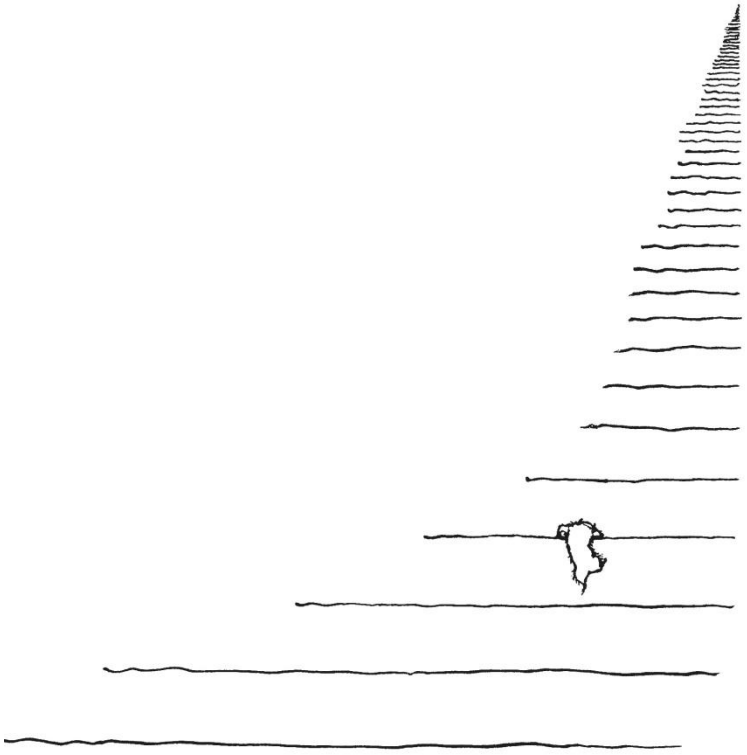
Measuring Animal Welfare and Applying Scientific Advances: Why Is It Still So Difficult?



UFAW International Animal Welfare Science Symposium

27th – 29th June 2017

Royal Holloway, University of London, Surrey, UK

UFAW
Established 1926

Published by:

Universities Federation for Animal Welfare
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Science in the Service of Animal Welfare

Welcome to the UFAW Symposium

We would like to welcome you to Royal Holloway for the latest in UFAW's programme of themed international meetings, which bring together leading scientists, veterinarians, policy makers and all those with an interest in animals and their welfare, and which UFAW initiated in 1957.

The theme of the symposium, which is 'Measuring animal welfare and applying scientific advances - Why is it still so difficult?', draws inspiration from a paper published by Mason and Mendl (*Animal Welfare 1993**) and it is our intention that this meeting considers some of the reasons underlying the continuing difficulty.

Animal welfare science is a relatively young field but it is developing rapidly. A recent review noted that over the last two decades the number of scientific publications in this area has increased by 10-15% annually. This research has been used to make many real improvements to the welfare of animals throughout the world.

There seems to be a growing consensus that what matters to those animals that are presumed to experience feelings, and therefore what should matter most to those concerned about animal welfare, is how those animals feel. However, this raises difficult questions, some of which are fundamental to the development of animal welfare science as a rigorous scientific discipline and the assessment of animal welfare. For example:

- ***Will we ever be able to demonstrate sentience?*** Knowing where to draw the line about which animals to care for is important to avoid wasting scarce resources on animals that are not sentient and to ensure that animals that are sentient are protected. Are there new techniques that could help or is the problem insoluble? Where should the line be drawn?
- ***Are the techniques that we have to study emotional state (affect) adequate*** or are there new and better ways of assessing how animals feel about themselves and their environment? How should we best choose and interpret measures? Do technological advances offer us alternative approaches? Is it worth trying to put a numerical value on animal welfare or are qualitative measures more appropriate?
- ***How does time fit into the equation?*** Over what period of time should welfare be considered – what is meaningful and relevant to the animal? Do animals experience time as we do? How should we weigh up the challenges and good experiences to come so as to arrive at a view about the animals' lifetime experience, and is this worth doing?
- ***How important is positive welfare?*** Should preventing suffering be our first priority or should we now be looking to maximise enjoyable experiences for animals in our care too? Is a permanent state of positive welfare possible, or do animals reset their emotional state so that attempts to achieve positive welfare are doomed to failure as the animal habituates to a better than adequate environment? What happens when those experiences preferred by an animal have a long-term negative impact on health?
- ***How robust is the data collected on animal welfare?*** Are there lessons to be learnt from other areas of research with respect to eg blinding, randomisation, pre-registration of hypotheses, null results, meta-analysis, clinical trials?

With the aim of developing new ideas and of promoting higher quality and better-focused animal welfare science, this three-day symposium will consider whether and how animal welfare scientists can make progress in these and other areas.

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 25 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

*** Mason G and Mendl M** 1993 Why is there no simple way of measuring animal welfare? *Animal Welfare 2:* 301-319

General Information

Organisers:

The Universities Federation for Animal Welfare (UFAW), the international animal welfare science society, 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.
- 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.

Information about the Symposium

The symposium is being held in the Windsor Building Conference Centre, part of the campus at Royal Holloway, University of London.

The symposium 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.

Registration:
Registration will take place in the foyer of the Windsor Building from 8.00am on Tuesday 27th June. Only delegates that are registered can attend the scientific programme in the Windsor Building Conference Centre.

In addition to their symposium pack, delegates will receive a badge and lanyard which allows access to the building, to meals/refreshments and to university facilities eg the fitness suite. Please ensure you wear your badge at all times.

Please note that registration is for an individual, not an institution, and is not transferable, unless this has been agreed in advance with UFAW. Failure to do so may result in individuals being denied entry to the meeting.

Catering:
Tea, coffee and lunch will be served in the foyer of the Windsor Building Conference Centre, at the times indicated in the timetable.

Internet access:
To access free Wi-Fi during the symposium, delegates are required to register. Search available networks and select 'CampusNet' and then choose the 'Guest User' option. Accept the terms of use. Enter username (UFAW) and password (UFAW2017) when prompted. After 60 seconds, you will be asked to close down and open the browser again. You will only have to complete this registration process once for the duration of your stay.

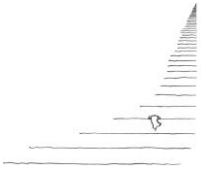
The same username and password will be required if accessing the internet in the bedrooms. Details are provided on the reverse of your key envelope.

Twitter:
The hashtag for the symposium is **#UFAWRH17**

Drinks reception and BBQ:
A drinks reception is being held in the North Quadrangle of The Founder's Building from 6.00pm on the evening of the 27th June which will include guided tours of The Picture Gallery, which contains world-class paintings, sculptures, prints, drawings and watercolours including works by William Powell Frith, John Everett Millais and Edward Burne-Jones. These will be at 7.00 and 8.00pm. The reception is followed by a self-service dinner in the Founder's Building Dining Hall.

On the evening of the 28th a BBQ will be held in the South Quadrangle of The Founder's Building for all delegates from 6.30pm. This will include a cash bar.

Entry to these is via the delegates' badge. Delegates can bring along partners/guests to both events but must have pre-booked their place.



Information on Presentations

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, each speaker has been asked to allow for at least 5 minutes for delegate questions.

The symposium will use a PC-based computer system running Office 2013 (at least) to run all PowerPoint presentations, so speakers need to ensure presentations are formatted for such. Presentations should be brought to the AV technician in the Windsor Building lecture theatre on a USB Memory stick and loaded prior to the session in which the talk is timetabled to take place – ideally during lunch or a refreshment break, or on registration, and at least two hours in advance. Presentation should be named so they include the speaker surname and session in which the talk is scheduled eg 'Smith 2.1 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 files are loaded (this will ensure all links within the presentation are maintained).

- **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 in the large seminar room, accessed from the foyer of the Windsor Building. We request that all posters should be put up during registration or before the first morning refreshment break on the 27th and taken down by no later than 4.00pm on the 29th.

Each poster should be mounted on a poster board, which will accommodate A0 Portrait size posters (ie 1189mm high x 841mm wide), using Velcro hook and loop fastenings. Velcro will be provided on the day for those who need it.

Please note: UFAW is are not responsible for loss or damage to any posters that are not removed by authors by 4.00pm on the 29th June. Any posters left behind will be automatically destroyed.

Poster sessions:
There will be three poster sessions, when authors will be available to answer questions about their posters. These will take place during the lunch break, and will start at 13.20. Delegates contributing posters are asked to ensure that they are standing nearby their poster during their allocated sessions – see list of posters

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**

Symposium language:
The symposium language is English. All oral presentations must be English as must the majority of the information contained in a poster. The symposium has no facilities for simultaneous translation.

Delegates are requested to not photograph or record the scientific programme. Speakers have been asked to provide a .pdf of their presentation that registered delegates will be able to access on-line after the event.

Details about the Venue

Address:
Royal Holloway, University of London
Egham, Surrey
TW20 0EX

The Royal Holloway campus is located in Egham - less than 40 minutes by train from central London and only seven miles from Heathrow airport.

Founded by the Victorian entrepreneur and philanthropist Thomas Holloway in 1886, the campus is set in 135 acres of parkland and includes the spectacular Victorian Founder's Building – which is one of the venues used by the symposium. The Founder's Building is built around two quadrangles and includes a beautiful gilded chapel and picture gallery – the latter the venue for the symposium drinks reception on the 27th.

Accommodation:

- **Check-in**

  Standard Single (Founder's)
  Check-in is available from 4.00pm at Founder's Halls Reception on the WEST side of the building (opposite the Founder's Field/the tennis courts). The Customer Service team will provide directions to your room and your room key. The Founder's Customer Services team can be contacted on +44 (0)1784 443052 between 7.00am and 10.00pm if required.

  Premium en-suite (Butler Hall)
  Check-in is available from 4.00pm at the HUB reception. The Customer Service team will provide directions to your room and your room key. The HUB Customer Services team can be contacted on +44 (0)1784 443285 between 7.00am and 10.00pm if required.

No vacancies exist for those who have not pre-booked accommodation.

If you will be arriving late, please email newhalls@royalholloway.ac.uk or call +44 (0) 1784 443285, **before** your arrival date.

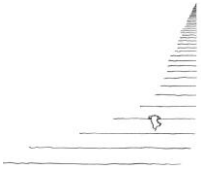
If your arrival is later than 10.00pm, security staff at the Founder's main reception desk (EAST side of the building opposite the new library/Windsor Building) or HUB reception (Butler Hall) will be able to issue your key and give directions to your room. If a member of the security team has provided the key, please ensure you check in with The Hub reception the following day to confirm your arrival. The security team can be contacted on +44 (0) 1784 443052 (Founders) / 443063 (HUB).

Please remember to bring electrical adaptors with you if travelling from abroad.

- **Check-out**

  It is important that all residential delegates check out by the advised time given at check-in, which is 10.00am on the day of departure. Limited luggage storage is available at the HUB Reception or in the Windsor Building Conference Centre.

  Taxis for departure can be ordered through the Conference Assistants up to Wednesday and from The HUB reception from then onwards.



Getting to Royal Holloway:

- **By air**
  For those arriving at London airports, we strongly recommend that you do not take the expensive Black cabs, but call either Windsor Cars http://www.windsorcars.com/ (+44 1753 677677) or Gemini Cars http://www.geminicars.co.uk/ (01784 471111). Windsor Cars have a dedicated email for pre-booking journeys: bookings@windsorcars.com.

  - **Taxi from Heathrow airport**
    If called on arrival, the cash price from London Heathrow (any terminal) is approximately £21.00. The driver will meet you at a given location within arrivals. The collection point at Terminals 1-4 is at WH Smith in Arrivals. At Terminal 5, the collection point is at Costa Coffee. The collection point will be confirmed when you call.

    If pre-booked, the cash price from London Heathrow (any terminal) is approximately £26.00. The driver will meet you in arrivals with a named sign.

  - **Taxi from Gatwick airport**
    A taxi from Gatwick costs £63.00 and must be pre-booked. This price includes a 40 minute waiting time and parking for up to an hour once the flight has landed.

  - **By bus**
    There is a bus service from London Heathrow Terminal 5 to Royal Holloway. The number 8 bus leaves from outside Terminal 5 (**not** from the Central Bus Station). If you arrive at another terminal, follow flight connection signs for "Internal airport transfer to T5".

    From the Central Bus Station, the number 441 bus also stops outside Royal Holloway's main entrance but it takes a less direct route and the journey is therefore longer.

    The timetable for bus route 441 can be found here http://www.surreycc.gov.uk/roads-and-transport/buses-and-trains/bus-timetables/ Click on Staines, Chertsey and Walton timetables. For bus route 8, the timetable can be found here: https://bustimes.org.uk/services/set_1-8-B-y08.

    From Gatwick Airport, take the bus to Heathrow and follow the procedure above, or telephone for a taxi.

- **By train**
  There are frequent services from London Waterloo station to Egham (35-40 minutes); Woking to Egham (35 minutes, change at Weybridge) and Reading to Egham (40 minutes). Services at weekends, especially those on Sundays, are less frequent than on weekdays. Train links (including Eurostar) to the rest of the country are available via the London stations or Reading.

  There are usually taxis waiting outside Egham station to take you to Royal Holloway, which is located less than a mile from the station. http://www.southwesttrains.co.uk/plan-your-journey.aspx

  - **Walking from Egham station to campus**
    Turn right out of the station along Station Road and walk about 100 yards to the junction and the traffic lights. Turn left at the junction and follow the road to the large roundabout; go left up Egham Hill. Royal Holloway's entrance is on the left immediately after the second footbridge.

- **By car**
  Royal Holloway is located on the A30 road, 19 miles from central London and about a mile south-west of the town of Egham. It is 2 miles from junction 13 of the M25 (London Orbital). After leaving the motorway, take the A30 west, signposted to Bagshot and Camberley (this is the Egham by-pass). At the first roundabout, take the second exit. At the second roundabout, take the second exit and continue on the A30 up Egham Hill. Royal Holloway is on the left at the top of the hill. Free parking is available on campus. The car parks are indicated on the campus map. https://www.venue.royalholloway.ac.uk/contact/campus-map . The SAT NAV post code is TW20 0EX.

  - **Car parking arrangements**
    There are a variety of car parks on-site. Butler Halls guests please use **P4, P7** or **P8** car parks, Founder's guests please use **P12** car park. Car parking spaces are free and allocated on a first come, first served basis. In the unlikely event that the on-campus car parks are full, please use **P14** or **14a** on the north side of the A30, off Harvest Road. **Please note no parking is allowed on the roads by the Halls of Residence. All parking must be legal, or Penalty Charge Notices will be issued.**

Other Information

Further catering details:
For delegates staying on campus, breakfast is served between 7.30-8.30am, at the following locations. For delegates staying in Butler Halls – Imagine (downstairs from the HUB dining hall); in the Founder's Building - Founder's Dining Hall.

In addition to any pre-arranged catering, delegates are free to enjoy on-site food and drink outlets. The Boilerhouse Café offers a range of sandwiches, wraps and snacks, as well as Starbuck's coffee, tea and speciality beverages. The Crossland Suite, overlooking the South Quad of the Founder's Building, offers a selection of breakfast items, homemade soups, salads, pizzas, cakes and pastries, as well as hot and cold drinks and a fully licensed bar. Opening hours for both are Monday – Friday, 8.30am – 5.00pm.

ATMs:
A hole-in-the-wall cashpoint is available 24 hours a day outside the Windsor Building and next to the Students' Union Building. The nearest banks are located in Egham town centre.

Medical:
If you should become unwell or suffer an injury, there are several options. The nearest Accident and Emergency department is at St Peter's Hospital in Chertsey. For first aid enquiries only, the College has its own Health Centre situated in the Founder's Building. It is open from 9.00am – 1.00pm and 2.00 - 5.00pm Monday to Friday. An out-of-hours answer phone will provide you with details of an on-call doctor, should you need medical assistance when the centre is closed.

Sport facilities:
Residential delegates have complimentary use of the Fitness Suite, an on-site gym which houses popular fitness equipment such as treadmills, weights and cross trainers.

Shop:
The Union Shop is located near to The Hub and the accommodation located in the Butler building. Opening hours: Monday – Friday: 8.00am – 5.00pm Weekends: 9.30am – 1.30pm. Other shops can be found in nearby Egham and Englefield Green.

Safety:
In the event of a fire or other emergency, please leave via the nearest emergency exit. Delegates should then go to the nearest Assembly Point indicated by a large Green and White sign. Each building has its own Assembly Point, which is identified by a number or letter, their location is given on the Fire Action Notices located at each Fire Alarm Call Point.

For the Windsor Building the nearest is Assembly Point 2, at the north end of the building, on the other side of the access road. This is also the assembly point for the North Quad, Dining Hall and Picture Gallery of the Founders Building. A check that everyone attending the Symposium is present will then be made.

All gangways, passages staircases and exits must be kept clear from any obstruction at all times.

If You Discover a Fire, you must:

- Operate the nearest fire alarm
- Leave the building by the nearest exit
- Go to your designated Assembly Point

Fire fighting equipment must only be used by persons who have been trained to do so, and only after the alarm has been sounded.

Fire evacuation procedure
If the Fire Alarm sounds at any time other than a scheduled testing time (or for longer than 30 seconds on a scheduled test, as above) then you must:

1. Leave the building by the nearest exit, closing the doors behind you
2. Report to your designated Assembly Point
3. Do not return to the building until authorised to do so
4. Do not use lifts
5. Founder's Building only – A red light will flash at the entrances/exits to the Building when the fire alarm has been activated and **re-entry into the building will only be allowed when these lights are turned off** (regardless of whether the sounders are sounding).

Assistance:
If, in an emergency, you need to contact somebody outside of office hours to do with the symposium content, please contact:
Dr Stephen Wickens. Tel: 07900 668334 or 01582 831818. Email: wickens@ufaw.org.uk

Please feel free to contact Customer Services or call 01784 443285 if you have queries about accommodation or facilities. Dialing 444 from your room will initiate an emergency response from our 24 hour security team.

History of Royal Holloway:

Royal Holloway College was founded by the Victorian entrepreneur and philanthropist Thomas Holloway in 1886. The self-made multi-millionaire made his fortune in patent medicines and, after initiating a public debate inviting suggestions as to 'how best to spend a quarter of a million pounds or more', he took his wife's advice that a college for women would prove 'the greatest public good'.

Royal Holloway College, largely inspired by the Château Chambord in the Loire Valley, was opened by Queen Victoria in 1886. The Founder's Building, which is built around two quadrangles and includes a beautiful gilded chapel and picture gallery, is one of the most spectacular university buildings in the world.

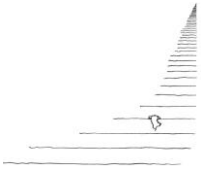
Thomas Holloway was not the first Victorian visionary to realise the benefits of an education for women. Elizabeth Jesser Reid, a pioneering social reformer, founded Bedford College in 1849 as the first college in Great Britain for the higher education of women. In 1900, Royal Holloway College and Bedford College became part of the University of London, the first institution in the UK to award degrees to women.

Both Bedford and Royal Holloway admitted male undergraduates for the first time in 1965, but their commitment to women's education remained. The 1982 partnership agreement between the two colleges paved the way for the merger in 1985 to create what is today known as Royal Holloway, University of London.

The College's Art Collections contain world-class paintings, sculptures, prints, drawings and watercolours including works by William Powell Frith, John Everett Millais and Edward Burne-Jones. The Gallery opens its doors every Wednesday, from 10am - 3pm during the autumn and spring terms.

SCIENTIFIC PROGRAMME:

Speaker Abstracts and Timetable



Symposium Timetable

Day One: 27th June 2017

8.00 – 9.10 Registration and Poster set up

9.10 – 9.20 Introduction		
9.10 9.20	**Hubrecht R** UFAW	Welcome and Introduction

9.20 – 10.30 Session 1.1 Chair: **Hubrecht R** UFAW, UK		
9.20- 10.05	**Mendl M and ES Paul** University of Bristol, UK	Animal affect: What is it, what do we know, and what can we know?
10.05- 10.30	**Franks B and JA Robbins** Columbia University, USA; University of British Columbia, Canada	What are we talking about when we talk about welfare?

10.30- 11.10 Break: Refreshments

11.10 – 12.50 Session 1.2 Chair: **Beausoleil N Massey** University, New Zealand		
11.10- 11.35	**Braithwaite VA, P Droege and DM Weary** Pennsylvania State University, USA; University of British Columbia, Canada	A comparative framework to determine which animals are aware of their pain
11.35- 12.00	**Clarkson JM, MC Leach, PA Flecknell and C Rowe** Newcastle University, UK	Handling method alters the hedonic value of reward in laboratory mice
12.00- 12.25	**Burn CC** The Royal Veterinary College, UK	Boredom in the beast: How time drags, and arousal and valence decline
12.25- 12.50	**Roelofs S, RE Nordquist and FJ van der Staay** Utrecht University, The Netherlands	Improving judgement bias tasks for measuring emotional state in pigs

12.50 – 14.00 Lunch, including Poster Session 1 (from 13.20)

14.00 – 15.35 Session 1.3 Chair: **McElligott A** Queen Mary University of London, UK		
14.00- 14.45	**Smulders TV** Newcastle University, UK	Can neuroscience offer new animal welfare measures?
14.45- 15.10	**Friel M, HP Kunc, K Griffin, L Asher and LM Collins** Universities of Nottingham Trent, Newcastle, Lincoln and Leeds and Queen's University Belfast, UK	Emotional valence affects the acoustic characteristics of vocalisations in pigs
15.10- 15.35	**Fuchs C, C Kiefner, S Reese, M Erhard and AC Wöhr** Ludwig-Maximilian-University of Munich, Germany	Sleep disturbances as an indicator for animal welfare – An example of the horse

15.35 – 16.10 Break: Refreshments

16.10 – 17.25 Session 1.4 Chair: **Martin J** University of Edinburgh, UK		
16.10- 16.35	**Llonch P, D Temple, E Mainau and X Manteca** Universitat Autònoma de Barcelona, Spain	From single studies to systematic evaluation: a new era of animal welfare assessment
16.35- 17.00	**Yeates JW** RSPCA, UK	Burdens of proof in determining animal sentience
17.00- 17.25	**Armstrong E, F Gualtieri, GK Longmoor, WJ Browne, G Caplen, A Davies, S Held, I Kelland, M Mendl, C Nicol, E Paul, RB D'Eath, V Sandilands, T Boswell and TV Smulders** Universities of Newcastle and Bristol and Scotland's Rural College, UK	The avian hippocampus is sensitive to chronic stress at the caudal pole
End 17.25		

18.00 – 22.00 Drinks reception, Founder's Building North Quad, followed by dinner

Day Two: 28th June 2017

9.00 – 9.10 Introduction

9.10 – 10.25 Session 2.1 Chair: **Golledge H** UFAW, UK		
9.10-9.35	**Poirier C, TV Smulders and M Bateson** Newcastle University, UK	How to measure long-term affective states
9.35-10.00	**Goold CM and RC Newberry** Norwegian University of Life Sciences, Norway	From between-individual to within-individual differences: what can we learn from individual-oriented analyses?
10.00-10.25	**Wolfensohn S** University of Surrey, UK	Use of the animal welfare assessment grid (AWAG) to monitor the life time experience of animals

10.25- 11.15 Break: Refreshments

11.15 – 12.50 Session 2.2 Chair: **Braithwaite V** Penn State University, USA		
11.15-11.40	**Sandøe P, B Forkman, R Nøhr, M Denwood and TB Lund** University of Copenhagen, Denmark	To what extent do experts agree? – a study of perceived validity of animal welfare indicators
11.40-12.05	**Boerrigter JGJ, WP Cofino, R Manuel, G Flik, R van den Bos and H van de Vis** Radboud University and Wageningen University and Research, The Netherlands	Toward a diagnostic tool that reflects the adaptive capacity-African catfish as case study
12.05-12.30	**Arrazola A, E Mosco, T Widowski, M Guerin and S Torrey** University of Guelph, Canada	Does feed restriction lead to fault bar development in broiler breeders?
12.30-12.50		Announcement of UFAW Medal for Outstanding Contributions to Animal Welfare Science and Young Animal Welfare Scientist of the Year

12.50 – 14.10 Lunch, including Poster Session 2 (from 13.20)

14.10 – 15.45 Session 2.3 Chair: **Burn CC** Royal Veterinary College, UK		
14.10-14.55	**Mason G** University of Guelph, Canada	The welfare significance of abnormal repetitive behaviours
14.55-15.20	**Keeling LJ and D de Oliveira** Swedish University of Agricultural Sciences, Sweden	Potential method to map animal body postures onto the valence and arousal dimensions of emotion
15.20-15.45	**Beausoleil NJ, CB Johnson, J Webster, M Farouk, A Sazili and S Dowling** Massey University, and AgResearch Ltd, Ruakura, New Zealand; Universiti Putra, Malaysia	Complementary approaches to understanding the welfare implications and 'return to normal' after electrical stunning for halal slaughter

15.45 – 16.20 Break: Refreshments

16.20 – 17.35 Session 2.4 Chair: **Weary D** University of British Columbia, Canada		
16.20-16.45	**Andrews C, D Nettle and M Bateson** Newcastle University, UK	Telomeres as biomarkers of lifetime experience? Evaluating critical pre-requisites using European starlings as a model
16.45-17.10	**Wigham E, S Wotton, A Grist and A Butterworth** University of Bristol, UK	The challenge of assessing welfare in abattoirs
17.00-17.25	**Allard SM, GA Fuller and SF Carter** Detroit Zoological Society, USA	The future of zoo animal welfare science?
End 17.35		

18.30 – 22.30 BBQ, Founder's Building South Quad

Day Three: 29th June 2017

9.20 – 9.30 Introduction

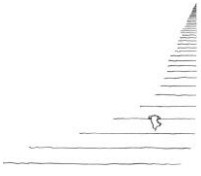
9.30 – 10.45 Session 3.1 Chair: **Lee C** CSIRO, Australia		
9.30-9.55	**Lawrence A and P Sandøe** Scotland's Rural College, UK; University of Copenhagen, Denmark	Positive animal welfare revisited with a focus on the role of behavioural expression
9.55-10.20	**Hosie CA, AM Holmes, C Emmans and TE Smith** University of Chester, UK	Marking time: the importance of considering timeframes when combining physiological and behavioural stress assessment
10.20-10.45	**Bennett RM** University of Reading, UK	Valuing animal welfare – economists' and policy makers' needs for welfare measurement

10.45- 11.25 Break: Refreshments

11.25 – 12.40 Session 3.2 Chair: **Edwards S** Newcastle University, UK		
11.25-11.50	**Espinosa J, JA Dallaire and GJ Mason** University of Guelph, Canada; Stanford University, USA	Do any forms of play indicate the presence of positive affective states?
11.50-12.15	**McLennan KM and MC Leach** Universities of Chester and Newcastle, UK	Using facial expression to assess emotional state
12.15-12.40	**Rees-Roderick CH, ELC Shepard and RP Wilson** Swansea University, UK	Towards a predictive framework for assessing physical tag detriment on birds

12.40 – 14.00 Lunch, including Poster Session 3 (from 13.00)

14.00 – 15.30 Session 3.3 Chair: **Mason GJ** University of Guelph, Canada		
14.00-14.25	**Reijgwart ML, CM Vinke, CFM Hendriksen, M van der Meer, NJ Schoemaker and YRA van Zeeland** Institute for Translational Vaccinology and Utrecht University, The Netherlands	Are all motivation tests the same? A comparison of three types of consumer demand studies in ferrets (*Mustela putorius furo*)
14.25-14.50	**Herborn KA, AG McElligott, B Wilson, MA Mitchell and L Asher** Universities of Newcastle and Queen Mary, London and Scotland's Rural College, UK	One chick calling alters the flock affective state
14.50-15.15	**Belshaw Z and LA Asher** Universities of Nottingham and Newcastle, UK	Welfare assessment in companion animal veterinary practice: Why it's just not that easy
15.15-15.30	Thank you and goodbye	
End 15.30		



KEYNOTE SPEAKER

ANIMAL AFFECT: WHAT IS IT, WHAT DO WE KNOW AND WHAT CAN WE KNOW?

M Mendl and ES Paul

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Measuring animal welfare remains difficult, even after more than 40 years of research. Long-standing debates about what welfare actually is, how to define it, and hence how to measure it underlie these difficulties, but even with their potential resolution through an emerging consensus that welfare is to do with what animals feel – their emotional (affective) states – significant challenges remain. These include: (i) defining animal affect; (ii) establishing what affective state an animal is in; (iii) finding measures that reflect this state; (iv) establishing whether animal affect is consciously experienced.

We can address challenge (i) by defining animal affect operationally, for example in behavioural terms. One such definition stems from a reinforcement-based view of affect: affective states are those associated with rewards and punishers, where rewards generate positive affect and are things for which animals will work, whilst punishers generate negative affect and are things that animals work to avoid (e.g. Mowrer, Gray, Rolls). This definition captures the notion of valence (positivity or negativity of affect) which is integral to dimensional views of human emotion and fundamentally important in an animal welfare context. It allows us to tackle challenge (ii) by providing a framework in which we can make assertions about an animal's affective state on the basis of the reinforcement value of preceding events. This, in turn, is essential for addressing challenge (iii); finding measures that reflect that state. Many such measures are now being investigated in animal welfare science and we argue that adopting the approach advocated here will help us to avoid circularity in interpreting findings and identifying those measures that best reflect the assumed state of the animal. The final challenge is the toughest – what exactly is it that we have measured? Following this approach, we can cogently argue that we have measured affective valence; a neurobehavioural state of relative 'positivity' or 'negativity'. However, can we go further and claim that our measures reflect the conscious experiences – feelings – implied by our everyday use of the word 'emotion'? If we accept that the problem of other minds cannot be solved, then the answer must be a behaviourist 'no'. If, on the other hand, we take a different philosophical stance, or we believe that we can gather enough evidence to argue by analogy that our study species shows sufficient similarities to humans to justify a claim for consciousness, then our answer may be 'yes'. Whichever is the case at present, new developments in the cognitive and neurosciences will bring us closer to answering this key question.

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Mike obtained a PhD in animal behaviour at Cambridge University in 1986. He then took a Royal Society European Research Fellowship to continue his work on behavioural development at Groningen University in the Netherlands, before returning to work at Cambridge University Vet School where he moved into the field of applied animal behaviour and welfare. He subsequently took up a position as a Behavioural Scientist at the Scottish Agricultural College in Edinburgh, continuing his work on pig behaviour and welfare, and then moved to Bristol University Vet School where he is now Professor of Animal Behaviour and Welfare, and has previously been Head of the Bristol Animal Welfare & Behaviour Group, and Deputy Head of School (Research). His current research interests are in the study of cognition, emotion, and social behaviour in domestic animals, with a view to using this information to improve animal welfare. Together with Dr Liz Paul, he developed a novel 'cognitive bias' approach to the assessment of animal emotions which draws on theory and findings from human psychology and cognitive neuroscience. He and Liz received the 2013 inaugural International Society for Applied Ethology Creativity Award, and the Alice Richie Trust Memorial Fund Award for their work in this area. Mike was awarded the UFAW Medal in 2014 for his contributions to animal welfare science, and the RSPCA/BSAS Award for Innovative Developments in Animal Welfare in 2015. Mike also works on more applied animal welfare issues, with current interests in the relationship between housing and husbandry procedures and the health and welfare of farm, laboratory and zoo animals, and chronic pain conditions in domestic dogs.
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WHAT ARE WE TALKING ABOUT WHEN WE TALK ABOUT WELFARE?

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Welfare isn't just difficult to measure, it's worse than that. Welfare is difficult to define and might be impossible to measure. But not because it involves subjective experience. As far as constructs go, welfare is a particularly thorny one. It encompasses different dimensions that don't always coincide and different time scales that can also produce contradictory information. For example, providing male mice with enrichment may increase natural behavior, but also heighten aggression, leading to increased suffering and tissue damage. Nevertheless, over time, because of these experiences, some mice may develop better coping skills and more optimistic cognitive biases. On their own, these different measures—natural behavior, pain, aggression, coping, cognitive bias—cannot determine whether enrichment produces better welfare. In other words, there is no objective way for animal-based data to determine the relative value of freedom from pain versus long-term psychological strength. Making this determination necessitates an evaluative judgment and it is possible that no single measure will ever be accepted as definitive.

All is not lost for animal welfare scientists, however. Regardless of its multidimensionality and evaluative components, welfare inevitably contains elements that are measurable. Indeed, the past few decades have seen great progress in our ability to make even the most private experiences objective. Nevertheless, no amount of refinement can prove what motivations an animal *should* have or that net-positive emotion *is* welfare. Accordingly, we believe a meta-theory of welfare could be beneficial for contextualizing the value of the data generated by animal welfare science studies. As a meta-theory, our model is silent on how welfare can and should be defined. Instead, it provides a framework for how welfare can and should be discussed and studied.

We propose that when people talk about welfare, three interrelated elements are at play. (1) The experiences and lives of the animals themselves. (2) The evaluator's theories about welfare. (3) The relationship between the evaluator and the evaluated. While there are measurable components in each of these three domains, only the first one is purely animal-based. Moreover, research isolated within any single domain cannot validate itself—the domains are interdependent. With this framework, we hope to help disentangle conflicting lines of evidence, provide clarity and focus to the goals of animal welfare science, and map out the roles of and relationships between the different fields of research concerned with the well-being of animals.

A COMPARATIVE FRAMEWORK TO DETERMINE WHICH ANIMALS ARE AWARE OF THEIR PAIN

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Pain is an enigma, we all know what it is, but nobody other than you can experience the pain you feel. Although pain is no longer considered to be an exclusively human experience, we struggle to agree on which animals are able to experience it. But determining which animals are aware of their pain, and so experience negative emotions associated with it, remains a central problem for animal welfare science. Because animals cannot verbally report what they are experiencing, it is difficult to understand what they feel, and if they do feel pain how they process it. To address this problem, we need to consider the mechanisms that underlie pain and then investigate the capacity for these kinds of process to occur in different animals. Constructing lists of attributes that are normally associated with human pain – nociception, protective motor responses, presence of opioid systems, long-term learning etc. – is inadequate without a theory that shows how these attributes demonstrate the capacity for conscious pain. We suggest that the affective aspect of pain, the conscious feeling of aversion, is central to concerns about animal pain and welfare, and so it is this aspect of pain that needs to be the focus for pain studies. Importantly, the affective component of pain is dissociable from the sensory component, both are normally interconnected and adaptive, but there are studies showing that these two can be uncoupled. In this presentation, we will argue why this dissociation is critical to understanding pain across the animal kingdom, and how it might help us to determine which animals experience negative emotions associated with tissue damage or injury. In our view, the felt emotion of pain aids the animal in flexibly responding to its environment and situations that may help it to reduce its pain, and to avoid similar, damaging situations in the future. We suggest that consciousness is necessary to determine a situation-appropriate response under novel conditions; to attend to and select relevant stimuli; and to tailor actions in pursuit of goals. Thus studies of pain in animals need to address these kinds of capacity. We will present a framework that takes a comparative approach to investigating pain and emotion in animals.

HANDLING METHOD ALTERS THE HEDONIC VALUE OF REWARD IN LABORATORY MICE

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Each year, in the UK alone, several million mice are bred for scientific purpose and used in experimental procedures. The handling of laboratory mice has profound effects upon their anxiety responses in standard behavioural tests. Specifically, tunnel handled mice exhibit fewer stress and anxiety-like responses in these tests, compared with mice handled via the standard method of handling via their tail. Despite the evidence, this handling refinement of using a tunnel has yet to be implemented widely across research institutions, perhaps because the full benefits of this handling method have not been fully evaluated.

Whilst it has already been established that current handling practices can induce stress and anxiety, it remains unknown whether handling is associated with longer-term alterations in mood suggestive of a depressive-like state in these animals. A core symptom of depression is anhedonia, traditionally assessed in rodents by assessing how much sucrose they consume. In this study, we investigated if and how long-term exposure to tail or tunnel handling influenced an animal's perception of rewarding sucrose solutions (4% and 16%). Specifically, we tested if handling method (tail or tunnel) impacted not only on total sucrose consumption, but also 'how' the solution was consumed through the detailed analysis of the animals licking microstructure.

We replicated previous findings and found that tunnel handled mice showed fewer behaviours associated with anxiety compared to tail handled mice (more interaction with a handler, more time on the open arms of an elevated plus maze, and reduced thigmotaxis in an open field test). Sucrose consumption and licking microstructure also differed according to handling method. Tunnel handled mice drank consistently more, and had greater lick cluster sizes when drinking 4% sucrose solution, indicative of increased responsiveness to reward.

This study provides the first evidence that tunnel handled mice have enhanced hedonic responses towards reward, providing more evidence that tunnel handled mice have a more positive affective state than tail handled mice. These data provide the first evidence that tail handling may induce longer-term alterations in mood that are analogous to a depressive-like state in humans, and support the implementation of tunnel handling of mice to improve their welfare.

