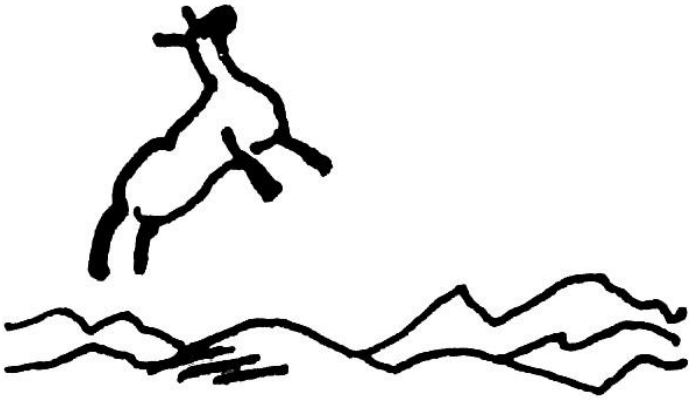
Advancing Animal Welfare Science: How Do We Get There? – Who Is It Good For?



UFAW International Animal Welfare Science Symposium

3rd - 4th July 2019

Site Oud Sint-Jan, Bruges, Belgium

UFAW
Established 1926

Science in the Service of Animal Welfare

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Welcome to the UFAW Symposium 2019

We would like to welcome you to Bruges 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 first held in 1957.

Animal welfare science advances are needed to inform decisions on the care and legal protection provided for animals. This symposium 'Advancing animal welfare science: How do we get there? – Who is it good for?' seeks to explore two major themes. These are:

1) Developments in animal welfare science that are likely to extend our understanding of animals' needs or how to assess animal welfare or sentience.

2) The interplay and relationship between animal and human welfare. While the primary ethical case for being concerned about animal welfare is the presumption that some animal species have feelings and that those feelings matter to them, benefits to humans are often put forward as reasons for improving animal welfare. Examples include: an improved product for farmed animals, better models for animals used in research or animals more likely to survive and breed successfully if released into the wild for the zoo community. However, it is also the case that animal welfare and human goals and interests are not always linked.

With the above themes in mind, those attending this symposium will:

- Learn about new and exciting innovations and methodologies in animal welfare research and arising from research into sentience in animals.
- Explore and test the extent of the idea that human and animal interests go hand in hand with improved welfare.
- Investigate areas of animal use where there are particular challenges to improving animal welfare.
- Identify new methodologies, approaches and technologies to improve animal welfare that have or could be used to address these challenges.

By considering whether and how animal welfare science can be used to make progress in these and other areas, our aim for the symposium is to develop and raise awareness of new ideas and to promote higher quality and better-focused animal welfare science.

This symposium is also intended to provide a platform at which both established animal welfare scientists and early career researchers can discuss their work and a forum for the broader community of scientists, veterinarians and others concerned with animal welfare to come together to share knowledge and practice, discuss advances and exchange ideas and views. We hope that it achieves these aims and fosters links between individuals and within the community.

We would like to thank all those who are contributing to the meeting, as speakers, poster presenters and chairs, as well as the delegates from the 25 countries who are attending. We look forward to a thought-provoking and engaging couple of days.

Stephen Wickens, Robert Hubrecht and Huw Golledge
UFAW

General Information

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

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

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

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

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

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

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

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

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

Information about the symposium

Venue:

Site Oud Sint-Jan
Zonnekemeers 18
Bruges 8000
Belgium

The venue for the symposium is Site Oud Sint-Jan, which forms part of a complex of buildings that include the 12th century medieval Hospital of St John (Oud Sint-Janshospitaal), one of Europe's oldest surviving hospital buildings. Other parts of the former hospital complex include the Hans Memling museum, where a number of the artist's works are displayed as well as hospital records, medical instruments and other works of art.

Getting to the venue
There are two different entrances to the Oud Sint-Jan Site: via the gate at Mariastraat 38 or via the Zonnekemeers, which is also where the car park can be accessed.

- **By car or public transport**
  People travelling by car can park in the Zonnekemeers car park. There are also other car parks nearby: Parking Centrum Zand or Parking Centrum Station.

- **On foot**
  The Oud Sint-Jan Site is just a 10-minute walk from the main railway station. When you leave the station (on the city centre side), cross over the station square and follow the signposts via the Oostmeers until you arrive at the Zonnekemeers. Plus code: 663F+42 Bruges, Belgium (NB This can be used instead of an address on Google maps).

  The entrance on the Mariastraat is opposite the Church of Our Lady, in the middle of the city centre. Plus code: 663F+MJ Bruges, Belgium

Registration:
Registration will take place in the lobby of the Site Oud Sint-Jan Conference Centre from 8.00am on Wednesday 3rd July.

On registering delegates will receive a delegate list, a timetable, a list of poster presentations and a badge, which allows access to the meeting and to lunch and refreshments. The programme booklet will only be available on-line so if you wish a hard copy then you will need to print it out in advance. Please ensure you wear your lanyard and badge at all times.

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

Talks will take place in the Ambassadeur lecture theatre, next to the lobby, with the poster session, lunch and refreshments being held in the Witte Roos room on the first floor at the times indicated in the timetable.

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

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 in the programme.

Catering:
Tea, coffee and lunch will be served in the Witte Roos room, on the first floor of the Conference Centre, which can be accessed by the stairs or lift from the lobby, at the times indicated in the timetable.

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

Blue	**Organiser and/or helper**
Yellow	**Speaker**
Pink	**Poster presenter**

Internet access:
To access free Wi-fi during the meeting connect to the following:
Network name: **UFAW2019**
Password: **bruges2019**

Social media:
Delegates are kindly requested to not take multiple photographs or record talks during the symposium, as this is distracting for others. Speakers and poster presenters have been asked, if willing, to provide a .pdf of their presentation that registered delegates will be able to access on-line after the event.

The hashtag for the symposium is **#UFAWBruges19**

Safety:
In the event of a fire or other emergency, please leave via the nearest emergency exit. Delegates should gather in the car park outside the building. A check that everyone attending the symposium is present will then be made. Do not return to the building unless authorised to do so.

Evening receptions:
A reception will be held at the De Halve Maan brewery on the evening of the 3rd July from 6.45pm, when delegates (and partners who have booked) will be able to sample some of their beers.

The brewery is a 3-4 minute walk from the conference centre. When you leave the conference centre turn left and head south. On reaching Zonnekemeers, turn left, cross the bridge, and then turn right onto Walplein. De Halve Mann address is: Walplein 26, 8000 Bruges, Belgium or Plus code: 662F+XM Bruges, Belgium (NB This can be used instead of an address)

There will also be a reception at Bruges' gothic City Hall the evening before the symposium, 2nd July, at 7.00pm for delegates who arrive early, where delegates will be welcomed to Bruges by City Alderman Mr Mathijis Goderis. Places for this are limited and have been allocated on a first come basis. The address for City Hall is: Burg 12, 8000 Brugge, Belgium Plus code: 665G+8R Bruges, Belgium

Accommodation:
We have arranged a range of different accommodation in Bruges, to suit all budgets. Click on this **link** for further details.

Alternatively, delegates can find their own accommodation. Search for 'hotels Bruges'.

To navigate around this booklet please use hotlinks - and back arrow, when showing

Background information about Bruges

Bruges:

The symposium is being held in the UNESCO world heritage city of Bruges, Belgium. Bruges, located in the north-west of Belgium, is one of the best preserved medieval towns in Europe and because of the number of its canals is sometimes referred to as the Venice of the North. Indeed the name Bruges is a derivative of an old-German word 'brugj' which means 'mooring place'.

From the 11th century the city was a prosperous trading metropolis and, as the main fortified residence of the counts of Flanders, a seat of political power. The most important trade centre in North West Europe over the next few centuries Bruges was also the site for the world's first ever stock exchange – the Beurs/Bourse. At the height of its prosperity and influence in the 15th century, famous painters such as Jan van Eyck and Hans Memling were attracted to the city to work for the Burgundian court. Buildings such as the City Hall were built at this time. The first book in English ever printed was also published in Bruges at this time, by William Caxton.

With the loss of the court and the increasing dominance of Antwerp and its port, Bruges experienced a long period of declining fortunes, although lace making flourished from the 17th century. The late 19th century saw Bruges become a popular destination for French and British tourists – and the development of nearby Zeebrugge (literally Bruges on Sea) as an important port. In 2009, UNESCO added the medieval city centre to its World Heritage list.

A guide to Bruges can be downloaded here

Symposium venue: Site Oud Sint-Jan:

Saint John's Hospital (Oud Sint-Janshospitaal) is one of the oldest preserved hospital buildings in Europe and has an eight hundred-year-old history of caring for pilgrims, travelers, the poor and the sick. The museum has exhibits on hospital life and how the wards would have looked. The building's supporting framework is also unique and is one of the oldest and largest in Europe. In the hospital chapel, the focus is all on the work of the most famous of the Flemish Primitives: Hans Memling. This painter lived and worked in Bruges in the 15th century and created his most important masterpieces here, including the famous Shrine of St Ursula, which was painted specifically for Sint-Janshospitaal. Also worth a visit are the Diksmuide attic, the old dormitory, the adjoining custodian's room and the pharmacy.

History

The old infirmary took patients in from the 12th to the middle of the 19th century. Initially anyone in need of food or a bed could come here. The nuns, however, had limited medical knowledge and devoted themselves mainly to the care of the soul.

Museum

The nuns owned unique artistic treasures that they exhibited for the first time in 1839 in the chapter house. The museum is now located in the old infirmary. The fact that the art objects are so closely connected to the location and its former inhabitants lends the museum an added value. Furthermore, many objects were specially commissioned by the hospital community and depict the patrons.

Collection

Sint-Janshospitaal owns six masterpieces by the Flemish primitive artist Hans Memling, as well as many religious paintings and sculptures. Objects of applied art, such as furniture, silverwork, medical instruments, reliquaries, archive documents, and apothecary pots reflect 800 years of care.

Other sites:
Most of the medieval architecture in Bruges has survived, making it one of the best preserved medieval towns in Europe.

