evolved as social herd animals. This allows animals to express natural behaviour and activity like mutual grooming and play activities.
- 3) F as Freedom: should represent the possibility of natural movement without restrictions (in the stable and paddock) that is not always guaranteed to all animals.
- 4) F as Facilitate training to promote the adoption of training techniques based on the learning capacity of equids. The optimal use of learning theory should be promoted since it is a fundamental principle in the equestrian education.
- 5) F as Follow a treatment to remember to the caretaker that animals should be treated and cured for any disease or problems according to a veterinary advise.

Those "5 F" principles are based on actual knowledge of equine needs with a natural living orientation; they can be a guideline by which unpleasant consequences of management condition and other restrictions can be identified and assessed according to the different check-list suggested.

We believe that these strategies can change considerations from empathic to a reactive listening "eg motivated by the wish to understand". It is our responsibility to translate the science of animal welfare in a clear way to the public. "5F principles" can help to support equine welfare with consistency and easy comprehensible approach.

COMPARING DIFFERENCES IN HEALTH AND BEHAVIOUR OF NEWLY RECOGNISED CROSS BREED DOGS (CAVAPOO) AND PARENT BREEDS

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Kennel Club “breed standards” detail the appearance and behaviour of that breed’s ‘ideal’ dog. Breeding to conform to these standards, which are heavily reliant on looks, can negatively impact the breed’s health and welfare. The effect on behaviour is not widely studied.

Newly recognised crossbreed dogs (NRCBD) are increasingly popular, for example the Cavapoo (Cavalier King Charles spaniel, CKCS, cross Miniature or Toy poodle). However, there are no recognised “breed” standards for breeders to breed towards.

Anecdotal criticism of NRCBDs is unknown temperament. However, a recent study showed no appreciable differences in Labradoodle behaviour compared to the parent breeds, Labrador and poodle, and for Cockerpoos there were no significant differences from the poodle and any significant differences favoured Cockerpoo temperament compared to Cocker spaniel.

Most pure-breed dog breeds have inherent welfare issues: diseases and disorders often linked to extreme conformation, such as painful syringomyelia in the CKCS due to the shortened skull. There are no reported studies comparing the prevalence of the diseases between the parent breeds and NRCBD.

Our study explored behavioural and health differences between Cavapoos and the parent breeds. It included questions from the Canine Behaviour and Research Questionnaire “CBARQ TM” (for example, aggression and fear) with further questions to identify undiagnosed and diagnosed health problems, focusing on those commonly found in the parent breed. The on-line survey, distributed through dog forums, and social media, resulted in 538 usable full responses. A further 361 data sets for behaviour were available from the existing CBARQ database.

Results suggest statistically significantly improved health of the Cavapoos compared to CKCS for clinical signs of Patella Luxation, Diabetes, Mitral Valve Disease, Syringomyelia, Episodic Falling Syndrome, Primary Secretory Otitis Media, Distichiasis and Hyperadrenocorticism, but only in signs of Episodic Falling syndrome and Primary Secretory Otitis Media when compared to miniature poodle (Kruskal Wallis with MWU post-hoc $P < 0.005$). Differences in diagnosis found CKCS to have more than expected Patella Luxation, Mitral Valve Disease, Syringomyelia, cataract compared to Cavapoos and poodles, but poodles had more than expected Otitis Externa compared to Cavapoos and CKCS (Chi-squared $P < 0.05$). This may indicate hybrid vigour for the NRCBD. Reduced incidence of aggression and stranger-directed fear, and increased trainability in Cavapoos, suggests improved behaviour for this NRCBD.

This information may enable owners to choose breeds with better welfare, with a temperament suited to their circumstances, which can also enhance the dog’s welfare and reduce the chances of rehoming.



LET ME SLEEP! – WELFARE OF DISTURBED BROILERS (*GALLUS GALLUS DOMESTICUS*)

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Elevated perching for rest and sleep is a highly motivated behaviour in red jungle fowl and their domesticated descendants. Resting behaviour is highly synchronized. Perching is considered a behavioural need in broilers and is hence important for their welfare but their resting synchrony is often low. Perch use in commercial conditions is negatively correlated with body weight and perches are rarely provided commercially. Disrupted sleep is therefore a potential welfare issue in broilers. We studied resting behaviour and position in broiler hybrids with differing growth rate. The aim of the study was to compare resting and sleeping behaviour and position in birds of three broiler hybrids under semi-organic (EU) conditions, provided wooden perches at 20, 40 and 70 cm height. Three hundred broilers; Ross 308, (R), fast growing n= 100; Rowan Ranger (RR), slow growing n= 100; and Hubbard CYJA57 (H), slow growing n= 100 were reared in one group on a littered floor at a stocking density of 1.84 birds/m². Birds were slaughtered at 84 days of age. Daytime behaviour was registered continuously on individual focal animals on four occasions and scan samplings on group level were performed on three occasions during daytime and three occasions during nighttime.

When sleeping on the floor during daytime, male birds disturbed other birds more often than female birds did ($P < 0.05$). R birds perched less and only on the lowest perches during both night (R 3.6 % \pm 2.33, RR and H 26.6 % \pm 2.33, $P < 0.01$, Least Square Means (LSM) \pm Standard Error (SE)) and daytime (R 0.3 \pm 0.19 birds per observation, RR 8.0 \pm 0.19 chicken per observation, H 7.3 \pm 0.19 birds per observation, $P < 0.01$, (LSM \pm SE)). Mortality in the R birds was 20%.

Fast growing broilers are not suitable for production systems with long rearing times, due to low welfare and high mortality. Males disturb other resting birds more than females on the floor but no disturbance of perching birds was recorded. On the basis of these preliminary observations we conclude that perches or other elevated structures ought to be provided in the commercial rearing environment for slow growing broilers.

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