BOREDOM IN THE BEAST: HOW TIME DRAGS, AND AROUSAL AND VALENCE DECLINE

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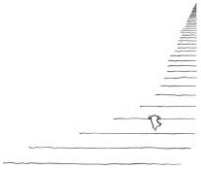
Boredom has likely adaptive value in motivating exploration and learning. Chronic inescapable boredom is extremely aversive in humans, and under-stimulation can harm neural, cognitive and behavioural flexibility. Animals are at particular risk of under-stimulation – and thus potential boredom – in captivity, which is often spatially and/or temporally monotonous. Yet boredom has sometimes been dismissed as a trivial problem or an anthropomorphic concept for animals, and biological research into boredom is scarce even in humans. Here I aim to facilitate hypotheses about how monotony affects behaviour and physiology so that boredom can be objectively studied, measured, and ultimately, mitigated. For example, clear hypotheses regarding boredom are required to help answer questions regarding whether certain abnormal behaviour is caused by boredom versus a specific frustration, or whether environmental enrichment effectively mitigates boredom rather than simply increasing behavioural diversity. I start by characterising the valence (pleasantness) and arousal (wakefulness) qualities of boredom, because both can be measured using diverse behavioural and physiological 'welfare indicators'. Boredom occurs when stimulation is insufficient to maintain an animal's optimal arousal levels; the suboptimal arousal is aversive, so the animal proactively resists low arousal and attempts to escape the situation or otherwise seek stimulation. Thus, behavioural indicators of boredom seemingly paradoxically include signs of increasing drowsiness, initially interrupted by bouts of restlessness, avoidance and sensation-seeking behaviour. This conflict between drowsiness and activity is not as surprising as it might first seem, as neuroscience has revealed that arousal is not a unitary phenomenon, so it is possible for arousal indicators to diverge depending on which relevant brain systems are active. Valence and arousal are not, however, quite sufficient to fully identify boredom. For example, human boredom is further characterised by a perception that time 'drags', and this effect of monotony on time-perception can too be behaviourally assayed in animals. I briefly explore the potential of paradigms such as peak interval and temporal bisection tasks for elucidating whether time is perceived as dragging by non-human animals in monotonous situations. Ethological research into boredom will help improve animal welfare in applied settings, and deepen fundamental biological understanding of human and animal boredom generally.



IMPROVING JUDGEMENT BIAS TASKS FOR MEASURING EMOTIONAL STATE IN PIGS

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Measuring judgment bias in animals has been recommended as a potential indicator of emotional state. Judgment bias refers to the influence of emotion on the interpretation of ambiguous information, i.e. a negative affective state will result in a pessimistic judgment, whereas a positive affective state will result in an optimist judgment of an ambiguous stimulus. Judgment bias tasks have been applied to numerous different species. However, several potential limitations have to be taken into account before their results provide an accurate measure of emotional state.

We have explored these limitations using an active choice judgment bias task for pigs. Twenty pigs were trained to discriminate between two tone-cues. A 'positive' tone predicted a large food reward, available in a designated goal-box. A 'negative' tone predicted a smaller food reward in another goal-box. After completing discrimination training, pigs were presented with ambiguous tone-cues of intermediate frequencies between the tones used during training. Approaches to the designated 'positive' or 'negative' goal-boxes in response to ambiguous tones were scored as optimistic or pessimistic responses, respectively.

Successful judgment bias testing relies on animals' successful discrimination training. A lengthy training period prior to testing is undesirable, as it could act as cognitive enrichment. This could mask any detrimental effects on animal welfare induced by experimental treatment. Our pigs required 22 ± 5.9 daily training sessions (mean ± SD) to complete discrimination training. Two pigs failed to complete discrimination training within 30 sessions and were excluded from judgment bias testing. Results from training sessions show that pigs were initially unwilling to approach the 'negative' goal-box, opting instead to always inspect the 'positive' goal-box for a possible large food reward. Punishment for incorrect responding during discrimination training could shorten the required training period for judgment bias testing.

An effect of repeated testing on optimistic choice percentage was found ($F_{1,153}$=6.59, P<0.0112). Pigs became less likely to choose optimistically as testing progressed. This indicates that the pigs learned that ambiguous trials were unrewarded. For judgment bias tasks to provide an indication of emotional state, ambiguous stimuli used during testing must be truly ambiguous. Loss of ambiguity with repeated testing could influence results of judgment bias tasks and lead to incorrect conclusions about animals' emotional state. Possible solutions are the use of secondary reinforcers and/or a partial reinforcement schedule during training and testing.

KEYNOTE SPEAKER

CAN NEUROSCIENCE OFFER NEW ANIMAL WELFARE MEASURES?

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At the core, the concept of animal welfare is based on the assumption that other animals can and do experience emotions and affect, just like humans do. Good welfare then, should involve minimizing the negative emotions experienced by the animals, and maximizing the positive emotions. The big problem, of course, is how to assess these emotions, especially in situations when they are not (or cannot be) expressed in overt behaviour patterns.

The brain structures that control emotions and affect are evolutionarily conserved across vertebrates. This makes it very likely that other vertebrates experience similar emotions to humans and that these are controlled in similar ways. Indeed, the whole field of pre-clinical research into psychiatric disorders is based on the assumption that emotional states akin to those of humans can be (at least partially) replicated in other mammalian species. I would argue that this assumption can be used in both directions, and that it should therefore be possible to make assumptions about the association between subjective states and neural processes in other animals from what we know about homologous situations in humans. Because the animals cannot express their subjective states to us, we should be able to use measurements of associated neural processes to make inferences about these subjective states.

In this presentation, I will briefly review what is known (and what is not yet known) about the neural basis of the experience of relevant emotional/affective states in the vertebrate brain. I will then discuss how this knowledge might be used to assess both immediate affective states in non-human animals and how it might be used to assess cumulative affective experience over longer periods of time. I will illustrate these points using my lab's first attempts at using such approaches in order to assess the experience of chronic stress in chickens and mice. Neuroscientific approaches to animal welfare measurement have the potential to be able to tap directly into the affective experiences of the animals in ways that would be impossible based on behaviour alone, but we have to be realistic about the practical situations in which these approaches can be used.

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Tom Smulders is Senior Lecturer in Evolutionary Neuroscience, and the Director of the Centre for Behaviour and Evolution, based in the Institute of Neuroscience at Newcastle University. He started his training as a Zoology student at Antwerp University in Belgium, and moved on to learn about Psychology and Neuroscience during his PhD at Cornell University in the USA. Throughout his career, his focus has been on brain evolution, both at large evolutionary scales (by comparing mammalian and avian brains) and at small scales (by studying differences in brain and behaviour between closely-related bird species). He takes a multi-faceted approach, which includes studying the selective pressures that lead to evolutionary changes in the brain, as well as the neural structures and functions that result from these selective pressures and the changes in behaviour these engender. His interests in the evolution of the hippocampus as a memory processor has recently led him to start investigating the role of the avian hippocampus in the regulation of the stress response, and as the location of potential biomarkers of chronic stress and hence poor welfare.
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EMOTIONAL VALENCE AFFECTS THE ACOUSTIC CHARACTERISTICS OF VOCALISATIONS IN PIGS

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Emotional states cause neurophysiological, physiological and behavioural changes which allow the individual to respond to a stimulus and these states can be mapped onto two dimensional space in terms of their valence (pleasant/positive vs unpleasant/negative) and arousal (bodily activation). Whilst good indicators of the arousal dimension of emotions exist, clear indicators of emotional valence are still lacking. Vocalisations are known to reflect the emotional state of the caller and the physiological component of emotional state causes systematic somatic changes, including changes to the anatomy involved in vocal production. We therefore investigated whether there is a consistent association between the valence of an emotional state and variations in the acoustic properties of vocalisations.

We assessed the relationship between the acoustic parameters of vocalisations produced during the cognitive bias test and responses to the trained stimuli. Twenty seven 9 week old pigs were trained and tested in a location-based cognitive bias test and vocalisations were recorded during the test then analysed using the acoustic analysis software PRAAT. Linear mixed effects models were used to investigate the relationships between the acoustic parameters of the vocalisations and emotional valence, as measured by responses in the test.

Several parameters were significantly affected by emotional valence. Specifically, call duration ($\chi^2(1)= 21.13$, $p < 0.001$) and amplitude modulation variability ($\chi^2(1) = 5.14$, $p = 0.023$) were decreased during the positive context when compared to the negative context. The second formant mean ($\chi^2(1) = 11.76$, $p < 0.001$) and percentage of call duration in which intensity was at its maximum ($\chi^2(1) = 5.13$, $p = 0.024$) were increased during the positive context compared to during the negative context.

These results suggest that acoustic parameters may provide a good indicator of emotional valence in pigs, thus vocalisations could provide an ideal way to non-invasively assess emotional valence in non-human mammals. Furthermore, our results link two methods for measuring emotions and provide the basis for future research to test predictions of the effect of emotional valence on acoustic parameters in different contexts. If the effects of valence on acoustic parameters can be reliably identified then measuring vocalisations in practical settings will enable quick and reliable assessment of the emotional status of vocalising animals. This will be invaluable for animal welfare science, where reliable, valid and practical welfare indicators are urgently needed.

SLEEP DISTURBANCES AS AN INDICATOR FOR ANIMAL WELFARE – AN EXAMPLE OF THE HORSE

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Sleep is a naturally-occurring state that involves both the body and the mind. Even though there is still little known about the complex function of sleep, it is part of every species ethogram and clearly vital for the performance and the well-being of an individual. Complete sleep deprivation has been shown to cause severe problems and eventually may lead to death.

Different sleep stages can be identified using polysomnography. Polysomnography simultaneously measures several body functions such as brain wave activity, eye movements and muscle activity. Sleep stages can therefore be differentiated into rapid eye movement (REM) and non-rapid eye movement (non-REM) sleep. Non-REM sleep can be further divided into light and deep sleep (= slow-wave sleep). REM sleep requires complete muscle relaxation and therefore only occurs in a recumbent position while non-REM sleep can occur while standing or lying down.

The authors made a call to owners whose horses suffer from atonic collapses during rest. A detailed online survey was completed by 177 horse owners. 37 horses with collapses were studied via clinical exams, 24-hour observation and polysomnographic measurements. Furthermore the stabling conditions on site were examined.

Affected horses suffered from up to 150+ collapses per day and subsequently sustained multiple injuries. Collapses mainly occurred at night with 33 horses refusing to lie down entirely. During the collapses most horses showed typical REM patterns in the polysomnography. The affected horses showed significantly altered and restless sleep profiles including REM sleep deficiency when compared to horses without collapses.

The online survey showed a significant correlation between the onset of the collapses and the last change of stable ($p < 0{,}001$). 25% of the horses also suffered from another behavioural disorder. From the 37 examined horses, 51.3% showed an obvious relation between the onset of the collapses and a definite event (illness, pregnancy, change of stable), in 36% the stable size was too small and 8 horses showed an altered behaviour (somnolent, hysterical). After the conclusion of the study, 6 of the 37 horses changed their respective stable which led to 4 horses being symptom free while 2 showed significant improvement.

Horses with atonic collapses suffer from a recumbent sleep deprivation. Due to this deprivation, the horses enter REM sleep while standing, causing atonic collapses. Reasons for not lying down can be various and can be an indicator for a lack of safety or poor mental or physical well-being.

FROM SINGLE STUDIES TO SYSTEMATIC EVALUATION: A NEW ERA OF ANIMAL WELFARE ASSESSMENT

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Recent studies rise concern about the validity and reproducibility of animal welfare research done under controlled conditions. This may be caused by infringing crucial research practices during design, conduction, analysis and reporting of experiments. Examples of poor research practice are the lack of randomisation, blinding, sample size calculation and replication which compromise the scientific validity of results. Additionally, due to the specific and standardised conditions within laboratories, results of single-laboratory studies may often have very little external validity. This imposes an ethical concern as, unless results that are scientifically valid and reproducible are obtained, animals may be wasted for inconclusive research, and any suffering imposed on them may be morally unjustifiable. Methods for animal welfare assessment are in constant evolution increasing the validity and collection easiness of animal welfare measures. The so called 'smart farming' concept integrates computing and sensing technologies that allows recording numerous behavioural (e.g. activity, rumination, feeding behaviour), physiological (e.g. thermal imaging) and metabolic (e.g. milk stress biomarkers) data. Additionally, experience from our own research and that of colleagues evidences the development of new animal-based measures of welfare that can be routinely assessed in an extensive range of farming systems. The validation of indicators that can be recorded during meat inspection to assess health (e.g. carcass bruising, pneumonia and pericarditis) and other welfare issues (e.g. body condition and cleanliness) is a good example of this. The combination of smart farming and welfare measures for systematic assessment may increase the access to farm animal welfare records, which can be used for research and further goals (e.g. auditing or labelling). This paper will identify the most relevant available technologies and measures that can be used for systematic assessment of farm animal welfare and discuss the variety of contexts and purposes they can be applied. In addition, we will discuss the importance of accessible data from systematic assessment, which could be the basis to create a welfare database similar to other phenotypical records such as the National Milk Record. In conclusion, the enormous potential to collect data combined with the use of convenient epidemiological analysis, could be very informative on the welfare status of livestock and help designing the future correction measures for improving farm animal welfare.

BURDENS OF PROOF IN DETERMINING ANIMAL SENTIENCE

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Animal welfare is both a scientific enquiry and a way to determine how best to improve the well-being of animals with which we interact.

One aim of modern animal welfare science is to attribute mental capacities to animals, in particular those for various forms of suffering and pleasure. Traditionally, animal welfare science has posited null hypotheses against which alternative hypotheses are tested. In effect, this means an animal is assumed to lack a capacity until satisfactorily proven otherwise. In comparison, owners, stockmen, technicians, officers and veterinarians make assessments and decisions based on their empathy and experience, often in the absence of scientific data.

To what extent should we require evidence of harmfulness to prohibit (or mandate) interventions that could benefit humans, and/or evidence of harmlessness to permit any action (or omission) that theoretical might harm animals? This paper considers how to determine burden of proof requirements by using our ethical analyses to inform our statistical analyses. Ethically, we can consider how we should be treated, and through a principle of generic consistency, attribute capacities to other animals in the equivalent way. Statistically, we can employ frequentist approaches (that set a priori p-values against which data may challenge null hypotheses) or Bayesian analyses (that combine a prior probability on a given hypothesis with additional data to form a posterior opinion). Both face particular challenges.

Different ontological and ethical viewpoints support different evidential requirements. For example, assumptions of human-exceptionalism and conservatism would support demanding requirements for evidence of harmfulness. Conversely, precautional approaches that "give animals the benefit of the doubt" might require those defending husbandry methods to provide convincing evidence that the animals involved lack a capacity to suffer (or possess a relevant capacity for pleasure).

This paper suggests a framework for determining appropriate burdens of proof in different decisions. In particular, it provides a framework for setting the burden of proof based on the degree of suffering and.or pleasure (in intensity, duration, number and risk), compared to the benefits of any particular husbandry method or proposed change. This provides an ethical defence of setting the burden of proof in risk-benefit analyses.

THE AVIAN HIPPOCAMPUS IS SENSITIVE TO CHRONIC STRESS AT THE CAUDAL POLE

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Assessment of animal welfare would benefit significantly from an objective marker which integrates experiences over a long time period in a valence-specific manner. In rodents, adult hippocampal neurogenesis (AHN) is suppressed by cumulative chronic stress, 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. For anatomical reasons, we hypothesised that the caudal pole of the avian hippocampus is homologous to the stress-responsive ventral region in mammals and therefore our primary aim in these experiments was to test whether AHN in the caudal hippocampus in poultry is sensitive to cumulative chronic stress.

Tissue was obtained from 64 HyLine Brown hens (aged 26 weeks at the end of the experiment) which were either kept in control conditions or exposed to randomized and unpredictable stressors over an 8 week period. As expression of the protein doublecortin (DCX) provides a marker of immature neurons arising from AHN, we used immunohistochemistry to stain DCX-positive cell bodies, which were quantified via stereological cell counts. Hens housed for 23 weeks in a preferred (high-welfare) versus non-preferred (low-welfare) environment were also sampled for the measurement of *DCX* mRNA expression levels via the quicker method of real-time PCR.

Whilst the density of DCX-expressing multipolar neurons did not differ between hens exposed to chronic stress and control birds in the rostral hippocampus ($\chi 2_1 = .173$, $p = .677$), stressed-birds exhibited significantly fewer DCX+ multipolar neurons at the caudal pole ($\chi 2_1 = 4.25$, $p = .039$); indicating a suppression of AHN under stress specific to this subregion. However, hens housed in preferred and non-preferred conditions did not differ in their rostral or caudal *DCX* mRNA levels. This null result may relate to limited sensitivity of the PCR method, or to a lack of modulation of neurogenesis levels by these particular conditions, at least after such a long time period.

We conclude that the caudal end of the avian hippocampus is sensitive to chronic stress. Using immunohistochemistry to measure neurogenesis in the caudal hippocampus post-mortem may provide an objective marker of the cumulative welfare state of poultry. Thus, this technique may be useful in the future for comparing the cumulative experiences of hens housed in different commercial housing systems.

HOW TO MEASURE LONG-TERM AFFECTIVE STATES

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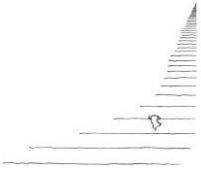
Affective states can be subdivided in two broad categories: emotions and moods. Emotions are suites of cognitive, motivational and physiological changes triggered by rewarding or punishing events and are usually short-lasting. In contrast, moods are not directly related to any particular event but seem to emerge from the integration over time of discrete emotional experiences and are usually long-lasting. There is a growing consensus that assessing long-lasting affective states is crucial for measuring animal welfare, but it is also notoriously difficult. In this talk, we will introduce a new method to assess moods in animals, inspired from neurobiology and psychiatry: namely the quantification of neurogenesis or alternatively the amount of grey matter, in the hippocampus. These two hippocampal measures have been linked to moods and mood disorders in humans and we will argue that with appropriate controls, they can be used to asses long-lasting affective states in other animals. We will review the evidence supporting the use of this method as a biomarker of mood in mammalian species and will discuss its potential to be used in other vertebrate species. We will describe how these measures can be used to compare the welfare impact of different husbandry or experimental procedures and to test the efficacy of any potential refinement. These points will be illustrated by preliminary results from our on-going research on long-term affective states in macaques and chickens. We will also discuss how these measures can help fulfilling the legal requirement to assess the absolute severity level of experimental procedures repeatedly applied to laboratory animals. Finally, we will discuss how moods relate to the concept of cumulative lifetime experience and what it might mean for an animal to have a life worth living.



FROM BETWEEN-INDIVIDUAL TO WITHIN-INDIVIDUAL DIFFERENCES: WHAT CAN WE LEARN FROM INDIVIDUAL-ORIENTED ANALYSES?

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Animal welfare is, primarily, a within-individual construct. Yet, classical experimental designs and data analyses in animal behaviour and welfare are focused on detecting average differences between groups. Individual differences in how animals experience and cope with their surroundings raise important distinctions between what occurs at the level of individuals and inferences made from aggregated or between-individual data. Investigations based on group differences obscure within-individual patterns or processes when, for example, the welfare status of different individuals changes at different rates or individuals experience differential welfare towards the same events or the same scenarios. This synthesis (1) draws on our own research on shelter dogs to illustrate how individual differences in behavioural plasticity and predictability can violate the measurement invariance of behavioural traits, and (2) highlights some individual-oriented approaches that may be used fruitfully in animal welfare research. These include (a) hierarchical regression modelling to quantify uncertainty in within-individual differences, (b) network analysis to understand individual heterogeneity in the organisation of behaviour, cognition and affect, and (c) single-subject research designs to explore within-individual dynamic processes. Advantages and disadvantages in the application of these approaches are exposed. Ultimately, the implementation of individual-oriented analyses to distinguish between- from within-individual differences offers greater clarity in the assessment of animal welfare.

USE OF THE ANIMAL WELFARE ASSESSMENT GRID (AWAG) TO MONITOR THE LIFE TIME EXPERIENCE OF ANIMALS

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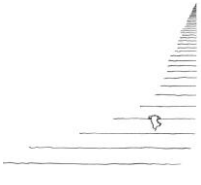
Numerous methods of animal welfare assessment have been reported but the majority only look at the animal at one moment in time. The Animal Welfare Assessment Grid (AWAG) is a tool to reflect the temporal component of suffering that is often overlooked and is helpful in balancing difficult decisions about the future of an animal or group of animals. Combining retrospective and prospective analyses to assess an animal's current and likely future welfare status, (its quality of life,) will facilitate end-of-life decisions in a wide range of species and circumstances.

The AWAG gives a schematic representation reflecting the five domains of animal welfare by assessing factors to measure the physical condition of the animal, its psychological condition, the effect of interventions and the environmental quality. It records the changes in the state of the animal over time allowing for predictive, retrospective, or scheduled, event monitoring and illustrates the temporal component of suffering. It produces a graphic illustration of the lifetime experience which can be interrogated at any time point, producing a grid showing the effect of each component of the domains of welfare. This allows the effect of specific refinements or interventions to be clearly evaluated and incorporates positive as well as negative aspects of welfare. The factors that are scored on the axes depend on species, type of use, what records and samples are routinely collected, and a team approach is required to define these factors. This in itself encourages consideration of the components of the ideal welfare state and the selection of appropriate welfare indicators. Using the AWAG allows objective feedback on changes affecting welfare, enables drilling down to the separate components of welfare and produces an easily understood visual representation, encouraging communication about welfare. The system allows specific areas to be identified as the particular cause of any change in welfare, enabling refinements to be focused appropriately to maximise improvements wherever possible. It is being used to assess welfare of primates in research and in a zoo environment, of carnivore species in the zoo and of wild birds, which has validated its use both in monitoring individual and groups of animals. It indicates how the well-being of animals can be improved and demonstrates to regulators, ethical review bodies or welfare groups that a proactive approach is being taken and that effective action is resulting in the delivery of improved husbandry and care.

Please visit www.vhive.buzz/awag to give your feedback on this system and help us develop the software so it will meet the requirements of you, your sector and your animals.



TO WHAT EXTENT DO EXPERTS AGREE? – A STUDY OF PERCEIVED VALIDITY OF ANIMAL WELFARE INDICATORS

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Background: In the absence of true validation, a simple face validity check is often relied upon to assess expert-derived measures of animal welfare. It is assumed that other experts in the field agree on what is a valid measure. However, little has been done to test this assumption.

Research questions: 1) To what extent do relevant experts agree on the validity of a number of specific measures of pig and cattle welfare and of the relative weight that should be assigned to the underlying principles of Good Health and Appropriate Behaviour? 2) Are there systematic differences across groups of experts relating to their professional role?

Methods: We used a questionnaire survey (a non-probability, availability sample) of animal experts. They were recruited from six European countries through the professional networks of the authors. The respondents' professions were divided between controllers/inspectors (33.1 %), researchers (30.9 %), consultants (17.7 %), and veterinary practitioners (15.5 %). The participating experts were introduced to 17 different animal welfare measures chosen from the Welfare Quality® project, relating to either pig or cattle welfare and relating to the principles Good Health and Appropriate Behaviour. They were asked to rate the perceived validity of each measure using an 11-point Likert scale (from 0 "very poor" to 10 "very good"). In total 307 animal experts working with cattle and/or pigs were contacted. Of these, 196 completed an online questionnaire (response rate=64 %).

Results: There was substantial disagreement on the validity of the 17 measures across all experts, even within professions and educational groups. All measures were rated as "poor" by a subgroup of experts. Standard deviation ranged from 1.4 in measures of Appropriate Behaviour in cattle to 2.2 in measures of Good Health in pigs), which reflect high variation in perceived validity on the 11-point response scale. The average perceived validity of measures relating to Good Health relative to those relating to Appropriate Behaviour was 0.89, 0.97 & 0.84 for pigs for Veterinarians/Consultants, Researchers & Inspectors respectively (significant difference between professions; p=0.011), but 1.14, 1.08 & 1.03 for cows for the same respective professions (p=0.054).

Summary: Experts do not agree on the level of validity of measures and face validity is therefore a weak argument when it comes to validating measures used in animal welfare studies. There were some significant differences between groups of experts but these were minor compared to the overall disagreement.

TOWARD A DIAGNOSTIC TOOL THAT REFLECTS THE ADAPTIVE CAPACITY- AFRICAN CATFISH AS CASE STUDY

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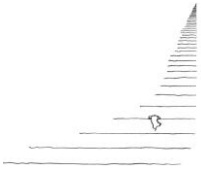
There is an increasing demand for more sustainable aquaculture and animal welfare is represented in the concept of sustainability. Chronic stress consumes energy normally used for growth, reproduction or resistance to pathogens. This reallocation of energy can influence the time to recovery from a new, acute stressor. Therefore, recovery from a standardized acute stressor on top of the normal or experimental husbandry conditions may reflect the allostatic load of that stressor and can be indicative of an animal's allostatic state under those husbandry conditions. In fish cortisol is a prime mediator of allostasis, as it influences processes such as energy metabolism, immune system and reproductive system.

Here, we present a model of the acute response to and recovery from a standardized stressor that reflects the fish's adaptive capability under normal husbandry conditions. For the development of this model we focussed on African catfish (*Clarias gariepinus*). Recovery from an acute stressor on top of normal husbandry was studied in juvenile A. catfish in experiments. Fish were kept for 30 days under several different rearing conditions. After a month fish were challenged by 15 minutes air exposure to assess their adaptive capacity. Blood was drawn from fish before air exposure, directly after, 15, 30, 45 and 60 minutes after air exposure and plasma cortisol was measured. A database for plasma cortisol was constructed with the results from these experiments. Data indicative of allostatic load under normal husbandry situations were selected from this database. The selected data were integrated into a model reflecting the stress response of African catfish under normal husbandry conditions. Using the data, outer limits (5% and 95%) of this stress response were calculated. Curve fitting was used to create a mathematical function representing the plasma cortisol peak and the recovery of cortisol to baseline levels. Using this function, a calculated recovery time was determined. A similar procedure for the outer limits (5% and 95%) was performed, providing a minimum and maximum calculated recovery time.

This first version of the model should be substantiated with additional data that cover a broader range of husbandry conditions meeting the requirements of catfish. We anticipate that the implementation of the recovery model may be valuable in future welfare assessments of African catfish farms or in interpreting results from scientific studies regarding welfare. We foresee that the model can substantially contribute to a standardized welfare and allostatic load assessment for cultured fish.



DOES FEED RESTRICTION LEAD TO FAULT BAR DEVELOPMENT IN BROILER BREEDERS?

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Broiler breeders are quantitatively feed restricted up to 43% of *ad libitum* feed intake, for the same body weight, during rearing to control their growth rate. Alternative feeding strategies that increase feed allotment and reduce voluntary feed intake have been developed to reduce hunger, frustration and lack of satiety; however, it is unclear whether qualitative feed restriction improves breeder welfare. Fault bars are malformations perpendicular to the rachis of the feather as a result of stress as a feather grows, and a high number of fault bars may indicate undernourishment, poor body condition, low survival probability, handling stress and individual's susceptibility to stress. The objective of this research was to compare the fault bars on feathers of feed-restricted broiler breeders on different feeding strategies. At 3 weeks of age, 1,680 Ross 308 pullets were allocated into 24 pens fed with one of four isocaloric treatments: 1) daily commercial diet (control); 2) daily alternative diet; 3) 4/3 commercial diet (4 on-feed days per week); and 4) graduated commercial diet with varying on-feed days per week. The alternative diet had an inclusion of 40% soybean hulls and 1-5% calcium propionate, increasing with time. At week 17, the juvenile wing feather (P8) was removed from 10 birds per pen, and at week 21, the same feather (induced) was cut for examination. Induced feathers are the regrowth and replacement of removed feathers within the same follicle. The number of fault bars was macroscopically recorded for both juvenile and induced feathers, and categorised based on fault bar length (longer or shorter than 5 mm). Feather mass and length were recorded. P8 feathers had an average of 3.1±0.2 fault bars (maximum 16 in juvenile feathers and 15 in induced feathers). Birds in the control treatment had a higher number of fault bars than birds in the other three treatments ($P<0.01$). Induced feathers tended to have a higher number of faults, longer than 5 mm, than juvenile feathers ($P=0.07$). Juvenile feathers had a higher feather mass relative to feather length, and feather mass was positively correlated with the number fault bars in juvenile feathers ($P<0.001$; $r=0.27$), but not in the induced feathers ($P=0.71$). However, it is unclear how feather mass or length affects fault bar formation. The incidence of fault bars was lower in alternative feeding strategies compared to control, which may indicate that these strategies helped to reduce the birds' susceptibility to nutritional stress.

KEYNOTE SPEAKER

THE WELFARE SIGNIFICANCE OF ABNORMAL REPETITIVE BEHAVIOURS

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Abnormal Repetitive Behaviours (ARBs) are a heterogeneous group of activities that range from forms derived from intention or redirected movements (e.g. escape-related 'scrabbling' in mink, feather-plucking in hens) through to forms indicating basal ganglia dysfunction (e.g. jumping and backward somersaulting in deer mice), with the aetiology of most being unknown (and what forms should be included as ARBs [e.g. wheel-running?] also being a matter of debate). Despite this lack of clarity (which reflects a need for more empirical research), some strong themes emerge when examining the relationships between ARBs and animal well-being. First, at the group level, prevalent ARBs specifically typify populations with aversive past and/or current experiences (with growing evidence that ARBs may reflect cumulative lifetime welfare). Second, the few exceptions to this type of pattern are largely 'false negatives', wherein, despite poor welfare, animals fail to develop ARBs. One likely explanation for this is that some types of aversive treatment promote inactive rather than active response styles (e.g. hiding, instead of repeated escape attempts that then develop into ARBs). Third, when focusing on individual differences *within* groups of similarly treated animals, subjects with spontaneously high levels of ARB are *not* consistently those with the poorest welfare. Again this pattern seems to be explained by response style: faced with aversive conditions, some individuals become highly inactive instead of displaying high levels of ARB. Thus ARBs are not good ways to identify which individuals are coping best or least well with a welfare-challenging situation; nor is genetically selecting against ARB likely to be a valid way to improve animal welfare.

Overall, the absence of ARBs in a population or management system is thus necessary, but not sufficient, to infer good lifetime well-being (being insufficient because ARBs are not always sensitive welfare indicators, being prone to false negatives). However, the presence of ARBs in a population or management system (e.g. as is common in lab mice, zoo-housed elephants and giraffes, and gestating sows) *is*, in contrast, reliably informative, warning of compromised welfare during these animals' lifetimes.

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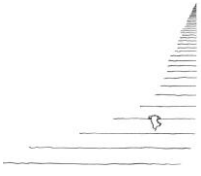
Georgia Mason is a behavioural biologist whose research interests are in the objective assessment of animal welfare, and the chronic effects that captive housing can have on brain, behaviour and well-being. She has a Ph.D. in animal behaviour from Cambridge University, where she also held a Clare College post-doctoral research fellowship. She taught vertebrate evolution and animal behaviour for 10 years in Oxford University's Zoology Dept., where she was also a David Phillips BBSRC fellow. She moved to Canada in 2004 to take up a Canada Research Chair at University of Guelph. Professor Mason has over 150 publications, including papers in *Nature*, *Science* and an edited, co-authored book on stereotypic behaviour.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POTENTIAL METHOD TO MAP ANIMAL BODY POSTURES ONTO THE VALENCE AND AROUSAL DIMENSIONS OF EMOTION

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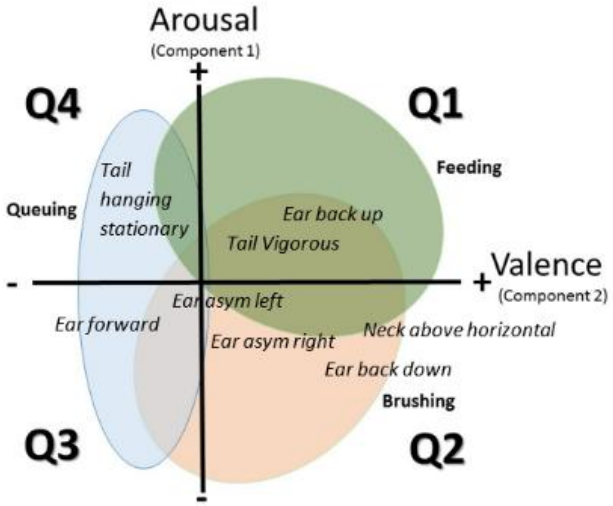
Welfare assessment would be much easier if we knew which body postures reflect which emotion. We perhaps know this for states such as pain or fear, but we lack an objective method to integrate observations of body postures into two-dimensional core affective space to identify a broader range of emotions. Here we propose a methodology that we suggest may 1) help identify new or provide supporting evidence for indicators of emotions for freely moving animals, and 2) help generate specific and testable hypotheses to further our understanding. Using the dairy cow as a model, we present this methodology and our results. We will discuss assumptions and possible limitations of the methodology, while highlighting its potential.

Over a 9-week period we observed ear, neck and tail positions of 72 loose-housed dairy cattle performing different stationary activities; eating roughage, being brushed by a mechanical rotating brush or queuing to enter a single automatic milking system. We identified body postures that were significantly different between these activities. From a principle component analysis we also plotted the data using concentration ellipses to illustrate how the ear, neck and tail positions clustered across the three different activities (see figure).

Based on existing published data that a neck position below the horizontal and the ear position back down are associated with a calm state in cows and that these two body postures loaded negatively on component 1, we named it arousal. Based on other studies suggesting that both feeding and brushing are experienced positively by cows and that these two activities loaded positively on component 2, we named it valence. We discuss what this mapping in 2-dimensional space implies for the other body postures and activities we had observed. For example, it would associate vigorous tail wagging in cows with a positive, high arousal state and the asymmetric ear position (left ear back) to a more negative emotion than right ear back. Such results are in keeping with studies in other species and are hypotheses that can be tested in cattle. Our prediction that queuing is experienced negatively could be explored using motivation tests.



Human ethology studies have confirmed the usefulness of observations of body posture. We suggest that body postures in other animals can be a window to their emotional state and that there is potential to use this method, following further testing in other situations, to help develop and validate this useful approach.

COMPLEMENTARY APPROACHES TO UNDERSTANDING THE WELFARE IMPLICATIONS AND 'RETURN TO NORMAL' AFTER ELECTRICAL STUNNING FOR HALAL SLAUGHTER

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In New Zealand, electrical stunning to render animals insensible is acceptable prior to Halal slaughter. Recently, a new device was proposed for stunning of sheep, goats and calves for commercial slaughter. To comply with Halal requirements, there was a need to demonstrate that animals so stunned are capable of returning to normal status, i.e. fit and healthy at point of slaughter. There are challenges associated with the use of either behavioural or neurophysiological methods in isolation for evaluating the effects of stunning. Therefore, we used measures of both behaviour and electroencephalographic (EEG) response to evaluate the welfare implications and time to return to normal after high-frequency head to back stunning of adult sheep and goats and young calves. For each species, 10 lightly anaesthetized animals were used to assess time to return to 'normal' EEG (>50% pre-stun EEG power). Another group of 10 conscious animals was used to evaluate time to demonstrate behaviours including head lifting, righting and standing. Goats, sheep and calves returned to normal EEG between 8.8 and 12.8 minutes after stunning, on average. While only 7 goats, 5 sheep and 2 calves stood during 30 minutes of undisturbed observation, all but one sheep was capable of standing when roused. Thus the device likely meets the criterion for Halal slaughter. EEG proved valuable for interpreting behaviour expressed in the early period after stunning by indicating the duration for which animals were unequivocally unconscious. For example, head lifting occurred during the period of epileptiform/isoelectric EEG, states which are incompatible with consciousness; thus this behaviour should not be used to indicate return of awareness. Behaviour facilitated better understanding of level of consciousness during the progression back to normal EEG; expression of purposeful, co-ordinated behaviour during this 'transitional' period (<50% pre-stun EEG power) suggests some level of awareness during which welfare may be compromised. For example, on average, attempts to right occurred during early transitional EEG while successful righting and attempts to stand occurred during late transitional EEG. On average, standing occurred after return of normal EEG though some animals stood much earlier. Together, these results indicate that to safeguard welfare, slaughter after stunning using this device should occur well before the time at which epileptiform/isoelectric EEG ceases. In the current context, complementary use of behaviour and EEG provides the most reliable support for achieving high animal welfare standards while also ensuring that culturally important requirements for Halal slaughter are met.

TELOMERES AS BIOMARKERS OF LIFETIME EXPERIENCE? EVALUATING CRITICAL PRE-REQUISITES USING EUROPEAN STARLINGS AS A MODEL

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Considering animals' lifetime experience is an important aspect of evaluating welfare, and European legislation concerning the use of animals in research emphasises such cumulative experience. Yet measuring cumulative experience poses a challenge. Telomere length or shortening is proposed as a promising biomarker of animals' cumulative stress. Telomeres are repetitive DNA sequences at the ends of the chromosomes which shorten with age. There is growing evidence that exposure to stress increases such telomere shortening. However, to serve as effective cumulative stress biomarkers, telomere dynamics should adhere to certain properties as pre-requisite. First, exposure to multiple stressors should have additive effects on telomere shortening. Second, stress-induced telomere shortening should be long-lasting, even after removal of the stressor. Third, telomere shortening should be influenced by stress exposure only during the time period of that exposure; there should not be carry-over effects after the period of stress exposure on subsequent telomere dynamics. Fourth, effects of stress on telomere shortening should be apparent across different life stages. We examined telomere dynamics longitudinally in wild-caught European starlings (*Sturnus vulgaris*), a common passerine animal model, to evaluate against these criteria. Using a hand-rearing manipulation of nutritional and competitive stress, we found that both stressors had independent effects on nestling telomere shortening. Shortened telomeres were still detectable in adulthood after birds had been subsequently reared under common conditions post-fledging. The rate of telomere shortening occurring during adulthood under standardized conditions was not affected by our earlier developmental manipulations. We found telomere shortening, rather than telomere length *per se*, to be the more sensitive biomarker of early experiences. We also examined telomere dynamics beyond early life, during experimental exposure to an unpredictable food stressor in juvenile starlings, for which we here report our preliminary findings. Our novel longitudinal experimental studies strengthen the case for telomere shortening as an integrative biomarker of cumulative stress.