Notable buildings include:

- City Hall – Constructed in the 14th century and one of the oldest city halls in The Low Countries.
- The Church of Our Lady, which is one of the world's highest brick towers/buildings. It houses Michelangelo's sculpture *Madonna and Child*, believed to be the only of Michelangelo's sculptures to have left Italy within his lifetime.
- The Belfry, a 13th century bell tower and one of Bruges' most famous landmarks.
- The 12th century Basilica of the Holy Blood. This houses a relic of the Holy Blood, allegedly collected by Joseph of Arimathea and brought to the city after the Second Crusade by Thierry of Alsace.
- With parts dating back to the 9th century, the Saint Salvator's Cathedral is the main church of Bruges.
- The Groeningemuseum, a modern museum which houses an extensive collection of medieval and early modern art, including Hans Memling, Jan van Eyck, Hieronymus Bosch and other Flemish Primitives.
- The Béguinage - a housing complex built to house beguines, lay religious women who lived in community without taking vows or retiring from the world.

A map of Bruges can be downloaded here

Other attractions:

- Exploring Bruges' canals.
  You can board at any of five landing stages for a half-hour boat trip around the canals. The boats run daily from 10.00am-6.00pm (last departure at 5.30 p.m.). The cost for a trip is € 8.00. Alternatively, you can walk along the inner canals. Starting at Zand Square and finishing at the Bonifacius bridge near Church of Our Lady this 2.8 km walk, will take you past many of the best sites of Bruges.

  Maps of other walks around Bruges can be found here

- The Lace Museum

- **Shopping**
  The most important shopping streets run between the Market Square and the old city gates: Steenstraat, Simon Stevinplein, Mariastraat, Zuidzandstraat, Sint-Jakobsstraat, Sint-Amandsstraat, Geldmuntstraat, Noordzandstraat, Smedenstraat, Vlamingstraat, Philipstockstraat, Academiestraat, Hoogstraat, Langestraat and the Katelijnestraat. Each street has its own character, eg The Steenstraat, features many of the major chain stores, the Langestraat has many little second-hand and bric a brac shops.

Travel

The simplest way to get to Bruges is by rail.

- **By rail**
  Bruges' main railway station is the focus of lines to the Belgian coast and provides at least hourly trains to all other major cities in Belgium (e.g. Antwerp, Ghent and Brussels), as well as to Lille, France. Further details on trains and times can be found on the Belgian Railways (NMBS) website.

  Bruges main station is also a stop for the high speed Thalys train service that runs Paris–Brussels–Ostend.

  International
  The station at Brussel-Midi/Zuid (Brussels South) is the Belgian hub for international rail traffic. Numerous high speed trains arrive in Brussel-Zuid daily, coming from Paris (Thalys/Izy and TGV), Lille (Eurostar, TGV and Thalys), London (Eurostar), Amsterdam (Thalys and Eurostar) and Cologne (Thalys and ICE).

  There are three trains an hour from Brussels-Midi/Zuid/South Station, which stop at Bruges on their way to Ostend, Knokke or Blankenberge. The travelling time between Brussel-Midi/Zuid/South and Bruges is approximately 1 hour.

  In Bruges
  From the railway station, there are frequent buses to the centre of Bruges. De Lijn bus leave every 5 minutes. A (one-way) ticket is valid for one hour and costs €3.00. There is also a taxi rank outside.

  For those looking to walk, the railway station is just 10-minutes from the main shopping streets and a 20-minute walk from the Market Square.

- **By air**
  Belgium has several airports into which European and international airlines regularly fly. Other large hub airports close by include Schiphol, Amsterdam (approximately 3 hours away by train, changing at Antwerp. Approximate cost: €70.00) and Charles de Gaulle Airport, Paris (approximately 3 hours 15 minutes away by train, changing at either Brussels Midi or Lille. Approximate cost: €70.00).

  Via Brussels Airport-Zaventem
  Brussels Airport (Zaventem) is an international airport 12km to the north-east of Brussels and about 90km from Bruges. It offers the best connections to Bruges. It has a train station from which there is a direct hourly train service to Bruges – with a journey time of around 60 minutes. In addition, many other trains from Brussels Airport-Zaventem regularly stop at Brussels-Nord, Brussels Central or Brussels-Midi/Zuit/South railway stations.

  Via Brussels South Charleroi Airport
  This international airport is to the south of Brussels and is approximately 150km from Bruges.

  The bus company Flibco.com offers a direct shuttle bus to and from the station of Bruges with a frequency of nine trips a day (there and back). Book online in advance for the cheapest fare. In addition, a regular coach service runs from the airport to Brussels-Midi/Zuit/South railway station from where a train to Bruges can be caught. Also, a special bus (Airport Express – A) operates from the airport to Charleroi-South railway station.

- **By road**
  Bruges is connected to the rest of Belgium through the nearby A10 (E40) motorway, which runs from Brussels via Ghent and Bruges to Ostend. The R30 is the main ring-road that runs around the outside of the old walled centre of Bruges.

Parking in Bruges
There is parking available at the symposium venue, Site Oud Sint-Jan (Zonnekemeers 18, Bruges 8000). Between 8.00am-8.00pm: the cost is €1.40/hour; between 8.00pm-8.00am: €2.50 for the evening/night. Payment to be made at the pay station in the car park:

Between 9:00am and 8:00 pm surface level parking in the city centre is limited in time (4 hours maximum) and is metered (€1.80 for the first hour, €2.40 for the second up to the fourth hour, in total €9.00 for 4 hours.)

Parking is unlimited and most cost-effective at one of the two central car parks: Centrum-Station (railway station) (€0.70/hour and €3.50/24 hours) and Centrum-'t Zand (€1.20 for the first hour and €8.70/24 hours). Both are situated within walking distance of the city centre. Included in the cost of parking at Centrium Station is a bus transfer with 'De Lijn' to the city centre.

Information on Presentations

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

- **Oral presentations**
  For all talks, the author highlighted in bold in the timetable will be presenting the talk. As part of the time allocated for each talk, speakers have been asked to ensure that at least 5 minutes are allowed for questions from delegates.

  All speakers must ensure that they have loaded a copy of their presentation on to the PC being used for the symposium in advance of the session in which they are to talk. This PC will be at the front of the Ambassadeur lecture theatre. As a guide, we would expect anyone speaking in the morning of the 3rd to have uploaded their talk during initial registration, which is from 8.00am, and the remaining speakers to upload their talks during the subsequent refreshment and lunch breaks.

  The symposium will use a PC based computer system running Office 2016 to run all PowerPoint presentations, so speakers need to ensure presentations are formatted for such. Presentation should be brought on a USB Memory stick. Presentations should be named such that the speaker surname and the session in which the talk is taking place is clear e.g. 'Smith 2.3 Stress and welfare'.

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

  Important note for Macintosh users
  To ensure that a presentation prepared on a MAC will be compatible with a PC computer, please note the following: Use a common font, such as Arial, Calibri, Times New Roman, Verdana etc. (special fonts might be changed to a default font on a visible on a PC computer running PowerPoint). Insert pictures as .JPG files (and not .TIF, .PNG or .PICT – as these images may not be visible on a PC computer running PowerPoint).

- **Poster presentations**
  Posters will be displayed in the Witte Roos room on the first floor, which is also the venue for the tea/coffee breaks and lunch. There will be two poster sessions during the Symposium. During the poster sessions, which are scheduled to begin at 13.20pm on 3rd and 13.30 on 4th July, authors have been asked to make themselves available to answer questions about their work. Accordingly, those contributing posters are asked to ensure that at least one of the contributing authors is standing nearby their poster during their session.

  Access to set up a poster is from 8.00am on the 3rd and all posters should be in place before the start of the conference at 9.00am or during the first morning refreshment break. They should be taken down by no later than 4.00pm on the 4th.

  The poster boards that will be used for the UFAW symposium will accommodate A0 portrait size posters (i.e. 1189mm high x 841mm wide). Posters should be able to be mounted on these using Velcro fastenings or pins. Pins/Velcro will be provided for those who need it on the day.

  Please note: UFAW is are not responsible for loss or damage to any posters that are not removed by authors by 17.00pm on the 4th July. Any posters left behind will be automatically destroyed.

SCIENTIFIC PROGRAMME:

Timetable and Speaker Abstracts

Day One

8.00 – 9.00 Registration. **Refreshments available from 8.30**

8.00 – 9.00 Poster set up

9.00 – 10.30 Session 1. Chair Hubrecht R (UFAW, UK)		
9.00-9.10	**Hubrecht R** UFAW, UK	Welcome and Introduction
9.10-9.50	**Garner J** Stanford University, USA	Keynote: From expediency to necessity: Why science without welfare thinking isn't science worth doing
9.50-10.10	**Bennett RM** University of Reading, UK	The benefits of animal welfare science
10.10-10.30	Rioja-Lang FC, H Bacon, M Connor, AB Lawrence and **CM Dwyer** University of Edinburgh and Scotland's Rural College, UK	Prioritising animal welfare issues using expert consensus

10.30- 11.00 Break: Refreshments

11.00 – 12.40 Session 2. Chair: Burn CC (RVC, UK)		
11.00-11.40	**Keeling LI** Swedish University of Agricultural Sciences, Sweden	Keynote: Assessing animal welfare: biology, methodology and technology
11.40-12.00	**Franco NH**, A Gerós, L Oliveira, IAS Olsson and P Aguiar Universidade do Porto, Portugal	Automatic and high-throughput thermal image analysis of freely-moving, group-housed laboratory animals, validated on a mouse model of LPS-induced sepsis
12.00-12.20	**Asher L** Newcastle University, UK	What can behaviour informatics of sensor data offers animal welfare?
12.20-12.40	Jorquera MF, FR Dunshea, S Fuentes and **EC Jongman** University of Melbourne, Australia	A pilot study of early detection of porcine pleuropneumonia using remote sensing and computer vision techniques over thermal infrared and RGB imagery

12.40 – 14.00 Lunch, including Poster Session 1 (from 13.20)