THE CHALLENGE OF ASSESSING WELFARE IN ABATTOIRS

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Good welfare at slaughter is paramount not only in minimising suffering of animals but also in producing high quality meat and meat products. However assessing what actually constitutes 'good welfare' in large commercial abattoirs continues to pose a significant challenge. Fundamental factors such as effects of transportation, reactions to novel environments and underlying commercial pressures make establishing a valid, reliable and feasible welfare assessment protocol difficult. Aspects of currently widely used welfare assessment frameworks, such as the Welfare Quality Assessment are not readily applicable or very difficult to measure in full in an abattoir environment. Accurately determining the welfare status of animals during the short period of time spent at the slaughterhouse has particular importance in evaluating the effect of welfare improvement measures. As part of the preliminary stages of a larger study we present a review of the literature regarding welfare assessment at slaughter and outline the processes involved to develop a novel welfare assessment protocol with a predominant focus on evaluating the human-animal interaction at the abattoir, and human operator attitudes to handling and treatment of the animals during their progress through the lairage and the slaughter process. It is planned that the assessment system developed will subsequently be used to assess and measure lairage and slaughter animal welfare outcomes, before, and after abattoir staff in a number of slaughter plants in the UK, and USA have received specific 'animal welfare' training.

THE FUTURE OF ZOO ANIMAL WELFARE SCIENCE?

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The field of animal welfare science has grown tremendously over the last several decades. Over the years, welfare assessments have progressed from being resource-based to animal- or evidence-based. Although advances have been made, the focus remains on aspects that are more readily discernible, and indicators of welfare, as they are being studied and reported on, are largely concerned with behavioral and physiological measures. These important indicators can inform on an animal's reaction to his or her environment, but are at times not clear with respect to how they relate directly to welfare. Even using them in combination remains challenging, as, for example, clear correlations between cortisol levels and behavior have been missing in some cases. Animal welfare scientists and practitioners working in zoos have promoted and are now routinely applying evidence-based methods, primarily using behavioral and physiological measures. This type of information is clearly important, but it is time for a dedicated effort to more fully understand the affective states of animals. The study of emotions is a critical component to not only understand but also improve the welfare of animals living in the care of humans. Several areas of work go beyond traditional measures of behavior and physiology and offer insight into the inner workings of animals, such as cognitive bias experiments, the use of biological markers other than classical adrenocortical measures and the use of infrared thermography. Although these methods present their own challenges, they also offer significant promise for the study of affective states and therefore for examination and understanding of animal welfare. The Detroit Zoological Society developed a framework to identify the critical components necessary to ensure animals living in the care of humans can thrive. Science is an important tool, but common sense and compassion are also at our disposal and absolutely must be part of the strategies we develop to understand and improve animal welfare. Continuing to rely on only some components and measures prevents us from fully evaluating and understanding well-being, and therefore limits our ability to provide animals with conditions that enable them to thrive. This presentation will review work conducted on animal emotions and suggest future avenues of inquiry important to understanding how animals in zoos are faring.

POSITIVE ANIMAL WELFARE REVISITED WITH A FOCUS ON THE ROLE OF BEHAVIOURAL EXPRESSION

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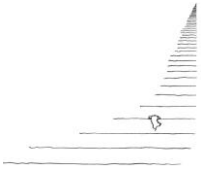
The concept of positive animal welfare has arisen relatively recently, partly as a response to the perception that animal welfare science and debate on welfare issues has been overly focused on 'negatives', and partly because of an increased scientific interest across life sciences in positive emotions (affect). Writings on positive welfare have generated new concepts and terminologies. For example, Edgar et al., (2013) developed a list of 'good life opportunities' to promote positive welfare (Comfort, Pleasure, Interest, Confidence, Health), first proposed by FAWC (2009). In parallel there has been a growing input from a range of disciplines, neuroscience, cognition studies and animal welfare science. An aim of this paper is to review what support these recent science advances provide for an improved understanding of the FAWC good life opportunities. Following from this we aim to identify remaining gaps in our knowledge of how to promote positive welfare in animals. In particular we want to focus on the welfare value of behavioural expressions. It is a very old idea that it is bad for welfare to prevent behavioural expressions, but there is growing awareness that conversely behavioural expressions may be linked to positive welfare outcomes. Whilst there have been some studies along these lines (e.g. study of the 'reward cycle') there remain a number of gaps in our understanding of how behavioural expression can give rise to positive welfare of which we will here focus on two: (a) Behaviours can be divided into those that exhibit properties of 'necessities' (such as feeding) and 'luxuries' (such as self-grooming). Whilst evidence circumstantially points to luxury behaviours as indicators of positive welfare there appear to have been no formal studies of the relationships between expressions of different luxury behaviours and positive welfare outcomes, and also whether and how luxury behaviours themselves specifically contribute to positive welfare as opposed to simply acting as indicators; (b) Another gap relates to the relevance of autonomy of behavioural decisions to positive welfare. It has long been known that having control over the timing of a negative stimulus can reduce its' harmful effects. However, we can find relatively little work that specifically sets out to study the relevance of control or autonomy of decisions on positive welfare outcomes. We believe that this update on positive welfare will contribute to the continuing development of the concept of positive welfare and the direction of future research and practical developments.



MARKING TIME: THE IMPORTANCE OF CONSIDERING TIMEFRAMES WHEN COMBINING PHYSIOLOGICAL AND BEHAVIOURAL STRESS ASSESSMENT

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Despite repeated calls for caution, elevated glucocorticoids have become equated with 'high stress levels' and are often the only measure used to assess welfare. It has long been recognised that complementary approaches provide a fuller picture. However, few studies use more than one physiological measure and even fewer collect detailed behavioural data. How we might appropriately measure stress over short and longer timescales is also vitally important for meaningful evaluation of welfare, but very rarely considered. Our work examining husbandry in the laboratory model *Xenopus laevis* sheds some light on the value of these approaches.

In one experiment, male (n = 16) and female (n = 20) *X. laevis* were housed in tanks with ecologically relevant (black = murky pond bottom) and non-relevant (white) background colours (presentation order randomised). Higher levels of water-borne corticosterone were observed after 48h in tanks with a white background compared to a black background in the females ($F = 10.721$; $p = 0.047$) but not males. Body mass decreased significantly more after 48h on white backgrounds ($F = 5.914$; $p = 0.021$) for both sexes. These physiological measures suggest a mixed but rather stressful impact of white backgrounds. However examining behaviour, at different time points, allows for more detailed interpretation. "Swimming" behaviour (indicative of general activity levels) was high for both sexes immediately after being placed in tanks – and no difference between black or white. However, 48h later this behaviour had decreased significantly on black backgrounds only ($z= -2.244$; $p = 0.042$). "Walling" behaviour (rapid, repetitive swimming which can generate snout lesions) was significantly higher on white than black immediately after being placed in tanks ($F = 4.523$; $p = 0.023$). After 48h however, this behaviour had decreased significantly on both colours (white: $z= -2.354$; $p = 0.017$; black: $z = -2.613$; $p = 0.007$) showing no difference between backgrounds.

This work shows that a range of measures, physiological and behavioural, provide more rounded stress assessment but that time frames can be critical for valuable interpretation. This combined approach generates results that are less amenable to swift conclusions, but this complexity should be embraced. Such data are likely to lead to a more nuanced understanding of "stress" in a particular species and, ultimately, lead to better improvements in welfare.

VALUING ANIMAL WELFARE –ECONOMISTS' AND POLICY MAKERS' NEEDS FOR WELFARE MEASUREMENT

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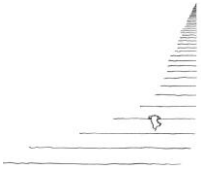
Policy intervention by government generally requires both *ex-ante* and ex-*post* evaluations of policy, usually incorporating cost-benefit analysis of the relative pros and cons of the intervention. This requirement assumes that both the costs and the benefits of policy can be adequately quantified and assessed. Quantification of the costs of policy to government, industry (e.g. livestock producers) and others in society (e.g. consumers) is relatively straightforward but the benefits of policy intervention are much more difficult to quantify. There is a substantial challenge for animal welfare science to provide quantitative and qualitative measurements and assessments of the welfare status of animals before and after intervention. However, for policy evaluation using cost-benefit analysis, there is a potentially greater challenge to provide quantitative estimates of the societal benefits of policy in relation to the societal costs in monetary terms. The nature and relationship of these two challenges and potential methods for addressing them are discussed. Example analyses in relation to interventions intended to improve the welfare of farm animals are presented using the economic concept of willingness to pay. The first example relates specifically to the implementation of the European Union broiler regulation in England and Wales whilst the second considers a more generalised approach for societal valuations of changes in animal welfare status. The merits and limitations of the different approaches raise important questions regarding the use of animal welfare science, economic and other information in animal welfare policy formulation and decision making. Moreover, it invites reflection regarding the nature and role of government intervention to protect and improve the welfare of animals.



DO ANY FORMS OF PLAY INDICATE THE PRESENCE OF POSITIVE AFFECTIVE STATES?

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To ensure good or excellent animal well-being, we need objective welfare indicators that are sensitive to positive affective states. Could some forms of play behaviour be useful, valid tools for this job? Researchers wanting to test this hypothesis by validating play behaviours as indicators of positive affective states must overcome two major challenges. The first is that the term 'play' covers a heterogeneous group of behaviours, such that data from one form or species cannot be directly applied to another form or species. The welfare significance of each type of play must therefore be validated *de novo* on its own merits (and furthermore, we already know that some forms of play actually increase rather than decrease in animals and humans in aversive situations). The second challenge is that identifying conditions that induce *absolutely* positive states in animals (rather than merely *relatively* positive states) is surprisingly difficult. To do this, we need clear, objective ways to operationalize 'pleasure', 'happiness' or 'contentment' in animals; and furthermore, we then need to be able to experimentally induce differing degrees of positive affect to assess empirically whether these influence play. The vast majority of welfare-oriented play research has not done this, but instead has compared animals in sub-optimal environments (e.g. those in isolation, or housed in small barren cages) with animals in better ones. However, despite the general lack of relevant data, two possible forms of play *have* plausibly been shown to be sensitive to positive affective states in animals: rough-and-tumble play in rats and locomotor play in piglets. Given this, and also given the great need for indicators of 'positive animal welfare', we will discuss how future validatory research could constructively build on these two intriguing cases, including highlighting some welfare-relevant *qualitative* aspects of human play that so far have been over-looked in animal play research (e.g. the degrees to which play behaviour is 'fragmented', oscillating between non-play and play activities). We hope our guidelines will pave the way for more rigorous validatory research, some of which might then identify qualitative or quantitative aspects of sub-types of animal play that do indeed indicate positive affective states.

USING FACIAL EXPRESSION TO ASSESS EMOTIONAL STATE

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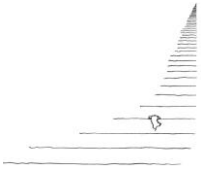
Assessing emotional states through the use of facial expressions is fairly routine in human medicine and research. This has facilitated the recognition of specific changes in the facial expression being associated with different emotional states. The use of facial expression to assess emotional states in animals is still in its infancy, but is gaining pace. The primary focus has been on assessing pain with the development of several species-specific "grimace scales" for laboratory, farm and companion animal species, with some of the facial changes showing consistency across the species. The current pain assessment scales have accurately identified several facial expression changes that occur in response to painful conditions, and are responsive to the administration of effective pain relief (i.e. causes a reduction in the pain-associated change). Facial expressions have been demonstrated to be reliable both within and between observers with minimal training, making them a potentially effective means of assessing pain in an experimental setting (i.e. retrospective, involving image and video collection and analysis). However, their utility in clinical practice (i.e. live) either in a laboratory, veterinary practice or farm needs to be further investigated. As a fairly new discipline there have been a number of conceptual and methodological issues identified in the development and use of facial expression scales to assess other emotional states. These must be overcome in order to ensure the effective use of such a tool and to preserve the reliability and validity of the current scales. This talk will discuss how facial expression can be used reliably to assess emotional states in animals and provide guidance on how such techniques should be developed and used to ensure validity.



TOWARDS A PREDICTIVE FRAMEWORK FOR ASSESSING PHYSICAL TAG DETRIMENT ON BIRDS

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The attachment of tags to free-ranging birds has greatly enhanced our understanding of avian biology. From the minutia of behaviours to vast transcontinental movements, animal-borne sensors can be used to answer suites of biological questions, relating to the physiology, behaviour and ecology of wild birds *in-situ*.

Tens of thousands of birds are equipped with tags each year. The recent explosion in the technological advancement of miniature sensors, along with the decrease in tag cost and size, makes animal-borne tagging technology an increasingly accessible and useful ecological tool. However, animal-attached devices have been shown to have numerous detrimental fitness implications, with some authors documenting reduced rates of reproduction and survival. Current guidelines for attachment of external tags to birds state that devices should not exceed 3% of the bird body mass. The implication is that physical detriment from the tags scales accordingly. This is obviously simplistic.

Here we introduce a unified framework for the assessment of putative physical tag detriment of birds. The framework combines, 1) Collated species specific activity-pattern data, 2) Primary physical issues resulting from tag-attachment (e.g. skin pressure, drag, moment arm, thermoregulation), and 3) Derived biological and ecological issues resulting from tag-attachment (e.g. metabolic costs of flight, swimming and walking, maximum climb rate, heat loss, speed, glide polar, lift to drag ratio, upthrust), in order to generate a "Predicted Physical Detriment Matrix" (PPDM). The PPDM serves to give a more realistic assessment of detrimental tag effects, for example, through provision of predicted daily energy expenditure metrics, as a function of both activity and environment, for tagged and non-tagged birds.

The eventual aim is that the PPDM will be incorporated into a freeware program. The user will be able to input critical details appertaining to the tag, attachment method and species, into the program, and in turn receive an approximation of the physical and biological impacts of the tag. The intention is that this PPDM freeware should be used, 1) By scientists intending to deploy tags on birds and, 2) By any body (such as the Home Office) responsible for approving the use of tags on birds. If a small fraction of current or proposed studies use the PPDM to modify study design this work could have a significant positive impact on wild animal welfare.

ARE ALL MOTIVATION TESTS THE SAME? A COMPARISON OF THREE TYPES OF CONSUMER DEMAND STUDIES IN FERRETS (*MUSTELA PUTORIUS FURO*)

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[2] Department of Animals in Science & Society, Faculty of Veterinary Medicine, Utrecht University, Utrecht, The Netherlands
[3] Division of Zoological Medicine, Department of Clinical Sciences of Companion Animals, Faculty of Veterinary Medicine, Utrecht University, Utrecht, The Netherlands
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Consumer demand studies are regarded as a valid method to assess an animals' motivation for different types of environmental enrichment. As experience with and knowledge on this type of studies increases, it has become evident that the results of a consumer demand study can be influenced by factors such as the type of task, the index used to calculate motivation, previous experiences of the animals and the social environment in which animals are tested.

Despite the large body of research on best practices concerning consumer demand studies, two important factors that can potentially influence the animal's motivation have not been studied yet: the number of enrichment chambers an animal can work for simultaneously and the items present in the home cage. These factors may not only affect the results of the study, but might also affect the interchangeability and validity of the different set-ups that have been used in the past.

We therefore compared the results of three types of consumer demand studies performed with the same animals. For this purpose, six ovariectomized female ferrets were successively tested in a 7-chamber, 3-chamber and 3-chamber "all-but-one" set-up.

In each set-up, we evaluated the maximum price paid (MPP) for the tested enrichment categories and control chamber, the number and duration of visits to the enrichment chambers and interaction times with the enrichments. Preliminary results indicate that a lower amount of enrichment chambers resulted in higher MPPs and smaller differences between the MPPs for the different categories. A lower amount of enrichment chambers also resulted in longer interaction times with the enrichments and more frequent and longer visits to the chambers. Adding highly preferred items to the home chamber in the "all-but-one" set-up resulted in equal MPPs for the empty and enrichment chambers, as well as shorter visits to the enrichment chambers compared to the regular 3-chamber set-up.

These results indicate that the outcome of a consumer demand study is affected by both the number of chambers and presence of items in the home chamber. As testing all the enrichment categories simultaneously and limiting the number of items in the home cage aid in discriminating between the enrichment categories, these should be added to the list of best practices for consumer demand studies.

ONE CHICK CALLING ALTERS THE FLOCK AFFECTIVE STATE

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When isolated, chicks (*Gallus gallus domesticus*) emit a repetitive, high energy 'distress' call, which aids social reinstatement. After around 5min in isolation, call rate halves. Pharmacological and cognitive bias studies suggest this reflects a shift within chicks, from an anxiety-like to a depression-like state. We tested whether exposure to one chick distress calling could alter the affective state of the flock. Specifically, whether call rate encodes information about that chick's position on the 'anxiety-depression continuum'. To produce stimuli, 24-day old broiler chicks were recorded during 10min isolation, where they exhibited the predicted decline in call rate from 60 to 30 calls/min. From these recordings, we extracted 100 calls from 5 chicks to generate two artificial sequences of vocalisations that mimicked the natural distribution of calls. The first used call rate and interval from minutes 1-3 of isolation, corresponding to the anxiety-like phase ("fast calling"). The second used attributes from minutes 8-10, corresponding to the depression-like phase ("slow calling"). To contrast with distress calls, we also extracted 'contact calls' from the same individuals in a social context ("control"). In two trials, we exposed small flocks (of 20 and 12 chicks respectively) to all three stimuli in a randomised order, for one 18hr day per stimulus (15min playback/hour). In trial 1, playback days were alternated with a day of cognitive bias testing, where we measured the time chicks spent digging in trays of sawdust in 5 locations: known positive (trained association with buried mealworms, removed for testing), known negative (never containing mealworms) and three new, intermediate locations. Exposure to slow calling significantly reduced weight gain on playback days. Compared to the control stimulus, exposure to fast calling reduced digging in the known positive location. However, exposure to slow calling reduced digging in all locations. In trial 2, we filmed playback trials with a thermal camera, to non-invasively monitor chicks for signs of stress. The onset of fast and slow calling, but not control calls, caused comb temperature changes consistent with acute stress. By the end of the day, however, baseline comb temperature (outside of 15min playback periods) was 1°C higher in chicks exposed to slow calling, suggesting chronic stress. With varied approaches, we present a cohesive case for social contagion, altering affective state, and potentially welfare, of the flock. With slow calling in particular, weight loss, disinterest in potentially rewarding stimuli and chronic physiological stress are all consistent with a depression-like state.

WELFARE ASSESSMENT IN COMPANION ANIMAL VETERINARY PRACTICE: WHY IT'S JUST NOT THAT EASY

Z Belshaw [1] and LA Asher [2]

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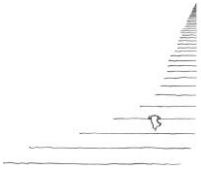
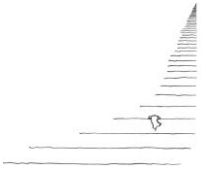
Companion animal veterinary surgeons are at the coal face of practical animal welfare assessment. The Royal College of Veterinary Surgeons' (RCVS) oath states "…ABOVE ALL my constant endeavour will be to ensure the health and welfare of animals under my care" and the RCVS Code of Professional Conduct for Veterinary Surgeons makes 139 references to welfare. But what does "welfare" mean in a companion animal veterinary context? It has been asserted that rigid definitions of terms relating to welfare are not needed. This may be true in welfare science where definitions may differ between studies, whilst still allowing progression within the field. However, the lack of clear, relevant definitions of key terms may present a major barrier to robust welfare assessments of companion animals. This is exemplified by the difficulty consistently applying the fifth welfare need, stated in Section 9 of the Animal Welfare Act (2006) as *"its need to be protected from pain, suffering, injury and disease",* to an elderly pet with naturally occurring diseases of old age that is under veterinary care.

In this presentation we will describe motivators and barriers for owners and veterinary surgeons to discuss, assess and improve welfare during a companion animal veterinary consultation. This is explored through presentation of both current assessment methods applied in a veterinary setting, and qualtatitive research which have explored the application of welfare in this context. Impacts of time, language and risk aversion will be highlighted. We will propose that unambigious definitions of key terms such as welfare, suffering and quality of life are necessary for those domains are to be consistently and accurately measured in veterinary settings. To support this assertion, we present evidence from a range of studies demonstrating the potential negative impact of undefined key terms on the welfare of owned companion animals and the challenges of converting current definitions into practical assessment for use by owners and veterinary surgeons. Finally, based on reviewing this evidence, we propose suggestions for alternative approaches to welfare assessment in a companion animal veterinary setting. We argue that these must include closer collaboration between animal welfare scientists, animal behaviour specialists and veterinary staff at all levels.



SCIENTIFIC PROGRAMME:

Poster Abstracts



List of posters

Poster session 1 on 27th June. Begins 13.20.
Poster session 2 on 28th June. Begins at 13.20.
Poster session 3 on 29th June. Begins at 13.00.

Poster session	
27th	**Addison IE and LH Thomas** (Veterinary Association for Wildlife Management, UK) Is there wild animal welfare? If so, when and what to worry about?
27th	**Anderson K, D O'Neill, H Zulch, R Meeson, D Sargan, D Brodbelt, J Summers and LM Collins** (Universities of Lincoln, Cambridge and Leeds, Royal Veterinary College, UK.) Epidemiology of canine osteoarthritis (OA) in the UK dog population as assessed at primary veterinary consultations
28th	**Arena L, GV Berteselli, S Messori and N Ferri** (Istituto Zooprofilattico Sperimentale di Abruzzo e Molise and University of Teramo, Italy) Development of a welfare assessment protocol for cats housed in rescue shelters. A preliminary study
27th	**Arndt SS and VC Goerlich-Jansson** (Utrecht University, The Netherlands) Assessing risks– which factors may affect animal welfare?
28th	**Autier-Dérian D** (Animal Welfare Consulting - Lyon, France) Quantitative and qualitative data go hand-in-hand
28th	**Autier-Dérian D, A Levieuge, E Fontaine, M Freulon, S Boue, C Quain, G Trombini and G Florence** (France Animal Welfare Consulting – Lyon and Service de Santé des Armées, France) Welfare assessment for military dogs
29th	**Bacon HJ, H Walters, V Vancia and N Waran** (University of Edinburgh, UK) Development of a robust canine welfare assessment for dogs in trap-neuter-return programmes
29th	**Baciadonna L and AG McElligott** (Queen Mary University of London, UK) Goats discriminate emotion-linked calls based on valence
27th	**Barnard S, DL Wells, PG Hepper and C Burani** (Queen's University Belfast, UK; Università degli Studi di Parma, Italy) Motor and structural lateralisation as measures of stress in dogs entering a kennel environment
27th	**Battini M, E Canali, F Dai, M Dalla Costa, C Dwyer, S Mattiello, M Minero and F Wemelsfelder** (Università degli Studi di Milano, Italy; SRUC, UK) The on-farm application of qualitative behaviour assessment to goats, sheep, donkeys and horses in the AWIN project
28th	**Baur Y, SJ Vick, A Weiss and HM Buchanan-Smith** (Universities of Stirling and Edinburgh, UK) An inter-disciplinary approach to measure positive welfare in captive gorillas
29th	**Bell LJ** (Myerscough College and Blackpool Zoo, UK) Can we use faecal corticosterone to measure the physiological stress response of transferred *panthera* in zoological collections? How stressful is transfer?
28th	**Berteselli GV, L Arena, F De Massis and P Dalla Villa** (Istituto Zooprofilattico Sperimentale di Abruzzo e Molise and Università di Teramo, Italy) Inter-observer agreement in dogs' welfare assessment in ten Italian long-term shelters
29th	**Bethell EJ** (Liverpool John Moores University, UK) Attention bias: A practical method for assessing 'psychological wellbeing' in non-human animals?
27th	**Blakeway SJ** (Sidmouth, UK) Keeping the discipline open: Inclusivity in animal welfare science

Poster session

28th **Brando S, L Tasker and HM Buchanan-Smith** (AnimalConcepts, The Netherlands; University of Stirling, UK)
Using the 24/7 animal welfare approach to promote the welfare of cynomolgus macaques (*Macaca fascicularis*) housed in research and breeding establishments

29th **Burani C, P Valsecchi, DL Wells and S Barnard** (Università degli Studi di Parma, Italy; Queen's University Belfast, UK)
Bowl half full or half empty? Assessing affective state in shelter dogs

27th **Busby D, SJ Rogers, C Bell and J Taylor** (Equine Behaviour and Training Association, UK; Epona TV, Denmark)
Improving recognition of equine fear and stress (A barrier to welfare improvement)

27th **Busby D, SJ Rogers SJ, B Hart and J White** (Human Behaviour Change for Animals, UK)
The need to apply the science of human behaviour change to improve animal welfare

28th **Bushby E, M Friel, A Wilkinson, S Cotter and LM Collins** (Universities of Lincoln and Leeds, Queen's University Belfast, UK)
Investigating the impact of pregnancy on cognitive bias in pigs

29th **Campos Luna IM, MC Leach, F Wemelsfelder, AL Miller and AR Beard** (Newcastle University and SRUC, UK)
Qualitative behavioural assessment: Preliminary results of its application for assessing laboratory mouse welfare

29th **Charlton GL, E Bleach, C Gauld, V Thorup and SM Rutter** (Harper Adams University and IceRobotics, UK)
Using accelerometers for early detection of dairy cow lameness

28th **Chincarini M, E Canali, N Ferri, M Mariscoli, M Minero, C Palestrini, L Qiu, A Torricelli and G Vignola** (Università degli Studi di Teramo and Milano, Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale', Politecnico di Milano and Consiglio Nazionale delle Ricerche, Italy)
Functional near infrared spectroscopy in animal cognition: Potentials and limits

27th **Chou J-Y, A Haigh, R D'Eath, D Sandercock, N Waran and K O'Driscoll** (Teagasc, Ireland; SRUC and University of Edinburgh, UK)
Use of different wood types as enrichment to reduce tail biting in pigs managed on fully-slatted floors

27th **Clegg ILK, HG Rödel, B Mercera, CE van Elk and F Delfour** (Université Paris 13 and Parc Astérix, France; Dolfinarium Harderwijk, The Netherlands)
Animal-based welfare measures in zoos: The case of captive dolphins

27th **Clegg ILK, HG Rödel, B Mercera, CE van Elk and F Delfour** (Université Paris 13 and Parc Astérix, France; Dolfinarium Harderwijk, The Netherlands)
Difficulties in interpreting the first indicators of positive welfare in dolphins

29th **Cooper J, A Vaughn, M Albentosa, H Hodges and L Chielo** (University of Lincoln,UK)
Using spatial dispersal patterns to assess value of space and quality of life in captive animals. Simple, robust tools for application in confined and unrestricted environments

29th **Cronin KA, EJ Bethell, SL Jacobson and SR Ross** (Lincoln Park Zoo, USA; Liverpool John Moores University, UK)
Measuring mood with minimal training: Latencies on a simple touchscreen task indicate mood in zoo-housed Japanese macaques (*Macaca fuscata*)

28th **Cruden J, O Burman and J Cooper** (GSK and University of Lincoln, UK)
A cage-base and environmental preference test for laboratory rabbits

28th **Czycholl I and J Krieter** (Christian-Albrechts-University, Germany)
Consistency of the Welfare Quality® assessment protocol for pigs during the fattening period

27th **Dale R, N Gillies, VV Vyazovskiy, M de Vos, P Flecknell and CE Bergmann** (University of Oxford and Newcastle University, UK)
Welfare assessments for non-human primates used in neuroscience research

Poster session

28th **Davidson NB and JL Hurst** (University of Liverpool, UK)
Laughing rats: A novel pest control solution?

27th **Davis N and L Holmes** (Chester Zoo, UK)
Animal welfare assessment processes in zoological collections

29th **Doyle RE, S Hazel, JE Zemitis, CA Ralph, K Plush, RS Morrison, GM Cronin and C Lee** (Universities of Melbourne, Adelaide and Sydney, South Australian Research and Development Institute, Rivalea Australia and CSIRO, Australia)
Developing a rapidly learnt judgement bias test in a confined environment

28th **DuBois C, K Merkies, DB Haley, TJ DeVries and P Lawlis** (University of Guelph, Guelph, Canada)
Examining the usefulness of qualitative data to supplement an on-farm equine welfare assessment tool

28th **du Plessis EW, NJ Beausoleil, CF Bolwell and KJ Stafford** (Massey University, New Zealand)
Validation of a combined conditioned-place aversion and approach-avoidance paradigm for evaluating aversion in chickens

27th **Fernández-Lázaro G, E Alonso-García and X Manteca-Vilanova** (University of Alcalá and Universitat Autònoma de Barcelona, Spain)
Personality studies and training: Useful tools to asses emotions and promote positive welfare in primates? A review

28th **Ferreira JM, IAS Olsson and AM Valentim** (Universidades do Porto and de Trás-os-Montes e Alto Douro, Portugal)
A less aversive anaesthetic to adult zebrafish

27th **Franco NH and IAS Olsson** (Universidade do Porto, Portugal)
Non-invasive infrared thermography for welfare assessment of laboratory rodents

28th **Green J and C Witham** (Newcastle University and Medical Research Council Center for Macaques, UK)
Filling in the gaps: considering nocturnal behaviour patterns in assessments of captive primate welfare

29th **L Greening, E Habershon, S Collop-Smith and T Ghaye** (Hartpury University Centre, UK)
Perceptions of positive equine welfare

29th **Hammerschmidt J and CFM Molento** (Federal University of Paraná, Brazil)
Protocol for expert report on animal welfare as support for court decisions in case of animal cruelty suspicion

27th **Harrison J, MLD Fallon and A Riach** (Askham Bryan College, UK)
The importance of access to outdoor space for domestic cats (*Felis catus*) in a rescue centre

28th **Hitchens PL, J Hultgren, J Frössling, U Emanuelson and LJ Keeling** (Swedish University of Agricultural Sciences and National Veterinary Institute, Sweden; University of Melbourne, Australia)
Improving animal welfare inspections by using epidemiological methods

29th **James C, LG Asher and J Wiseman** (University of Nottingham and Newcastle University, UK)
The impact of ultraviolet wavelengths on broiler chicken welfare indicators

28th **Kophamel S, M Martínez-Novoa and GA María** (University of Zaragoza, Spain)
The human-pet bond. From beginning to end. A Spanish survey

28th **Leung V, E Zhang and DSJ Pang** (Universities of Montréal and Saskatchewan, Canada)
Real-time application of the Rat Grimace Scale as a welfare refinement in laboratory rats

27th **Lima MLP, JA Negrao, T Grandin, AP Freitas and CCP Paz** (Instituto de Zootecnia and Universidade de São Paulo, Brazil; Colorado State University, USA)
Easy assessments to measure the welfare improvement in handling facilities of livestock farm

Poster session

27th **Lima MLP, JA Negrao, T Grandin, AP Freitas and CCP Paz** (Instituto de Zootecnia and Universidade de São Paulo, Brazil; Colorado State University, USA)
What behaviour trait could be introduced to be used in a beef cattle experimental farm routine?

27th **Lundmark F, H Röcklinsberg, B Wahlberg and C Berg**
(Swedish University of Agricultural Sciences, Sweden; Åbo Akademi University, Finland)
Mind the gaps! From intentions to practice in animal welfare regulations

28th **Mackay AH, GM Cronin, M Singh, PJ Groves and D Phalen** (The University of Sydney, Australia)
A pilot study: A microbiological approach to understanding feather pecking in laying hens

28th **Martin JE and DEF McKeegan** (Universities of Edinburgh and Glasgow, UK)
The elusive boundary between consciousness and unconsciousness: Spectral analysis of EEG may hold the key

29th **Martinez CA, P Szenczi, L Pérez, R Hudson, ME Morones and M de L Alonso** (Universidad Autónoma Metropolitana-Xochimilco, UATx, Universidad Nacional Autónoma de México and Unidad Médica Veterinaria de la Policía Montada de la CDMX, Mexico)
Evaluation of individual differences in the stress response to mother-young separation in the domestic horse

28th **McLennan KM, MJ Corke and F Constantino-Casas** (Universities of Chester and Cambridge, UK)
Biomarkers of pain - separating pain from inflammation

29th **Mondon M, R Merle and C Thöne-Reineke** (Freie Universität Berlin, Germany)
Systematic review on animal welfare indicators in dairy cattle to identify those of highest validity

27th **Morgan K, A Wilkinson and J Cooper** (University of Lincoln, UK)
Public perceptions of feline characteristics in re-homing shelters and the impact these have on adoption success

29th **Newell KJ, J Chitty and FM D Henson** (University of Cambridge and 'Smartbell', UK)
Use of real-time geo-location to remotely monitor locomotory behaviour as a potential proxy for well being in experimental sheep

28th **Noble CE, LM Wiseman-Orr, AM Nolan, EM Scott and J Reid** (NewMetrica Ltd, University of Glasgow and Edinburgh Napier University, UK)
Validation of a feline generic health-related quality of life instrument with an add on module for osteoarthritis

29th **O'Neill DG, JF Summers, DB Church and DC Brodbelt** (The Royal Veterinary College, UK)
Vetcompass: A new face for robust animal welfare research data

27th **Oxley JA, CF Ellis, W McCormick and A McBride** (Romford, Moulton College and Universities of Northampton and Southampton, UK)
A survey of common rabbit handling methods and reasons for their use

27th **Oxley JA and SA Gaines** (Romford and RSPCA, UK)
The welfare implications as a result of breed specific legislation in the UK

29th **Perera BVP, JL Brown, C Thitaram, RPVJ Rajapakse and A Silva-Fletcher** (The Elephant Transit Home and University of Peradeniya, Sri Lanka; Smithsonian Conservation Biology Institute, USA; Chiang Mai University, Thailand; The Royal Veterinary College, UK)
Calves using faecal corticosteroid metabolites as indicator at the Elephant Transit Home, Sri Lanka

28th **Reaney SJ, H Zulch and LM Collins** (University of Lincoln, UK)
Using pet owners in assessments about their pets personality and health status: Which human characteristics may influence responding

28th **Reijgwart ML, NJ Schoemaker, MC Leach, CFM Hendriksen, M van der Meer, CM Vinke and YRA van Zeeland** (Institute for Translational Vaccinology, Utrecht University, The Netherlands; Newcastle University, UK)
Development and validation of a Ferret Grimace Scale (FGS)

Poster session

29th **Riemer S, L Assis, T Pike and DS Mills** (University of Bern, Switzerland; University of Lincoln, UK)
Are your ears burning when I'm not there? Distance monitoring of positive and negative affective states in dogs with infrared thermography

29th **Robbins JA, B Franks and MAG von Keyserlingk** (University of British Columbia, Canada)
More than a feeling: an empirical challenge for descriptive, mental-state accounts of animal happiness

27th **Rose PE, J Linscott, S Banks and R Cromie** (University of Exeter, Wildfowl and Wetland Trust, Sparsholt College Hampshire, UK)
Benchmarking positive welfare in commonly-housed zoo birds

28th **Sandri C, A Martini, S Normando, W Magnone, B Regaiolli and C Spiezio** (Parco Natura Viva – Garda Zoological Park and University of Padua, Italy)
Could animal behaviour and behavioural flexibility be measures of welfare of zoo animals: The case of a mixed-species exhibit of Watusi cattle in a safari park

27th **Schmitt O, LA Boyle, K O'Driscoll and EM Baxter** (Teagasc, Ireland; University of Edinburgh and SRUC, UK)
Assessment of the emotional state of pigs reared artificially or by a sow

27th **Scullion Hall LEM, S Robinson and HM Buchanan-Smith** (University of Stirling and AstraZeneca, UK)
Integrating measures of welfare in the laboratory-housed dog

27th **Sommerville R, M Upjohn, K Wells and A Thomas** (Brooke Action for Working Horses and Donkeys, UK)
From paper to practice: Collaboration as impetus for implementation of the latest animal welfare concepts

29th **Spence CE, M Osman and AG McElligott** (Queen Mary University of London, UK)
Public attitudes to animal sentience and welfare

28th **Spiezio C, C Vandelle, B Regaiolli and C Sandri** (Parco Natura Viva, Garda Zoological Park, Italy; University of Liège, Belgium)
How do we measure the effectiveness of environmental enrichment for zoo chimpanzees' welfare?

29th **Stirling J** (Edinburgh Napier University, UK)
Does the cage-trapping of corvids cause unnecessary suffering? A behavioural study of trapped magpies

28th **Stokes JE, DCJ Main, S Mullan, MJ Haskell, F Wemelsfelder and CM Dwyer** (University of Bristol, SRUC, UK)
Collaborative development of positive welfare indicators with dairy cattle and sheep farmers

27th **Stomp M, S Henry and M Hausberger** (Université de Rennes 1, France)
Are positive emotions reliable indicators of welfare in horses?

27th **Studer BHP, J Volstorf, MF Castanheira, JL Saraiva and P Arechavala-López** (fair-fish international association, Switzerland; Mediterranean Institute for Advanced Studies, Spain)
FishEthoScore - Assessment of fish species' potential for welfare in farming

28th **Sutherland MA, GM Worth, M Stewart and KE Schütz** (AgResearch Ltd., LIC and InterAg, New Zealand)
Leaving no stone unturned: Assessing the welfare of calves reared on stones

29th **Tamioso PR, A Boissy, X Boivin, H Chandèze, S Andanson, E Delval, CA Taconeli, GP Silva and CFM Molento** (Federal University of Paraná - UFPR, Brazil; Institut National de la Recherche Agronomique – INRA, France)
Behavioral responses of sheep submitted to human presence and brushing

Poster session

29th **Tanner N and A Marshall** (University of York and Flamingo Land Ltd., UK)
Influence of husbandry and enclosure design on the welfare of captive giraffes

28th **Telkänranta H, A Koskela, S Somppi, MV Kujala, H Törnqvist, O Vainio and M Vainionpää** (University of Helsinki, Aalto University and Veterinary Clinic Askel, Finland; University of Bristol, UK)
Thermography reveals emotional arousal in rats encountering highly preferred food

27th **Thorpe SKS, N Hanson, E Saunders, R Pietragello-Brown, C MacDonald, K Pullen and J Chappell** (University of Birmingham, Twycross Zoo and BIAZA, UK)
An enclosure design tool to enable zoos to create integrated, wild-type enclosures for Great apes

27th **Ursinus WW, B Rietveld-Piepers, JH Bongers and THM Sijm** (Netherlands Food and Consumer Product Safety Authority, The Netherlands)
Animal welfare risk assessment of the food supply chain

28th **Vandenabeele SP, RP Wilson and A Grogan** (Swansea University and Royal Society for the Prevention of Cruelty to Animals, UK)
New technology can help assess stress levels of animals

28th **van der Laan JE, AS van der Wal, LM Bril, JAM van der Borg and CM Vinke** (Utrecht and Wageningen University and Research, The Netherlands)
Canine welfare monitoring: evaluating nocturnal activity as an indicator of adaptability of dogs to a shelter environment

29th **van Rooijen J** (Wageningen, The Netherlands)
Answers to questions concerning the scientific study of animal welfare and suffering

27th **Varner GE** (Texas A&M University, USA)
A utilitarian framework for categorizing and assessing welfare improvement strategies

28th **Vogel CJ** (The Chamber of Experts, UK)
Examining the animal – the starting point of welfare assessment

28th **Webber CE and PC Lee** (University of Stirling, UK)
Behavioural development and play in elephant calves

29th **Wells DL, PG Hepper, ADS Milligan and S Barnard** (Queen's University Belfast, UK)
The value of paw preference as a measure of canine welfare

27th **Westen HR** (World Horse Welfare, UK)
The ongoing horsemeat scandal

29th **Williams CJA, LE James, W Joyce, C Taulbjerg, CAC Leite, MF Bertelsen and T Wang** (Aarhus and Copenhagen Universities and Copenhagen Zoo, Denmark; Federal University of São Carlos, Brazil)
Assessing acute and post-operative welfare in reptiles: Case studies in snakes and terrapins

27th **Witham CL** (Newcastle University and MRC Centre for Macaques, UK).
Using automated video analysis to monitor social relationships in group-housed macaques

28th **Zhang E, V Leung and DSJ Pang** (Universities of Saskatchewan and Montréal, Canada)
The influence of rater training on reliability when using the Rat Grimace Scale

28th **Zhang Y and CJC Phillips** (University of Queensland, Australia)
Climatic influences on the mortality of sheep exported from Australia to the Middle East

28th **Zobel G and J Webster** (AgResearch Ltd. and Massey University, New Zealand)
"Farming by phone" - Is there a risk that increasing use of technology will erode our obligations to care for animals?

IS THERE WILD ANIMAL WELFARE? IF SO, WHEN AND WHAT TO WORRY ABOUT?

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Where an ecosystem is undisturbed there is no excuse for human intervention - to save the antelope is to starve the lion. However, where man has unbalanced an ecosystem e.g. by removal of apex predators, there is now a welfare argument for intervention.

However it is axiomatic that "No feelings - No welfare" [1]. Consciousness/feelings can never be proved by behavioural or physiological criteria[2] and no marker, e.g. a neural correlate of consciousness, has gained general acceptance. So when are feelings? Only then do behavioural or physiological criteria have any welfare meaning and can there be a science of animal welfare.

Assuming consciousness did not jump into existence fully fledged e.g. as an emergent property inevitable at a certain of stage brain complexity, it will manifest gradations as brains evolve, selected for increased effectiveness of responses to more and more environmental challenges. The chief of these must be responding to immediate danger, which used the reflexes and associatively-learned behavior found in even the simplest animals, and eventually conscious recognition via feelings.

We suggest that pain and panic were the first to break through into consciousness, as they signal the need for immediate action: pain means injury and panic failure of coping[3]. Thus these emotions may give the most immediate increase in survival value for being felt, so selected at a simpler brain level than the rest. First things first - it is obviously more important to evolve feelings to figure out immediate danger than to revel in distant metaphor!.

But 'where to draw the line'?. In our thinking, this will differ according to the emotion considered, and whether there is requisite brain capacity. The levels of consciousness at which more complex emotions emerge must mirror increasing levels of brain complexity, in particular that of the cortex in mammals and its analogues in birds and fish, (Though, cephalopods?). The pre-cortical reptilian brain[4] provides for the basic survival emotions as physiological and behavioural responses. Add on cortex and you add on the likelihood of feelings, progressing to more and more complex emotions, eventually Shakespeare, and the moral capacity to worry over wild animal welfare.

In sum, we argue for a graded appearance of feelings, pain and panic being the feelings most likely to appear early by natural selection, so the prime (perhaps, for markedly less corticalised non-primate brains, the sole) welfare consideration when managing wild species.

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EPIDEMIOLOGY OF CANINE OSTEOARTHRITIS (OA) IN THE UK DOG POPULATION AS ASSESSED AT PRIMARY VETERINARY CONSULTATIONS

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In order to prioritise welfare-diminishing diseases in veterinary medicine, reliable information on prevalence, severity, duration and other aspects are crucial. Osteoarthritis (OA) is the most common joint disease in both human and veterinary medicine, posing a considerable challenge to canine welfare, and therefore epidemiological investigation in this disease is warranted.

The aims of this study were to evaluate the epidemiology and impact of OA in dogs, and to describe clinical diagnosis and management of OA in primary-care veterinary practice. In order to investigate the psychological as well as physical impact of OA on quality of life, this study aims to identify dog behaviours associated with OA.

The VetCompass database was used to access clinical data from dogs attending primary-care veterinary practices in the UK. The study included all VetCompass dogs under veterinary care during 2013. Candidate OA cases were identified using a combination of search terms across the database and a random subset were then manually evaluated against a case definition.

Of 455,557 study dogs, 16,437 candidate OA cases were identified of which 6104 were manually checked and 4196 were confirmed as OA cases. Additional data on demography, clinical signs and management were obtained via clinical data review and automated extraction processes, then exported for analysis.

The estimated prevalence (accounting for subsampling) of OA was 2.48% (95% confidence interval: 2.44-2.53). The mean age of diagnosis of OA occurred at 8.6 years (± 3.6yrs, SD). Golden retrievers (2.87%), Labradors (2.27%), German Shepherds (1.83%) and Rottweilers (2.01%) were the most frequently diagnosed breeds. Of the OA cases 19.9% had at least one behavioural complaint, with quietness and reluctance to exercise reported most frequently. Regarding management, 88% of OA cases were given at least one treatment for OA. Results of epidemiological findings will be discussed in relation to the impact on canine welfare, and how these metrics can be used to prioritise OA in veterinary medicine.

DEVELOPMENT OF A WELFARE ASSESSMENT PROTOCOL FOR CATS HOUSED IN RESCUE SHELTERS. A PRELIMINARY STUDY

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Millions of cats routinely enter animal shelters each year around the world. Currently, there are no general minimum standards for shelter cats' housing, handling and dispositions (e.g. adoption, return to the original location or euthanasia). From the moment a cat enters a shelter its welfare may be threaten by a broad range of potential stressors, such as the confinement in unfamiliar surroundings, change in daily routine and group housing. In addition, inadequate environment and inappropriate shelter management might further impair the welfare conditions of the animals. Measuring shelter cats' welfare is of importance both in relation to their long-term confinement and to the adoptions' success. Shelter cats' welfare assessment is challenging both due to general lack of well-validated welfare indicators in the scientific literature and to the heterogeneity in facilities and environments, which may make the assessment difficult.

This study describes the development of a new tool potentially useful to assess cats' welfare with a holistic approach. The protocol includes different welfare measures, being either management, resource or animal-based, which are to be recorded at three assessment levels: shelter (n=6: animals' turnover, mortality, clinical issues, feeding, health management and socialization), pen (n=9: area, structure, feeding, water supply, bedding, litter, environmental enrichment, behaviour and emotional state) and individual (n=6: body condition score, diarrhoea, respiratory problems, lesions, lameness and behaviour). Each of the above-mentioned measures might contain sub-measures (e.g. the "water supply" measure includes the assessment of number of bowls, bowls' dimensions, the number of bowls' posts, the presence of water, and the cleanliness of water).

The preliminary version of the protocol was designed to be easy to conduct, standardised, carried out with minimal expense (in terms of time and resources) and generating minimal stress response in cats.

The preliminary protocol was applied in 26 Italian cats shelters; 746 cats were individually assessed, with the aim of testing its validity and its feasibility and to refine the welfare indicators, identifying those being useful to assess cats' welfare and discarding those less relevant.

A logistic regression will be carried out to assess the potential of the protocol as a tool to identify welfare hazards in shelter environments. Furthermore, once obtained a final protocol, a test-retest reliability test will be also performed. The obtained protocol would be the first one allowing a holistic assessment of cat welfare in shelter conditions.

ASSESSING RISKS– WHICH FACTORS MAY AFFECT ANIMAL WELFARE?

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Ensuring animal welfare in general is imperative from a legal and ethical point of view and a distinct scientific and societal goal.

Objective, science-based frameworks are necessary to address issues related to animal welfare and to enable appropriate management hereof.

Identification and characterization of potential risks and benefits for the welfare of animals can be put into practice by implementing 'risk assessments'. Risk assessment plans (RAPs) are a useful tool for welfare managers, as they might be used as guidelines to address and ultimately improve procedures, circumstances and/or management strategies.

A RAP focusses on a defined target population, identifying relevant risk factors related to environmental conditions like housing and management, without assessment of animal based measures.

The exposure of the target population to the potential risk factors, and possible consequences thereof for the welfare of the population are characterized using on site data collection and literature research.

Weighting of the identified risk factors regarding their potential impact is enabled by classification into four different categories, each comprising four scores:

1. Generalization (which part of the target population is exposed to potential risks)
2. Duration of exposure to potential risks
3. Intensity of exposure to potential risks (ranging from mild to terminal)
4. Probability of exposure to potential risks

We would like to present the implementation of animal welfare risk assessments by means of an example, and will highlight the advantages and challenges of a RAP while aiming at objectively assessing risks to the welfare of a dog population housed in a research kennel.

In our view, this approach provides a highly valuable scientifically sound and objective framework for identifying risks for animal welfare. We are convinced that this approach will facilitate communication and management to prevent, reduce or eliminate the risks that might negatively affect animal welfare.

QUANTITATIVE AND QUALITATIVE DATA GO HAND-IN-HAND

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Irrespective of the approach used to assess animal welfare, all "animal-based measures" are intrinsically connected with the observation of the animals, which actually matters for ethology. Behaviour data can be collected and analysed in a quantitative way, as "traditional" ethology always does; but they can also be collected and interpreted in a qualitative manner, in the way behaviourist veterinary surgeons always do in their clinical approach. Actually one would rather speak about standardised versus non-standardised methods and to compare which is the best to evaluate animal welfare.

The question also lies with the training and competences of the people carrying out the welfare assessment, notably whether they are veterinary surgeons or not. For instance, confronted with a wound, going through a standardised assessment framework, such as Shelter Quality © for dogs or Welfare Quality© for farm animals, a veterinary surgeon would not only look at the size of the wound but would also consider the potential future evolution of the lesion and the pathology behind before he scores the wound.

Moreover, one of the most difficult questions to answer is whether the animal has a normal behaviour or not. What is considered normal for one species, one breed or one individual might be abnormal for another. Behaviours might be reactive or pathological. Among other considerations, these illustrations tend to highlight that we need to ask ourselves whether standardised methods are relevant enough to distinguish normal versus abnormal behaviours.

The presentation will seek to question the pros and cons of both standardised and non-standardised approaches with the aim to assess and improve animal welfare. Several examples will be used to illustrate how this apply for a same species bred for different uses (e.g., such as dog used in a laboratory setting or as pet, such as a pig bred in a laboratory setting or in a farm for food). The responses depend not only on the persons building the assessment's protocol or those leading the evaluation, but also in the true aim of the welfare assessments.

No matters what yardstick one chooses to apply: it is of most importance that ethologists and behaviourist veterinary surgeons share their experiences because quantitative and qualitative, standardised and non-standardised approaches are not mutually exclusive but can truly build the one on the other.

WELFARE ASSESSMENT FOR MILITARY DOGS

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The use of French military dogs depends on a specific regulation which focuses on environmental based measures. Moreover, working with dogs implies life conditions such as isolation during resting which could be detrimental for a social species. For two years, the French Army's animal welfare group has been developing a new protocol to evaluate the welfare of working dogs whatever their use.

Two thousand five hundred French dogs are currently deployed over the world in military operations. Most of them are Belgian shepherd males but more females and varied breeds are used years to years. Dogs are trained for many tasks, such as detection of drugs or explosives, search of people, security of individuals or locations or even avalanche research dog.

Dog's welfare assessment has to be carried out at different times from its acquisition to its retirement at about 8 years old, taking into account the exposition to significant constrains such as threatening events or extreme temperatures. At specific times, retirement or when abnormal behaviors appear, dog's welfare is assessed through a behavioral consultation. A standardized protocol inspired by the Shelter Quality© is also used to assess dogs' welfare hold in shelters. The four principles of Welfare Quality© are highlighted and developed through twelve criteria. Measures are taken at different levels and locations depending on the dog's work and concern management, resources and animals. Due to the impact of dog's welfare on his efficiency, acceptable thresholds of each measures are considered of high importance.

This example will show how the Shelter Quality© protocol can be implemented for military dogs.

DEVELOPMENT OF A ROBUST CANINE WELFARE ASSESSMENT FOR DOGS IN TRAP-NEUTER-RETURN PROGRAMMES

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Trap-Neuter-Return (TNR) is considered by animal welfare charities, academics and the OIE, to be an essential tool in the control of dog populations, zoonoses and human-dog conflicts. The ubiquitous nature of TNR, its application by leading animal welfare organisations, and the poor welfare implications of alternative dog population control measures, all contribute to the perception of TNR as a positive welfare intervention. However the variety of techniques used in TNR projects, combined with the focus on population control, may result in the suffering of individual dogs within the programme.

This project has reviewed existing scientific literature, and harnessed the experiences of staff in TNR programmes through a Delphi analysis to develop a composite canine welfare assessment protocol comprising both behavioural and resource-based measures. This welfare assessment protocol, has been trialed and refined at two existing TNR programmes to ensure practicality in the field.

A robust and practical dog welfare assessment will allow individual dog welfare to be objectively measured throughout the TNR process, and for individual projects to benchmark their progress in improving dog welfare in TNR. Identification of key welfare problems within a project also allows for remedial action to be taken in order to safeguard dog welfare.

The authors have additionally identified gaps in current understanding and interpretation of dog behaviours amongst the stakeholders contributing to the protocol. This highlights the need for education in canine behaviour, even amongst staff who work regularly with dogs, in order to allow them to accurately evaluate, and thus ensure, dog welfare.

GOATS DISCRIMINATE EMOTION-LINKED CALLS BASED ON VALENCE

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Animals may transmit information about emotional states through their vocalisations. We investigated whether goats can discriminate conspecific calls with different emotional valences (positive vs negative), using a habituation-dishabituation-rehabituation paradigm. Subjects (n = 24) were initially habituated to a stimulus by exposing them to 9 calls from the same animal (positive or negative). After habituation, a stimulus of opposite valence was presented (n = 3 calls). Finally, the stimulus that the subject was habituated to, was presented again (n = 1 call) to check for a new attention shift. The time spent looking at the sound source and the physiological reactions to the calls were measured. During habituation, goats reduced the rate of looking towards the speaker (linear mixed-effect model (LMM); χ 2(1) = 30.01, $p < 0.001$), indicating the expected effect. Looking increased between the 1st (D10) and the 2nd (D11) call of dishabituation (LMM; χ2 (1) = 5.58, p = 0.01). When the re-habituation call (R13) and the 3rd call of dishabituation (D12) were analysed, an effect of the valence was found (χ2 (1) = 5.38, p = 0.02); overall, goats looked more when a negative call was played. Heart rate decreased during habituation (LMM; $\chi^2(1) = 30.01$, $p < 0.001$, mean first call: 123.85 ± 3.71 BPM, mean last call: 108.59 ± 3.48 BPM), regardless of the valence, and did not change in either the dishabituation or rehabituation phases. Heart-rate variability (HRV) during habituation was marginally affected by valence (LMM; χ 2(1) = 3.75, p = 0.052); it was generally lower when a positive call was played (mean: 53.55 ± 2.39 ms) compared to negative (mean: 57.21 ± 2.01 ms). When the first call of dishabituation was played, HRV was affected by valence in the opposite direction (LMM; χ 2(1) = 4.37, p = 0.033); higher when a positive call was played (mean: 59.59 ± 4.95 ms) compared to negative (mean: 48.53 ± 6.1 ms). Finally, the 3rd call of dishabituation was compared to the rehabituation call and an interaction effect was found between call number and valence (LMM; χ2 (1) = 4.36, p = 0.03). HRV was lower for negative rehabituation calls (mean: 51.76 ± 7.33 ms) than for positive rehabituation calls (mean: 70.12 ± 3.52). Our results indicate that goats discriminate between calls of different valence. Investigating the perception of emotion-linked calls in livestock is important for evaluating their potential role in emotional contagion.

MOTOR AND STRUCTURAL LATERALISATION AS MEASURES OF STRESS IN DOGS ENTERING A KENNEL ENVIRONMENT

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Previous studies have largely reported that shelter dogs may suffer poor welfare especially during the first few days upon entrance to a kennel environment.

Commonly used welfare indicators are often resource- and time-consuming. The identification of quick and easy-to-assess measures to identify those animals that may be at welfare risk when kennelled, would enable a prompt intervention aimed at improving welfare.

Laterality, i.e. the specialized functions of the left and right brain hemispheres when processing emotional and environmental information, has been increasingly used in non-human animal research as a predictive indicator of personality traits, emotional processes and stress reactions. Motor bias, such as the preferred use of one hand or paw over the other when performing a task, is one of the most widely used measures of laterality. Structural lateralization, however, has received less attention, although previous studies have reported an association between, for example, hair whorl characteristics and behavioural tendencies in dogs, horses and cattle.

Our aim was to investigate if motor (i.e. paw preference) and structural (i.e. hair whorls) measures of laterality could be used as predictive indicators of stress (i.e. cortisol levels) in a sample of 30 dogs entering a rescue shelter.

Early morning urine samples were collected on the animals' first day after kennel admission to assess cortisol levels. We recorded the presence and direction (clockwise/anticlockwise) of hair whorls on specific areas of the body (chest, mandible and elbow). Finally, we scored the preferred paw used by the dog during a food-retrieval task (Kong™ test).

Analysis showed no significant correlations between the animals' cortisol levels and measures of motor laterality (direction and strength of paw bias). We could not detect whorls in 6 dogs due to their hair type or touch sensitivity. For the remaining 24 dogs, no significant differences emerged in the cortisol level of dogs with a clockwise versus anticlockwise hair whorl in any of the body areas observed. However, dogs presenting with a hair whorl on their elbow had significantly lower cortisol levels that dogs which did not have a hair whorl on that body area ($Z = -2.23$, $p = 0.02$).

Our preliminary results suggest that there could be a relationship between hair whorl characteristics and stress levels in dogs entering a kennel. Structural indicators of laterality may provide a quick and efficient measure of welfare risk for shelter dogs.

THE ON-FARM APPLICATION OF QUALITATIVE BEHAVIOUR ASSESSMENT TO GOATS, SHEEP, DONKEYS AND HORSES IN THE AWIN PROJECT

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Positive welfare indicators play an important role in communicating commitment to achieving "higher welfare" standards, and should be included in animal welfare assessment protocols. Qualitative Behaviour Assessment (QBA) is one of several indicators used to evaluate positive emotional state in farm animals. This method relies on the integration by assessors of perceived details of behavioural expression, posture, and context, using qualitative descriptors such as relaxed, confident or anxious. Satisfactory inter-observer reliability and relations with other scientific welfare measures in a range of species have been reported for QBA when applied in controlled experimental studies, however varying results in on-farm conditions indicate a need for further investigation and validation.

We reviewed the outcomes of research carried out for the EU-funded Animal Welfare Indicators (AWIN) project, which was aimed at investigating the possibility of including QBA in the on-farm welfare assessment protocols for goats, sheep, donkeys, and horses.

For each of the four species, a list of QBA descriptors was developed by expert focus groups, and subsequently tested on farm. Goats and donkeys were assessed at group level by teams of 2-4 observers with varying backgrounds, while sheep and horses were assessed individually by 3 observers, respectively. After adequate training, inter-observer reliability for all the species was found to be high ($p<0.001$). In goats, non-significant correlations were found when observers were not adequately trained. Principal Component Analysis (correlation matrix, no rotation) was used to identify main dimensions of expression for each of the four species, with PC1 generally characterising "mood", and PC2 describing "arousal", confirming that QBA allows to distinguish between animals with different emotional states. Animal scores on these dimensions correlated in various ways with other welfare measures taken for the different species. In donkeys, PC1 scores were positively correlated with positive responses to human-animal tests; in horses, animals that obtained positive scores on all other AWIN welfare indicators received significantly higher PC1 scores ($p<0.01$); in goats, flocks with positive PC1 scores showed significantly lower percentages of poor hair coat condition ($p<0.05$); in sheep, meaningful significant correlations were found between QBA scores for individual sheep on four expressive dimensions and measures of social, vigilance, and vocal behaviour, and flight distance to an approaching human ($p<0.05$).

These findings contribute to the validation of on-farm QBA, and suggest that QBA has the potential to add valuable information on animals' emotional state that is complementary to other measures, and may help judge the animals' overall welfare state.

AN INTER-DISCIPLINARY APPROACH TO MEASURE POSITIVE WELFARE IN CAPTIVE GORILLAS

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Research on emotions, and on longer-term affective states such as mood in animals, represents a new direction for enhancing our understanding of positive animal welfare. We are integrating a range of inter-disciplinary methods, with a temporal dimension, to measure positive animal welfare. For group-living mammals, positive social interactions are identified as being a critical component to good well-being and can serve as arenas to study positive emotion, mood, and personality. The objective of this study is to quantify potential welfare indicators and validate them to provide a scientifically recognized measure of positive animal welfare for gorillas (*Gorilla g. gorilla*). We are using a combination of four promising indicators of gorillas' positive welfare, on four different temporal scales across the lifespan to understand the relationship amongst these welfare indicators. This combined approach investigates the inter-relationship of positive emotion and mood (measured through direct observation of behaviour, $n_{gorillas}$=24), life status (accessed from zoo records and the International Gorilla Studbook, status 2012, $n_{gorillas}$=2103), personality (human-rated through the validated Hominoid personality questionnaire, $n_{gorillas}$ =203) and correlated happiness (human-rated Subjective Well-Being (SWB) "happiness" questionnaire, $n_{gorillas}$ =189) in relation to close social engagements. Positive social interactions include core emotions, such as care (parent-infant relationship) and play behaviour. Mood lasts longer than emotions and can help us to understand the temporal patterning of emotions. Zoo records on life status (including health status, rearing history, breeding success, number of transportations between zoos, and longevity) were analysed in relation to the human-rated personality profiles of the gorillas. Preliminary analyses found that five out of six personality factors identified are reliable predictors of observed positive emotion (play), friendship (homophily, measured in concerning similarity in personality between dyads and time spent in proximity) and "happiness". We showed that "happier" gorillas (those who score higher on SWB) have more socio-positive interactions, such as proximity, a higher life expectancy, and score higher in the "Extraversion" personality factor, leading us to conclude that gorillas scoring high on "Extraversion" live a longer and more pleasurable life than low scorers. This integrated approach of different measures and time scales highlight ways to increase animal welfare in captivity. We suggest that enhancement and cultivation of close positive relationships serve as an upward spiral to boost positive emotion and mood, improve health, increase reproductive success and can lead to a better quality of life for social mammals in captivity.

CAN WE USE FAECAL CORTICOSTERONE TO MEASURE THE PHYSIOLOGICAL STRESS RESPONSE OF TRANSFERRED *PANTHERA* IN ZOOLOGICAL COLLECTIONS? HOW STRESSFUL IS TRANSFER?

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Measuring the stress response of individuals within the zoo environment has been of recent interest due to current research in methods to monitor welfare by non-invasive measures such as faecal glucocorticoids. Albeit potentially stressful, the transfer of individuals as part of an Endangered Species Breeding Programme (EEP) is inevitable for securing suitable pairings for maximising genetic diversity within a captive population. It is therefore, of importance to ensure that the physiological impact of a transfer and social introduction of individuals of breeding concern is minimised to ensure the success of breeding pairings and ultimately viable offspring.

Faecal samples were collected from three male and three female *Panthera* housed within EEP collections before, during and after their transfer including Amur leopard (*Panthera pardus orientalis*) (n=3), Amur tiger (*P. tigris altaica*) (n=2) and Sri Lankan leopard (*P. p. kotiya*) (n=1). The number of samples collected varied between individuals due to logistical concerns and availability of samples. A total of 192 samples were analysed with the following per species; 122 Amur leopard, 62 Amur tiger and 8 Sri Lankan leopard.

All samples were collected, labelled and stored following set project protocols to reduce collection variability and sample contamination. All samples were analysed at NZSS Chester Zoo endocrinology laboratory using a standard ELISA protocol to determine the amount of corticosterone (ng/g faeces) with strict biosecurity throughout.

Data was analysed using a Kruskal-Wallis statistical test to determine any significant difference between faecal corticosterone, individual, species, gender, age, phase of transfer including pre, during and post period and length and mode of transport.

Results indicate that individual ($P=0.039$), species ($P=0.020$), age ($P=0.020$), phase of transfer ($P=0.002$) and 'type of transfer' ($P=0.011$) significantly differed. Corticosterone peaked for most individuals post transfer with noted differences between male and female individuals.

No clear distinction in faecal corticosterone between transfer phase (pre, during and post) can be seen despite being of initial concern. All peaked corticosterone returned to baseline with a four week period post-transfer indicating a short time frame for the physiological stress response to be compromised. Findings indicate that there is no distinct stress period following transfer and thus, may not be of direct welfare concern.

INTER-OBSERVER AGREEMENT IN DOGS' WELFARE ASSESSMENT IN TEN ITALIAN LONG-TERM SHELTERS

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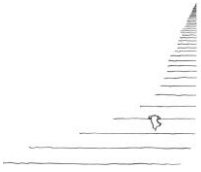
Dogs confined in long term shelters can be affected by several factors that can be detrimental for their welfare such as poor environment, social deprivation, overcrowding and inappropriate management. Due to individual variability, dogs may perceive the same stressors differently, thus exhibiting different responses when housed in similar conditions. For this reason, it's important to provide a tool capable of assessing the individual dog's reaction to the environment.

The Shelter Quality Protocol was designed to be concise and easy to implement in assessing dogs' welfare, in identifying critical aspects of the shelter environment and management and in assessing welfare risks. A first version of the Protocol has been modified in order to improve its feasibility and accuracy in assessing some welfare measures. A second version was produced. The second version of the Shelter Quality Protocol (SQP^2) contains 23 welfare measures and the emphasis is on animal-based measures to estimate the actual welfare state of animals.

The aim of this study was to test the inter-observer agreement between two different assessors evaluating a sample of long-term confinement dogs' shelters thought the application of SQP^2. The assessors were previously trained in using the SQP^2 and ten Italian shelters were simultaneously assessed by the two assessors. 365 dogs were evaluated in total.

Inter-observer agreement was evaluated using the Cohen's Kappa for qualitative variables and Pearson' correlation for quantitative variables. Level of significance was set respectively at $\alpha \leq 0.0020$ and $\alpha \leq 0.0025$, after applying the Bonferroni correction. For all analyses, a z score and p value were also computed to indicate whether agreement was more than could be expected by chance alone.

Level of agreement between the two observers on the qualitative variables was quite high, ranging from substantial (0.61-0.80) to almost perfect (0.81-0.99): body condition k =0.83; lameness k = 0.82; skin condition k = 0.84; shelter from wind k = 0.93 safety of bedding k = 0.64. Inter-observer agreement was also significant across the two assessors with Pearson correlation coefficients ranging from 0.51 to 0.92 (e.g. anxious = 0.60; curious = 0.74; sociable = 0.83; barking level = 0.61). Good inter-observer agreement exists in assessing dogs' welfare using the SQP^2 that remains an useful tool as its first version.



ATTENTION BIAS: A PRACTICAL METHOD FOR ASSESSING 'PSYCHOLOGICAL WELLBEING' IN NON-HUMAN ANIMALS?

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How individuals cope with stress underlies long-term fitness and psychological wellbeing. In humans, there is a well-established literature demonstrating a role of automatic attentional processes (attention biases) in resilience to stress and, conversely, the onset and maintenance of emotional disorders. These effects are mediated by developmental and genetic factors. Recent work has shown that attention biases can be measured in non-human primates and show consistent patterns of change in animals who have recently undergone stressful husbandry interventions such as a veterinary health check. In this poster I present data on the relationship between attention bias and behavioural coping style in a non-human primate, discuss potential mediating effects of early life stress and genetic factors, and discuss the future directions for this area of research including the development of technological tools and potential use for assessing positive affect.

KEEPING THE DISCIPLINE OPEN: INCLUSIVITY IN ANIMAL WELFARE SCIENCE

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Animal Welfare Science has already made a valuable contribution to growing global awareness of animal welfare, and to reducing animal suffering. However, much more can and still needs to be done, and this will require greater collaboration and active engagement between, for example, researchers, NGOs, educators, science communicators, and society as a whole.

With sentience now generally acknowledged for at least some animals, and with animal emotion now on the agenda, we need to embed the precautionary principle in animal welfare, as it is already embedded in environmental policy and regulations; we need to ensure 'good animal welfare science' is framed broadly to allow local ownership for locally relevant, animal-centred protection; we need to communicate effectively so that new knowledge can help bring change in all parts and at all levels of society; and we need to find ways to reflect collaboratively and ensure active engagement of the people who live with and care for animals, as well as the people who can influence policy about animals.

As this conference highlights, we also have to work in the absence of knowledge and need to consider how we advance animal welfare in these circumstances without insisting on more science before taking action.

In this paper, the author looks at these challenges from a community-level perspective, through practical experience of building animal welfare into primary and secondary school education, clinical veterinary work, local community and international development projects, and work with animal welfare charities.

The paper examines animal welfare frameworks, such as FAWC's Five Freedoms and the Hand framework developed by the Donkey Sanctuary, animal welfare assessment protocols such as the AWIN (Animal Welfare Indicators Project) models and QBA (Qualitative Behavioural Assessment), and other simple checklists; contrasting their roles in science, education, public engagement and policy development; and their place in relation to conference questions such as societal perceptions of sentience and affect, and the role in public engagement of quantitative, qualitative and social approaches to science; tracking and responding to welfare across the whole lives of animals; and the balance between precaution, positive welfare and prevention of suffering on the resource-use choices we make.

In conclusion, the author argues for the growing discipline of animal welfare science to remain humble and outward-facing, resisting any temptation to tribal exclusivity, and to be constantly engaging as an equal with all areas of society, and with the complexity of real-world animal welfare challenges.

PROMOTING THE WELFARE OF LABORATORY-HOUSED CYNOMOLGUS MACAQUES (*MACACA FASCICULARIS*) – 24/7 ACROSS THE LIFESPAN

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The 24/7 animal welfare concept is a holistic evaluation framework. It enables care staff to map out whether the needs and wants of individuals under their care are being met across their lifespan and in relation to life stages, variations in husbandry routines and other factors impacting welfare. In the laboratory, animal welfare is formally considered in terms of Refinement, one of the 3Rs principles that underpin legislation controlling the use of animals. The concept of Refinement has advanced beyond attempts to minimise suffering in response to regulated scientific procedures and the definition harmonised to promote well-being over the animals' lifetime.

Cynomolgus macaques (*Macaca fascicularis*) are the most commonly used nonhuman primate for research and testing. We used a multidimensional welfare assessment tool to compare controls (n=40: m=20; f=20) and a matched group of macaques, subject to human socialisation. Socialisation was associated with enhanced welfare, as indicated by differences in behaviours recorded from macaques undisturbed in the home pen after handling, and during the following night. Our data highlight the importance of positive animal-human interactions for the macaques' welfare by enabling them to cope better with handling and restraint. The 24/7 framework, provides a novel and comprehensive approach to help facility staff understand the impact of positive and negative events throughout the whole life cycle.

BOWL HALF FULL OR HALF EMPTY? ASSESSING AFFECTIVE STATE IN SHELTER DOGS

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The kennel environment may cause poor psychological welfare for dogs due to lack of stimuli and social contact. The dog's behavioural and emotional state may affect both its ability to cope with a confined condition and its chances of adoption, ultimately affecting its well-being. For example, a dog in a more negative affective state may find a kennel environment more challenging and may show a lower disposition to establish human contact.

Recent theoretical and empirical findings have shown that the affective state of an animal can be assessed by observing its judgement bias (i.e. optimistic or pessimistic) of an ambiguous stimulus. Previous studies in human and non-human animals have shown the link between affective states and different factors such as social attention, temperament, life conditions and personal adaptation to life environment.

Thus far, the links between affective state, behavioural tendencies and cognitive skills in dogs have been largely overlooked. In this study, we investigated if the dog's judgement of an ambiguous stimulus (using the latency to reach a bowl as a cue of pessimistic or optimistic dog's expectation) could be predicted by specific behavioural traits (scored using a Qualitative Behaviour Assessment, QBA, tool) and/or the dog's coping stile when presented with a problem-solving task (impossible test).

Preliminary analyses on 25 dogs showed that subjects that readily asked for human help in front of an impossible task were slower than more "persistent" dogs in reaching the bowls during the judgement bias test, suggesting that personality and social disposition may influence the outcome of the task rather than the emotional state alone. Moreover, results showed that dog scoring high on "depression" (assessed via QBA) took longer (than others) to reach the bowl in the near negative position (linear mixed-effects model, $p < 0.005$) than in any other location. This is in line with previous findings showing that individuals affected by a greater level of depression have also a greater expectation of lack of reward.

Overall, this project has a great importance on both a scientific and practical standpoint. It is the first time that the judgement bias test has been associated with the dog's coping style during a problem-solving task. From our results, some evidence emerged to suggest that the QBA could be used as an easy-to-implement tool to assess the affective state of dogs housed in kennels.

IMPROVING RECOGNITION OF EQUINE FEAR AND STRESS (A BARRIER TO WELFARE IMPROVEMENT)

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One of the key welfare challenges, as identified by equine industry professionals by the University of Bristol partnering with World Horse Welfare, is that people fail to recognise fear, stress and pain in horses. This in turn prevents advances in improving the welfare of horses across the UK.

This study explores the perceived lack of recognition of some negative welfare states in horses. We will use the results to inform an educational outreach programme to address this barrier to improvements in welfare.

The preliminary study considered whether a selection of horse owners could correctly identify signs of anxiety in the horse in a series of video clips. The clips covered a variety of contexts where negative emotional states in horses were visible including during dressage, liberty work and general handling 'life skills'. Horse owners were asked to comment on the horses' demeanour and responses were clustered. For comparison the clips have also been assessed by equine behaviour professionals from a variety of backgrounds and accreditations and were found to be interpreted consistently with one another.

The results will be used to inform our 'Ladder of Fear' project; we will focus on the signs that owners tend to most frequently miss or misinterpret including triangulation of the eye, tension in the mouth and swishing the tail. Ignoring the subtle signs and behaviours of anxiety in horses is likely to lead to more overt behaviours, such as biting and rearing, which can be dangerous when handling them and is of course a welfare concern.

THE NEED TO APPLY THE SCIENCE OF HUMAN BEHAVIOUR CHANGE TO IMPROVE ANIMAL WELFARE

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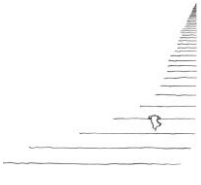
The root cause of much animal suffering is human behaviour. However, traditional approaches to improving animal welfare have focussed on providing a service, such as accessible veterinary treatment, or campaigning for people to change their consumer habits. The animal welfare sector has only recently started to turn to social sciences to better understand human behaviour and how to apply that understanding in the planning and implementation of projects and campaigns.

Areas of application include: the initial research stage; making educational materials more memorable; changing the way vets and project staff work with animal owners; education outreach strategies; engagement with communities to tackle animal welfare concerns; mass campaigns.