14.00 – 15.30 Session 3. Chair: Olsson IAS (University of Porto, Portugal)		
14.00-14.15	**Dalla Costa E**, M Chincarini, L Qiu, L Spinelli, A Torricelli, S Cannas, C Palestrini, E Canali, B Cozzi, N Ferri, G Vignola and M Minero Università degli Studi di Milano, Teramo and Padova, Politecnico di Milano, Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise G. Caporale and Istituto di Fotonica e Nanotecnologie, Italy	Can functional near-infrared spectroscopy (FNIRS) give us reliable insights on sheep brain activity?
14.15-14.30	**Huertas SM**, PE Bobadilla, M Prieto and JM Lestido Universidad de la República and JM Lestido Project Management, Uruguay; OIE Collaboration Center on Animal Welfare and Livestock Production Systems (Chile-Uruguay-México)	A new methodology to improve animal welfare during transport: "PROGAT"
14.30-14.45	**Volkmann N**, B Kulig and N Kemper University of Veterinary Medicine Hannover and University of Kassel, Germany	The sound of claw lesions: Detection of lameness by acoustic analysis
14.45-15.00	Knock M and **GA Carroll** Hartpury University Centre and Queens University Belfast, UK	The potential of post-mortem carcass assessments in reflecting the welfare of beef and dairy cattle
15.00-15.15	**Stracke J**, D Klotz, P Wohlsein, S Döhring, R Günther, N Kemper and B Spindler University of Veterinary Medicine Hannover, Hochschule Osnabrück, University of Applied Sciences and Heidemark Mästerkreis, Germany	Scratch the surface. Histopathology of foot pad dermatitis in turkeys
15.15-15.30	**Rutherford N**, F Lively and G Arnott Agri-Food and Biosciences Institute and Queens' University Belfast, UK	The use of rumen temperature boluses as a novel welfare assessment tool in cattle: illustrated by monitoring stress-induced hyperthermia

15.30 – 16.00 Break: Refreshments

16.00 – 17.40 Session 4. Chair: Moons CPH (University of Ghent, Belgium)		
16.00-16.20	**Burn CC** The Royal Veterinary College, UK	Stopping senseless standardisation: How not to waste laboratory animal lives
16.20-16.40	**Gray HE**, L Zhang, X Ye, N Allinson and LM Collins Universities of Leeds and Lincoln, UK	Automatic monitoring of pig health and welfare
16.40-17.00	**Cobb M**, A Carter, A Lill and P Bennett Monash and La Trobe Universities, Australia	Advancing the welfare of working dogs: What's preventing science helping the canines who help us?
17.00-17.20	**Andrews C**, A Gott, V Neville, D Nettle and M Bateson Newcastle University and University of Bristol, UK	Do individual differences in multiple measures of affect and welfare correlate?
17.20-17.40	**van der Goot MH**, SS Arndt and HA van Lith Utrecht University, The Netherlands	Increasing animal welfare and reliability of results from preclinical trials and animal studies: Zooming in on variation in adaptive response patterns within and between three inbred mouse strains

End 17.40. Drinks reception De Haalve Maan from 18.45

Day Two:

9.20 – 10.50 Session 5. Chair: Arnott G (Queen's University Belfast, UK)		
9.20-9.30	**Statham P** University of Bristol, UK	Introduction to second day – AWRN initiative
9.30-10.10	**Van de Vis H** Wageningen Livestock Research, The Netherlands	Keynote: Challenges associated with assessing and improving the welfare of farmed fish
10.10-10.30	**Rawson TE**, MS Dawkins and MB Bonsall University of Oxford, UK	Mathematical modelling of Campylobacter in a broiler flock
10.30-10.50	**Webster J** and G Zobel AgResearch Ltd., Hamilton, and Massey University, New Zealand	Animal welfare assessment – Do we know what we are missing?

10.50 – 11.35 Break: Refreshments

11.35 – 12.50 Session 6. Chair: Molento CFM (Federal University of Paraná, Brazil)		
11.35-11.55	**Foreman-Worsley R** and M J Farnworth Nottingham Trent University, UK	A systematic review of social and environmental factors and their implications for indoor cat welfare
11.55-12.15	**van Dierendonck MC** and CPH Moons Ghent and Utrecht Universities, Belgium	The WELPA project: Can human behaviour change (HBC) techniques help to improve equine welfare in riding schools and livery yards?
12.15-12.35	**Spiezio C**, C Sandri and B Regaiolli Parco Natura Viva - Garda Zoological Park and University of Bologna, Italy	To assess zoo animal welfare using the behavioural variety index (BVI)
12.35-12.50	UFAW Award	UFAW Medal for 'Outstanding Contribution to Animal Welfare Science' / UFAW 'Young Animal Welfare Scientist of the Year'

12.50 – 14.10 Lunch, including Poster Session 2 (from 13.30)

14.10 – 15.30 Session 7. Chair: McElligott AG (University of Roehampton, UK)		
14.10-14.30	**Trevarthen A**, M Mendl, E Finnegan, E Paul, A Resasco and C Fureix Universities of Bristol and Plymouth, UK; National University of La Plata, Argentina	Inactive but awake behaviour as a potential indicator of a housing-induced depressive-like state in mice
14.30-14.50	**Cronin KA**, ST Saiyed and LM Hopper Lincoln Park Zoo and University of Notre Dame, USA	Evaluating whether animal and human interests align in a zoo-based ambassador animal program with African penguins
14.50-15.10	**Henderson LJ**, TV Smulders and J Roughan Newcastle University, UK	Benefits of tunnel handling persist after additional procedures
15.10-15.30	**Vieira de Castro AC**, J Barrett, D Fuchs, S Pastur, L de Sousa and IAS Olsson Universidade do Porto, Portugal; University of Edinburgh, UK; University of Trieste, Italy	The effects of dog training methods on companion dog welfare and dog-owner bond

15.30 – 16.00 Break: Refreshments

16.00 – 17.10 Session 8. Chair: Tuyttens F (IVLO, Belgium)		
16.00-16.20	**Telkänranta H**, E Paul, M Ramirez, G Caplen, S Held, HR Whay and M Mendl University of Bristol, UK and University of Helsinki, Finland	Lateral differences in eye and nostril temperature: A novel approach to developing thermographic methods to measure emotions
16.20-16.40	**Morello GM**, S Brajon, S Capas-Peneda, J Hultgren, JM Ferreira, C Gilbert and IAS Olsson University of Porto, Portugal and Swedish University of Agricultural Sciences, Sweden; Babraham Institute, UK	Understanding pup mortality in laboratory mouse breeding: how the presence of an older litter in the cage aggravates pre-weaning mortality in mice housed in trios and in pairs
16.40-17.00	**Lecorps B**, DM Weary and MAG von Keyserlingk University of British Columbia, Canada	Are dairy cows depressed after calving?

End 17.10

FROM EXPEDIENCY TO NECESSITY: WHY SCIENCE WITHOUT WELFARE THINKING ISN'T SCIENCE WORTH DOING

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Laboratory animal welfare has traditionally used expediency to argue for changes in policy or practice – i.e. we have argued that "good welfare is good business" (e.g. in the case of nesting material), or that "good welfare is good science" (e.g. in the case of positive reinforcement training primates). This talk will argue that good welfare is a necessity – that science without welfare thinking isn't science worth doing, as evidenced by the current reproducibility and translatability crisis.

The scale of the reproducibility and translatability crisis is now widely understood beyond the small number of researchers who have been studying it and the pharmaceutical and biotech companies who have been living it. This talk will make the case that this is not a time for despair, but a time of intellectual excitement and hope, and that lab animal welfare is central to understanding and resolving both crises. The emerging literature on these issues contains recurring themes which represent a paradigm shift, and thus potentially the birth of a new discipline (which we have proposed be termed "therioepistemology"). At the micro level this is a shift from asking "*what have we controlled for in this model?*" to asking "*what have we chosen to ignore in this model, and at what cost?*" At the macro level, it is a shift from viewing animals as tools or reagents, to viewing them as patients in an equivalent human medical study.

The shift to viewing animals as patients forces us to not only consider their welfare, but also to consider how their welfare impacts science itself. Thanks to the groundwork laid over the last 15 years by a variety of authors, we not only understand many of the causes of poor reproducibility and translatability, but we also know the features of animal work that lead to reproducible work with a good chance of translation. This talk will outline six questions that serve as a heuristic for critically evaluating animal-based biomedical research for opportunities to make this shift in perspective. Of these six questions, one explicitly focusses on welfare, but in fact all six can be viewed as different perspectives on the welfare of the animals involved at the individual, model, and population levels. Accordingly now is a time for action where we manifest change in the *status quo* of how animal research is done, and in this new approach, good welfare is not expedient, it is necessary.

THE BENEFITS OF ANIMAL WELFARE SCIENCE

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Animal welfare science has the potential to provide substantial benefits for both animals, humans and the environment. This paper outlines the nature of these benefits and the beneficiaries, pathways by which potential benefits can be realised and the conditions necessary for their realisation. Beneficiaries include citizens and consumers, producers and animal keepers, policy makers, scientists, the environment and animals. The nature of benefits ranges from the financial to the physical, mental, emotional and broad societal wellbeing. The pathways for the realisation of benefits from advances in animal welfare science are many and are strewn with challenges and obstacles. The paper charts important pathways and uses examples to illustrate how and why advances in animal welfare science can result in greater or lesser benefits both to animals and to society. The paper draws on different types and sources of evidence to demonstrate the major challenges associated with ensuring that advances in animal welfare science result in real and tangible benefits. Reference is made to animal welfare science, moral philosophy, psychology, consumer and behavioural science, economics and legal and institutional factors amongst others in a broad and inter/trans-disciplinary perspective. The paper provides some thoughtful discussion regarding the benefits of different types of animal welfare science in society, how those benefits might best be optimized given the beneficiaries and the trade-offs involved and the important role of animal welfare scientists and researchers.

PRIORITISING ANIMAL WELFARE ISSUES USING EXPERT CONSENSUS

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Animal welfare concerns cover a diverse range of species, where human activities affect animal lives, and issues. The importance of specific welfare issues can be determined by public or political concerns, and by the scientific assessment of the amount of suffering caused to the animal, or benefit achieved, from the particular welfare concern. For funders with limited resources it can be necessary to determine how and where to focus attention for research or awareness raising. To meet this need we conducted a modified Delphi analysis to determine welfare priorities for farmed (cattle, pigs, sheep, goats and poultry), and companion animals (dogs, cats, rabbits, horses, non-traditional companion animal species or 'exotics') and managed wildlife. We recruited 144 experts (12-19 per species group) including academics, veterinarians, charity workers and industry professionals. For cats, horses, rabbits, exotics and wildlife we first used discussion boards to develop a comprehensive list of possible welfare issues as identified by the experts. For other species a list of welfare issues was developed from an extensive literature search. Experts were then asked to score each issue from 1 (none/never) to 6 (high/always) for severity, duration and prevalence of each issue. Issues that scored ≥3 on average for any parameter were then considered in the 2nd round, which asked experts whether they agreed these were the most important welfare issues. Finally, a Delphi workshop was held to reach a final list of ranked welfare issues within species group and an overall list. For conventional companion animals, inappropriate environments, lack of understanding of behavioural requirements, obesity and delayed euthanasia decisions were all considered as important welfare issues. For exotic pets, lack of knowledge by owners, and sometimes by veterinarians, were considered the highest ranking issues. For farmed animals not meeting behavioural needs, poor pain management, neglect, and poor stockperson skills or knowledge were identified as the most important welfare issues. When considered as a whole a number of 'cross-cutting' themes were identified including: lack of knowledge of animal keepers, delayed euthanasia decisions, welfare issues relating to breeding decisions, issues relating to social behaviour of the species, lack of appropriate health or veterinary care, inappropriate diets, chronic or endemic health issues, lack of an appropriate environment, 'problem' behaviours (and how these are dealt with) and neonatal morbidity and mortality. This study suggests that lack of knowledge and understanding of animal needs plays a significant role in poor welfare for many species.