We consider human behaviour change (HBC) in four pillars: the process of change (e.g. models of change including the transtheoretical model outlining stages of change in individuals, the theory of change planning tool and the Behaviour Change Wheel); the psychology of change (exploring motivation, external and internal influences, barriers, habits/routines, beliefs, attitude and group psychology); the environment for change (including social marketing); and ownership of change (e.g. using participatory methods to facilitate change).

This talk will first summarize the emerging interest in human behaviour change for animal welfare and then review the authors' experiences in applying relevant principles from social sciences to various animal welfare contexts including working horses and roaming dogs. The talk will introduce the 'Human Behaviour Change for Animal Welfare (HBCAW) Think Tank', a project aiming to drive this work forward.

Without better applying the science of why humans do (and don't do) behaviours that impact animals, we will struggle to be effective at improving animal welfare – lack of understanding human behaviour change is a barrier towards advances in animal welfare.



INVESTIGATING THE IMPACT OF PREGNANCY ON COGNITIVE BIAS IN PIGS

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Cognitive bias is a method recently applied to the assessment of animal welfare based on the change in judgment influenced by different affective states. Pregnancy involves a huge physical and physiological adjustment, however to our knowledge no research has investigated how these changes could influence an individual's cognitive bias in a non-human animal. During a pilot study our aim was to investigate if (i) cognitive bias changes during pregnancy, and (ii) cognitive bias varies depending on the stage of gestation. Five Large White gilts were trained to distinguish between a positive (P) and negative (N) reference probe, situated in opposite corners of an experimental pen. Each individual received a five trial "refresher" sequence involving alternating P and N probes before being tested two weeks before mating and four (early pregnancy) and ten weeks post-mating (late pregnancy). Random test sequences included the two reference probes interspersed between three ambiguous probes: near positive (NP), near negative (NN) and middle (M). The latency to reach each test probe was recorded and the means analysed using a Friedman statistical test. There was a significant difference (P=0.015) in the group response to the M ambiguous probe before pregnancy and in early and late pregnancy, showing a difference in their cognitive bias. During early pregnancy the group appeared to be showing an optimistic bias in relation to the M probe, however during late pregnancy this changed as they began showing a pessimistic bias. No significant difference was found for the NP (P=0.076) and NN probes (P=0.069), however this may be due to the small sample size. A significant difference was also found between all three ambiguous probes at each time of testing (before - P=0.015, early - P=0.016 and late - P=0.016) showing that all three probes were viewed as different. These results suggest that pregnancy does impact on the cognitive bias of gilts, most likely due to the fluctuating hormone levels that occur during pregnancy, and would benefit from further research in the future.

QUALITATIVE BEHAVIOURAL ASSESSMENT: PRELIMINARY RESULTS OF ITS APPLICATION FOR ASSESSING LABORATORY MOUSE WELFARE

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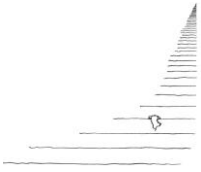
Exhibition of a species-specific behavioural repertoire is essential for the normal biological function of animals and so their welfare. In addition, ensuring laboratory animals have good welfare will improve the reproducibility of the experimental results and lead to accurate interpretation of biological events. These events are expressed in physiological, health and behavioural changes which can be affected when welfare is compromised, thus potentially confounding any research carried out.

Currently, the assessment of laboratory mouse welfare is made using physical, behavioural and environmental indicators that are considered to overlay the main aspects of animal welfare. However, these welfare indices may not directly assess animal's psychological welfare. Assessment of animal emotional states has been controversial because of it subjective self-experienced nature. However, the similarity between humans and mammals in terms of behaviour, physiology, neural anatomy and biochemistry as well as the advances in our understanding of animal cognitive capabilities (e.g. cognitive abilities in orangutans and pessimistic cognitive bias in dogs) has lead us to investigate new methods for assessing psychological aspects of welfare. The aim of this study is to assess if Qualitative Behavioural Assessment (QBA) can be used as a valid and reliable indicator for assessing mouse welfare.

Qualitative Behavioural Assessment is a welfare indicator that uses the expressive body language of the animal to assess the individual experience. We hypothesise that QBA can be used as an indicator of the psychological aspect of welfare in laboratory mice based on the ability of the assessor to recognise potential mental states by observing expressions of the mouse body language.

The QBA was validated in three stages. Stage one involved the assessment of inter and intra-observer reliability using Free-Choice Profiling, which is a method that allows observers to select their own descriptors to describe animal body language. Stage two validated a set of fixed behavioural expressions by assessing their inter-observer reliability when used by assessor observing laboratory mice. Stage three involved the cross-validation and practicability assessment of QBA in conjunction with other mouse welfare indicators.

The analysis of this data is currently being undertaken and will be reported once it is complete. QBA has been used successfully used as a valid indicator of positive emotional states in other species (e.g. pigs, sheep, and calves) so its integration into laboratory assessment should improve the assessment of laboratory mouse welfare.



USING ACCELEROMETERS FOR EARLY DETECTION OF DAIRY COW LAMENESS

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Lameness is a chronic source of pain for dairy cows and is a serious welfare problem within dairy herds, but it can be difficult to detect, particularly the early stages. Research has shown that dairy cow behaviour such as walking, standing and lying duration may change due to the onset of lameness and therefore leg-mounted accelerometers may be able to detect the early signs of lameness. As part of a larger study, research at Harper Adams University (HAU) is currently investigating whether CowAlert® (IceRobotics Ltd, Edinburgh, UK) could detect changes in dairy cattle behaviour, indicative of lameness. One hundred Holstein x Friesian cows, at various stages of lactation, from the HAU herd were fitted with three IceQube® accelerometers (IceRobotics Ltd, Edinburgh, UK); one on each hind leg and one on the front left leg for 24 months. The sensors record lying and standing duration, frequency and duration of lying and standing bouts and step count, together with a three-dimensional Motion Index. From this a daily IceScore® (IceRobotics Ltd, Edinburgh, UK) mobility value was calculated. Statistically significant changes in individual dairy cow activity cause an increase or decrease in the IceScore, which results in a mobility alert being generated. To establish the cause of the alert the cows were inspected within 24 hours. They were given a mobility score of 1-5 (1=sound; 5=severely lame), an udder score to identify redness and lesions, and hocks and knees were given an injury and swelling score. Each cow was given a calving score, based on the level of assistance required during calving (0=no assistance; 4=major veterinary assistance), plus all other health issues were recorded, as were any group changes. Additionally, during a fortnightly visit from the hoof trimmer, cows flagged by the CowAlert system had all four feet inspected, and any problems were mapped and recorded. Preliminary results are promising, with numerous foot and leg diseases detected during the early stages. However, alerts caused by changes to the cow's management and physiology during the lactation cycle are proving challenging, but an automated system for early detection of lameness which monitors dairy cows 24h/d, 365d/year could be a valuable tool for early diagnosis and treatment of developing lameness.

FUNCTIONAL NEAR INFRARED SPECTROSCOPY IN ANIMAL COGNITION: POTENTIALS AND LIMITS

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Finding non-invasive animal based indicators of animal emotion and cognition processes is an important goal in disciplines ranging from comparative neuroanatomy to animal welfare science. The functional near infrared spectroscopy (fNIRS) is a non-invasive brain imaging technique that measures changes of oxyhemoglobin concentration [O_2Hb] and deoxyhemoglobin concentration [HHb]. Such changes are related to the neurovascular coupling and allow scientists to infer information about the underlying neuronal activity occurring in a specific brain area. Differently from fMRI, fNIRS can be applied in unsedated animals after short training periods. So fNIRS shows great potential in the multiple scenarios of animal cognition and animal emotion studies.

Nevertheless, the current limits of this technology must be taken seriously into account. At the moment, the assessable cerebral structures are mostly limited to the cortex, while subcortical structures well known to play a crucial role in emotions cannot be reached. Another limit is that scientific information about modern functional neuroanatomy in animals is scarce or lacking; a certain degree of knowledge on brain functions, neuroendocrine milieu and cognitive processes of a given species is mandatory to develop and define the emotional processes.

We will present preliminary results of a pilot study to a three-year long project. The project adopts a multidisciplinary approach to the study of the functional organization of the central nervous system (CNS) of freely-moving sheep by the non-invasive application of fNIRS. Our aim is to record the hemodynamic response of selected areas of the brain involved in the performance of various tasks by applying especially adapted fNIRS instruments to the head of the sheep. A series of behavioural motor and associative tasks were planned to analyse basic executive functions and potential brain capacities. Combining the exploration of the neural substrates underlying cognitive functions with existing behavioural and physiological measures will strengthen knowledge of how animals perceive different environmental situations.

USE OF DIFFERENT WOOD TYPES AS ENRICHMENT TO REDUCE TAIL-BITING IN PIGS MANAGED ON FULLY-SLATTED FLOORS

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Tail-biting is a serious issue in pig farming, with significant negative effects for pigs and farmers alike. This study aimed to find an economically feasible and effective solution on farms managed on fully-slatted slurry systems to reduce tail-biting, focusing on assessing the adequacy of using wood as environmental enrichment. Four different wood types (beech, larch, spruce and Scots pine) were assessed. A total of 800 tail docked finisher pigs on an Irish commercial farm were used, with 8 pens (n=25 pigs/pen) provided with each wood type, conducted over time in 2 replicates (16 pens/replicate). In each pen a single wooden post was offered to the pigs in commercially available metal wood dispensers. Two chains hung from either side of the bottom of the holder. The length, weight, moisture level and hardness of the wood were measured weekly. Tail and ear lesion scores, tear-staining, tail posture, and direct behaviour observation of pigs were carried out every other week. Carcasses were inspected in the slaughterhouse for further verification of tail damage and condemnation records. Results showed that spruce was consumed significantly more quickly than other types of wood in terms of weight loss and reduction in length of the posts ($p<0.001$). With regard to time spent interacting with the wood, pigs were observed using the spruce more frequently than the other wood types ($p<0.05$). Pigs also interacted with the wood more often than the chains in spruce pens ($p<0.001$). However, there was no difference in the frequency of harmful behaviours (tail/ear/flank-biting) observed between treatments. There was a positive correlation between ear lesion and tear-staining scorings ($r_p=0.286$, $p<0.01$), and between tail lesion and tail posture scorings ($r_p=0.206$, $p<0.05$). These results indicate that tail posture and tear staining could have potential as on-farm welfare assessment tools to inspect the severity of pen-level tail and ear biting respectively. No visceral condemnation that could be associated with wood use was found in the factory, and different wood types did not affect the average daily gain of pigs. There was no difference in the effectiveness of the different types of wood in reducing tail or ear damage, but levels were low in all treatments. Further work will focus on detailed analysis of pig behaviour with these wood types, and using undocked pigs to validate their effectiveness in controlling tail biting.

ANIMAL-BASED WELFARE MEASURES IN ZOOS: THE CASE OF CAPTIVE DOLPHINS

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Animal-based measures are considered essential in comprehensive welfare assessments, and are thought to be more accurate than resource-based measures even though often harder to conduct. This outlook was based upon experience with farm animals, where factors such as individual identification, short life-spans and large groups sizes often makes animal-based measures inappropriate. In zoos and aquariums (zoos hereafter) however, care is individualised, animals are in small groups, and are often easily accessible.

Dolphin welfare research is in its early stages and although there are no validated measures yet, many with potential have been suggested, and especially behavioural indicators. Recently a framework for a comprehensive bottlenose dolphin (*Tursiops truncatus*) welfare assessment was proposed (the "C-Well Assessment"), containing a combination of animal and resource-based measures adapted from the well-accepted Welfare Quality® farm assessments. However the measures need further validation, and recent advances in the field have also provided new channels of investigation. For example, cognitive bias tests with dolphins revealed that those who judged more optimistically performed higher levels of synchronous swimming, and lower levels of anticipatory behaviour, in their free-time. Synchronous swimming, as an affiliative behaviour, could therefore be an indicator of positive welfare; in another study it was also found to increase significantly after training sessions. Anticipatory behaviour has been proposed as a welfare indicator for other animals since it may reflect the balance of reward systems. As zoos have highly structured daily schedules of feeding and other events, anticipatory behaviour might well be an salient animal-based measure for dolphins. Recent results have shown that dolphins' anticipatory behaviour towards cued events can highlight their preferences for such additions to their environment. As with terrestrial animals, cortisol levels are being explored as a welfare parameter, but only recently has a multi-facility project been launched in order to publish baselines and diurnal variation. Keeper assessments of animals have been shown as valid, reliable and are animal-based: a current project is testing whether trainers' scoring of dolphins' motivation during training can function as welfare tool.

Animal-based measures of welfare are certainly useful in zoo settings, and future studies will help us to move towards being able to quantify welfare. With regards to dolphins in captivity, the training techniques and the type of Human-Animal Relationships are unique to this setting and are likely closely linked to welfare: these factors can be both influencers and indicators of welfare but we must develop ways to measure them.

DIFFICULTIES IN INTERPRETING THE FIRST INDICATORS OF POSITIVE WELFARE IN DOLPHINS

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Research is slowly increasing regarding the welfare of dolphins in captivity. Thus far there are no published and validated indicators of dolphin welfare, but potential measures can be found in the disciplines of behaviour, health and cognition. The small number of studies investigating dolphins' emotional states have tended to focus on negative affect, as in terrestrial animal welfare. However, recent studies propose several possible indicators of positive welfare in bottlenose dolphins (*Tursiops truncatus*).

Anticipatory behaviour has been suggested as a generic welfare indicator since it may reflect the balance of reward systems, where moderate levels reflect positive anticipation but excessive levels indicate frustration and lack of stimulation. A study conducted by the authors testing dolphin cognitive biases agrees with this, since those judging optimistically performed less anticipatory behaviour towards training sessions. However it is unclear where the threshold of anticipation lies, above which the behaviour has negative implications. The authors latest investigation compared anticipatory behaviour before different cued events, and asked for the first time whether the level of anticipation predicted the level of participation in the upcoming event. Such information will start unravelling the meaning of anticipatory behaviours, so that one day standardised applications within welfare investigations may be possible.

It was recently shown that synchronous swimming, an affiliative behaviour, peaks after training sessions. This may function to reaffirm social bonds, and concurs with acoustic data from a study showing that whistle rates (often cohesion calls) also increased after sessions. The cognitive bias experiment also found that animals who judged more optimistically performed more synchronous swimming in their 'free-time' during the testing days, strengthening the notion that this behaviour indeed reflects positive affective states. But again, there is much future work to be done on this potential indicator, principally further investigation into the speed and proximity between partners since this seems to impact the behaviour's expression. Play is often classified as a positive welfare indicator, and dolphin studies are starting to piece together those contexts and factors that impact the behaviour.

In summary, there are many promising potential indicators of positive welfare in dolphins. As this branch of welfare science develops, the links between these measures and affective state will hopefully be clarified and thus allowing for development of practical tools.

USING SPATIAL DISPERSAL PATTERNS TO ASSESS VALUE OF SPACE AND QUALITY OF LIFE IN CAPTIVE ANIMALS. SIMPLE, ROBUST TOOLS FOR APPLICATION IN CONFINED AND UNRESTRICTED ENVIRONMENTS

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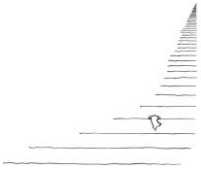
The value of space for group-living animals fluctuates over time and space due to movement of group members, so has proved difficult to assess using conventional consumer demand approaches more suited to individual animals. Complex monitoring platforms developed to study movement patterns require sophisticated models to extract and analyse useable data. We propose the use of simpler models based on sampling dispersal patterns over time and space using a toolbox of conventional behavioural and ecological sampling methods. This will be illustrated by data from laying hens in contrasting environments; enriched cages and commercial free range flocks.

In the caged studies, hens could choose between enriched cages of similar dimensions in flocks of 10, 8, 6, 4 and 2 birds (equivalent to between 750cm2 per bird and 3750cm2 per bird). Variance to mean ratio (VMR) were derived from head counts to assess if hens follow even (VMR=0), random (VMR=1) or clustering dispersal patterns (VMR>1). VMR was no different than zero for flocks of 10 and 8 birds, above zero for 6 and 4 bird flocks and no different from one for 2 bird flocks. This suggests that at the higher stocking densities the hens were seeking to maximise personnel space producing an even distribution between cages. This was confirmed by hens' dispersal patterns when choosing different sized cages and by increased work-rate of hens to leave cages with higher stocking densities.

In free range systems head counts were sampled by establishing quadrats at different distances from shed to investigate relationship between VMR and use of range areas. Near shed, hens showed stocking densities similar to those found in cage studies, whereas VMR rose with distance from shed, with hens adopting clustering patterns of dispersal. Hens sampled from these outer areas showed a wider range of behaviours (particularly foraging) and better feather condition suggesting an association between dispersal and more traditional welfare measures. These studies involved simple tools (video stills and quadrats) to sample changes in distribution over time and space. The data strongly suggests even distributions are associated with inadequate personnel space and poor quality of life, whereas the more variable or clustered distributions may be associated with positive welfare where animals can adopt patterns of resource use that are unrestricted by space or social inhibitions. Further work would be valuable to assess the robustness of these findings across situations and the causality of relationships.



MEASURING MOOD WITH MINIMAL TRAINING: LATENCIES ON A SIMPLE TOUCHSCREEN TASK INDICATE MOOD IN ZOO-HOUSED JAPANESE MACAQUES (*MACACA FUSCATA*)

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Welfare scientists are striving to develop techniques to measure emotional states in animals in order to better evaluate the evasive, psychological component of welfare. Recently, tasks designed to measure judgement biases (or "cognitive bias tasks") have gained attention as a potential promising approach. However, these tasks typically require initial training for the animals which has proven to be time consuming and difficult to execute across individuals and environments. Thus, there is a need for additional, simpler approaches to evaluating psychological welfare.

At Lincoln Park Zoo, we tested a troop of Japanese macaques (*Macaca fuscata*) on two approaches to measuring psychological welfare. All research relied on the macaques' voluntary participation engaging with touchscreen computers integrated into their habitat. The first approach followed a standard cognitive bias paradigm in which the animals first had to learn to associate arbitrary stimuli with a highly preferred or less preferred reward. We utilized multi-modal stimuli so that cues contained a combination of auditory and visual information. However, the monkeys failed to demonstrate the initial discrimination learning required to advance to testing (range attempted: 20-579 trials per individual). We then attempted a second approach that relied on the subjects' latencies to touch potentially threatening (conspecific face with directed gaze) and non-threatening (conspecific face with averted gaze) images, relative to control images (grey squares). Subjects were provided the same food reward on all trial types. Subjects voluntarily took part in 200 baseline trials (collected over 5-7 different days depending on subjects' individual participation) and in as many trials as possible during three days of the putatively stressful Chicago Air & Water Show during which loud jets frequently fly overhead. We obtained responses from four monkeys in the baseline and stress condition (range 100-258 trials per subject under stress). Results indicated a significant effect of condition, with an increase in latency to touch images of conspecific faces during stress compared to baseline ($F_{1,2} = 52.94$, $p = 0.04$). These findings suggest that emotional states may be revealed through response latencies in tasks that do not involve intense training. These promising results will be augmented by additional work to elucidate essential components of the methodology to ensure the approach is both simple and reliable.

A CAGE-BASE AND ENVIRONMENTAL PREFERENCE TEST FOR LABORATORY RABBITS

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Measuring rabbit welfare in a research setting has some challenges, in particular the housing is standardized and rabbits may appear to be sedentary and not show observable signs of anxiety. Caged laboratory rabbits normally spend the majority of their time on a perforated floor-base or, when housed in floor pens they may spend the majority of their time on a wood substrate such as sawdust.

Giving captive animals control over their environment through environmental enrichment and/or choices can enhance their wellbeing. This can be achieved in a number of ways for example by offering nesting material, tunnels and substrate. However, without being able to ask the animals which resources they prefer, it is not easy to ascertain which environment will most closely meet their needs.

We hypothesized that rabbits would work to gain access to a preferred substrate from the choice available.

12 male New Zealand White (NZW) rabbits were individually housed for the duration of the study in three connected cages. They were offered a choice from typical substrates available to laboratory rabbits –Aspen wood chips, sawdust, hay and an empty cage. They were then able to access each substrate via a weighted entry door; the weight of which was increased every 24 hours over a five day period. The exit door was unweighted.

A Latin Square design was used to ensure all combinations were included for each rabbit over the six-week study. Time spent in each cage was recorded over 20 hours throughout the 12 hour dark phase and for up to eight hours of the light phase. This presentation will discuss the study design and results. All animal studies were ethically reviewed and carried out in accordance with Lincoln University Ethical Review Procedure, and the GSK Policy on the Care, Welfare and Treatment of Animals, which determined that the work did not constitute a procedure under A(SP)A 1986. Preliminary results suggest that rabbits preferred the three alternatives over the Aspen wood chips as they work hard to access all other substrates. There is also evidence of partial preferences that may be related to using particular floor types for specific activities. For example, rabbits preferentially defecated away from their home cage. These findings indicate that the rabbits had a strong preference for firm floor type, and avoided soft substrates. Choice of floor types may therefore be more important than providing a single flooring to satisfy a variety of needs.

CONSISTENCY OF THE WELFARE QUALITY® ASSESSMENT PROTOCOL FOR PIGS DURING THE FATTENING PERIOD

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Due to the public emotional debate concerning animal welfare, it has become a necessity to establish an objective measurement tool. To this purpose, the Welfare Quality® protocols were developed. The Welfare Quality® Assessment protocol for growing pigs consists of a Qualitative Behaviour Assessment (QBA), direct behaviour observations (BO), a Human Animal Relationship Test (HAR) and different individual parameters, e.g. presence of tail-biting or bursitis.

The aim of this study was to assess the test-retest reliability of the protocol with special emphasis on the consistency during the fattening period. Therefore, three farms (all-in-all-out systems) were assessed repeatedly, i.e. every two weeks during two consecutive growing periods. Altogether 42 protocol assessments were carried out by one trained observer. The results of each single parameter of the protocol were compared between the repeated assessments with Spearman's rank correlation coefficients (RS). Thereby, correlations were calculated between the two consecutive assessments with an interval of two, four, six, eight, ten and twelve weeks.

The QBA did not present sufficient test-retest reliability in any of the comparisons of farm visits except for the term content, which presented moderate to good correlations in all comparisons (RS: 0.55 to 0.89). For the BO, the evaluation of exploration directed towards enrichment material was of good reliability for the two-week interval (RS: 0.40 to 0.62), however, it decreased when the intervals became longer. The evaluation of social behaviours presented weak to negative correlations in all intervals. The HAR was of good reliability (RS: 0.81 to 1.00). The individual parameters coughing and sneezing did not present sufficient reliability. Most of the other parameters presented consistency in the two-week interval. However, the longer apart the compared assessments, the lower the correlation became, differing in detail for the different parameters.

In conclusion, this study suggests that the QBA is not a reliable parameter and other parameters for the evaluation of positive emotions should be reconsidered. Concerning the evaluation of social behaviours, it should be proven whether the relatively short BO is actually valid or if e.g. the observation time has significant effects on the outcomes. The disagreement concerning coughing and sneezing can probably be explained by the fact that animals were treated if there was evidence for a severe infection. The revealed information on the decreasing consistency of the other parameters during the fattening period suggests that there are age or other timely effects that need to be taken into consideration.

WELFARE ASSESSMENTS FOR NON-HUMAN PRIMATES USED IN NEUROSCIENCE RESEARCH

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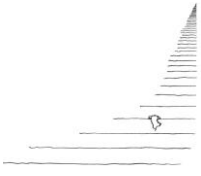
Assessing and improving the welfare of non-human primates used in biomedical research is a key element in order to implement the concept of the 3Rs effectively, particularly the concept of Refinement. However, assessing the acute as well as longer-term experience in a group-housed setting provides particular challenges.

A non-invasive novel method has been established and validated, which aims to record an individual animal's daily activity profile and behavioural repertoire, using accelerometers. Long term data of procedure related- and unrelated events have been validated against a range of non-invasive endocrine measures such as salivary, faecal and urinary cortisol. Comprehensive analysis of sleep patterns following procedure –related and unrelated intervention have been undertaken, assessing the impact of non-procedure-related events on rhesus macaques (e.g. relocation between housing areas) and typical neuroscience procedures such as surgery and general anaesthesia for restraint (e.g. MRI) on the animals.

The presentation will discuss which and how various welfare measures could provide valuable tools to complement current assessment methods with the view to identify and evaluate possible refinements and further improve the wellbeing of non-human primates used in neuroscience research.



LAUGHING RATS: A NOVEL PEST CONTROL SOLUTION?

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Current pest control aimed at rats (particularly *Rattus norvegicus*) is a major welfare issue as poisons and traps are often inhumane and kill large numbers of non-target rodents, such as bank voles. It is also not very effective as rats often avoid poisons and traps. A species-specific rat attractant has the potential to reduce the welfare burden of rodent control, and improve its efficacy, by attracting rats to humane control measures, whilst repelling non-target species. We assessed whether 50 kHz rat calls, known as 'rat laughter', could be used as a species-specific rat attractant.

To test if rats are attracted to 50 kHz rat calls, we tested male and female Wistar rats (n = 16) in an arena where they had a choice between a commercially available bait box through which test sounds were played from a speaker, and a silent bait box. Testing consisted of a 15 minute habituation period, followed by 15 minutes testing with sounds. Each rat was tested with 3 sounds: female rat 50 kHz calls, rat movement sounds and regularly intermittent white noise.

To test if bank voles were repelled by 50 kHz rat calls, we used the same experimental design as for rats, with male and female wild caught bank voles (n = 16) as test subjects. Bank voles were tested with 2 sounds: female rat 50 kHz calls and regularly intermittent white noise.

To assess if test subjects were attracted or repelled by calls, time spent in the side of the arena without the speaker was subtracted from time spent in the side containing the speaker to create bias scores. Bias scores were compared between treatment groups using repeated measures ANOVA.

Both male and female rats preferred bait boxes playing 50 kHz rat calls compared to regularly intermittent white noise. This preference was not seen when the response to 50 kHz calls was compared to rat movement sounds. Bank voles showed no preference or avoidance of 50 kHz rat calls compared to regularly intermittent white noise.

These results indicate that rats are attracted to 50 kHz rat calls, but bank voles do not avoid these calls. Therefore, 50 kHz rat calls have the potential to be used as a rat attractant, but other approaches need development to repel non-target rodents, as part of measures to reduce the negative welfare impact of rodent control.

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ANIMAL WELFARE ASSESSMENT PROCESSES IN ZOOLOGICAL COLLECTIONS

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In recent years there has been an increasing demand for effective animal welfare assessment processes for zoological collections. Welfare auditing has been conducted for many years in the livestock industry and has also been adapted for use in animal shelters and laboratory settings. Although staff in zoological collections will perform daily checks and monitor the health of their animals, only a small number of collections may additionally review the species they hold using a specifically designed formal auditing system.

The recent animal welfare strategy published by the World Association for Zoos and Aquariums (WAZA) highlights the importance of monitoring not just the physical wellbeing of the species in our care but also the psychological needs, which may be more difficult to assess using quantitative methodology. To accurately monitor changes in welfare we feel it is important that an auditing process takes into account the additional records which are collected routinely by caregivers and enables a more systematic approach to identifying welfare issues which may be underlying or chronic.

Good welfare auditing systems need to provide sufficient information to identify potential welfare issues but be concise enough that caretakers have the time to complete them. The frequency that the assessment is conducted should be considered in line with additional welfare monitoring tools and a clear priority action list should be the result of each assessment. The assessments should be tailored to the specific taxa being audited to ensure that relevant and useful questions are considered and the process should include all species including invertebrates and aquatic species which are often overlooked.

In this talk we will discuss the importance of regular welfare monitoring in zoological collections and the potential implications on animal wellbeing, husbandry and conservation breeding success. The practicalities of conducting a welfare audit and its application to a wide range of taxa will also be considered.

DEVELOPING A RAPIDLY LEARNT JUDGEMENT BIAS TEST IN A CONFINED ENVIRONMENT

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Judgement bias is the most promising methodology currently available to assess animal affect, but the practicalities of training and testing can limit its use. Our objective was to develop a judgement bias test for sows housed in farrowing crates. The procedure needed to be learnt rapidly and easily applied to confined sows.

There were 24 sows housed in farrowing crates from 4 days pre-farrowing for four weeks (time of weaning). We used an in-situ spatial go/no-go task while the sows were housed in 560 mm-wide crates. When the sow's snout touched a visual target (silver rectangle) in one corner above the feeder (340 mm wide) at the front of the crate she was rewarded with a sugar cube, which was delivered with the assistance of a secondary reinforcer (a clicker). In contrast, when the sow touched the target in the alternate corner she was 'punished' (not rewarded and received 10s time out). The time to respond to the rewarded target was almost instantaneous and the maximal time to respond was set at 4s before a non-response was recorded. Sows received two training sessions (average 260s) and after one training session achieved 85% accuracy in the task ($P<0.05$). One ambiguous location was chosen 226 mm and 114 mm from the positive and negative locations respectively.

Of the 24 sows, 20 learnt the task; 17 were tested for judgment bias at early and late lactation; three completed only one of the two tests, and; four never ate the reward. Survival analysis was used to test responses to the cues over time, with sow fitted as a random effect. There were significant cue × time interactions ($p<0.001$). Sows touched the positive cue 98% of the time and the average response time was 0.4s (SEM±0.04s); negative cue: 11% touched, average 3.8±0.04s; ambiguous cue: 55% touched, average 2.6±0.13s. Sows were more likely to touch the positive cue in late lactation (early: 94% touched, average 0.6±0.07s; late: 99%, 1.8±0.03s), possibly reflecting more time to learn the task and/or increased appetite after farrowing. Response times to the negative and ambiguous cues were consistent during early and late lactation.

Validation following affect manipulation is required. This methodology may have application for animals with restricted/slow movement; in confinement; when social separation is undesirable; when ex situ testing is inappropriate (e.g. zoo settings). This method also allows the animal to be exposed to treatments during testing.

EXAMINING THE USEFULNESS OF QUALITATIVE DATA TO SUPPLEMENT AN ON-FARM EQUINE WELFARE ASSESSMENT TOOL

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The measurement and assessment of animal welfare is important, not only for the understanding of current welfare issues, but also for the identification of potential welfare risks. Recently, with the introduction and revisions of the National Farm Animal Care Council's (NFACC) Codes of Practice in North America, livestock oversight bodies have begun to implement programs to create and utilize welfare assessment tools, with the goal of improving the standards of animal care.

Implementing a similar program in the equine industry, however, does not come without challenges. One, in particular, is that of industry diversity; within a single horse farm, differences can exist in animal age, breed, size, background, lifestyle, and ownership. Knowing this, we sought to design and evaluate a comprehensive equine welfare assessment tool to determine if diverse equine farms could be comprehensively assessed in a timely and reliable manner.

To gain insight into industry professionals' opinions related to welfare issues, a Delphi survey was run. Little information was gleaned as opinions varied greatly regarding what constituted a true "welfare issue", with the only recurring theme being that of lack of knowledge.

Due to the paucity of quantitative data regarding the horse industry in Canada, previously validated and relevant animal-, resource- and management-based measures were selected for suitability, reliability, and ease of use for the design of the assessment tool. These measures were chosen specifically to assess risk factors under the requirements established in NFACC's Code of Practice for the Care and Handling of Equines. From there, existing welfare auditing models from other species were used as a framework to build upon and create an assessment tool capable of being utilized in a variety of farm types (e.g. therapy, riding, etc.).

Horse farms (n=25) were recruited via email or telephone to participate in the three-step testing of the assessment tool, in which they completed: (1) a self-assessment, (2) an on-farm assessment conducted by two trained assessors, and (3) a post-assessment interview. Farms were assessed from August to December 2016, and represented a wide range of different horse uses. In addition to quantitative data collected on-farm, supplemented qualitative data was collected through a self-assessment and post-assessment interview to examine differences in owner perception of their facilities and to help understand the impacts and value of on-farm assessments to equine stable owners.

VALIDATION OF A COMBINED CONDITIONED-PLACE AVERSION AND APPROACH-AVOIDANCE PARADIGM FOR EVALUATING AVERSION IN CHICKENS

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Various modified atmosphere methods are used for the stunning and killing of poultry. Forced exposure studies suggest that many such methods cause unpleasant experiences before loss of consciousness, and are aversive to poultry. However, the results of the few approach-avoidance studies undertaken are equivocal. The failure of animals to leave a modified gas environment, when given a choice, may reflect their physical inability to do so, rather than their lack of aversion.

To overcome this limitation, a combined approach-avoidance and conditioned-place aversion paradigm was utilised to evaluate aversion in chickens. A 2-chamber experimental box, which allowed free movement between the test chamber (TC) and a neutral chamber (NC), was used. Eight layer hens were trained to obtain a reinforcer (worms) from a coloured bowl in the TC by standing on a wooden block. During the conditioning period, the reinforcer was presented in a green bowl with no aversive stimulus, or in a red bowl associated with a known aversive stimulus (an air puff to the hen's face during feeding attempts).

Hens were exposed to two 5-minute trials, one with the red bowl and one with green bowl, with the air puff canister present but not activated in both trials. The order of testing was randomised, with each hen serving as its own control. Hens began the test in the NC and latency to enter (LTE) the TC and time spent in the TC was measured. Hens took significantly longer to enter the TC when the red bowl was present than with the green (Median LTE 7s, IQR 4-12 [green]; Median LTE 103s, IQR 16 to undeterminable (since not all hens entered the TC) [red], $p=0.002$), and spent less time in the TC with the red bowl (Median time 295s, IQR 294-297 [green]; Median time 135s, IQR 18-289 [red]; $p=0.009$).

These results suggest that the hens learnt to associate the aversive air puff with the red bowl and that they expected to be puffed when the red bowl was presented. This paradigm may prove valuable for testing relative aversion to various modified atmosphere methods in the future.

PERSONALITY STUDIES AND TRAINING: USEFUL TOOLS TO ASSES EMOTIONS AND PROMOTE POSITIVE WELFARE IN PRIMATES? A REVIEW

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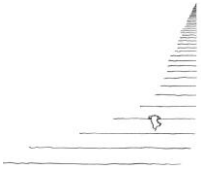
Consideration of the mental well-being of animals rests on the assumption that animals have emotional capacities, such that they attempt to minimize negative emotions and to seek positive emotions. However not all individuals react in the same way to challenging situations and measuring animal personality or temperament is gaining attraction in the scientific community as a way to guide behavioural management decisions on captive animals. Also, positive reinforcement training techniques have been proved to be useful tools in the management and welfare of captive animals.

In the study we focus on the interaction of these two concepts (personality and training) and review different articles which applied them in different species of nonhuman primates to discuss their suitability as techniques to asses' emotions and promote positive welfare.

Pubmed, Sciencedirect and Scopus databases where searched for generic words as primates, training, personality and temperament. Only eight articles were found to focus specifically on these four concepts and measure how temperament or personality of nonhuman primates can influence training and their welfare.

Four articles used trait rating to measure personality whereas four used behavioral coding. The species more used were macaques followed by chimpanzees and only one study not published yet used lemurs. Data suggest that personality influence training: more exploratory nonhuman primates or identified with the trait rating "activity" or "openness" had higher training success than individuals ranked as inhibited or more reactive to humans.

It is concluded that measures of personality could help to tailor training programs to the specific needs of each individual. Additionally, identifying positive affective states (play, care, social contact, serotonin levels) or actions to promote them (enrichment environments, regular exposure to positive reinforcement) will facilitate training and ensure a positive effect on the welfare of the individual. In order to do this, it is necessary to assess the animals' affective states. Cognitive bias has emerged as a one of the most successful methods to do this. We suggest, therefore, that captive primate welfare will benefit for a research program that combines cognitive bias and possibly other methods to assess emotions, personality and training.



A LESS AVERSIVE ANAESTHETIC TO ADULT ZEBRAFISH

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The use of zebrafish as an animal model is growing rapidly. However, the development of refinement to improve the welfare of these animals in research is lagging behind for critical procedures such as anaesthesia and euthanasia. Anaesthesia refinement tends to be reduced to clinical efficacy, often disregarding the effect on animal welfare. Thus we aim to study the aversion of the adult zebrafish to the standard MS222 and to a new anaesthetic protocol, propofol combined with lidocaine.

Twenty-four mixed-sex AB zebrafish were randomly assigned to MS222 (150mg.L^{-1}, n= 8), propofol/lidocaine (5mg.L^{-1} of propofol combined with 150mg.$L^{-1}$of lidocaine, n= 6) and HCl (water bath at pH3, n= 10) group. HCl was used as a positive control, as pH3 is aversive to zebrafish. Aversion was tested in a conditioned place aversion task consisting in pairing a potentially aversive treatment with a previously preferred environment, resulting in avoidance of the paired environment. Animals were habituated to two tanks connected with a tube and with different light intensities distinguishable by zebrafish. After evaluating animals' preference, they were trained for a maximum of 10 days to pass throughout the tube to eat. Afterwards, the treatment was applied on the rewarded side. After full recovery, the zebrafish returned to the apparatus with clear water – post-treatment trial.

Number of visits, latency and time spent in each compartment was analysed in the training, treatment exposure and in the post-treatment trial, using Friedman's test with pairwise comparisons and Kruskal-Wallis with Dunn's test.