ASSESSING ANIMAL WELFARE: BIOLOGY, METHODOLOGY AND TECHNOLOGY

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This talk highlights some of the advances to identify aspects of an animal's biology that are relevant when assessing its welfare, as well as some of the challenges that still remain. I will also present examples of different methodologies and technologies already used on commercial farms to monitor animal welfare, those on their way to be implemented, and speculate about some new areas in the future.

Using technology to monitor and control the housing environment is routine on most farms and technology is increasingly being used to collect information on the animal's biology (animal-based measures) on the farm, during transport and at slaughter. Some are automated versions of existing (manual) methods of assessing welfare, but many technologies involve and some are driving the development of new methodological approaches to welfare assessment. Whereas a decade or so ago, the main limiting factor was the time needed for people to collect animal-based measures, a limitation now seems to be the knowledge to analyse and interpret them. Besides benchmarking levels of specific animal-based measures, real time and continuous data collection allows us to detect small deviations from the normal and this has opened a new world of possibilities regarding early warning and notification systems. The potential to collect large amounts of behavioural data is also contributing to our understanding of individual differences and, perhaps in the future, to new animal-based measures.

Continuing to look to the future, it is of interest to speculate on how big data on animals can be used together with housing and management data to guide changes in farming and handling practices, and so reduce risks to welfare. How far into the future is smart housing, that responds in real time to evidence on how well animals are coping? Can big data provide new insight on how best to integrate many different indicators to an overall assessment of welfare? Also, how can indicators of animal welfare be linked with indicators of environmental sustainability and sustainable development in general? These are all challenging areas.

In summary, there are many new and exciting possibilities in the area of animal welfare assessment. However, in our rush to use new technologies, it is nevertheless important to not only collect more data because we now can, but because these data are biologically meaningful and relevant.

AUTOMATIC AND HIGH-THROUGHPUT THERMAL IMAGE ANALYSIS OF FREELY-MOVING, GROUP-HOUSED LABORATORY ANIMALS, VALIDATED ON A MOUSE MODEL OF LPS-INDUCED SEPSIS

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Body temperature variation provides meaningful information on animal health and welfare. For laboratory rodents, its assessment raises however several difficulties. The use of rectal or infrared thermometers requires taking animals out of their home cage and restraining them, which in itself affects the thermal readout, by quick-onset hyperthermic stress response. Telemetry sensors dispense from frequent handling. However, aside being a more costly method, sensor implantation requires microsurgery and a post-operative period, making it more invasive and time-consuming. Thermosensitive passive integrated transponder (PIT) tags are the smallest – and hence less noxious – sensors. These must however be read at close range (~5 cm), hence group-housed animals must be picked up for each reading to avoid reading cage-mates' sensors, thus defeating the purpose of contactless measurement.

Infrared thermography has been proposed as an alternative for monitoring surface temperature variation in laboratory animals. However, lack of dedicated software for biomedical purposes, and labour-intensiveness of thermal image analysis impose limitations.

We established mean body surface temperature (MBST) as a robust parameter for monitoring temperature variation from thermal images of group-housed, freely-moving mice – as opposed eye, tail or ear temperature – by comparing consecutive images of animals changing their body conformation (stretched vs. hunched) and head position (tilted vs. looking up). Following this, we developed *ThermoLabAnimal,* a software application for automatic assessment of MBST. The software automatically removes the thermal background from images and detects the animals, removing the need for manually defining a region of interest. A key feature is a batch analysis mode for automatic and high-throughput analysis of a virtually limitless number of image files. Since the software reads thermal images in '.CSV' format, it is compatible with most thermal camera manufacturers.

We validated our method and software on a murine model of septic shock, achieved by intraperitoneal injection of a high dose of lipopolysaccharide, which is quickly followed by non-transient, progressive hypothermia. This response was identified by both the readout of subcutaneously implanted PIT tags and automatic assessment from thermal images taken simultaneously. Thermal imaging moreover allowed identifying a temperature drop below the reading range of the PIT-tags (33°C-43°C). In line with the 3Rs, we monitored animals already used in another ongoing research project.

In brief, our methodological approach, which may likely be applied to other species and research fields, has the advantages of allowing thermal assessment of laboratory animals with minimum impact on physiology or behaviour, while eliminating observer errors and bias.

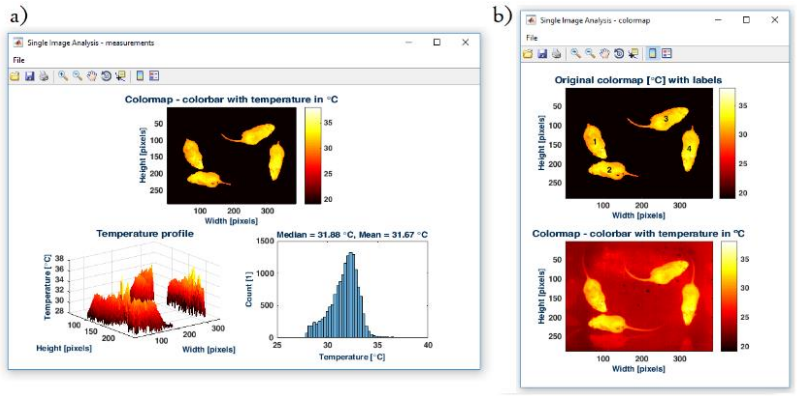

Figure legend
Thermolabanimal can yield mean and median body surface temperature from all mice in an image (a), as well as detect and provide data for each animal separately (b)

WHAT CAN BEHAVIOUR INFORMATICS OF SENSOR DATA OFFERS ANIMAL WELFARE?

L Asher

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Animal behaviour can now be monitored remotely using a range of sensor technologies, in detail and duration which were previously impossible. Sensor technologies can be used, with some limitations, to replace existing methods. For example, sensors can be used for behaviour recognition, identifying what behaviour an animal is performing at a point in time. This can dramatically speed-up data collection, as compared to manual behaviour scoring. Notwithstanding the benefits of time saving, using sensor methods to replace existing behaviour scoring methods vastly underutilises the potential of such devices to contribute to animal welfare. Here I will review how new approaches, based on behaviour informatics are transforming animal welfare science.

Behaviour Informatics is the building of computational theories, systems and tools to model, represent and analyse the behaviour of individuals, groups and organisations. In biology the introduction of informatics has been compared to the microscope in terms of the transformative science it has permitted. I argue that this same potential of the informatics fields exists for behaviour and that this can be harnessed to the benefit of animal welfare. Broadly I identify four ways in which behaviour informatics can provide new insights into animal welfare. I draw upon theoretical and practical knowledge of animal welfare to support these four broad and complementary approaches to behaviour informatics: (i) measuring longitudinal behaviour; (ii) summarising qualities of behaviour data; (iii) identifying changes or anomalies; (iv) inductive approaches behaviour.

Behaviour informatics can be used to measure circadian and other longitudinal rhythms or sequences of behaviour, where predictable rhythms are known to be important for health. Furthermore, different time scales at which different patterns of sequences of behaviour occur can be distinguished. Specific qualities of behavioural data can be measured, such as how predictable or chaotic behaviour is, which could be applied to measure stereotypy. Behaviour Informatics can identify subtle changes or anomalies in behaviour by gathering detailed information on what is expected for that species or that individual. Bottom-up inductive approaches can be used to identify new coordinated actions or features of behaviour associated with poor or good welfare, without anthropocentric biases. Some of the key advantages of new approaches include; identifying welfare compromise in real time, measure dynamics of behaviour (onset, offset, duration), and integration across multiple data streams.

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A PILOT STUDY OF EARLY DETECTION OF PORCINE PLEUROPNEUMONIA USING REMOTE SENSING AND COMPUTER VISION TECHNIQUES OVER THERMAL INFRARED AND RGB IMAGERY

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Actinobacillus pleuropneumoniae (APP) infection, which causes porcine pleuropneumonia, is considered a major problem in the pig industry worldwide. This disease can occur as an acute, subclinical or chronic infection. The acute form of APP is more likely to occur in pigs from 8 to 16 weeks of age, generating symptoms as early as 11 to 23 hours after the animal is infected. Due to the economic impact on the swine industry and the impact on the wellbeing of pigs, early identification of acute and subclinical infected animals is essential. This study aimed to identify whether remote sensing and computer vision algorithms over RGB (red, green, and blue) and thermal infrared (TIR) imagery, are useful tools to detect early signs of respiratory disease in pigs.

Twenty weaned pigs were challenged with a virulent strain of APP and observed for clinical signs before the challenge and 4 times during the day after the challenge (around 7:30, 10:30, 12:30 and 14:30). Clinical observations included nasal discharge, coughing, anorexia, laboured breathing, lethargy and reddened conjunctiva. Each symptom was scored on a scale from 0-3 and pigs were considered showing clinical signs of disease with a score of 2 in any of these categories. At the same time RGB and TIR imagery were used to measure changes of eye and ear temperature, heart rate and respiration rate. Observations were taken while pigs were held 1m from the camera to facilitate recordings.

Data from animals that showed clinical signs of illness during the last observation time (n=5) were compared with data from animals that showed no signs of ill-health (n=6). Highly significant differences ($P<0.001$) were observed between sick and healthy pigs in heart rate and eye and ear temperature with higher heart rate and higher temperatures in sick pigs. The largest change in temperature and heart rate was observed between 7.30 and 10.30, around 4-6 hours before clinical signs of illness became apparent. These results suggest that remote sensing and computer vision techniques could be a useful tool to detect early signs of disease before clinical symptoms are observed, assisting in early detection and treatment of respiratory diseases in pigs. In addition, these results indicate the importance of further research to study the capability and possible application of this technology in on-farm monitoring and management of pigs.

CAN FUNCTIONAL NEAR-INFRARED SPECTROSCOPY (FNIRS) GIVE US RELIABLE INSIGHTS ON SHEEP BRAIN ACTIVITY?