Positive control animals took more time to enter in the previously preferred side after conditioning. No difference was seen for this parameter in the other groups. After conditioning, the positive control group had a higher latency to enter in the preferred side than the propofol/lidocaine group. This treatment seemed to induce a lower degree of aversion compared with HCl, and MS222 animals showed an intermediate aversion. Moreover, propofol/lidocaine treated animals spent more time in the preferred side, while 5 out of 8 animals of MS222 group and no animals from the HCl group showed this preference.

Thus, none of the anaesthetic protocols seem to be aversive for adult zebrafish. The new anaesthetic protocol presented has the advantage of being more practical to use and cheaper than MS222. Further experiments need to be made to refine this anaesthetic protocol in different ages, strains, and experimental situations.

NON-INVASIVE INFRARED THERMOGRAPHY FOR WELFARE ASSESSMENT OF LABORATORY RODENTS

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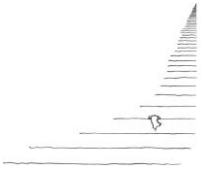
Variations in body temperature, such as fever and hypothermia, signal altered physiological states (eg infection, inflammation or stress), making it a relevant indicator of health and welfare in homeothermic animals. In laboratory rodents, temperature is typically measured by a rectal or infrared thermometer, which requires picking up and restraining each animal, in turn causing anxiety and stress with subsequent hyperthermic stress response (which increases with repeated handling), influencing results.

A possible alternative is telemetry, but sensor implantation warrants anaesthesia and micro-surgery, and subsequent post-operative care and recovery, often requiring single housing and posing the risk of lesions, infections, or immune and other physiological changes. Additional animal welfare problems come from sensor-related discomfort. Moreover, each animal requires its own sensor, driving up costs, and short battery life hinders long-term studies.

The disadvantages of these methods for data reliability and animal welfare call for novel approaches. One possible option is infrared thermography, already in use in veterinary research and practice, but until now rarely used with laboratory animals in biomedical research. Here, it may have several applications, including monitoring of anaesthesia, identifying (thermogenic) stress, and response to thermal stress conditions. For experimental infections, it allows identifying both infection-related fever and final-stage hypothermia, signalling 'humane endpoints'. The possibility of visualizing full-body surface heat patterns, both in real-time and recordings, and in the context of the temperature of the environment and cage mates – with minimum interference with normal behaviour and welfare – are added advantages.

An obstacle to the use of this technology has been the bulkiness and prohibitive cost of thermal cameras. However, low-cost miniaturized thermal cameras have recently become available as accessories for mobile devices (smartphones/tablets) costing as little as 250€. Their small size and portability can allow for cage-side/top assessment, hence avoiding animal manipulation, while the multiple capabilities of the devices open room for dedicated apps, and fast sharing of data (by Internet/Bluetooth) within and from the animal facility, as possibly automation. While their precision allow detecting surface temperature differences as low as 0.1ºC, their accuracy and validity to inform on core body temperature warrants further research. This talk will address current efforts to compare the accuracy of low-cost thermal cameras with 20x more expensive high-end equipment, and to determine whether these can inform on core body temperature, to tap their potential for easy, fast, reliable and affordable monitoring of the health and welfare of laboratory animals, and potentially others.



FILLING IN THE GAPS: CONSIDERING NOCTURNAL BEHAVIOUR PATTERNS IN ASSESSMENTS OF CAPTIVE PRIMATE WELFARE

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There is a wealth of knowledge concerning the behaviour of captive primates, particularly how their behaviour can be interpreted to serve as an indicator of psychological wellbeing. Monitoring monkey's welfare often includes looking out for behavioural signs of distress (such as exhibiting stereotypies or increased aggression) but most of our current knowledge base is focussed on day time behaviours. Despite the fact that rest takes up more than half of a diurnal primate's life span it is rarely considered in research and there is therefore a void of knowledge surrounding nocturnal behaviour patterns and their implications for welfare. This is of great concern to laboratory primates, where half of the lives of these captive animals are essentially being ignored. Given the physiological similarities between humans and monkeys and the well-established finding that sleep disruption can be related to stress and depression in humans, it is plausible that monitoring nocturnal patterns could provide insight in to the psychological wellbeing of laboratory primates.

My research aims to investigate nocturnal behaviour as a measure of welfare in captive Rhesus macaques. There are three main lines of enquiry:

1. Understanding what constitutes normal sleep in this species and establishing if there is a relationship between sleep patterns and stress
2. Determining if there are consequences of poor sleep patterns on the future mental wellbeing of the animals
3. Developing an automated system, using infra-red recording equipment and custom written software, as a practical way for laboratory staff to conduct routine surveillance of night time activities

Footage has been collected at two different UK locations (a laboratory facility and a breeding centre) since February 2015. The footage has been subject to a combination of automatic and manual behaviour scoring, and the scores used to analyse patterns of behaviour in relation to different stressful events (such as health checks and blood sampling procedures) across several studies.

The overall aim of this body of research is to investigate if observing nocturnal behaviour has the potential to be a novel, non-invasive, effective tool to assist in monitoring welfare in laboratory primates.

PERCEPTIONS OF POSITIVE EQUINE WELFARE

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Positive equine welfare (PEW) is a contentious phrase. For example there are many expressions of 'the positive'. There are many practices of equine welfare which serve horse and human interests and sometimes these conflict. PEW is also something which can be objectively measured but also carry personally constructed meanings. The extent to which the phrase 'positive equine welfare' conveys a shared understanding and appreciation within the equine industry currently is little known. This study was designed as a preliminary exploration of this issue.

Semi-structured interviews were conducted with three professional breeders and three professional riding instructors using the following three questions;

1) What is your understanding of positive welfare
2) What do you believe are signs of positive welfare
3) What do you consider good practice that would promote positive welfare in the equine industry

At the heart of this qualitative inquiry into positive equine welfare was the coding of interview data that followed the process set out by Saldana (2016). A code was defined as a researcher-generated construct that attributed collective meaning to portions of the interview transcripts. A first round of coding was done individually and skeletal categorical frames designed. A rigorous process of intersubjectivity followed to determine how far codes were agreed and how these could be consolidated to synthesise a more robust 'meaning map' showing categories and their relationships.

Ultimately interviewees appeared to define positive equine welfare with reference to practice, as opposed to conceptually, which might be expected of professional practitioners. Two core categories '(the) Individual' and 'External Factors' became apparent. The first category highlights the importance of realizing that the understanding, perceptions, and experience of each individual can influence practice, which in turn has an impact on equine welfare outcomes. The second category references perceived industry 'gold standards' of practice. Interviewees indicated that these standards were often difficult to meet. Very clearly these practitioners discussed practice that could be considered altogether as a holistic approach to horse care and welfare. Reference to the individual needs of the horse, alongside tones of anthropomorphology and subjectivity, were detected within transcripts. Reference to the need for education around welfare (generally and for the self) highlighted areas for further consideration.

PROTOCOL FOR EXPERT REPORT ON ANIMAL WELFARE AS SUPPORT FOR COURT DECISIONS IN CASE OF ANIMAL CRUELTY SUSPICION

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Our objective was to develop and test a protocol for expert report on animal welfare when there is suspicion of crimes against animals. Based on welfare assessment literature, the protocol includes four groups of indicators: nutrition, comfort, health and behavior. Each group is assessed as inadequate, regular or adequate; results are then integrated into a final welfare degree. A simple integration method is employed, based on thresholds, for five final degrees: very low, low, regular, high or very high welfare. Very low welfare is declared when three or more groups of indicators are classified as inadequate or when open intentional physical aggression is present; low welfare is reported when one or two groups of indicators are inadequate; regular welfare when two or more groups of indicators are considered regular, high welfare when only one group of indicators is regular, and very high welfare when all groups of indicators are considered adequate. Very low and low welfare situations are reported as animal abuse, subject to criminal penalties. Regular welfare situations are monitored for corrective measures. Cases where high or very high welfare is characterized are dismissed. A preliminary protocol was first used in two circuses, providing sentences of abuse for one elephant and five lions. Subsequently, it was tested with 101 community dogs and results were mostly regular (60.4%) and high (35.6) welfare. The protocol was adapted to puppy mill (260 dogs) and dog shelter (375 dogs) situations, through group evaluation, providing animal abuse evidences related to faults in cleanliness, good health and adequate nutrition. The protocol was also adapted to draught horses (32), with 90.6% of the horses presenting very low welfare. Regarding suspicion of cockfighting, the protocol allowed for animal abuse confirmation in all 41 cocks studied, even though there was no fighting flagrant. With two polar bears in a zoo, the results showed necessary improvements for animal quality of life and allowed for the animal abuse accusation to be dismissed. We conclude that the protocol allows differentiation of animal welfare status to better decide whether an animal is under abuse. We hope that the refinement in the recognition of crimes against animals, especially considering cases where no physical lesion is present, will improve perception of animal suffering, facilitate the field work of those involved in this type of investigation, and offer a contribution to the improvement of animal welfare in our society through proper action and crime reduction.

Project funded by CAPES Pró-forenses

THE IMPORTANCE OF ACCESS TO OUTDOOR SPACE FOR DOMESTIC CATS (*FELIS CATUS*) IN A RESCUE CENTRE

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Contained environments such as catteries, can be stressful for *Felis catus*, resulting in undesirable behaviours due to space restrictions. Shyan-Norwalt (2005) suggests that cats use windows and sunlight much less often than expected within the home environment; however they provide behavioural options that would be particularly important for welfare within rescue centres.

This study focuses on ten, randomly selected, cats in a rescue centre. A range of ages, genders and time spent in cattery were included; however these were not equally matched. Each cat's position and behaviour was recorded every minute over four days, for two hours per day. Four of the hours being when outdoor access was restricted and four hours when outdoor access was not restricted.

The cat pens (1.3x3.5 metres) were adjacent to each other, separated by solid panels, and outdoor sections were covered. Hideouts and beds were placed within both sections of each pen, along with some toys.

A Paired-*t* test was used to find out which behaviours were significantly different when outdoor access was restricted. The behaviours which were significantly different were observation (t_9=3.46, P=0.007) and sniffing (t_9=2.26, P=0.05) which increased with access and resting (t_9=-5.93, P=0.001) which increased when access was restricted. These behaviours suggest that outdoor access could improve the welfare of cats due to the increase in active and investigative behaviours. No correlation, however, was found between time spent at the cat flap and window, when outdoor access was restricted, and time spent outside, when given outdoor access (Spearman Rank: r_s=0.235, P=0.513).

IMPROVING ANIMAL WELFARE INSPECTIONS BY USING EPIDEMIOLOGICAL METHODS

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Animal welfare epidemiology is developing rapidly as a discipline. Epidemiological studies can be conducted to (1) obtain insight into animal welfare status at the individual- or population-level, (2) identify factors associated with animal welfare status, (3) create benchmarks for welfare status that can be monitored over time, (4) develop forecasting models that predict future welfare status, and (5) assess the effects of intervention strategies. The approaches used vary due to differences between data sources regarding the definitions of animal-based measures (ABMs) or resource- and management-based measures of welfare, as well as the methods employed to analyse associations between the two.

Here we apply epidemiological methods to data routinely collected by competent authorities in official animal welfare control. We report on findings and lessons learnt in the analysis of data from 2010 to 2013 for premises with horses in Sweden (n=13,321 inspections) as an example.

Measures of welfare status

Premises-prevalence of non-compliance with one or more ABMs (social contact, body condition, hoof condition and cleanliness) was used as an outcome of poor equine welfare and 95% confidence intervals (CI) were estimated. For routine random inspections, the premises-prevalence of poor equine welfare was 9.5% (CI 7.5, 11.9). The data available dictate the level at which prevalence of poor welfare can be estimated. Where possible, numerator and denominator data at the individual animal level should be recorded. To reduce bias, prevalence from random sampling of the population should be reported. ABMs should be objectively measured.

Associations between outcomes and inputs

Multivariable logistic regression was used to identify factors associated with poor welfare, adjusting for clustering on premises to account for multiple inspections. Non-compliance with requirements for supervision, care or feeding of horses, facility design, personnel, stable hygiene, pasture and exercise area maintenance, not being notified of an impending inspection, a previous complaint or deficiency, spring compared to autumn, and not operating a professional equine business were significant predictors. Animal welfare data can be difficult to model due to multi-collinearity and interaction effects. More advanced epidemiological methods may be needed to fully explore such data.

We confirmed the value of collecting routine data on animal welfare, and identified improvements required for its future use in benchmarking and assessment of interventions. Consensus in the use of animal welfare data in epidemiological studies will help ensure consistency of results, thus facilitating comparisons with like-studies in the future.

THE IMPACT OF ULTRAVIOLET WAVELENGTHS ON BROILER CHICKEN WELFARE INDICATORS

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The aim of the study was to investigate the impacts of Ultraviolet wavelengths (UV) on a variety of welfare indicators. We explored UVA and UVB wavelengths. UVA is visible to chickens and may provide a valuable source of environmental enrichment, in turn facilitating more harmonious flock interactions. UVB wavelengths promote endogenous vitamin D synthesis, which could support the rapid skeletal development of broiler chickens. Lameness and skeletal abnormalities represent an important welfare issue in the poultry industry.

Day-old Ross 308 birds were randomly assigned to one of three treatments, 1) White Light Emitting Diode (LED) control group, representative of farm conditions. (18 hour photoperiod) 2) White LED & supplementary UVA LED lighting (18 hour photoperiod) and c) White LED (18 hour photoperiod) with supplementary UVA & UVB fluorescent lighting (30 micro watts/cm^2 UVB at bird level) on for only 8 hours of the total photoperiod to avoid over-exposure of UVB. Birds were kept at a stocking density of 33kg/m^2 and fed ad-lib on a commercial diet. Welfare indicators measured were; feather condition (day 24 n.546), tonic immobility duration, a measure of stress responsiveness (day 29 n.308), and gait quality, using the Bristol Gait Score (day 31 n.299). For statistical analysis, generalised linear or ordinal logistic regression models were fitted in R statistical software.

Results showed, improved feather condition in treatment 2, compared the control ($p=0.03$). Treatment 2 birds also had a lower average tonic immobility duration of 1.02 ± 0.10 (SE) minutes, compared to 1.52 ± 0.12 (SE) minutes in the control group ($p=0.03$). Lighting condition had no effect on Bristol Gait Score.

Results suggest UVA may be beneficial for broiler chicken welfare. While treatment 2 and 3 both provided UVA, the improvements in welfare indicators were not consistent in both treatments. One possible explanation is that the beneficial effects of UVA are exposure time dependent. While no gait effects were apparent using the Bristol Gait Score, skeletal health will be explored further using Dual Energy X-Ray Absorptiometry.

Future research identifying the links between UVA exposure, feathering rate and stress, such as positive impacts on activity patterns, spatial distribution and flock interactions are of further importance to broiler welfare.

THE HUMAN-PET BOND. FROM BEGINNING TO END. A SPANISH SURVEY

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Pet owner behaviour is a major variable in determining animals' welfare and plays a key role in its assessment. The objective of this study is to analyze the characteristics of the bond between owners and their pets using a Likert-type scale questionnaire. A total of 1,572 personal surveys were performed in Zaragoza, a city with a population of half a million, typically used as a model for social studies (item-total correlation between 0.24 and 0.60 and a Cronbach α reliability of 0.89). The survey sections were: beginning of bond; status in the family; emotional bond; physical and social interaction; health, food, hygiene and education; end of bond, and overall rating of bond. Differences were analyzed using the SAS CATMOD procedure. 34% of people adopted and 35% bought their pet in specialized stores (37% said their pet was a gift). There were significantly more women adopters than men who adopted ($p \leq 0.05$) and also more adopters among the young than the elderly ($p \leq 0.05$). 91% consider their pet to be one more family member and 93% see them as sentient beings, entitled to having their rights recognized (significantly higher in women $p \leq 0.05$). 91% feel great empathy with their pets when they suffer (higher in women $p \leq 0.05$). 75% consider they would overcome an illness more quickly in the company of their pet, again with greater significance in women ($p \leq 0.05$). 98.3% feel responsible for the welfare of their pets (100% in women). 80% percent take their pet to the vet for regular check-ups. 70% want their pet to socialize and have spent time training it, mainly using rewards rather than punishments. Only 30% would hire a professional to train their pet. 72% walk their pets 2 or 3 times a day, allowing them sufficient time for physical exercise and to socialize. 100% would never abandon their pet. 70% would do everything possible to keep their pet alive in old age, this being more evident in women ($p \leq 0.05$). 76% would give up their pet for adoption if they could not care for it properly, while only 8% would resort to euthanasia. The average (± SD) of the overall rating of the importance of pets to their owners, on a scale of 1-10, is 8.83 (± 1.42). Women score higher than men (9.06 ± 0.04; $p \leq 0.05$).

REAL-TIME APPLICATION OF THE RAT GRIMACE SCALE AS A WELFARE REFINEMENT IN LABORATORY RATS

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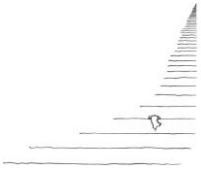
Rodent grimace scale scores have been recently validated for pain assessment in a range of acute pain models. The standard method of applying these scales is retrospective, as it relies on the collection of video and images before scoring can proceed. This process is time consuming, delaying the recognition of pain and timely intervention. The aim of this study was to compare real-time application of the Rat Grimace Scale (RGS) with the standard method, thereby evaluating the role of the RGS in improving pain management and welfare.

Thirty-six male and female Sprague-Dawley rats were randomly allocated to receive one of three treatments 30 minutes before before administering intra-plantar carrageenan (under general anaesthesia): buprenorphine (0.03 mg/kg, subcutaneously), multimodal analgesia (buprenorphine [0.03 mg/kg] and meloxicam [2 mg/kg], subcutaneously), or saline. Real-time observations (interval and point) were compared to the standard RGS method using concurrent video-recordings over a 24 hour observation period. Comparisons between scoring methods were made with two-way ANOVA for repeated measures and a post-hoc test applied if a significant main effect was observed. The Bland and Altman method for repeated measures was used to compare agreement between scoring methods.

Four animals were excluded due to misinjection (two from the saline group and one from each analgesic group). Analgesic treatments provided effective analgesia after carrageenan injection. Both the standard RGS and the real-time interval observation methods were able to discriminate between saline and analgesia treatment groups ($p < 0.05$). Real-time point observations showed a limited ability to discriminate between treatments. Real-time interval observations showed minimal bias, underestimating RGS scores from the standard method by 0.09, and acceptable limits of agreement (-0.63 to 0.46).

These results indicate that applying the RGS in real-time through an interval scoring method is feasible and effective, allowing refinement of laboratory rat welfare through rapid identification of pain and early intervention.



EASY ASSESSMENTS TO MEASURE THE WELFARE IMPROVEMENT IN HANDLING FACILITIES OF LIVESTOCK FARM

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The use of corral for handling beef cattle is essential but improper handling in inadequate facilities causes stress to the animals, which may become fearful or aggressive increasing risk of accidents to the handlers or the animals. In Brazil, most of the traditional corrals on farms were not constructed according to the best behavioral principles of moving livestock.

The experiment was conducted in six farms to evaluate the effect of changes in corral and adoption of good handling practices on cattle behavior, blood cortisol and lactate. Corral changes included obstructing the cow's vision when the handler walked deep into the animal's flight zone and the elimination of bright objects, color contrasts, puddles, shadows, and darkness in the corral. Handling was improved by training handlers in a single session showing them how to work in a calm and quiet manner. They were instructed to avoid shouting, pushing and hitting the experimental animals and it was eliminates dogs and electric goads.

410 heads of zebu cattle including adult cows, heifers (15 to 20 month of age) and steers (15 to 20 month of age) were used. Each animal was processed twice. The first section was in a traditional corral and handling and 5 to 7 days later, the animals returned to the refurnished corral and good practice principles for handling. During restraint for blood collection, the animals were classified in calm and agitated. It was recorded the entrance and the exit (walk=1, trot=2 or run=3) of the squeeze chute.

The risk ratio analyses showed the improved corral and handling presented lower agitation (0.47) and heifers were 1.4 times more agitated than adult cows. Steers were calmer than heifers (risk ratio=0.535). Improved corral and handling had a positive effect ($P<0.001$) for gaits score observed, blood cortisol and lactate. Before corral and handing modifications 64% of animals were agitated and after changes just 36% were agitated. Comparing calmer and agitated animals during restraint, it was effect ($P<0.001$) on the chute entrance (1.22 vs 1.63), the exit (1.39 vs 1.90), cortisol (46.8 vs 51.9 ng/mL) and lactate (34.48 vs 56.25 mg/dL). After the two data collection in each farm, we did feed back to handlers presenting the results, showing movies, pictures and numbers about their own work. Entrance and exit scores were easy to record and good to demonstrate the changes in cattle behavior. Actions to improve design of corral and quality of handling result in calmer zebu.

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WHAT BEHAVIOUR TRAIT COULD BE INTRODUCED TO BE USED IN A BEEF CATTLE EXPERIMENTAL FARM ROUTINE?

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Livestock farms that develop selection program usually have corral routines to weight animals, including some other handling activities. The IZ (Sertaozinho, SP, Brazil - 21°10' S; 47°57' W), has a selection program started in 1978, using performance test in feedlot for bulls and post weaning weight adjusted to 550 days of age for female on pasture.

The objective was to study an easy measurement of behaviour to be introduced in data collection, during corral routine. It was used 702 growing bovines of three breeds (Nellore, Kankrej (*Bos indicus*) and Caracu (*Bos taurus* adapted) with average of 1.2 ±0.13 year old. They were evaluated in two different corrals, a traditional facility (TF) and a humane handling designed facility (HF). All data collection was made during 10 days, randomized in both corral. The same team of handlers worked in both corral and the processing was blood collection and weigh. The behaviour traits were evaluated during restraint in chute and were temperament score (TS), entrance score (ENT), exit score (EX) and flight speed (FS). The blood parameters analysed were cortisol and lactate.

The results showed that the TS was affected just by corral ($P<0.0001$), ENT by breed ($P<0.0001$), gender ($P=0.0075$) and corral ($P<0.0001$). EX and FS were affected by breed ($P<0.0001$), corral ($P<0.0001$) and live weight ($P=0.0002$). Cortisol was affected by breed ($P<0.0001$), gender ($P <0.0001$), FS ($P=0.0082$), and corral ($P=0.0455$) and lactate by breed ($P<0.0001$), gender ($P=0.0294$), corral ($P=0.5874$), ENT ($P<0.0001$), TS ($P=0.0414$) and EX ($P= 0.0267$). Caracu breed seems to be calmer, presenting lower score for ENT, EX and FS but presented high cortisol (42.6 ng/mL) compared to Nellore (38.5 mg/dL) and Kankrej (29.9 ng/mL), showing to us they can be more sensitive, comparing to zebu.

Females, compared to males, presented worse scores, probably because of they stayed at pasture after weaning and the male stayed in feedlot. The corrals was very important, affecting all characteristics, showing us that the design of the facility is very important during handling, the animal can see the way to go when walk to the chute, can be afraid or not, depending what they are seeing or the position of handler. The EX or FS was associate of live weight and could be introduced in a data collection routine. The EX is an easy measurement to be introduced recording if the animal walks, trots or run in the moment of exit of chute.

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MIND THE GAPS! FROM INTENTIONS TO PRACTICE IN ANIMAL WELFARE REGULATIONS

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The overall aim of this project was to investigate and describe the intentions of different stakeholders behind various types of animal welfare regulations (both governmental legislation and private standards), and how efficient these systems were in improving animal welfare. An expert questionnaire was used and text analyses on regulations (including preambles and explanatory notes) from four different European countries were carried out, as well as text analyses concerning content and structure of four different Swedish regulations for dairy cows, including corresponding control guidelines. Finally, the dairy farm control outcomes were analysed based on the official control and private audits from the private standard 'Arlagården'.

The results showed that the aims of a regulation were often more aspirational in terms of animal welfare than the detailed requirements turned out to be. While the intentions promised to protect the lives and welfare of animals, to treat animals as sentient beings, to give them a life in dignity, behave naturally etc., the regulations nevertheless accepted tethered and crated animals, painful procedures without anaesthetics, early separation of mothers and young, etc. The policymakers rarely defined core concepts such as 'natural behaviour' and 'unnecessary suffering'.

The private standards for dairy cows in Sweden to a large extent covered the same requirements as the legislation. However, due to vague wordings and different ways of measuring it was not always clear if the requirements were truly identical between the regulations. The private standards more often measured animal welfare at a herd level instead of an individual level, indicating that these standards offered a protection level for individual animals below the legislated level.

The two different control systems in the last sub-study focused on slightly different areas; dirty dairy cattle being the most common non-compliance at official controls, and dirty cowsheds at Arlagården audits. Neither of them focused on mastitis or lameness, which are common animal welfare issues for dairy cows. One reason for this is that the occurrence of disease is not automatically an animal welfare non-compliance. Hence, control statistics do not necessary mirror a regions' true animal welfare level. In both systems organic farms had a lower risk for non-compliance compared to conventional farms.

In order for regulations to improve animal welfare further there is a need to reduce the gaps between intentions, requirements and assessments within a regulation, but also between different regulations claiming to have the same animal welfare intentions.

A PILOT STUDY: A MICROBIOLOGICAL APPROACH TO UNDERSTANDING FEATHER PECKING IN LAYING HENS

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Feather damage due to severe feather-pecking (SFP) is one of the greatest welfare concerns impacting the egg industry worldwide. Numerous studies have been conducted in an attempt to establish its underlying cause, however, the motivations behind SFP are not understood. This abnormal behaviour may result in poor plumage condition, feather loss and damage to the integument. The problem occurs across all housing systems and its high prevalence accentuates the need to develop effective methods of prevention and control.

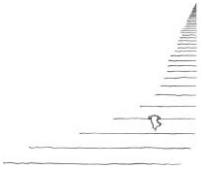
One theory proposes that SFP is a redirected behaviour, associated with the inability of motivated birds to satisfactorily dust bathe. In addition, previous studies have shown feather lipids will accumulate and become stale on the plumage when birds are deprived access to a dust-bathing material. Thus, preen oil may serve as a possible attractant for feather pecking.

We hypothesised that microbial changes on the feathers and skin are related to an increased risk of SFP, when ISA Brown hens housed in a floor pen system were restricted from access to a dust-bathing substrate. Thus, in this study, we aimed to limit the effectiveness of dust-bathing behaviour and assessed the bacteriological relationship between feather-pecked and non-feather-pecked birds upon initiation of a feather-pecking outbreak.

Descriptive data analysis indicated feather-pecked birds had double the amount of bacteria on the rump, uropygial gland and vent compared to non-feather-pecked birds, while the opposite was true for the breast. A possible explanation is that the breast remains the most thoroughly oiled region during preening and has frequent contact with the litter material (e.g. when squatting on the floor) compared to other regions of the body.

The current trial was a preliminary investigation and future studies aim to develop a reliable model to initiate feather-pecking behaviour, which could be applied to determine whether SFP is linked to dust-bathing deprivation, increased stress or both. Upon elucidation of this phenomenon, interventions could be applied as a means to mitigate SFP in laying hens.

The authors would like to acknowledge the Poultry Research Foundation and the Australian Veterinary Association Limited for funding the experiment.



THE ELUSIVE BOUNDARY BETWEEN CONSCIOUSNESS AND UNCONSCIOUSNESS: SPECTRAL ANALYSIS OF EEG MAY HOLD THE KEY

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Definitions of consciousness in relation to welfare assessment of killing methods for livestock primarily relate to the theory of medical awareness and "state-consciousness". Electroencephalography (EEG) provides objective data characterising the electrical activity on the surface of the brain, and is a key method of assessing consciousness during killing and slaughter. Other techniques such as behavioural assessment (e.g. loss of posture) and physiological measures (e.g. heart rate) are also useful, but EEG is considered to be the most reliable, as it provides a direct measure of brain electrical activity. Broad use of the term "EEG activity" can relate to analysis by visual interpretation as a measure of loss of consciousness which has limitations as it is fundamentally a subjective approach. A more powerful analysis technique for EEG output is now available, which transforms excerpts of the original EEG trace into power frequency spectra, via Fast Fourier Transformation. Then, calculated spectral variables (such as median frequency) are generated and related to ranges associated with distinct consciousness states. Very few studies have recorded behavioural, physiological and EEG data in the same animal during slaughter or killing, or have adopted both spectral analysis and multiple visual based "EEG activity" measures on the same data. We did this in two trials, which were part of a large project evaluating the welfare impact of Low Atmospheric Pressure Stunning (LAPS) in broiler chickens. EEG, ECG and behavioural data were recorded and pooled across the two trials for individual birds (N=50). Pearson's correlations were used to identify associations between key loss of consciousness indicators, including various parameters assessed both visually and quantitatively (e.g. latency to: loss of posture, presence of slow-waves in trace, total power <10% of baseline EEG and EEG spectral variables). Latency to loss of posture assessed behaviourally was highly correlated with latency to median frequency thresholds (F50<6.8Hz ($r=0.501$, $P=0.028$) and F50<12.7Hz ($r=0.339$, $P=0.042$)), but was not correlated with visual inspection noting the presence of slow-wave EEG. Time to death indicators were not correlated, with all EEG methods showing brain death occurring significantly earlier than the behavioural measures (mean difference 82±1.8s). The results suggest that behavioural indicators are highly conservative measures of loss of consciousness and brain death, and EEG spectral analysis provide greater accuracy by allowing identification of the presence of slow-wave EEG in periods of gradual change prior to complete loss of consciousness. Collectively, the results suggest that spectral analysis has the potential to allow objective identification of transitions between states of consciousness, and thus can significantly contribute to welfare assessment during slaughter and killing.

EVALUATION OF INDIVIDUAL DIFFERENCES IN THE STRESS RESPONSE TO MOTHER-YOUNG SEPARATION IN THE DOMESTIC HORSE

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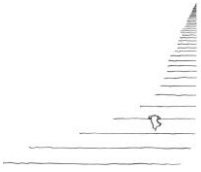
The study of animal personality is one of the fastest growing areas of research in behavioural biology and in parallel, there has been an increasing interest in its implications for animal welfare. Personality affects how animals cope with stress and may have a strong influence on the success of reproduction and management. Weaning of the young of farm and companion animals almost always happens earlier than it would naturally among their wild-living ancestors even though mother-young separation has been described as a stressful psychological process that might compromise the physical and mental well-being of animals.

The aim of our project is to evaluate individual differences in the stress-response during mother-young separation in mares of the domestic horse as their foals develop and to compare different methods of evaluation; behavioural observation (vocalization, body posture, locomotion etc.), physiological monitoring (heart rate variability, HRV), and the "Horse Grimace Scale" of the protocol AWIN.

We are assessing the level of stress of mothers during brief separations from their foals in different-age multiparous mares of the Azteca breed (n=20). Each mare is tested four times until weaning; when her foal is three days, six weeks, twelve weeks and six months old. All tests include a baseline (15 min), separation (2 min) and reunion (15 min) phase. With continuous video, audio and HRV monitoring we are able to quantify the absolute values and the extent of change during each test in the measured variables. We analyze the repeatability of the individuals' behavior across trials by (G)LMM-based intra-class correlations calculated as the proportion of phenotypic variation that can be attributed to between-subject variation and we also test for associations between the results of the different methods.

By identifying traits showing stable between-individual differences in behaviour and physiology, which are consistent over time and that presumably reflect the internal state of the animal, we hope to be able to recognize early the individuals with lower tolerance to stress, which is key for the appropriate management of horses. Data analysis is in progress and we will present our finding at the conference.



BIOMARKERS OF PAIN - SEPARATING PAIN FROM INFLAMMATION

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Biomarkers such as Substance P, and pro-inflammatory cytokines IL-1β, IL-10, IL-12 and TNF-α have been observed to increase in response to known painful conditions such as footrot and mastitis. However, these compounds are inflammatory mediators and hence when inflammation is present, may not be reliable biomarkers of pain. There is a need to identify biomarkers that are specific to pain and that are not influenced by inflammation. Activin-A has recently been observed to regulate pain neuropeptide transmission and even to induce tactile allodynia, making it a possible biomarker of pain that is separate from inflammation.

Serum activin A concentrations of sheep experiencing naturally occurring footrot (n=13) and acute mastitis (n=5) were compared to those of non-diseased control sheep (n=14). Sheep were sampled on day 0 before treatment, and on day 7 and day 42 (mastitis) or day 90 (footrot) when considered fully recovered. Data was analysed using Ri386 3.1.1 and a linear mixed-effects model fitted by maximum likelihood, using the lme4 package (lme function) to compare the activin A levels across the three time points. Fixed effects included treatment groups, day, breed, gender and farm.

Day explained most of the variation in serum activin A concentration in the footrot group; however, upon further investigation serum activin A concentrations did not differ between the three days (χ^2 = 4.51, df=2, P>0.05). The model did not improve with the addition of the other fixed effects. Treatment group alone was the best model for sheep in the mastitis group (114.08 ± 11.97 ng/mL) showing higher values in the diseased sheep across time when compared to the control sheep (68.79 ± 5.81 ng/mL) (t=-3.56, df = 10, P=0.005). The model did not improve with the addition of the other fixed effects.

Activin A has a complex role in inflammation and pain modulation, with different responses according to the disease involved. Footrot is a localised disease and so although activin A is likely to be increased within the affected tissue, it is not entering the systemic circulation. Acute mastitis is a systemic disease, with pyrexia indicating that cytokines are entering the systemic circulation. The high blood levels of activin A seen in mastitis cases after apparent recovery, may be representative of the long term tissue damage caused by the mastitis.

The response of activin A needs further investigation and serum activin A should not currently be used as a sole biomarker of pain.

SYSTEMATIC REVIEW ON ANIMAL WELFARE INDICATORS IN DAIRY CATTLE TO IDENTIFY THOSE OF HIGHEST VALIDITY

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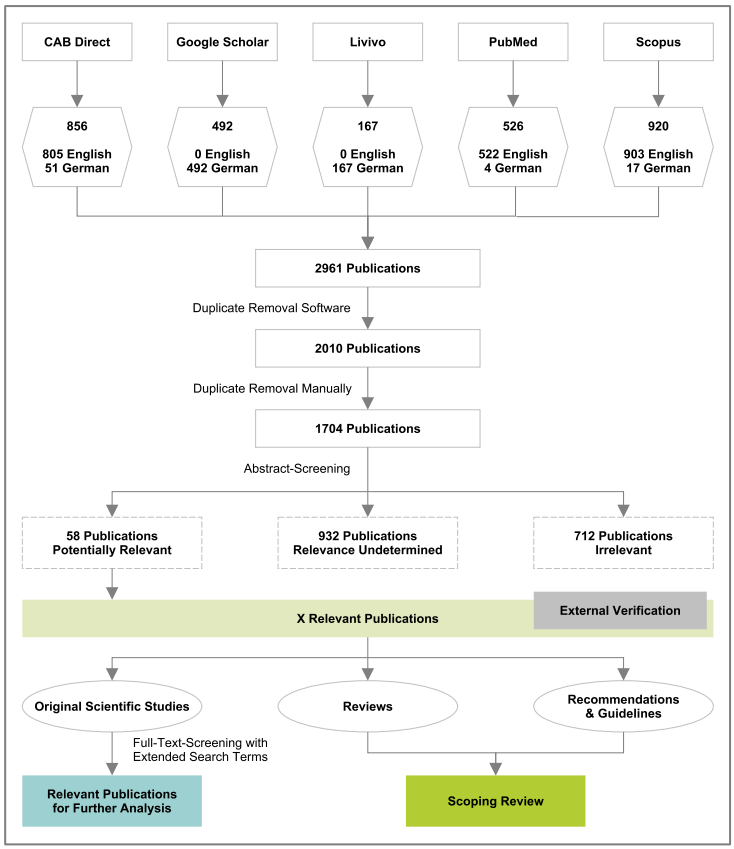
Due to recent developments (amongst others: the legal anchoring of animal protection in the German constitution as a national objective, the amendment of the German animal protection law and the rising consumers demand for animal-welfare-conformed produced food) one can postulate a rising interest of society in animal protection and, even more, in animal welfare regarding livestock. The interpretation range of the term animal welfare as well as the involvement of different stakeholders, result in a variety of indicators that are mainly resource- and management-based. Until now, little systematic investigations regarding the evidence of scientific studies and the validity of animal welfare indicators in dairy cattle exist. Therefore, it is the objective of the project to review literature on animal welfare indicators systematically, to assess its quality and to identify those animal-based welfare indicators of highest validity.

First, we outlined the complexity of the terms "animal welfare" and "Tierwohl" by wide search, focusing on the different meanings in political, societal and scientific background to better understand and classify existing animal welfare indicators. In a first glance on European and German animal welfare assessment protocols regarding dairy cattle and their indicators, we hardly found animal-based indicators which are not only health-oriented but include aspects beyond that. (Mondon et al., Berl Münch Tierärztl Wochenschr, aop 2017; DOI: 10.2376/0005-9366-16080).

For the Systematic Review, we searched within five databases for peer-reviewed and non-indexed literature, using a strict protocol regarding the English/German search terms. The outcome was limited to publications of the last five years, to dairy cattle as the species of interest and geographically to Europe, regarding the content of the studies.

After the removal of all duplicates, we are now confronted with the abstract-screening and categorizing of 1704 publications, separating peer-reviewed publications from Guidelines, Recommendations, Reviews and others. The following full-text-screening and discussion of original scientific studies (increased list of search terms) shall list empiric verified animal welfare indicators and identify those of highest validity.