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Functional near-infrared spectroscopy (fNIRS) is a noninvasive optical technique for monitoring the concentration of oxygenated and deoxygenated haemoglobin in human cerebral cortex. Recently, fNIRS has been increasingly used in animal studies, but research is needed to improve measurement accuracy and result reliability (e.g. rejecting possible extracerebral contributions). A wearable continuous wave (CW) fNIRS system (Octamon, Artinis Medical Systems, The Netherlands) was used to measure the cerebral activity of ten freely moving ewes (Sarda breed, 8-month-old) undergoing a motor task (30s baseline, 30s walking; ten repetitions) and a startling test (after 30s baseline an umbrella was opened in front of the sheep for 3s, followed by 60s recovery; five repetitions). fNIRS sensors were applied on the depilated sheep forehead and held in place with a customized head cap. Two pairs of transmitter-receiver at short (10mm) and long (30mm) distance were used to record light intensity at two wavelengths (760nm, 850nm) from the left and right hemisphere. Data were fitted to a CW model for photon diffusion in a two-layer geometry to estimate absorption changes with respect to the baseline in the bottom layer (representing cerebral cortex) and in the upper layer (representing tissues above brain: scalp, skull, CSF). Upper layer thickness was derived from anatomical measurements, while baseline optical properties (absorption and reduced scattering coefficients) were derived from time-resolved reflectance measurements on the same sheep. Beer's law was then used to calculate oxygenated haemoglobin changes (ΔO_2Hb) and deoxygenated haemoglobin changes (ΔHHb) in both layers. Results of the motor task showed no changes in the upper layer and a canonical response in the bottom layer (ΔO_2Hb increase and ΔHHb decrease) in both hemispheres when sheep were walking (Fig 1a). For the startling test, we found no changes in the upper layer and, after the stimulus, a canonical response only in right bottom layer (ΔO_2Hb increase and ΔHHb decrease) (Fig 1b). These results confirm that CW fNIRS allowed to non-invasively measure cerebral cortex activity in freely moving sheep and that the use of short and long distance pairs of transmitter-receiver, coupled to a two-layer model for photon diffusion, was useful to reject extracerebral contributions. Measuring cerebral areas activation has the potential to give us new insights in the study of animal emotion and welfare.

This study was approved by the Italian National Ethical Commission (authorization n°457/2016-PR) and supported by MIUR-PRIN2015 (Grant 2015Y5W9YP).

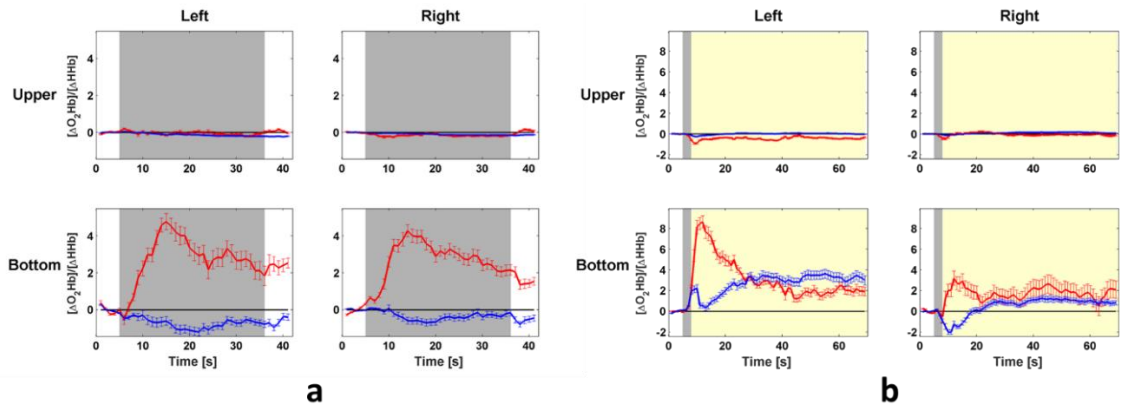

Fig 1 - ΔO_2Hb (in red) and ΔHHb (in blue), average value ± SD calculated over repetitions and sheep, for the upper and bottom layer for both hemispheres (left and right). (a) Motor task: white part refers to baseline (sheep stand still), while grey part refers to sheep walking. (b) Startling test: white part refers to baseline (sheep stand still), grey part refers to umbrella opening and yellow part refers to fear reaction.

A NEW METHODOLOGY TO IMPROVE ANIMAL WELFARE DURING TRANSPORT: "PROGAT"

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Land transport is the most common mean used to transport beef cattle to slaughter houses. Factors like long distances, routes in bad condition and rough driving can affect animal welfare. Poor loading and unloading facilities can aggravate the situation causing animal suffering and presence of carcass bruises provoking great economic losses to the entire sector. Aiming to protect animals from impacts against the sharp edges of transport vehicles and during loading and unloading maneuvers, a solution applying the knowledge of the automotive and metal-mechanic industry, was designed and constructed in Uruguay. The device is called PROGAT® and consists of an elastic strip placed inside the trailer of a truck and steel paddles that act as "funnel" that are pneumatically activated to cover the door frames, both inside the cage and in the main door entrance. The device was validated, comparing 19 trips from farm to slaughter house, consisting of two identical trucks (brand, model, year, maintenance) with similar cattle for slaughter, one vehicle with the device and another without it. Both vehicles where loaded at the same time and departed from the same farm, day, hour and route, arriving together to the same plant. Trained observers recorded the loading and unloading of 1,177 animals and after slaughter for the presence of bruises, their location and depth. The results showed that animals transported in a truck with PROGAT® had a significantly lower proportion of bruises ($p < 0.001$) than those in the conventional vehicle. A small proportion of bruises was observed in the rump area (where the meat cuts of greatest commercial value are located) as well as in the ribs and on the shoulder. No bruises grade 3 (the deepest, with significant muscle loss) were recorded in vehicles with PROGAT®. The data showed that animals transported in a conventional vehicle had 1.6 greater probability of presenting at least one bruise ($p < 0.001$). It is concluded that the PROGAT® device installed in a vehicle transporting cattle constitutes a clear improvement in animal welfare by reducing the amount of bruises produced during transport from the farm to the slaughter house.

THE SOUND OF CLAW LESIONS: DETECTION OF LAMENESS BY ACOUSTIC ANALYSIS

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Animal welfare is one of the most important quality indicators in livestock production for many consumers and of rapidly growing social relevance. An important factor for animal welfare in cattle farming is the detection of lameness, which is caused by diseases of the claws and limbs. The presented study is part of a project aiming to develop a system which is capable of an automated and early diagnosis of lameness in cattle by analysing the footfall sound. It was conducted in a freestall barn where the lactating cows were housed in two sections. The pen of group 1 (n=36) consisted of slatted floor and group 2 (n=40) was housed in a deep straw barn. Testing of the cows walk was conducted along a runway with slatted floor situated outside the barn. In one part of this alley (length: 3.1m; wide: 0.8m) eight piezoelectric sensors recorded the footfall sounds of the cows. Simultaneous the locomotion of the animals was scored (LS1=non-lame; LS2=uneven gait; LS3=lame), their run was recorded by video and the cows were weighted. Subsequently the cows were examined by a professional hoof trimmer and were grouped into a four-level system concerning their claw lesions (0=no disease; 1=non-infectious disease; 2=infectious disease). The average time for passing the measuring section (WS) was 3.68 seconds and the mean standard deviation in the volume (SDV) was 0.019 decibels. The mean WS was significantly higher in the cows with LS2 (4.09s) and LS3 (3.78s) compared to animals with LS1 (3.21s) and, thus, showing a smooth and quick gait pattern. The SDV in the recorded sound signal was considered as a factor for the force of cow's footsteps. Therefore, a higher value of SDV describes an increased difference between sound signal and no sound signal. Actually, cows with non-infectious diseases showed a significantly lower SDV (0.017dB) than healthy ones (0.021dB). This result confirmed the assumption, that in particular cows with non-infectious diseases have the greater sensitivity to pain and demonstrate a less forceful respectively loudly gait pattern. These first results clearly show the potential of footfall sound analysis for individual lameness detection.

The project is supported by funds of the Federal Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany via the Federal Office for Agriculture and Food (BLE) under the innovation support programme.

THE POTENTIAL OF POST-MORTEM CARCASS ASSESSMENTS IN REFLECTING THE WELFARE OF BEEF AND DAIRY CATTLE

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There is increasing interest in utilizing meat inspection data to help inform farmers of the health and welfare of their herds. The aim of this study was to determine the ability of carcass assessments in beef and dairy cattle to reflect the welfare of the live animal. A secondary aim was to determine how beef and dairy cattle differed in their incidence of various conditions at slaughter. Ante-mortem measures of lameness, cleanliness, skin lesions, hair loss and body condition, and post-mortem measures of carcass bruising and carcass weight, were assessed in 305 beef (n = 123) and dairy (n = 182) cattle from an abattoir in south-west England. The age and sex of each animal, slaughter day and number of movements before slaughter were also recorded. For dairy cattle, sex and slaughter day were predictors of carcass bruise score while skin lesion score, body condition, age, slaughter day and number of moves were predictors of carcass weight. For beef cattle, lameness score, cleanliness score and age were predictors of carcass bruise score while lameness score, body condition and sex were predictors of carcass weight. These results suggest that recording carcass weight and carcass bruising at meat inspection may have potential as a general indicator of health and welfare status in cattle. Animal characteristics such as sex and age should be taken into account when interpreting the results. In addition, recording of input-based information such as slaughter day and cattle movements may help in identifying the source of welfare problems. Dairy cattle had lower carcass weights, poorer body condition, more bruising and tended to be lamer than beef cattle. All of the recorded issues affected both breeds and are therefore relevant to record in both beef and dairy cattle. Longitudinal research is now needed to compare lifetime welfare status of cattle to damage visible on the carcass.