PUBLIC PERCEPTIONS OF FELINE CHARACTERISTICS IN RE-HOMING SHELTERS AND THE IMPACT THESE HAVE ON ADOPTION SUCCESS

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National UK animal welfare charities have reported increases in the number of animals coming through their doors year after year. Shelter environments can negatively impact on the welfare of the animal due to stress and suggests a clear need to reduce the number of this population. This study aims to investigate factors that may affect a cat's adoptability and gain insight into the public's perceptions of feline characteristics in rehoming shelters. Data was obtained from Wood Green Animal Charity and consists of 5974 entries from their cattery department. Preliminary analysis for the effects of age, sex and coat colour on the length of stay (LoS) of the cats in the shelter and their outcomes (rehomed or euthanized) was conducted. Previous work had suggested that some coat colours were associated with longer stays (for example black or black and white cats) than others. The majority of cats in the shelter were classified as non-pedigree domestic short hair. Black cats (21.8%) and black and white cats (23.3%) made up a large proportion of the rescue population. There was an effect of age on length of stay with cats under 6 months of age having significantly shorter LoS than adult cats but LoS was significantly longer for cats over x years of age. There was an interaction between coat colour and LoS with black cats taking significantly longer to leave shelters as age increased and ginger cats showing no change in LoS as adults. Similarly there was no effect of coat colour on chance of euthanasia with less than 5% of cats having to be put to sleep largely for severe health issues. This data is consistent with other studies that find that older cats are harder to rehome. The finding of no biases with coat colour contrasts with other work which suggests that Wood Green's approach to rehoming reduces chances of biases due to coat colour. The project is currently adding additional factors to data set including impact of changes in management such as open and closed access to shelters and promotions such as Halloween rehoming rates. The results of this study are expected to help introduce new methods in rehoming strategies by increasing interest in those cats who may be overlooked and to promote a successful adoption. Subsequently this should reduce the length of stay in the animal shelter, therefore, having a positive impact on cat welfare.

USE OF REAL-TIME GEO-LOCATION TO REMOTELY MONITOR LOCOMOTORY BEHAVIOUR AS A POTENTIAL PROXY FOR WELL BEING IN EXPERIMENTAL SHEEP

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Sheep are widely used in musculo-skeletal research particularly in translational pipeline research testing orthopaedic devices or therapies prior to first in man studies. The overwhelming majority of studies rely on post mortem data to validate the response to treatment, with little attention being paid to functional outputs such as behaviour changes or pain. One of the difficulties in assessing pain and well being in sheep is their flocking instinct and flight response, making conventional behavioural/clinical observations when humans are present potentially misleading.

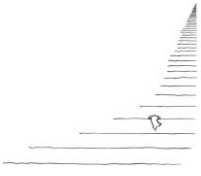
In this research we propose that the use of novel remote technology to measure aspects of behaviour underpinned by locomotion will provide insight into the well being of the animals used in musculo-skeletal research.

The aim of this study was to evaluate whether a novel real-time Geo-location system (Omnisense Series 500, Cambridge, UK) could provide accurate and meaningful data in sheep. This system contains a 3-axis accelerometer, a 3-axis magnetometer, 3-axis gyroscope and altimeter in addition to standard position location sensors.

Thirty-five adult female Welsh Mountain sheep were recruited into the study. Each animal was fitted with a mobile location sensor mounted on a conventional raddle harness. Twelve fixed sensors were installed at the periphery of the field in which the animals were housed and a Wherebox Clusterbox Location server installed at the periphery of the field. Recordings were taken from each sheep every 10 seconds, 24 hours per day for the duration of the study (15 weeks). All animals were kept as one flock in one field for the duration of the study. Data was analysed using a 'Smartbell' software system

Using the Omnisense Series 500/Smartbell software the maximum/minimum and mean distance travelled, velocity and 'height of animal = lying down/standing' were recorded for each animal. In addition each of these parameters was recorded and plotted against time to give a temporal record of events for each 24h period. A locator plot was also obtained for each animal for each 24h period, allowing distance travelled from water sources, feed points and field entrances to be calculated.

This study has shown that the use of new, novel technology can remotely and accurately identify the behaviour of experimental sheep in a natural situation i.e. out in the field in a settled social group and can provide robust information on behaviour and well being in the animals.



VALIDATION OF A FELINE GENERIC HEALTH-RELATED QUALITY OF LIFE INSTRUMENT WITH AN ADD ON MODULE FOR OSTEOARTHRITIS

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Advances in veterinary medicine over the last 20 years have made a considerable impact on cat health and longevity and the prevalence of chronic disease has increased accordingly, with diseases such as chronic renal disease and hyperthyroidism, well recognised for many years, and others such as osteoarthritis and cognitive dysfunction syndrome (CDS) causing behavioural changes indicative of a significant reduction in welfare and health related quality of life (HRQL). Formally recognised in human medicine, the latter is a multi-dimensional construct that is subjectively experienced by and is uniquely personal to the individual and this has been widely used in people to measure the impact of chronic disease and chronic pain and as an outcome measure in clinical trials. Health related quality of life measurement tools can be generic, measuring the impact of any chronic disease, or disease specific. While disease specific instruments may be more sensitive, generic instruments may be the only option when co-morbidities are present. If we adopt for animals a conceptualisation of HRQL that is similar to that for people, then the importance of measuring 'how the animal feels' about its circumstances is clear. However to date there is only one instrument for the dog and none for the cat that adopts this approach, alternative tools focusing in the main on physical limitations imposed by disease. We have used well established psychometric methodology, the gold standard for developing such measurement instruments', to construct a HRQL structured questionnaire instrument for cats which includes an owner reported generic 'stand-alone' core (GC) for the measurement of non-specific chronic disease and an optional osteoarthritis (OA) Module (OAM) that combines owner and clinician response data. The instrument is delivered online and instantaneously computes scores in 3 generic domains for the core component -vitality, comfort and emotional wellbeing- and 3 disease specific (OA) domain scores. Validity (content, criterion and construct) and reliability are key properties of a scientifically robust measurement scale and should be demonstrated before a scale is used in a clinical context.

We report on the validity of this clinical tool and demonstrate its usefulness as an indicator of feline health and wellbeing.

VETCOMPASS: A NEW FACE FOR ROBUST ANIMAL WELFARE RESEARCH DATA

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If strong ink is the oxygen of the writer, and absolute love is the oxygen of motherhood, then good data must surely be the oxygen of the scientist. But, alas, deficiency of good data (and even worse, the availability of poor data) has regularly thwarted the aims of animal welfare researchers trying to unravel complex issues surrounding the health, behaviours, demography, geography and human interactions of animals. So, although it is undoubtedly true that without *any* data, there may be *no* research, a further truism is surely that without *good* data, there may be no *safe* conclusions.

This presentation will explain the exciting new face of animal welfare data from the expanding VetCompass framework at the Royal Veterinary College, London. The VetCompass Programme collects anonymised electronic clinical data from veterinary general practices and merges these into a single database that is accessible online. Covering over six million UK animals, VetCompass offers opportunities for Big Data analyses that can answer an almost limitless range of clinical questions, with 26 peer-reviewed papers already published. The robustness of these data benefits from inclusion of every animal under veterinary care, information recorded to high quality veterinary standards, following the lives of animal over time and having access to all demography, clinical notes and treatments throughout.

Welfare advances are a central ethos to VetCompass studies which all require *a priori* statement on benefits animal welfare. VetCompass data already support diverse welfare studies such as longevity, disorders and undesirable behaviours across multiple research centres to harness the widest collaborative input.

This presentation will describe the use of the online VetCompass database to examine demographic, physical and behavioural attributes of animals and how data on these features can be extracted and analysed for robust welfare studies. Methods to apply natural language processing to 'computer-read' veterinary clinical notes and code these to standardised VeNom nomenclature terms will be elaborated. Novel metrics for extracting prevalence, duration and severity scores across a range of disorders will be discussed.

The world is changing. Opportunities now are less about how welfare scientists can get *some* welfare data and more about how we can *best use the mountains* of high-quality data that VetCompass already holds to derive the best outcomes for animal welfare.

A SURVEY OF COMMON RABBIT HANDLING METHODS AND REASONS FOR THEIR USE

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Rabbits are both popular pets commonly seen within veterinary practices, and frequently used in laboratories in the United Kingdom and elsewhere. However, to date there is minimal research that has investigated why and how people handle rabbits and why they choose to use such methods. In addition, few studies have considered the sources individuals use to learn about rabbit handling and their reasons to not use specific handling methods. Therefore, to investigate this, five handling methods were chosen that were frequently reported within pet owner, laboratory and veterinary rabbit literature (see figure 1). An online questionnaire gathered data about participants' experience of and views about these methods. The survey was distributed through social media and through conference attendance. Inclusion criteria were being a UK resident and currently or previously worked with or owned rabbits. In total, 2644 responses were gathered. The majority of respondents (90.3%) were located in England, currently owned rabbits (83.2%), and had more than one rabbits (71.2%). A variety of work settings were represented and wide range of years of experience with rabbits. Of the five handling methods, the most commonly used was holding the rabbit against the chest whilst supporting its weight (method B) (86.2%) and the least common was Scruffing the rabbit whilst supporting its weight (Method E) (15.3%). Though several reasons were given, moving the rabbit was the most frequently reported reason for using four out of the five methods. The most common rationale for not using a method was the respondent considering it to not be a suitable way to handle rabbits. Participants gained knowledge about rabbit handling from a wide range of sources, primarily from books and veterinary practices. While this research indicates public awareness of the negative welfare consequences of some methods, as indicated by a minority of participants using Scruffing, clearly more work is required to promote suitable handling, regardless of why the animal is handled. These decisions should be based on evidence, and more research is required to fully understand the implications for rabbit welfare of the various handling methods used, both those discussed within and outside this study.

Figure 1. Common handling methods: a) under arm, b) against chest, c) in front of chest, d) placed on back, e) scruffing (Photographs taken by C.F.E. (author 2)).

THE WELFARE IMPLICATIONS AS A RESULT OF BREED SPECIFIC LEGISLATION IN THE UK

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In 1991, the Government introduced the Dangerous Dogs Act in response to a number of high profile attacks. Under section one of this Act, four types of dogs traditionally bred for fighting (pit bull terrier, Dogo Argentino, Filo Brazilero and Japanese Tosa) are banned. The aim of this law was to reduce bites and protect public safety despite there being no specific evidence to suggest that fighting dogs are inherently aggressive or unique in bite style and ability to cause damage. The underlying basis of breed specific legislation (BSL) is very weak and since the prohibitions have been in place, the number of hospital admissions for dog bites and strikes have increased substantially. In addition unintended negative consequences have arisen which directly affect dog welfare.

Therefore, the aim of this research was to review the current literature, highlighting case studies on the welfare implications of BSL. We review the current welfare implications relating to dogs processed under BSL e.g. seizure and impact of the kennelled environment, as well as those relevant to dogs which are exempted from the prohibition and kept under strict conditions (e.g. muzzled and on a lead in a public place). Because the identification process is made predominantly on the basis of appearance, regardless of the previous behaviour of the dog in question, these welfare implications are likely to stretch further afield than just dogs with genetic parentage of the prohibited types including dogs deemed to look sufficiently like them (e.g. a Pit bull terrier).

This review also highlights a number of areas where improvements to the welfare of dogs affected by this law could be achieved e.g. introducing standard guidance for the management of seized dogs as well as a means to revise the conditions for exempted dogs. We also identify areas of further research such as how best to protect the welfare of dogs exposed to long term confinement and exempted dogs whose behaviour is restricted.

EVALUATION OF WELFARE STATUS OF REHABILITATING ELEPHANT CALVES USING FAECAL CORTICOSTEROID METABOLITES AS INDICATOR AT THE ELEPHANT TRANSIT HOME, SRI LANKA

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Sri Lanka has the highest density (per hectare) and nearly 10% of global population of wild Asian elephants. As a consequence of the escalating human-elephant conflict, 12 elephant calves are orphaned annually and some are cared at the elephant transit home (ETH) in Udewalawe, Sri Lanka. The objective of the ETH, which receives 90% of calves under 1 year of age, is to return orphaned elephants from temporary human care back into their natural 'wild' environment. Calves are managed with minimum human contact until six years of age and they are formed into groups and released into the wild.

We measured faecal glucocorticoid metabolites (GCM) as a potential indicator of stress and welfare in the period before and after release of elephants from the ETH. The study population was ten elephants (6 male and 4 female) between five to seven years of age. These elephants were released from the ETH in March 2015. The elephants were radio-collared for post-release monitoring. Faecal samples were collected each month, from eight months before and fifteen months after release. Samples (n=53 before and n= 151 after release) were oven dried at 70^0C for 12-24 hours and stored at -20^0C until analysis. Faecal extracts were assayed for GCM using a validated immunoassay at the endocrine laboratory at Veterinary Faculty of Chiang Mai University, Thailand.

Results were analysed using repeated measures ANOVA to ascertain whether the GCM values changed over time in the pre- and post release periods. The average faecal GCM values at before release were 52ng/g. Faecal GCM significantly increased in the first week after release to an average of 97ng/g and in the second week after release to 101ng/g. The average value during the first month after release was 96ng/g. In the next 14 months the GCM concentration decreased and was between 30ng/g and 47ng/g with an overall average of 38ng/g. The results show that release of young elephants into the wild caused a significant and temporary increase of faecal GCM but after a period of adaptation the GCM declined. There were no significant differences between the GCM levels of males and females. In addition, the results suggest that elephants maintained at the ETH before release had higher faecal GCM excretions than elephants adapted to a wild environment, but further work is necessary.

In conclusion, this study suggests that elephants released back to wild undergo a period of significant stress for 3-4 weeks.

USING PET OWNERS IN ASSESSMENTS ABOUT THEIR PETS PERSONALITY AND HEALTH STATUS: WHICH HUMAN CHARACTERISTICS MAY INFLUENCE RESPONDING

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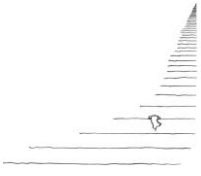
Pet owners are often relied upon to provide detailed information about the behaviour and/or health of the animal in their care. This information can then be used to inform treatment (in the case of reported ill health) and /or make decisions about the welfare and quality of life of that animal. Whilst there is a moderate amount of research looking at what human characteristics influence our attitudes towards animals, such as the influence of empathy and personality in the recognition of pain and sentience in animals, little research has tried to understand the effect these characteristics may have on the quality of an individual's reporting.

As part of a larger online survey looking at the association between pain behaviour and personality in domestic dog's information was collected from dog owners about; the view they held of their dog, their level of knowledge surrounding medical issues, their experience of painful conditions and their personality using the BFI-44. The aims were to be able to determine a) whether there was any association between owner and dog personality and b) whether the characteristics of the individual pet owners impacted the assessments they made about their dog's pain behaviour and their dogs personality.

An association was observed between the owner's and the dog's personality. Dog owners who were more conscientious gave their dogs higher scores on training-focus, motivation and amicability. Also, the owners level of neuroticism, how they viewed their dog and their perceived level of medical knowledge had the potential to impact their attitudes and therefore the responses they provide when giving assessments about their dog's personality and health. No associations were observed between the owner's experience of pain and the pain scores they gave their dog.

These findings are discussed in relation to the implications they may have on the health assessments in domestic dogs. If we are to utilise owner reports during clinical practice, it is important (especially when trying to account for why some dogs reportedly differ in their responses to painful conditions) to control for both internal and external sources of variance.



DEVELOPMENT AND VALIDATION OF A FERRET GRIMACE SCALE (FGS)

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Ferrets are a relatively common working and pet animal and are commonly used as an animal model, particularly in the study of human influenza. To optimize animal welfare during these studies, refinement strategies should be implemented, such as timely and accurate recognition and treatment of pain. However, effective means of assessing pain in ferrets is currently lacking, thereby necessitating further research on this critical topic.

Facial grimace scales have recently been developed and validated for the assessment of pain in a limited range of species, such as mice, rats, rabbits, cats, horses, sheep and lambs. A ferret grimace scale has yet to be developed or validated. Therefore, we aim to develop a ferret grimace scale to investigate whether facial expressions could be used as an effective means of assessing pain.

We compared the facial expressions of 19 female ferrets at multiple time points before and after intraperitoneal implantation of a telemetry probe (t = -22, -19, 2, 5, 26 and 29). Five facial action units (FAUs) were objectively identified from comparing lateral images of the ferret faces: 1) orbital tightening; 2) nose bulging; 3) cheek bulging; 4) ear changes; and 5) whisker retraction. The practical use of these FAUs to identify ferrets before and after surgery was subsequently tested by asking participants from around the world to score a range of images of the ferrets. The participants were blind to the procedure performed, the treatments administered and the time point of each image.

Results showed significantly higher total Ferret Grimace Scale scores at five hours' post-surgery compared to baseline. Even though further validation studies are necessary, these changes in facial expression in the ferrets after surgery suggest that pain can potentially be recognised using the Ferret Grimace Scale (FGS).

ARE YOUR EARS BURNING WHEN I'M NOT THERE? DISTANCE MONITORING OF POSITIVE AND NEGATIVE AFFECTIVE STATES IN DOGS WITH INFRARED THERMOGRAPHY

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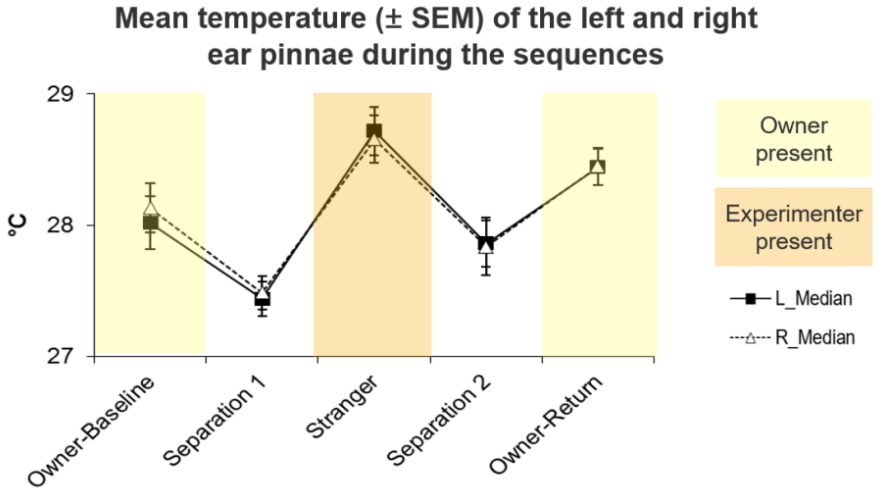
Infrared thermography represents one way of noninvasively measuring physiological reactions associated with positive and negative affective states. We here tested six pet dogs in a brief separation test (modelled after dog-human 'attachment tests'), which included contact with their owner, with a stranger and short periods of social isolation. Previous studies using attachment tests have demonstrated that isolation in an unfamiliar environment is associated with physiological and behavioural indicators of stress in pet dogs, with social reunion constituting a positive experience.

During the different sequences of the test, dogs were filmed by a thermographic camera set up in the corner of the room, around 6-8 m from where the dogs spent most of their time. Still images in which both ears of the subject were in a position suitable for temperature analysis were extracted manually from the videos and analysed in Matlab using custom-written functions. The reliability of the measures within a sequence and inter-rater reliability were very good.

Dogs showed a significant decrease in ear pinnae temperature when left alone in an unfamiliar room – a stressful situation for most dogs. In contrast, when a person (either the owner or a stranger) was present, temperature of the ear pinnae increased significantly. Ear pinnae temperature thus serves as an indicator of (separation) stress and can be used in the monitoring of separation problems in pet dogs. There was no significant difference between temperature of the left and right ears in any sequence.

To our knowledge, this is the first study to demonstrate that 'long distance' thermographic measurements (6-8 m away from the target animal) yield reliable measurements of physiological stress reactions in animals. The method has several advantages; no restraint is required at any time (c.f. heart rate monitor), data are collected in real time (compared to a slow cortisol response), and there is no need for a person to be present.



MORE THAN A FEELING: AN EMPIRICAL CHALLENGE FOR DESCRIPTIVE, MENTAL-STATE ACCOUNTS OF ANIMAL HAPPINESS

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Many animal welfare scientists appear to hold a hedonistic concept of welfare—that welfare improves the extent to which an individual has more positive experiences and fewer negative ones. Accordingly, a popular (and arguably *the* most popular) view is that measures of welfare should reflect an animal's subjective experience. The substantial advances in assessing animal's subjective experience have enabled us to now reflect on whether such indicators *on their own* capture the welfare state of the animal. To investigate this claim, we presented lay participants (n=515) with one of four randomly assigned conditions: a chimpanzee living a 'natural' life with positive subjective states (NAT-POS), living an 'unnatural' life with positive subjective states (UNAT-POS), living a 'natural' life with negative subjective states (NAT-NEG), or living a 'unatural' life with negative subjective states (UNAT-NEG). Our findings indicated that the participants' welfare judgments depended on the life the animal was living more than they did on how the animal was feeling: for instance NAT-NEG was rated as having better welfare than UNAT-POS. Importantly, we also found that the supposedly more purely psychological concept of happiness was also influenced by normative judgments about the animal's life: NAT-POS was rated as happier than UNAT-POS. These findings cast serious doubts on claims that animal welfare and indeed, happiness are ultimately a matter of subjective feelings. More generally, we also discuss the value of using empirical methods to make progress on conceptual problems in animal welfare and ethics.

BENCHMARKING POSITIVE WELFARE IN COMMONLY-HOUSED ZOO BIRDS

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This research aimed to assess behavioural normality and identify indicators of positive welfare in two types of common zoo bird: flamingos and wildfowl. Activity patterns of free-living wildfowl have been investigated extensively, and time budgets of captive flamingos can also be found in the literature, therefore providing a suitable benchmark for comparison of activity patterns of birds held in zoological collections.

Diurnal activity budgets of a range of captive wildfowl species were measured and compared against published research, to examine how environmental conditions, time of day, species, sex, and enclosure features influence behaviour. Nine species of wildfowl at WWT Slimbridge Wetland Centre were observed over spring/summer 2015 and of 2016 to calculate activity budgets. Similarly, activity budgets of five species of flamingo, held in flocks from over 230 to 21 birds were also measured across the whole duration of the year, and compared against mean values (% time) for state behaviours available in published literature.

Observations occurred during set times of the day in the morning, at midday and then early and late afternoon with activity budgets and enclosure use measured by individual focal following for 15 minutes (for wildfowl) and instantaneous scan sampling of flamingo flocks. Zoning of enclosures based on biologically-relevant areas available to the birds was conducted to assess changes in enclosure usage over time, via a modified Spread of Participation Index.

A meta-analysis of flamingo activity showed there to be similar activities presented across time of day, but with more time spent preening than foraging compared to free-living flamingos. captive wildfowl rested more in the morning, foraged and moved more in early afternoon, and preened more during late afternoon. Enclosure assessment showed birds to favour exhibit zones in line with their ecology, and showed that enclosure usage changed over the course of the day (for both flamingos and wildfowl). Enclosure usage was unequal for all species studied, suggesting that key enclosure zones relevant to performance of important (i.e. high-value) behaviours are well-utilised by the birds. Stereotypic behaviours were not seen in these captive flamingo populations, and occurred for a highly insignificant amount of time for some wildfowl.

Overall, comparative study of captive birds (from direct observation) against free-living birds (using a meta-analysis of published data) can be used to evidence management and enclosure design to provide opportunities for naturalistic behavioural repertoires to be performed.

COULD ANIMAL BEHAVIOUR AND BEHAVIOURAL FLEXIBILITY BE MEASURES OF WELFARE OF ZOO ANIMALS: THE CASE OF A MIXED-SPECIES EXHIBIT OF WATUSI CATTLE IN A SAFARI PARK

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Modern zoological gardens aim at guaranteeing the welfare of the animals thorough environmental enrichment programs and good husbandry practice (e.g.: mix-species exhibit) favouring the performance of species-specific behaviours. Visitor presence is an important variable in zoos and could have positive (enriching), negative (stress) or neutral (no effect) implications for animal welfare and need therefore to be investigated. Animal welfare can be assessed trough the investigations of how animals try to cope with their environment and thus behaviour can be a useful tool in assessing an animal's welfare. This study aims at assessing the welfare of a Watusi cattle herd hosted at Parco Natura Viva in the presence and absence of visitor cars through behavioural observations. These herbivores are hosted in the Safari plain, a large mixed-species exhibit housing different herbivore and bird species. Two 10-min sessions per day per subjects were carried out, one in the morning and one in the afternoon, for a total of 24 sessions per subject. To obtain information about the impact of public presence on the cattle behaviour, each session was divided into two periods, one in the presence (Safari park opened) the other in the absence (Safari park closed) of visitor cars. A continuous focal animal sampling was used. The study cattle showed species-specific behaviours at both the individual and social level and no abnormal behaviours were found, suggesting a good state of welfare. In the presence of visitors, Watusi cattle were more active, show interest toward cars and spend less time in the out of sight condition, suggesting a positive and enriching effect of public on their behaviour. Studies aimed at assessing the state of well-being of animals hosted in zoos are essential in order to improve the management and to monitor health and welfare state of the subjects.

ASSESSMENT OF THE EMOTIONAL STATE OF PIGS REARED ARTIFICIALLY OR BY A SOW

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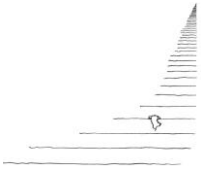
Large litters are a challenge when the number of piglets born alive exceeds the sow's rearing capacity (i.e. no. teats, colostrum and milk yield). Management strategies are needed to optimise survival and growth of super-numerous piglets. One method involves transferring 7 day-old healthy piglets from their mother to a Rescue Deck (RD) and feeding them milk replacer for the remainder of the pre-weaning period. This allows their dam to act as a foster mother for super-numerous piglets from newly farrowed large litters. However, RD piglets' welfare might be compromised by early separation from their mother and a low space allowance. This study aimed to evaluate immediate and longer-term effects of artificial rearing on pigs' emotional state.

Qualitative Behaviour Assessment (Pig Welfare Quality® Protocol) was used to evaluate the emotional state of RD and Control (sow reared, C) piglets. Pigs were directly observed in group by one non-blinded observer pre (21.00 ± 3.14 days) and post (68.74 ± 1.32 days) weaning and during finishing (100.07 ± 1.23 days) in their home pens (n = 11 to 20 pens) for 20 min. The 20 fixed descriptors of the protocol were scored by placing a vertical mark on a 125 mm horizontal valence scale, and scores were computed to obtain the total score.

Principal Component (PC) analysis was performed on the descriptors' scores and suggested that pigs' emotional state could be described through two PC. Groups loading high on PC1 were perceived as more content, enjoying, playful, positively occupied, lively and happy, and less tense than groups loading low. Groups loading high on PC2 were perceived as more active, playful, and agitated, and less relaxed and calm than groups loading low. General Mixed Models compared scores between treatments over time. Pigs' emotional state (total score of the 20 descriptors) did not differ between treatments, but there was an interaction between treatment and time ($P < 0.001$). RD pigs had the lowest total score (*i.e.* poorest emotional state) pre-weaning (43.11 ± 6.48 *vs.* 77.82 ± 6.48; $P < 0.005$) and had the highest total score (*i.e.* best emotional state) post-weaning (60.44 ± 4.83 *vs.* 30.70 ± 5.29; $P < 0.001$) and finishing (71.94 ± 4.97 *vs.* C: 50.48 ± 6.18; $P < 0.01$), compared to C pigs.

These results suggest that while artificial rearing initially has a negative effect on pigs' emotional state, they may cope better emotionally with weaning than sow reared piglets.



INTEGRATING MEASURES OF WELFARE IN THE LABORATORY-HOUSED DOG

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When choosing measures of welfare, it is necessary to choose measures which are valid and therefore meaningful to the animal. While many potential measures of welfare have been identified in the dog, the relationship between measures of behaviour, physical health and cognition are not always clear and it can be difficult to identify the most meaningful measures of welfare. In laboratory-housed animals, understanding the link between welfare and physical health is particularly important to ensure that negative welfare does not adversely affect data output and conversely, to ensure that potential Refinements to the life experience of dogs do not introduce unwanted effects.

Some techniques such as cardiovascular recording, blood sampling or judgement bias testing may provide information about the internal state of the animal, but are invasive or can be difficult to conduct in the laboratory environment. Behavioural data are readily collected but often lack information about physical health or affect.

In this poster, we present data from studies of welfare in populations of laboratory-housed dogs. Our research has demonstrated consistent patterns and relationships amongst a number of measures of welfare. It is necessary to understand the relationships and patterns in welfare measures in order to conduct welfare assessment which is practical and reveals information about the internal state of the animal. We present data investigating relationships between factors such as behaviour, cardiovascular output, judgement bias, clinical pathology and pressure sensitivity and use them to present an integrative picture of laboratory-housed dog welfare.

FROM PAPER TO PRACTICE: COLLABORATION AS IMPETUS FOR IMPLEMENTATION OF THE LATEST ANIMAL WELFARE CONCEPTS

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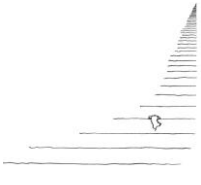
Non-governmental organisations (NGOs) whose mission is to improve animal welfare have a duty of transparency for their methodology and impact. NGOs may, however, encounter difficulties when it comes to integrating recent animal welfare science developments into field interventions. First, the translatability of the most fundamental welfare findings may be challenged when transposed to real-life contexts. Secondly, poor access to scientific information, training and resources can slow the dissemination of updated animal welfare concepts in low-middle-income countries (LMICs). Brooke is a field-based NGO working towards improving the welfare of working equids in LMICs. In line with recent scientific trends, our work is aimed at shifting the culture surrounding welfare assessment from traditional suffering-only assessment methods (i.e., Five Freedoms) towards a more balanced approach (i.e., positive welfare and lifetime experience). We propose that an integrative and collaborative approach involving NGOs, academic and field-based practitioners, optimises the opportunities of development of animal welfare science while simultaneously improving animal welfare in practice. One opportunity has included collaboration with universities to host student research projects and electives. This proved advantagous as it provided experience to students about the context and field experience NGOs operate with, and allowed them to conduct a project whose findings could directly be put into use in practice. Meanwhile for the NGO, existing large historical datasets were utilised, which otherwise would not have occurred due to time and resource constraints. Furthermore, the students' results could be communicated directly with staff working on the programmes (in this case in Ethiopia and Pakistan), who could consider how to implement them to benefit equine welfare. The students and associated academics could also bring their current knowledge of the latest animal welfare concepts to challenge and update those used in NGOs. We believe collaboration is key, for academia and NGOs, for the latest animal welfare science to be implemented into real life welfare improvements, especially in LMICs.



PUBLIC ATTITUDES TO ANIMAL SENTIENCE AND WELFARE

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Animal sentience may be defined as the ability of non-human species to perceive, feel or experience subjective states. This concept is a central component of animal welfare research on the basis that the capacity for suffering necessitates consideration of well-being. Similarly, an individual's belief in animal sentience is thought to influence public views on the ethical use of animals. Previous research has highlighted that species are afforded protection based on perceived phylogenetic levels of sentience. However, there is little evidence amongst the literature of how the public constructs the concept of sentience itself. Improving scientific understanding of attitude formation regarding belief in animal sentience is therefore crucial, particularly in light of recent changes in public consumption of animal products. We investigated attitudes towards animal sentience as a method of understanding moral decision-making in relation to meat consumption and animal welfare. A modified Repertory Grid was used to investigate public perception as part of an online survey in which participant's generated constructs relating to animal sentience. Participants (n = 5433) submitted a total of 26,541 constructs over a 3-month period. Analysis showed variation between demographic groups in their perceptions of characteristics required for sentience as well as characteristics subsequent allocation to differing species. The prominence of some characteristics (e.g. pain and emotion) indicates a widespread belief in the capacity for suffering across species boundaries, contrasting with industry/scientific standards, which are largely mammal-centric. Across demographics, intelligence was commonly designated as unimportant for animal welfare despite being one of the most frequently submitted constructs. This suggests that while clearly associated with increasing levels of sentience, intelligence may be considered of minor relevance to animal welfare decision-making processes among the public in comparison to other constructs such as pain or emotions. This study represents an important advance in our understanding of public attitudes to animal sentience and welfare, which is essential for future progress in ensuring the ethical use of non-human species within society.

HOW DO WE MEASURE THE EFFECTIVENESS OF ENVIRONMENTAL ENRICHMENT FOR ZOO CHIMPANZEES' WELFARE?

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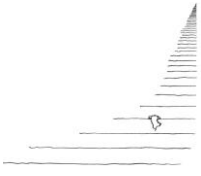
The environmental enrichment is widespread among modern zoos and appears to be useful to encourage the performance of species-specific behaviours and to promote animal physical and psychological welfare. Hand reared chimpanzees are used to exhibit behavioural and social deficiencies. This study aims to evaluate whether a manipulative enrichment program could improve chimpanzee's well-being and reduce abnormal behaviours where present. Subjects of the study were 11 chimpanzees (*Pan troglodytes*), 6 hand reared and 5 parent reared. The research was made of 2 different periods: during the first period (baseline) chimpanzees were in their usual environment with a food related environmental enrichment program, whereas in the second period subjects were provided with an enrichment program to which manipulative enrichment devices were added. For each period, twenty-two 10-min sessions per subject were done, during 2 daily sessions. Data about individual and social behaviours were collected; the statistical analysis was done using nonparametric statistic tests ($p < 0.05$). All subjects performed individual and social species-specific behaviours; however, 4 of 6 hand-reared chimpanzees showed occasionally abnormal behaviours (rocking and apathy). In the second period, active normal behaviours were performed significantly more than during the baseline. In particular, playing was shown more during the second period than in the baseline. Results from the individual level analysis revealed that the environmental enrichment program provided in the second period reduced the performance of abnormal behaviours in chimpanzees raised by humans; indeed, only two hand reared chimpanzees performed abnormal behaviours in this period. Results suggest a positive effect of the manipulative environmental enrichment on the behaviour and welfare of captive chimpanzees by promoting the performance of species-specific behaviour in all the subjects and a reduction in abnormal behaviours of the hand-reared individuals.



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 (± SEM) over daylight hours on the first day of captivity was 36.78 (± 1.10) and 86.25% (± 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 ±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.

COLLABORATIVE DEVELOPMENT OF POSITIVE WELFARE INDICATORS WITH DAIRY CATTLE AND SHEEP FARMERS

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The Five Freedoms have advanced welfare by focusing attention on reducing harm and safeguarding the basic needs of farm animals. However, both reducing negative welfare and promoting positive welfare are necessary for improving quality of life. A framework was proposed (FAWC, 2009) to promote five opportunities of comfort, pleasure, interest, confidence and a healthy life that are required for a good life. A number of on farm assessments of positive welfare have been developed, from grading resources provided to animals which promote positive behaviour opportunities), measuring pleasurable behaviours such as play directly, to direct observations of body language and emotion, but these approaches have yet to be adopted as part of industry practice.

Since society values animals' quality of life, promoting positive welfare can lead to a marketable advantage for farmers. Policy initiatives including education programmes, incentive systems, certification schemes and legislation are all potential vehicles through which positive welfare should be advocated. Furthermore, rewarding positive welfare can motivate farmers' more than just penalising negative welfare, since this enriches farmer satisfaction and wellbeing.

Taking a participatory approach, this project is working with groups of dairy cattle farmers and individual sheep farmers to develop positive welfare indicators to take forward for on farm trial and use. A review of the positive welfare science has been completed to validate the ideas generated by the farmers. Before the on-farm trial phase, agreement with industry stakeholders will be sought on the applicability, end use and monitoring mechanisms for the indicators. The project will then work with the farmer and industry stakeholders to trial validity, reliability and practicality of the indicators. To facilitate uptake within industry, the outcomes will be disseminated at a stakeholder policy forum.

ARE POSITIVE EMOTIONS RELIABLE INDICATORS OF WELFARE IN HORSES?

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Assessing horse welfare is a crucial issue for obvious ethical reasons but also because it has been shown to have an impact on reproductive and cognitive abilities. Welfare also affects the relationship of horses with humans both at work and outside work; it enhances security for people and thus it constitutes a social issue too. Studies combining behavioural, postural, physiological and sanitary data suggest that it is possible to identify and validate indicators of altered welfare but also of well-being, that is, of a positive affective state. Although it has been proposed that positive affective states could arise from the sum of positive emotions experienced daily, the link between these short term experiences and the chronic state that characterizes the welfare state is not clear yet. Indeed, emotions are short-lived affective reactions and not necessary depict the chronic state of the animal. Moreover, identifying expressions of positive emotions remains more difficult than identifying those of negative emotions, while discriminating valence (positive/negative) from intensity (high/low) when measuring emotions is both necessary and delicate. For example, adult play or anticipatory behaviours are both of high intensity but may not have the same valence if one considers the short term or the chronic affective state. Lastly, low intensity indicators of positive emotions emerge and might be better candidates for revealing a "well-being" state. The aim of this review is to propose a critical view of measuring short experienced positive emotions, evaluating their interest for welfare assessment and present novel perspectives of investigation through behavioural and electrophysiological recordings.