SCRATCH THE SURFACE. HISTOPATHOLOGY OF FOOT PAD DERMATITIS IN TURKEYS

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Measuring the severity of foot pad dermatitis (FPD) is one important indicator for animal welfare in turkeys. There is a variety of scoring systems used to classify FPD. However, slaughterhouses in Germany generally refer to a five-scale scoring (0-4) to grade the feet of the animals, here using an automated camera system. This system is based on colour-detection and measures the percentage of necrotic lesions on the metatarsal foot pad – with a rising severity grade indicating a higher scoring level. In order to validate this automated system on the one hand and the aptitude of the chosen scoring system on the other, the presented study aimed at analyzing the different scoring categories more in detail. Therefore, 100 feet of turkeys (20 feet per scoring scale) were sampled at the slaughterhouse. To obtain the size, the lesion was measured by length x width, additionally the number of lesions was evaluated. Then, tissue was collected from the center of the biggest lesion/per metatarsal foot pad. This was fixed in 10% neutral buffered formalin and embedded into paraffin wax. Cross sections (3-4 µm thickness) were stained using haematoxylin/eosin. Microscopic examination was done using a light microscope with 40-400x magnification and histological analysis was performed by examining the occurrence and severity grade of different parameters (hyperkeratosis, erosions, ulceration, re-epithelialised granulation tissue and multifocal perivascular pododermatitis).

Correlation between severity score and the size of the lesion was strong ($r_{sp} = 0.9$). However, against the odds the presented study did not confirm a linear increase in the severity of the histological parameters depending on an increase of the severity score. In fact hyperkeratosis was found to be present in all severity grades already, with a decreased occurrence in the most severe scoring class. Multifocal perivascular pododermatitis was most present in scoring class 2, with showing a decreased severity in scoring level 3 and 4. There were no differences in ulceration between scoring classes 2-4; in feet scored 1, more than 50% exhibited ulcerations already.

Therefore, this study not only contributes to a better understanding of the pathophysiology of FPD, but raises the question if, in view of animal welfare, a scoring system based on the size of the lesion only, is sufficient to describe the severity. Considering the histopathological findings the threshold values might have to be adjusted, however, further research according the perception of pain regarding ulcerations is needed.

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THE USE OF RUMEN TEMPERATURE BOLUSES AS A NOVEL WELFARE ASSESSMENT TOOL IN CATTLE: ILLUSTRATED BY MONITORING STRESS-INDUCED HYPERTHERMIA

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There is increasing interest in Precision Livestock Farming, aiming to support goals of sustainable intensification. To date this technology has focussed on optimising animal health and performance. However, there is potential for this technology to enable the assessment and enhancement of animal welfare. Here we present a study illustrating how rumen temperature (RT) boluses offer a novel welfare assessment tool beyond the detection of ill-health for which they were originally developed.

During the pre-slaughter phase cattle are subject to a number of stress-inducing situations, including transportation, mixing and a novel environment. This has a detrimental effect on animal welfare; but also has commercial implications through reduced meat quality; due to insufficient post-mortem muscle acidification following the activation of the sympathetic nervous system. Stress-induced hyperthermia is a well-documented physiological response to stressful events. However, the continuous, non-invasive monitoring of core body temperature in farm animals remains unpractical on a large scale. This is now changing through the development of new technologies. Thus, the objective of this study was to investigate the relationship between pre-slaughter RT, existing welfare measures and instrumental meat quality. Forty Holstein bulls (15.8 ± 0.08 months of age; 575.9 ± 8.84kg live weight) had a RT bolus (Thermobolus, Medria) administered, which recorded RT at 5 minute intervals. Bulls were weighed and blood sampled at 24 and 0 hours prior to transport (26 miles) to a commercial abattoir. A post-slaughter blood sample was obtained during exsanguination. Ultimate pH, an indicator of pre-slaughter stress, was assessed on the *longissimus dorsi* muscle. Blood samples were tested for cortisol, creatine kinase (CK) and lactate dehydrogenase (LDH) concentration. During the pre-slaughter phase, comprising transport and lairage, mean and maximum RT rose significantly (P<0.001) by 0.51°C and 0.57°C, respectively, in comparison to the 48 hours prior to transportation. Cortisol, CK and LDH were significantly (P<0.001) elevated at slaughter in comparison to basal levels, with a positive correlation (P<0.001) between pre-slaughter RT and CK. Ultimate pH was strongly correlated with mean (P=0.002) and maximum (P<0.001) pre-slaughter RT. Therefore, this study demonstrates associations between RT and existing validated measures of welfare and meat quality, highlighting additional benefits of bolus technology.

STOPPING SENSELESS STANDARDISATION: HOW NOT TO WASTE LABORATORY ANIMAL LIVES

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Animal research is due a revolution. Researchers are trained that extreme standardisation is desirable, and that we are more likely to find significant effects by creating uniform and sterile backgrounds. We try to create 'clean slates', so that any effects are unmissable. However, extreme standardisation is neither possible nor desirable. This is because animals are affected by myriad factors that we cannot control, cannot even perceive, or both. Animal senses differ from our own, so they can be affected by odours, ultrasound, and other influences that we understand poorly. Small variations in husbandry can affect animal behaviour and physiology in ways we cannot predict, so 'identical' experiments conducted in different laboratories can yield different results.

Even if standardisation were possible, realisation is dawning that it is undesirable: it contributes to the 'reproducibility crisis', wasting animal lives on invalid results. Knowledge of epidemiology, microbiome, epigenetics and other such fields emphasises that we live in a complex world, so any effects we find must be robust enough to weather the storm of other influences. Research shows that, if we build blocks of variation into our experimental designs, results are more likely to be replicable and valid. Such experiments do not require more animals to be used, and they increase, rather than lessen, the chance of finding (real) effects.

The classic sterile environment also needs rethinking, as environmental enrichment is key to normalcy, and recent research has shown the value of using animals with realistic microbiomes; using abnormal animals leads to further spurious and non-replicable results.

It is time for laboratory animal researchers to embrace 21st century knowledge and research tools to ensure that, when animals must be used, the information gained from them is relevant and valid. The role of funders, publishers, and research organisations will be key to helping researchers to make this leap effectively and without fear of jeopardising their careers. Some potential mechanisms for creating behaviour change will thus be suggested.

AUTOMATIC MONITORING OF PIG HEALTH AND WELFARE

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There are approximately 770 million pigs farmed globally each year, with this number continually growing due both to an increasing human population and a rise in per person meat consumption. Pig welfare and productivity are both affected by poor pig health, but manual health monitoring by farm staff can be both time consuming and imprecise. There is therefore an urgent need to develop affordable precision livestock technologies to automate the early detection of potential health and behavioural issues. Declines in health may be preceded by changes in activity and behaviour budgets, such as decreased movement and a reduction in eating and drinking. Therefore, detecting and tracking the movement of individual pigs presents an ideal objective for automatic monitoring. Several previous studies in this field have used RFID tagging, 3D cameras and 2D image processing techniques and, though successful in their attempts, there is room for improvement in terms of both cost and system efficiency. Here we present a 2D camera-based system using computer vision and deep learning techniques to automatically detect and track pigs with a custom image analysis algorithm. The system does not require the pigs to be physically marked or tagged in any way and functions both in daylight and under near infra-red light during the night. The average tracking success over a trial of 1500 frames was 95.2% with no loss of individual tracks, meaning that all pigs remained correctly identified throughout. The system can cope with common on-farm challenges such as images being obscured by flying insects, poor lighting conditions and pigs occluding one another. We present the feasibility of using the system to monitor, in real time, the health, welfare and productivity of pigs in group indoor housing. We also discuss the potential of using the system as an early warning alarm to predict problems later in life and evident in end-of-life outputs.

ADVANCING THE WELFARE OF WORKING DOGS: WHAT'S PREVENTING SCIENCE HELPING THE CANINES WHO HELP US?

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Animal welfare is an increasingly important consideration for the sustainability of industries utilizing animals. Domestic dogs are currently used in a wide range of roles, including companion, protection, stock herding, detection, assistance and sporting contexts. The work of these dogs is both economically and socially valuable. Perceived welfare of dogs in these contexts varies significantly from poor to very high and can differ between industry stakeholder groups and the general public. Despite significant scientific research into canine breeding, behaviour, training, housing, health and husbandry practices over the past twenty years, many working and sporting dog industry groups do not currently operate from a platform of evidence-based best practice. Many working and sporting dog sectors having success rates (pups bred or purchased for purpose achieving operational working status) under 50%. These practice failures have received significant public and media scrutiny with respect to canine wastage, with some sectors losing their social licence to operate. Using a strategic gap analysis approach, we examined the challenges relating to scientific, social, political and ethical factors that may influence the five domains of welfare for working and sporting dogs. This analysis, in conjunction with a review of the literature and consultation with experts from specific, relevant fields, identified factors preventing animal welfare improvements from becoming established in everyday practice within working dog sectors. Drawing on the fields of strategic planning, culture change and quality management, we also identify established strategies in engagement, communication, collaboration and innovation that would help overcome these challenges. We advocate moving toward a transparent, evidence-based best practice industry environment with a healthy ethos of continuous quality improvement, that connects industry stakeholders in order to develop solutions to shared challenges. We demonstrate that animal welfare science can produce successful applied outcomes that can advance the welfare of working and sporting dogs, and propose that it will need to play a critical part if such dogs are to have sustainable roles in our society.

DO INDIVIDUAL DIFFERENCES IN MULTIPLE MEASURES OF AFFECT AND WELFARE CORRELATE?

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Few animal studies to date have examined the extent to which putative cognitive measures of affect are related within individuals. A number of cognitive measures of animals' affective state, such as judgement biases and sensitivity to reward losses or gains (successive contrast effects), have arisen from consideration of the cognitive signatures of human emotions or emotional disorders. Human perception of time is also often modulated by emotional experiences and altered in psychiatric disorders such as anxiety and depression, making it a potential novel measure of affective state in animals. Here, we consider the extent to which individual differences in these cognitive traits correlate with one another, and with additional welfare measures, in a cohort of European starlings (*Sturnus vulgaris*). In this cohort, we manipulated stressful developmental experience in terms of the amount of food received as nestlings and the begging effort required to get it. Then in a series of studies, we measured birds' developmental and adult telomere attrition (a putative measure of cumulative stress), and as adults their hypothalamic-pituitary-adrenal axis response to an acute capture-handling-restraint stressor, behavioral response to reward loss or gain in successive contrasts, pessimism in a cognitive bias task, and time perception in a peak procedure task. We examine how strongly individual differences in these welfare measures correlate, shedding light on the extent to which they may be considered to measure the same underlying construct.

INCREASING ANIMAL WELFARE AND RELIABILITY OF RESULTS FROM PRECLINICAL TRIALS AND ANIMAL STUDIES: ZOOMING IN ON VARIATION IN ADAPTIVE RESPONSE PATTERNS WITHIN AND BETWEEN THREE INBRED MOUSE STRAINS

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Inter-individual differences in behavioral response in mouse inbred strains are often written off as unfortunate noise. We suggest that part of this variation may provide useful information on variation in adaptive capacities in response to aversive or positive stimuli. More insight in these capacities ensures more accurate assessment of which individuals are at risk for compromised welfare. At the same time, on a more fundamental experimental level, capturing part of this variation may better control for confounding variables and thus improve reliability of preclinical results.

In order to do so we have developed a method that allows for the assessment of temporal behavioral response curves on an individual level. Our approach follows the dynamic concept of animal welfare that states that an animal is likely in a positive welfare state when it is capable and able to react appropriately (i.e. adaptively) to the demands of the environmental circumstances, enabling it to reach a state that it perceives as positive. This view implies that in order to assess which individuals are able to adapt one should measure the temporal progression of a response, alongside the magnitude of that response.

We assessed the level of inter-individual variability in adaptive capacities to an aversive stimulus in three commonly used mouse inbred strains by testing male BALB/cAnNCrl, C57BL/6NCrl and 129S2/SvPasCrl mice [N = 40 per strain] for four consecutive 5-minute trials in an initially unknown environment [the modified Hole Board]. Adaptive capacities were assessed by behavioral responses and corticosterone levels.

For analysis, behavioral responses were summarized in composite variables representing underlying behavioral dimensions: anxiety, avoidance behavior, locomotion, arousal and exploration. Scores on these behavioral dimensions were combined with corticosterone levels for each individual, resulting in six trajectories per mouse. Multivariate approaches subsequently explored whether it was possible to 1. identify homogenous subgroups of individuals that show the same response over time within a single dimension, and 2. Identify response types: subgroups of individuals that consistently group together across multiple dimensions.

The results showed that mice indeed grouped together across multiple dimensions: the analyses yielded two response types of different adaptive value. Interestingly, these types were displayed by individuals of all three strains. Also, some strains showed greater within strain variability than others. We are currently elaborating on these findings in a follow-up experiment that explores whether taking this variation into account indeed increases reliability of results in preclinical trials and animal studies.

CHALLENGES ASSOCIATED WITH ASSESSING AND IMPROVING THE WELFARE OF FARMED FISH

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World-wide approximately 360 finfish species are reared for food production in aquaculture. Finfish represent a class of animals in which there is huge variety regarding phylogeny, behaviours and habitats. Due to this diversity, the welfare needs of fish can differ noticeably. In addition, these welfare needs also depend on their life stages.

For finfish a wide range of rearing systems are used. These rearing systems can be grouped in two categories: i) land-based (e.g. ponds); and ii) water-based, for instance cages. During rearing fish are also subjected to a large variety in handling operations.

Obviously, the variety in finfish species, rearing systems and handling operations, present a challenge to assessment of fish welfare throughout production. The implementation of technologies and/or management procedures to improve their welfare poses a challenge as well.

To assess welfare of fish, welfare indicators are needed. These indicators are measures of fulfilment of the welfare needs for a given species and life stage under the production conditions concerned. Two types of welfare indicators exists, i.e. animal-based indicators (e.g. skin condition) and input-based indicators (e.g. stocking density). For both types of indicators standards are needed to determine whether welfare is e.g. good, acceptable or poor. Subsequently, welfare assessment schemes can be developed. Clearly, the use of a welfare assessment scheme only is not focused on preventive measures, nor control of the entire process. To achieve this, an approach based on 1) a thorough analysis of conditions used during production, considering the specific requirements of a fish species and its life stages; and 2) a review of the entire process, is needed. For this Quality Assurance appears to be a suitable approach, as it is process-oriented, efficient, focused on preventing hazards, it involves establishing critical steps and standards for these steps.

To implement technologies and/or management procedures to improve fish welfare, the following two-step approach is proposed: 1) proof of concept: establish specifications in a laboratory setting for a technology or for a management procedure by assessment thereof in a team; 2) evaluate the implementation of the results in practice.

In the view of the author, the combination of Quality Assurance and welfare assessment schemes is a generic approach to monitor and safeguard welfare of farmed fish. To control an implemented technology/management procedure, it is recommend to supplement the two-step approach by the use of a Quality Assurance system, as third step.

MATHEMATICAL MODELLING OF *CAMPYLOBACTER* IN A BROILER FLOCK

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The bacterial genus *Campylobacter* is one of the leading causes globally of human gastroenteritis, with its primary route of infection being through poultry meat. Despite decades of study we appear to be no closer to preventing outbreaks within commercial chicken flocks, and the application of biosecurity measures is limited by a lack of understanding of the transmission dynamics within a flock. Our work is the first to undertake a mathematical modelling approach to *Campylobacter* population dynamics within a flock of broilers (chickens bred specifically for meat). A system of stochastic differential equations is used to simulate the diverse and fluctuating conditions within the gut of a broiler, and models the routes of infection between co-housed birds. The presented model allows us to give mechanistic explanations for key infection dynamics that have been long-observed and poorly understood. We highlight several driving mechanisms behind observed infection phenomena, simulate experimentally observed inter-strain competition, and present a promising approach to hypothesising new methods of preventing flock outbreaks.

This mathematical framework shows that poor bird welfare and gut health are the biggest contributing factors to sustained periods of high infection. Improving the welfare of broiler chickens can mechanistically reduce the chances of *Campylobacter* infiltrating a flock, and hence directly reduce the chances of human infection.

ANIMAL WELFARE ASSESSMENT – DO WE KNOW WHAT WE ARE MISSING?

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Our conventional approach to animal welfare has been to measure and interpret from a human perspective. Common approaches are to use physiological measures for which we have validated methodology or to measure behaviours for which we have anthropomorphic explanations. We can also be restricted by a tendency to look for patterns that we want to see, or are expecting to see. There is nothing wrong with these approaches, and indeed they have expanded the boundaries of animal welfare science to where we are today. However, opportunities exist for measuring far more and add more value. Studies are revealing aspects of sensory abilities and communication among animals that were previously unknown, such as frequencies we cannot hear, and light spectrums we cannot see. New technologies are also extending our ability to measure in different realms. Therefore, there is increasing evidence that we are not seeing the whole picture when we are trying to understand what an animal is experiencing. Much of the information or messaging may be lost, and incorrect inferences made, simply because we may not even know what we are missing.

We are exploring this hidden world and it is revealing a fuller perspective of sentience and animal experiences. We will discuss the use and limitations of two methodologies, infrared thermography and high frame rate video combined with machine learning, to identify and interpret facial changes. Infrared thermography has revealed emotional responses, captured as changes in temperature patterns. We are also using high frame rate video to extend this work and automatically detect a range of emotional responses, thus applying affective computing in an animal welfare paradigm.

The ultimate aim is to gather a more complete assessment of animal experiences that can be used to provide assurances about quality of life. Extending our assessments into the animal's domain will be credible to a broader section of society than a purely human-centric approach.

A SYSTEMATIC REVIEW OF SOCIAL AND ENVIRONMENTAL FACTORS AND THEIR IMPLICATIONS FOR INDOOR CAT WELFARE

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Cats are one of the world's most populous companion animals, yet little is known about how home environments are adapted relative to their needs. Outdoor access is thought to be beneficial for both the physical and mental wellbeing of cats, yet as urbanisation increases, reducing owner access to outdoor spaces, increasing numbers of cats are kept strictly indoors. The impact of an indoor lifestyle on feline behaviour and welfare is little explored and poorly understood. This study used a systematic review to assess scientifically validated knowledge concerning social and physical environments and their implications for indoor cats. A total of 61 papers were analysed. Only n=21 papers directly addressed at-home indoor scenarios with the remainder consisting of shelter/cattery (n=27) or laboratory (n=16) (some papers explored multiple environments). Across studies there was little evidence of rigour or systematically controlled approaches. Methods frequently used cat-stress-scores (CSS) and ethograms, neither of which were consistently standardised; substantially reducing the ability to compare findings among studies. Numerous studies explored similar variables (i.e. provision of hiding space (n=9)) yielding little additional knowledge. Measures of welfare and behaviour were often assessed using single parameters in controlled environments. Although this may be useful and applicable to cat experiences within shelters, catteries and laboratories, the findings do not necessarily translate to dynamic and variable household environments. Major findings include the benefits of enrichment such as hiding boxes and vertical resting spaces, as often recommended by veterinarians or feline charities. However, other advice provided, such as the provision of feeding enrichment for psychological welfare, although not necessarily disputed, appears to be scientifically untested. Additionally, despite the social environment being likely to have a substantial effect on cat welfare, it is particularly under-studied in the home, especially in terms of its complexity (e.g. presence of young children or dogs). Overall, the review identified substantial gaps relative to cat experiences and welfare in multifactorial home environments. Understanding the impact of indoor lifestyles and promoting mechanisms to minimise negative impacts on cat welfare remains an important yet underexplored area of research.

Following the review, a questionnaire on the lifestyles of cats was distributed, covering enrichment, social environment and prevalence and expression of problem behaviours and health issues. A total of n=5,469 responses were gathered. Within these responses are sub-populations of indoor-only cats (n=2,270) and those with indoor/outdoor access (n=3,101), cats who live with other cats (n=2,988), dogs (n=983) or children under 17 (n=1,049).

THE WELPA PROJECT: CAN HUMAN BEHAVIOUR CHANGE (HBC) TECHNIQUES HELP TO IMPROVE EQUINE WELFARE IN RIDING SCHOOLS AND LIVERY YARDS?

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At least 470 equine facilities are situated in Flanders (Belgium) and anecdotal data indicate there is room for improvement in the welfare of the horses stabled there. This study first examined the current daily practice at Flemish equine facilities through an online questionnaire (122 respondents). The questions were based on the environmental parameters of the Dutch Equine Welfare Quality® protocol "KPW" (covering all 12 WQ® criteria). Next, 15 facilities (a balanced cross section of the industry) were recruited for a proof-of-principle demonstration project. Thirteen facilities participated until the end. The KPW protocol was used to measure welfare before (PRE, announced, June 2017) and at the end (POST, unannounced, March 2018). All participants were visited to discuss their KPW-assessment results and potential solutions for their farm, and the owners were encouraged to improve their facility before the POST assessment. To understand the potential additional impact of using HBC to encourage implementation of measures to improve the welfare, two routes were explored: a "spray-and-pray" workshop was offered before the discussion visit (10/15 participated) and frequent contact/visits were organized in between the PRE- and POST-assessments to overcome resistance to change (7/13 participated). Group A 6/13 participated in both options, Group B only workshop (5/13) Group C only HBC 1/13, Group D 1/13 did not participate in any option. During the assessment, 20 randomly selected horses were evaluated per facility. Twenty-three environmental- and animal-based combination factors were assessed for each selected horse. In total, data were collected on 244 horses across 13 farms during the PRE-assessment and 245 during the POST-assessment. Feeding management improved significantly (Wilcoxon Signed Rank $p < 0.05$) after 8 months (A 5/6; B 2/5; C 1/1) despite the POST assessment being in the winter period. At 12 facilities, at least 1-6 (management) improvements were made, such as significant adaptations of feeding practices or creating group-paddocks to allow daily turnout during mucking-out for horses who previously had once a week grazing. The facility who did not participate in any option belonged to group D. Four facilities (A 3/6, B1/5) had specific plans for, or started, structural adaptations (rebuilding, creating social contact options between neighbouring boxes; extra paddocks for winter turnout; etc.). In the questionnaire after the POST assessment, 11 owners mentioned they would not have made adaptations towards a better welfare without the HBC sessions. The proof-of-principle was successful, the use of HBC (7/7) had more success than only "spray-and-pray" (3/5).