FISHETHOSCORE - ASSESSMENT OF FISH SPECIES' POTENTIAL FOR WELFARE IN FARMING

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The project for a global online fish ethology database (FishEthoBase) started in 2013 with the idea of establishing all-embracing ethological profiles of fish species frequently farmed, researching for all ethological findings available (from wildlife, lab, and aquaculture) and depicting a detailed ethological profile of a species by summarising the findings, indicating research gaps and providing recommendations for the field (cf. poster in UFAW conference 2016).

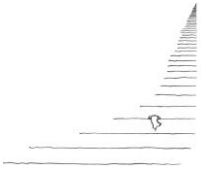
Given the about 450 species already farmed globally and the protracted creation of such full profiles, we developed an additional short profile approach with a reduced set of criteria in order to produce in less time a science-based "FishEthoScore" of as much species as possible, thus indicating the species' welfare state under conventional farming conditions, the potential to improve welfare under best existing or contrivable farming conditions, and the certainty of our findings.

The 10 criteria we are focusing on to date confront the usual farming conditions of a species with its home range (horizontal and vertical) and migration behaviour, its reproductive and social behaviour, its aggressiveness, its need for habitat enrichment, its copying strategy, its proneness to malformations, and its suitability to humane slaughter.

With the FishEthoScore we pursue 4 objectives: to help new farming projects in deciding which species to grow, to indicate major welfare problems and possible relief to ongoing farms, to inspire the industry to concentrate its efforts on the most farmable species, and to call the attention of scientists to research gaps. In parallel, further full profiles will be developed for the species with highest demand of more detailed information.

A first synopsis on the short profiles under way suggests that some problems occur throughout most of the species: confinement vs. natural home range, unstructured habitat vs. need of substrate and/or shelter, stress and injuries due to husbandry system, and handling vs. coping abilities. A general trait is the lack of reliable protocols for humane slaughter as well as for the avoidance of feed components based on fisheries, thus extending aquaculture driven fish welfare problems to wild fish stocks.

Before end of June 2017, about 24 short profiles will be online: *fishethobase.fair-fish.net*, including Salmoniformes, Cypriniformes, Perciformes, Acipenseriformes, Pleuronectiformes, etc., based on which we will present a broader synopsis on the major problems of several groups of species and an insight into the interdependences of welfare criteria.



LEAVING NO STONE UNTURNED: ASSESSING THE WELFARE OF CALVES REARED ON STONES

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In New Zealand some farmers are using stones as a rearing substrate for young calves instead of sawdust, which is otherwise commonly used. The rationale for rearing calves on stones is for economic reasons and perceived health benefits. However, this practice has raised some public concern about rearing calves on stones. Therefore, the welfare of calves reared on stones was assessed in a series of experiments incorporating measures of biological functioning, positive affective state and animal preference. Skin temperature was on average 1.3°C lower for calves reared on stones compared to sawdust but body weight, cleanliness and indicators of health (eg. immunoglobulin-G, creatine kinase and serum amyloid-A concentrations) and stress (eg. cortisol concentrations) were not affected by rearing substrate. On average over the first 6 weeks of life, calves reared on stones spent 3% less time lying and 0.08% less time performing locomotor play (over 24 h) in the pens where they were reared. In addition, calves reared on stones performed less vigorous play behaviour; there were fewer head shakes, jumps, kicks and leaps compared with calves reared on sawdust. When released into an arena away from the home pen, a greater rebound effect of play behaviour was observed in calves reared on stones who spent more time playing (running, bucking and kicking) compared to animals reared on sawdust. These results suggest that calves reared on sawdust are more comfortable and in a more positive affective state than calves reared on stones. There was no evidence of any health benefits of rearing calves on stones. When calves were given free access to different rearing substrates (sawdust, rubber chip, sand and stones) they showed a clear preference for the sawdust over the stones (76.6±0.90% vs. 0.5±0.90% time lying respectively, mean ± S.E.M.) and stones were ranked as the least preferred substrate for lying. The overall findings from these studies suggest reduced welfare of calves reared on stones; they were colder, spent less time lying, played less, and showed a greater rebound effect of play when tested in an arena test. We also speculate that, irrespective of the scientific evidence from these studies, this practice will never gain social licence or acceptability in many countries due to the negative perception of rearing young animals on stones.

BEHAVIORAL RESPONSES OF SHEEP SUBMITTED TO HUMAN PRESENCE AND BRUSHING

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Positive emotional states have been recently studied in farm animals. We investigated the perception of thirty-eight Romane ewes submitted to the presence of a familiar observer (H) and brushing by a familiar observer (B). Sheep belonged to two genetic lines, more (R+) and less (R-) reactive to temporary social separation. Body postures, head orientation, ear changes and postures, eye aperture, tail moves and ingestion were assessed. Data were analyzed using generalized linear models, considering generalized estimating equations and potential intra-animal correlation. The effects of treatment, genetic line and phase (2.5 min pre-, 3.0 min during and 2.5 min post-treatment) were included in the models, in addition to their interactions. Significant treatment and phase interactions were observed for most indicators ($P<0.05$). It was noted that H ewes tended to show less body posture changes in the pre-treatment phase (0.50±0.23) than B ewes (2.06±0.78), whereas during the treatment, the opposite was observed ($P<0.05$). During the treatment, H ewes showed higher number of head orientation changes (14.08±2.32) than B sheep (2.71±1.28) ($P<0.01$), suggesting that B sheep were more relaxed during brushing. In addition, for R+ ewes, H sheep showed more head orientation changes (16.25±2.44) than B sheep (7.07±1.31) ($P<0.01$). During the treatment, a higher number of ear changes was found for the H group ($P<0.01$), and R+ ewes showed higher number of ear changes (10.83±1.06) than R- ewes (7.68±0.87) ($P<0.05$). Higher proportion of raised up or asymmetrical ear posture was noted pre- (0.73±0.05) than during the treatments (0.53±0.06), in which the horizontal ear was performed for longer ($P<0.05$). Among R+ sheep, H sheep showed raised up or asymmetrical ear postures for longer (0.63±0.06) than B sheep (0.45±0.05) ($P<0.05$). It was also found that H ewes had lower proportion of closed or half-closed eyes (0.15±0.04) than B ewes during brushing (0.53±0.06) ($P<0.01$), supporting the fact that brushed sheep experienced a relaxing state. In addition, overall, R+ sheep showed closed or half-closed eyes for longer (0.25±0.04) in comparison with R- sheep (0.13±0.03) ($P<0.01$). Brushed ewes also wagged their tails for longer that non-brushed sheep mainly during (B: 0.16±0.05; H: 0.01±0.003) and after the treatments (0.02±0.009; 0.007±0.002) ($P<0.01$). Among R+ sheep, B ewes spent more time ruminating (0.48±0.08) than H ewes (0.12±0.06) ($P<0.01$). All the behavioral indicators strongly suggest that both treatments induced a relaxing state in sheep, especially during brushing. Comparing more and less reactive sheep provided significant differences which warrant further studies.

INFLUENCE OF HUSBANDRY AND ENCLOSURE DESIGN ON THE WELFARE OF CAPTIVE GIRAFFES

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The importance of maintaining good animal welfare in zoos is paramount, and is normally addressed by adhering to official husbandry guidelines. However, there are very few scientific comparisons between zoos to confirm best practice. Collecting data from multiple institutions allows for relationships to be found between different aspects of care and welfare indicators, such as enclosure design and reproductive success.

At CIRCLE, we have developed a model for assessing the influences of husbandry techniques on zoo animal welfare. This model has been applied to Humboldt penguins, flamingos and scimitar-horned oryx, and is now being applied to giraffes. We are using a questionnaire survey directed at all European zoos with giraffes. The aim is to gather data on their husbandry methods, enclosure design, nutrition, breeding, health and veterinary care. Captive giraffes often have problems relating to overgrown hooves due to a lack of abrasive substrate and movement, more so than many other ungulates, due to the dangers associated with anaesthetising such a large animal. Behavioural abnormalities stemming from a lack of browse or similar stimulation, such as wall licking and excessive grazing, are also common in zoo giraffes.

From our preliminary data, we have found relationships between aspects of giraffe care and their welfare, especially relating to hoof care and stereotypies. Once complete, to the data will be used to make husbandry recommendations for the care of captive giraffes to improve their mental and physical welfare, and their breeding success.

THERMOGRAPHY REVEALS EMOTIONAL AROUSAL IN RATS ENCOUNTERING HIGHLY PREFERRED FOOD

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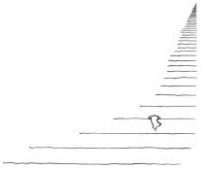
Thermography is increasingly used in studies on animal emotions. To gain information on physiological processes linked to emotions, an infrared camera can be used to measure subtle changes in skin and eye temperatures that correlate with changes in blood flow and muscle activity. Most thermographic studies on animal emotions have focused on detecting a temperature decrease in the nose and eyes, which indicates vasoconstriction caused by sympathetic activity during emotional arousal. Development of further thermographic methods to measure animal emotions will require identifying indicators for other physiological processes during emotional arousal as well, as they may be linked to partly different emotional experiences.

The aim of this study was to test a potential indicator for which there is evidence from human studies: temperature increase on the forehead. It is thought to be caused by a rise in core body temperature due to increased thermogenesis ("emotional fever") and by increased blood flow to periorbital muscles. Another aim was to contribute to practical design of thermographic experiments for freely moving animals.

We tested whether exposing rats to highly preferred food would elicit a measurable rise in their forehead temperature. The animals were six outbred female rats, living in a large enriched communal cage, fed *ad libitum*. Each rat was tested separately, moving freely while it was presented alternatingly with ordinary food (whole grains) or highly preferred food (salmon paté). Three repetitions per rat were carried out for each type of food, counterbalanced for the order of presentation. During the first 60 seconds of eating, the facial temperature was recorded with a FLIR T620 thermal video camera. Data were collected from the thermal videos at 5-second intervals (+- 2.5 s) from the forehead and from a standard reference point on the nose bridge.

During the first 30 seconds, exposure to preferred food elicited a significantly higher forehead temperature than exposure to ordinary food: the mean differences from the reference point were 3.0°C (SEM 0.2) vs. 2.6°C (SEM 0.2), respectively (F=8.4, p<0.01, linear mixed-effects model). From 35 seconds onwards the difference was no longer significant. This change may reflect a transition from an appetitive to a consummative phase of pleasure; the former is more plausible to elicit arousal.

In conclusion, our results suggest forehead temperature is a promising indicator for emotional arousal in rats. The experimental setup proved to be successful and contributes to the practical design of thermographic experiments for fast-moving unrestrained animals.



AN ENCLOSURE DESIGN TOOL TO ENABLE ZOOS TO CREATE INTEGRATED, WILD-TYPE ENCLOSURES FOR GREAT APES

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Holding a species for survival in modern zoos must go beyond simply preserving animals for their genetic material to conserving the whole organism - the behavioural traits and physical adaptations that are a vital part of what defines each species and determines their ability to survive in the natural environment. Great apes are, however, some of the most difficult species to keep successfully in captivity due to their large size, enhanced intelligence and the problems of replicating structurally and mechanically complex arboreal environments in captive conditions. Zoos need to be empowered with effective tools to ensure healthy, wild-type captive populations within a range of budgets.

We are creating an Enclosure Design Tool (EDT) that will enable zoos to develop independently effective strategies to ensure captive great apes are able and motivated to express and maintain wild-type behaviours. We are currently working with chimpanzees but will expand the EDT to all great apes over the next 5 years. The web-based tool will allow zoos to automatically compare the behaviour of their chimpanzees to wild chimpanzees, and it will then make zoo-specific recommendations about how to modify the enclosure to elicit wild-type behavioural profiles. The EDT will give zoos: 1) easy functional access to latest research data on wild chimps (and other apes); 2) an evidence-based method to measure the effectiveness of habitat changes and 3) an approach to enclosure design based on the mechanical behaviour of forest canopy and the physical and cognitive challenges it poses to wild chimpanzees.

In this presentation we will show how the tool works and discuss some of the problems we have encountered with defining wild-type behavioural repertoires. We welcome feedback from zoos on how we can improve the EDT and match it to zoo requirements.

ANIMAL WELFARE RISK ASSESSMENT OF THE FOOD SUPPLY CHAIN

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Animal welfare can be at stake in various stages of the animal production process. Legislation is an important tool to set rules for acceptable standards of animal welfare. The Netherlands Food and Consumer Product Safety Authority (NVWA) enforces the Dutch and European law, also for animal welfare aspects. In order to better focus its activities, the NVWA recently initiated a risk-based and knowledge-driven enforcement strategy by assessing whole supply chains of (food) products, from farm-to-fork. This way major risks are to be identified and follow-up actions for inspection can be made more effective and efficient.

The currently addressed supply chains are red meat, poultry meat, eggs, and dairy. With regard to animal welfare, animals may face challenges on farm, during transport and at the slaughter plant. It is generally known that many welfare issues exist ranging from tail biting in pigs on farm to hyperthermia in poultry pre-slaughter. Many of the standards in legislation on animal welfare are open and many exceptions exist. This makes enforcement occasionally difficult when aiming to reduce animal welfare issues. Moreover, preventing one risk may induce another risk, e.g. the number of foot pad lesions in poultry can be reduced by reducing water provision to prevent wet litter, but simultaneously may lead to excessive thirst. This implies that all animal welfare issues in the same or different parts of the chain need to be compared first, before making informed decisions which to tackle. Therefore, impact and prevalence are estimated for each identified welfare issue. We identified knowledge gaps due to a lack of a) scientific and practical knowledge, b) validated animal based welfare indicators, and c) systematic registration of animal welfare issues and compliance levels.

The (semi) quantitative risk assessment approach not only results in advice for the enforcement authorities and policy on the most relevant welfare issues, but also aims to develop scientifically validated animal-based welfare indicators that are non-invasive and cost-effective. These should furthermore allow for systematic registration of data that provides the desired information leading to proper animal welfare assessments in practical situations.

To conclude, successfully implementing the proposed enforcement strategy to assess animal welfare risks is highly dependent on usage of correct animal-based welfare indicators. Nonetheless, this knowledge-based risk approach holds great promise for a more effective inspection and risk-focused animal welfare improvements from farm-to-fork. Additionally, it has potential to jointly rank animal welfare and food safety risks.

NEW TECHNOLOGY CAN HELP ASSESS STRESS LEVELS OF ANIMALS

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When working with living animals, it is common knowledge that any action from simple observation to handling in order to perform body measurements, for instance, can have an impact on them. The impact can range from higher vigilance when being approached by humans to severe increase in stress levels when the animals cannot escape and are captured/handled.

In order to minimise these effects, we need to better understand how they occur and the factors that can modulate their intensity. One good example of the refinement such investigation can bring is probably one study which showed that rodents were more stressed being handled by men than by women. However, this study involved rather invasive and even lethal methods (euthanasia) to study stress response. We believe that new technology can help study stress with less of an impact. Indeed, since new technology can tell us about the physiological state of animals, it can also inform us about their stress level. Amongst the parameters which can be recorded using data-logging devices (e.g. heart rate loggers, accelerometers...) and ultimately help assess stress level are; budget activities, heart rate, posture, movement (including micro-movement) and energy expenditure.

With such data, however, remains the problem of where to set the threshold of unacceptable stress. In other words, how the collected data translate in reality for the animals. We tried a theoretical, though, powerful approach based on modelisation as to be able to convert collected data into something more meaningful. During one of our studies, we measured the energy expenditure of cormorants in captivity using recording devices (accelerometers) and could ultimately model the consequences it would have for wild cormorants in terms of swimming and therefore feeding efficiency. This study also highlighted the importance of time factor.

CANINE WELFARE MONITORING: EVALUATING NOCTURNAL ACTIVITY AS AN INDICATOR OF ADAPTABILITY OF DOGS TO A SHELTER ENVIRONMENT

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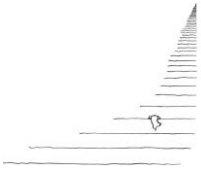
After relinquishment, shelter dogs are faced with the challenge to adapt to a new environment. To monitor this adaptability process, physiological and behavioural parameters need to be developed and validated as useful and practical indicators of adaptability of individual dogs.

Therefore, we evaluated nocturnal activity (measured by an accelerometer), resting behaviour, urinary cortisol/creatinine ratio (UCCR), weight, and stress-related behaviour in 34 shelter dogs (n_s). Measurements were taken on three moments: the first night and morning after intake at the shelter (P1, n_s=34), after a two-week acclimatisation period in the shelter (P2, n_s=32) and post-adoption (P3, n_s=19). A control group of pet dogs at home (n_c), matched to the characteristics of the shelter dog group, was also assessed for nocturnal activity and UCCR. Mixed models were used to analyse the influence of measurement moments and characteristics of the dogs on the measured variables.

Results show that shelter dogs had a higher total nocturnal activity at P1 than P2 (P=0.003) and had a higher nocturnal activity than pet dogs at home (P<0.01). Considering observed resting behaviour during the night, dogs spend a larger percent of time 'recumbent with head down' and moved less in P2 compared to P1 (P=0.01 and P<0.05, n_s=5). In line with former studies, UCCRs were found to be higher at P1 than at P2 and P3 in shelter dogs (P<0.005). UCCRs were higher in dogs in the shelter than in the matched control dogs both at P1 and P2 (P<0.001, n_c=23), but there was no difference between P3 and control dog UCCRs. Shelter dogs lost weight from P1 to P2 (P<0.001, n_s=34). So far, no significant difference in stress-related behaviour has been found between P1 and P2.

These findings suggest that nocturnal activity may be a useful new parameter to monitor canine adaptability to a shelter environment.



ANSWERS TO QUESTIONS CONCERNING THE SCIENTIFIC STUDY OF ANIMAL WELFARE AND SUFFERING

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"Will we ever be able to demonstrate sentience?" No, the founders of ethology (behaviour biology) had good reasons to exclude feelings:

1) As causation. When we assume that something is caused by a feeling no further research is possible. In a similar way as when we in physics assume that something is caused by God no further research is possible. The use of feelings as causations could therefore damage the study of causation. That feelings emerged during the evolution does not imply that they have a function. Also the white colour of bones has emerged during the evolution, nevertheless this colour has no function. Bones are white because chalk is white. Because bones are invisible in nature there is no reason to evolve coloured bones. This would only be costly and, therefore, decrease fitness. Perhaps animals have feelings because this is an inevitable consequence of being an animal.

2) As object of study. Feelings are less exact than behaviour. Behaviour can be observed by the senses of more than one researcher. This makes it, in principle, possible to repeat the observations. Animal feelings can not be observed by the senses of any researcher. Tools that help us to observe behaviour are extensions of our senses. There exist no tools that help us to observe feelings.

We have to recognise that within the *Naturwissenschaften* it is principally impossible to prove the existence of animal feelings. That feelings are excluded as causation and object of study does not imply that feelings do not exist, in a similar way as that the exclusion of God as causation or object of study from physics does not imply that God does not exist.

"Are there new techniques that could help..?" Not in demonstrating sentience. However, research within the *Naturwissenschaften* is able to make the idea that feelings exist more convincing by showing relevant similarities between our body and behaviour and those of animals. Which similarities are relevant we may find by establishing the relations between our body, behaviour and feelings. New techniques could be helpful in this approach.

"Where should we draw the line between animals with and without sentience?" In the end this remains a matter of personal taste.

Kennedy (1992) wrote "...van Rooijen sensed that what scientists are sitting on here in fact are the horns of a dilemma." and "This would seem to be a realistic position to adopt."

Reference:
Kennedy, J.S. (1992) The New Anthropomorphism. Cambridge University Press, p. 114-115).

A UTILITARIAN FRAMEWORK FOR CATEGORIZING AND ASSESSING WELFARE IMPROVEMENT STRATEGIES

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Advocates of welfare-improving reforms ask a variety of strategic questions: Is there general public support for such a reform? Can we get legislators' support? Is there an influential professional society that will partner with us? Is it too early in the evolution of societal attitudes to achieve? And so on. I present a framework for categorizing and assessing proposals that reflects this variety of questions by making two sets of distinctions.

The first is among four types of rules that are found within what I call our "intuitive level system of rules"—"ILS rules" for short. These are: (1) laws, (2) codes of professional ethics, (3) the shared "common morality" of a culture, and (4) a kind of "personal morality" that some individuals adopt in opposition to their culture's common morality.

In this poster, I introduce the resulting framework, and I illustrate its application by contrasting changes in laws and codes of professional ethics, on the one hand, and changes in common morality on the other. Laws and codes of professional ethics normally have canonical written versions and formal procedures for amendment. Our shared common morality, by contrast, has neither any canonical written version nor any formal procedure for amendment. How and why the norms of common morality change is unclear, but changes in common morality have the potential to be faster and more sweeping than changes in laws and codes of professional ethics. What reformist strategy to adopt is thus an important, but difficult pragmatic decision.

EXAMINING THE ANIMAL – THE STARTING POINT OF WELFARE ASSESSMENT

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Animal welfare assessments are most commonly carried out by three groups of people; owners, personnel from investigating bodies e.g. RSPCA inspectors, and veterinary surgeons. Based on and illustrated by experience of hundreds of animal welfare cases prosecuted in the UK, the author discusses the aims and limitation of these very different ways of examining animals.

The routine examination by a veterinary surgeon are then considered in depth to consider

1. Whether the veterinary clinical examination assesses animal welfare at all!
2. The difference between clinical and forensic veterinary examinations
3. How much attention vets pay to animal behaviour during their various examination, and how this might be improved.

Experience suggests that vets are more concerned with putting a name to a diagnosis rather then dealing with the overall effect of any problems on the animal's welfare. An example would be that a vet may be more concerned with finding a flea on a dog or cat than they are with the degree of adverse effect that flea might have been causing.

BEHAVIOURAL DEVELOPMENT AND PLAY IN ELEPHANT CALVES

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Asian *(Elephas maximus*) and African (*Loxodonta africana*) elephants in the wild are currently assessed as endangered and vulnerable, respectively (IUCN Red List). Management of *ex-situ* elephants aims for coordinated captive breeding to produce a sustainable population of elephants, and to educate the public about conservation issues.

Our understanding of early elephant development is limited, and, in particular, we lack studies on normal social development of wild Asian elephant calves. Given recognised problems of sustaining captive elephant populations into the future, with problems of welfare and wellbeing, we urgently need to understand the welfare status of calves in captive facilities.

Behaviour and pattern processes of development in captive elephant calves from birth to weaning, were compared with a baseline derived from wild calves. Wild elephants offer a reference for normal development representing "optimal" calves in a complex social context and give captive facilities a best welfare practice goal to work towards.

Although it appears that young calves raised by their mothers in captivity have similar activity budgets to those seen in wild calves, only two of the 14 main captive study calves are both alive and not orphaned. Captive calves were more independent than wild calves in terms of their proximity to mother and were found to spent much more time in play. We explore the limits of play as a useful welfare indicator in captivity, especially in relation to activity budgets.

The benefits that a calf brings, such as developing normative multi-generational matrilineal groups and enabling positive social bonding stimuli from calf presence, need to be balanced against ensuring adequate space for families to grow, as well as ensuring captive bred males are cared for. Facilities have an obligation to ensure that these conditions are neither damaging nor detrimental over the very longest term for the animals under their care. This research addresses gaps in our understanding of early elephant development and provides suggestions to underpin welfare improvements.

Physical development, mother-calf bonding and the establishment of motor and social skills are thus all essential for normal calf development and these are assessed for calves in captivity. Captive African and Asian elephant calves were studied in three UK zoos; wild Asian elephants in Uda Walawe National Park, Sri Lanka; and we have access to existing datasets of wild African calves from Amboseli, Kenya.

THE VALUE OF PAW PREFERENCE AS A MEASURE OF CANINE WELFARE

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Motor bias has the potential to be used as an applied tool for assessing vulnerability to stress and welfare risk in animals. Establishing an individual's susceptibility to emotional dysfunction using this tool, however, is very dependent upon finding an appropriate method of categorising an animal correctly as ambilateral, left- or right-limbed. This study explored dogs' paw preferences using a number of measures to determine whether the animals' performance was consistent or varied between tasks.

Paw preference was assessed using 4 measures commonly used to record motor bias in dogs, namely, the 'Kong' test (in which the animal has to use its paw/s to stabilise a food-filled ball), the 'tape' test (in which the dog has to use its paw to remove tape from its nose), the 'lift paw' test (in which the dog has to give its paw upon request) and the 'first step' test (in which the dog has to walk down a number of stairs). Thirty pet dogs undertook each task. Animals were classified as ambilateral, left- or right-paw preferent on the basis of their performance on each task.

The distribution of the dogs' paw preferences was not significantly different from that expected by chance alone for the 'Kong', 'lift paw' or 'first step' tests ($P>0.05$ for all chi-squared tests). However, dogs were significantly more likely to be ambilateral on the 'tape test' than to employ their left or right paw ($\chi^2=12.68$, $df=2$, $p=0.002$). The strength ($F[3,87]=7.06$, $p=<0.001$), but not the direction ($F[3,87]=0.13$, $p=0.94$), of the dogs' paw use differed significantly across the 4 tests. Dogs' paw preferences were significantly ($p<0.05$) stronger on the 'lift paw', than any of the other tests. Analysis revealed no significant correlation in the strength or direction of the dogs' paw preferences between the various tests of motor bias.

The findings from this study suggest that lateralised behaviour in the domestic dog is task dependent and raise questions as to the value of using certain measures of motor bias as an indicator of cerebral asymmetry in this species. Different tests of motor bias yielded different paw preferences in the same individual; this begs the question as to which one, if indeed any, is a true reflection of brain asymmetry. Further work needs to explore the relationship between different measures of paw preference and cerebral asymmetry to determine which can be used a reliable indicator of emotional well-being and vulnerability to stress in quadrupedal animals such as the dog.

THE ONGOING HORSEMEAT SCANDAL

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Despite the fact that every year hundreds of thousands of horses are slaughtered in EU-approved slaughterhouses, horses are often not recognised as a meat-producing species. In fact, their legislative designation varies throughout the EU (and in third countries); whilst in some Member States horses are considered to be livestock, in others they are considered to be pets.

This is because, unlike the majority of animal species slaughtered for human consumption, relatively few horses are bred specifically for meat. Most horses are used for work, leisure or competition purposes and, as such, horses commonly arrive at a slaughterhouse simply because they are no longer 'productive' due to injury, ill-health or behavioural issues, or because there is no market for them. Consequently, slaughter horses form an extremely heterogeneous group. Individuals differ physically, behaviourally and experientially and this can present unique welfare challenges. Furthermore, in many countries there still exists a taboo around slaughtering horses, which can hamper objective discussions on welfare and plays a part in pushing the trade behind closed doors.

Significant flaws in the equine identification system within the EU, coupled with lifetime exclusion of horses from the food chain following administration of certain medications (due to a lack of research on minimum residue levels), have helped to create a trade where fraud is rife, welfare problems are commonplace and enforcement agencies are too busy dealing with documentary issues to focus on welfare.

Legislation governing welfare during the slaughter process is based primarily on research concerning the main meat species and rarely considers the unique requirements of horses, for which peer-reviewed research is minimal. Although there is now a welcome body of literature highlighting the adverse effects of long-distance transport on horses destined for slaughter, very few studies have looked at the processes prior to and after the journey to slaughter.

This dearth of objective research may be due to the relatively low number of horses slaughtered in comparison to the main meat species, the heterogeneous population and associated difficulties in producing controlled study designs, or the taboo on horse slaughter. Whatever the reason, there are clear gaps in our scientific knowledge both of the welfare effects of this process on horses and, most importantly, of the practical means to ensure high welfare throughout the process regardless of the horse's age, size or background.

ASSESSING ACUTE AND POST-OPERATIVE WELFARE IN REPTILES: CASE STUDIES IN SNAKES AND TERRAPINS

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Reptiles are increasingly kept as pets, form part of zoological collections and are extensively used in physiological research, mandating that their welfare is upheld, including in the peri-surgical period. Information on optimising anaesthetic and analgesic protocols, however, has not kept pace with that in other taxa. Reptiles have diverse physiology which must be addressed, and their sometimes cryptic behavioural repertoire has limited integration with physiological parameters in assessing their welfare. Our aim is to combine these methods to provide insight into the impact of analgesic and anaesthetic interventions in two groups: the snakes, represented by the common pet *Python regius*, and in species used in physiological research - the South American rattlesnake *Crotalus durissus*, and yellow-bellied terrapin, *Trachemys scripta scripta*.

Pythons were examined via video recording over a 10-minute period after infusion of saline or capsaicin (a chemical nociceptive stimulus) delivered via a subcutaneous catheter. The efficacy of opiate analgesics (morphine and butorphanol at 2-10 $mg.kg^{-1}$) at ameliorating the effect of capsaicin were assessed, both using behaviour and instantaneous heart rate, measured via electrocardiogram. Feeding behaviour was also assessed over 4 weeks following anaesthesia with or without a nociceptive stimulus. The effect of morphine versus a saline control on blood gases, heart rate, blood pressure and plasma corticosterone concentration over the peri and post-operative (48h) period was assessed in *Crotalus durissus*. This followed the surgical placement under isoflurane anaesthesia with bupivacaine local anaesthesia (2 $mg.kg^{-1}$) of a catheter in the vertebral artery for blood sampling. In these two cases morphine was found to cause pharmacological effects in snakes (relative tachycardia, and bradypnea), without evidence of anti-nociception (no significant reduction in movement or heart rate change after capsaicin installation or corticosterone concentration post-surgically), leading to further questions about the role of opiates in snakes, and requiring further study, while long term feeding behaviour was correlated with prior experience of a nociceptive stimulus.

Anaesthetic intervention using atropine (1 $mg.kg^{-1}$) was assessed in *Trachemys*: we hypothesised that it could hasten recovery from gas anaesthesia via changing cardiac shunting patterns during isoflurane elimination. We quantify atropine's effect on post-surgical parameters, as well as the main effect of intracoelomic surgery under an anaesthetic regimen of isoflurane and analgesia (lidocaine, prilocaine and meloxicam) on post-operative movement, blood flow patterns, pressure and heart rate. We also investigate whether post-operative catecholamine concentrations are reflected in the blood glucose, lactate, behaviour and cardiovascular changes more amenable to clinical use.

USING AUTOMATED VIDEO ANALYSIS TO MONITOR SOCIAL RELATIONSHIPS IN GROUP-HOUSED MACAQUES

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Behavioural monitoring of captive macaques is a useful tool for monitoring their welfare. Macaques are bred for research at centres around the world and used for biomedical and behavioural research. Of particular concern for welfare in captive rhesus macaques is the high level of aggression seen in some groups. Macaques are by their nature an aggressive species with a strict dominance hierarchy yet levels of injury vary widely between groups (even those housed under identical conditions). Behavioural monitoring can help reduce fight injuries partly through allowing colony managers and care-staff to understand the dynamics of each group.

Behaviour monitoring by care staff is time consuming and most institutions do not have the resources to do this on a regular basis. We have focussed on developing an automated video analysis system to monitor rhesus macaque behaviour. Our initial aim was to identify individuals in group-housed macaques with a high level of success. We are now able to identify individuals with a success rate of 95% using face recognition techniques.

This project combines face recognition and tracking with social network analysis with the aim of providing care staff and colony managers with information on the social structure of a group including the dominance hierarchy and "friendships". Cameras were set up on 6 different breeding groups of rhesus macaques (each group containing 1 male, 4-8 females and up to 8 juveniles) and recorded high definition videos. These videos were analysed offline in Matlab at a rate of 5fps. For the preferred partners two monkeys were considered in proximity if they both were identified in 3 frames within a 15 second window. This was repeated for at least four days and used to construct an association matrix. The videos were also scored manually for proximity and the association matrices from the manual and automated scoring methods compared (Mantel Test; significant correlation; $P<0.05$). From the association matrix we can identify monkeys that spend significantly more time together than by chance.

Understanding these social relationships can help colony managers and care-staff make better informed decisions about how to add or remove monkeys from a group or form new groups. This should lead to a decrease in fight injuries and an improvement in welfare.

THE INFLUENCE OF RATER TRAINING ON RELIABILITY WHEN USING THE RAT GRIMACE SCALE

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Animal facial expression ("grimace") scales have been developed for use in diverse species, including rodents, as a means of identifying the presence of pain and response to analgesics. Reported training in the use of these scales varies greatly, from self-directed learning with training manuals, to structured discussion with an experienced rater. Variation in training may contribute to observed data variability and limit widespread adoption of these scales. The aim of this study was to evaluate the effect of rater training on inter-rater reliability when using the Rat Grimace Scale (RGS).

Two sets of training images, comprising 42 and 150 images, were collected in the course of unrelated projects with several acute pain models, including intra-plantar injections of carrageenan and complete Freund's adjuvant, plantar skin incision and telemetry instrumentation surgery. Four female trainee raters, with no previous knowledge of the RGS, progressed through two rounds of scoring training. With the aid of a training manual, 42 images were scored during the first round (S1), followed by the 150 images (S2a). Trainees recorded comments for any images they found difficult to score and an experienced rater led a group discussion following each round. The 150 images were re-scored in a final round (S2b). There was a 2-3 week interval between each round. Inter-rater reliability was evaluated using the intra-class correlation coefficient (ICC) and ICCs compared with a Feldt test.

Inter-rater reliability showed a progressive improvement with training. Calculated ICCs for RGS scores averaged from the 4 action units (eyes, ears, nose/cheek, whiskers) increased from S1 (0.58 [95% CI: 0.43-0.72]) to S2b (0.85 [0.81-0.88], $p < 0.01$) and between S2a (0.68 [0.58-0.76]) and S2b ($p < 0.01$). For individual action units, the greatest increases were for ears (0.40 [0.25-0.56] to 0.72 [0.66-0.77]) and nose/cheek (0.36 [0.21-0.52] to 0.71 [0.65-0.76]). ICCs for trainee raters ranged from 0.41 to 0.70 after S1, improving significantly to 0.88 to 0.91 after S2b ($p < 0.01$, all comparisons).

These data indicate that structured training in the use of the RGS results in improved scoring performance and inter-rater reliability. The role of rater training with other facial expression scales remains to be determined.

CLIMATIC INFLUENCES ON THE MORTALITY OF SHEEP EXPORTED FROM AUSTRALIA TO THE MIDDLE EAST

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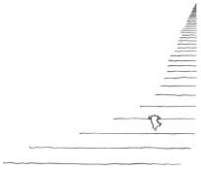
Little is known about the causes of sheep death in sea voyages from Australia to the Middle East, in particular the influence of climatic factors. Mortality data from 417 shipments of sheep export over an 11-yr period (Nov. 2004 to June. 2015) were analysed retrospectively. The results confirmed a seasonal mortality pattern, with significantly higher deaths occurred on sea voyages arriving in the Middle East in summer or autumn than those in winter or spring. Heat stress and seasonal changes in adipose tissue mobilisation are hypothesized to explain the seasonal sheep deaths related to inanition on board shipments. Other voyage factors associated with sheep mortalities included departure year, departure day in the year, voyage duration, and single or multiple exporters. Approximately one-quarter of the variance in sheep mortality during sea export was explained by these voyage variables and the port weather variables, average temperature at departure and destination ports, maximum temperature, maximum wind speed, average visibility and average dew point at departure port. The strong correlation with seasonal factors suggest that restriction of the trade from Australia during summer in the Middle East is warranted. Refinement of the model used by the live export industry from Australia to predict and moderate the heat stress risk and adjust stocking density should be undertaken to include the weather at the departure port, as well as acknowledging the growing risk of extreme weather in the Middle East due to global climate change and the increasingly accurate forecasts of weather in the Middle East.



"FARMING BY PHONE" - IS THERE A RISK THAT INCREASING USE OF TECHNOLOGY WILL ERODE OUR OBLIGATIONS TO CARE FOR ANIMALS?

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Our once familiar farming systems are being rapidly transformed by the introduction of new technologies, due to the lure of remote monitoring, automation and production efficiencies. Similarly, researchers are often swayed by possibility to include new technology in studies without full validation. Does this trend carry a risk of weakening our bond with animals, which has built up over centuries of domestication, and reneging on the contract of care which lies at the heart of animal husbandry? For example, how many animals are too many for a stockperson to look after without detrimental consequences?

Applying technology to animal husbandry has many benefits to both production and research systems, however we urge caution with how far and how fast changes are implemented. The reasons which make technological solutions so pervasive are obvious: increases in efficiency from reduced labour costs, increases in production, reduction of negative human-animal interactions, constant monitoring, the ability to detect patterns we might not naturally see and perhaps simply because the technology is available. Technology is so intertwined in modern society that when problems are encountered we often reach first for a technological solution. There are risks to welfare as well as societal costs associated with the over-use of, and increasing reliance on, technology in farming and research that must be considered. Obvious downsides are the removal of direct animal contact and supervision along with a corresponding loss of farmer/caregiver skills. There is also a deeper impact associated with the withdrawal of human contact from species which, due to domestication, benefit from human contact and a positive bond with their caretakers. Finally, the continued and growing integration of technology into our systems creates broader and far-reaching consequences including environmental degradation, unequal resource and food distribution, and conflicts between technological solutions and traditional/religious beliefs.

We would like to promote discussion on the wider consequences of increasing technology use in our husbandry systems rather than accepting this as a *fait accompli*. New technologies should improve animal welfare in addition to providing benefits such as increasing food production and promoting scientific knowledge. Perhaps most importantly, our relationships with animals and duty of care should not be fundamentally degraded by the increased use of technologies in animal husbandry.