TO ASSESS ZOO ANIMAL WELFARE USING THE BEHAVIOURAL VARIETY INDEX (BVI)

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Focusing on the presence of species-specific behaviour and the absence of abnormal behaviour and comparing time budgets between wild and zoo settings, has been proven to be a good methodology to assess welfare of the animals. However, to suggest methodologies in the assessment of good rather than acceptable welfare and developing indicators to address the positive welfare of each individual have become increasingly important in animal welfare science. The variety of behaviours performed by each subject could be used as a positive welfare indicator since behavioural variety could be lost during challenging situations that could characterize controlled environments. This study aims to propose a Behavioural Variety Index (BVI) as a tool to routinely monitor the zoo animals' positive welfare. In the current research, basing on data collected through continuous recording of focal animal behaviour, a method used in the human literature to assess hygiene behaviours was reviewed to propose the so-called Behavioural Variety Index (BVI). First, a list of species-specific natural behaviours as complete as possible should be identified based on the existing literature on a species and behaviours should be grouped in different subsets. To calculate the index for each subset, each item is scored as 0 or 1 (performance of the behaviour). The BVI is the sum of all indices. The BVI might help in the evaluation of the variety of behaviours performed by each individual and monitor the diversity of the behavioural repertoire of zoo animals. The comparison of the data on behavioural time budgets between the zoo individuals and wild conspecifics as well as the BVI should provide quantitative and qualitative information on the animal welfare state.

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

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

- 2018 Professor Paul Flecknell (Newcastle University, UK)
- 2017 Professor Sandra Edwards (Newcastle University, UK) and Professor Jeff Rushen (University of British Columbia, Canada)
- 2016 Professor Donald Broom (University of Cambridge, UK) and Professor Christopher Wathes (The Royal Veterinary College, UK)
- 2015 Professor David Mellor (Massey University, New Zealand) and Professor Georgia Mason (University of Guelph, Canada)
- 2014 Professor Mike Mendl (University of Bristol, UK) and Professor David Fraser (University of British Columbia, Canada)
- 2013 Professor John Webster (University of Bristol, UK) and Professor Peter Sandøe (University of Copenhagen, Denmark)
- 2012 Professor Christine Nicol (University of Bristol, UK) and Professor Marian Stamp Dawkins (University of Oxford, UK)
- 2011 Professor Ian Duncan (University of Guelph, Canada)

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

Previous winners have been:

- 2018 Dr Rebecca Meagher (University of Reading, UK)
- 2017 Dr Pol Llonch (Universitat Autonoma de Barcelona, Spain)
- 2016 Dr Rowena Packer (The Royal Veterinary College, UK)
- 2015 Dr Jasmeet Kaler (University of Nottingham, UK)
- 2014 Dr Lisbet Pluym (Ghent University, Belgium)
- 2013 Dr Nuno Franco (Institute of Molecular and Cell Biology, Porto, Portugal)
- 2012 Dr Charlotte Burn (The Royal Veterinary College, UK)
- 2011 Dr Lucy Asher (University of Nottingham, UK), Dr Emma Baxter (Scottish Agricultural College, UK) and Dr Lisa Collins (Queen's University Belfast, UK)

INACTIVE BUT AWAKE BEHAVIOUR AS A POTENTIAL INDICATOR OF A HOUSING-INDUCED DEPRESSIVE-LIKE STATE IN MICE

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An important goal in the assessment of animal welfare is to develop measures of affective state. In humans, chronic negative affective states such as clinical depression are associated with symptoms such as reduced activity and a lack of engagement with the environment. Recent work has started to investigate 'inactive but awake' (IBA) behaviour as a potential measure of welfare in animals, however the link between this behaviour and affective state has not yet been well-validated and characterised. We investigated this link with two strains of commonly used laboratory mice (C57BL/6J and DBA/2J, C57 and DBA hereafter), which have previously been shown to vary in their display of IBA. We took a novel approach by manipulating housing conditions to monitor how IBA behaviour differed following an environmental shift. Thirty-one C57 and 31 DBA mice were mixed-strain pair housed in either a non-enriched (potentially depressogenic) cage (NE; N=16 cages) or a large, highly enriched cage (EE; N=15 cages) for three weeks (Phase 1). Half the cages were then swapped to the opposite housing condition (i.e. NE-EE: N=8 cages or EE-NE: N=8 cages), whilst the other half remained in their environment for a further three weeks (Phase 2). We tested the hypothesis that IBA is an indicator of a depressive-like state and hence predicted that mice housed in NE would display more IBA than those in EE. Furthermore, we expected mice to display more IBA in the EE-NE condition following their environmental shift compared to those housed in NE throughout. Based on previous research, we also predicted C57s to display more IBA than DBA mice. To test these hypotheses, home-cage behaviour was monitored over 12 days during each phase using scan sampling (24 scans/day/mouse). We found that mice spent a greater proportion of scans displaying IBA in the NE than EE condition during phase 1 (χ^2_2=6.92, p=0.003), however contrary to our predictions, DBAs showed more IBA in NE cages than C57s (χ^2_2=5.04, p=0.02). Mice in the EE-NE condition showed the greatest increase in IBA behaviour between phases compared to all other conditions (treatment*phase: χ^2_{10}=11.76, p=0.040). These results suggest IBA has potential as an indicator of a housing-induced depression-like state in mice and provide a platform for validation with additional behavioural indicators within our work. The strain differences measured here conflict some previous findings and warrant further investigation to assess the generalisability of these results across the same and different strains of mice.

EVALUATING WHETHER ANIMAL AND HUMAN INTERESTS ALIGN IN A ZOO-BASED AMBASSADOR ANIMAL PROGRAM WITH AFRICAN PENGUINS

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Many accredited zoos engage in "ambassador" animal programs during which zoo visitors are invited in close contact with animals. In direct and indirect ways, ambassador programs can help zoos meet their missions of education and conservation. However, ambassador programs present particular challenges to ensuring animal welfare. In the present study, we assessed the effects of a new ambassador program on the welfare of zoo-housed African penguins (*Spheniscus demersus*). The program was designed to prioritize animal welfare while maintaining consideration of the visitor experience. In this program, a small group of visitors entered a dedicated portion of the penguins' enclosure up to twice daily. The penguins had the choice to enter or leave this area, and visitors were not permitted to touch the penguins. We evaluated changes in penguin behavior and space use associated with offering the program, and whether individual temperament predicted voluntary participation. We also collaborated with a learning and evaluation team to determine whether the program lead to desired outcomes for visitors. Data were collected for 16 weeks on a colony of 15 penguins and included 43 "Penguin Encounter" events. Behavior during Penguin Encounters was primarily characterized by engaging with enrichment offered by staff. Investigation of visitors was surprisingly rare. Heat maps of the penguins' space use revealed that penguins did not avoid the area in which visitors were seated, suggesting comfort with visitor presence. However, there were marked individual differences in the penguins' voluntary participation in Penguin Encounters which correlated with the results of a temperament test. Specifically, we found that penguins that were more "bold" participated more often, whereas several "shyer" penguins never participated. However, age and sex also corresponded with participation and the relative contribution of these factors is not yet clear. To determine whether offering Penguin Encounters disrupted interactions in the colony, we compared behavior following encounters to behavior during a matched control period lacking an encounter, and found no differences in affiliative or aggressive behaviors. Overall, we conclude that this specific non-contact ambassador program designed to offer the penguins control over their participation had a neutral or positive impact on penguin welfare. Results from the visitor evaluation component indicate that satisfaction was high even though physical contact was not permitted and penguins could leave at any time. These findings demonstrate a case in which human and animal interests appear to align, and provide a framework for evaluation of ambassador animal programs in zoos.

BENEFITS OF TUNNEL HANDLING PERSIST AFTER ADDITIONAL PROCEDURES

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Millions of mice are used every year for scientific research, representing the majority of scientific procedures conducted on animals. The standard method used to pick-up laboratory mice is known as tail handling and involves the capture, elevation and restraint of mice via their tails. There is growing evidence that, compared to tunnel handling, tail handling increases physiological and behavioural signs of anxiety and stress, and induces anhedonia; hence it probably has a negative impact on mouse welfare. Despite this, tunnel handling is yet to be implemented widely across laboratories. To determine the possible reasons for this, we designed a thematic survey to gather feedback on the obstacles and barriers that may be preventing more widespread use of tunnel handling by researchers and other animal care staff. In addition, we investigated whether additional scruff handling and minor procedures negated the reduction in anxiety-related behaviour in tunnel compared with tail handled mice. Even in relatively stress-prone BALB/c mice, tunnel handling caused a substantial reduction in anxiety compared with tail handling, regardless of whether the mice also experienced scruff handling or injection. This suggests that the welfare benefits of tunnel handling are widely applicable and not diminished by the use of other putatively more invasive procedures that are frequently used in the laboratory. We discuss these results and those of the thematic survey with regard to their welfare implications and potential for improving scientific outcomes.

THE EFFECTS OF DOG TRAINING METHODS ON COMPANION DOG WELFARE AND DOG-OWNER BOND

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Methods for training companion dogs range broadly from those using mostly aversive stimuli to those focusing on positive reinforcement. The use of aversive-based methods has been suggested to negatively affect dog welfare and dog-owner relationship. However, the scientific basis is limited: most studies are based on owner-reports and they focus on shock collars. Hence, the present study entails an in-depth study of the effects of training methods on companion dog welfare (Study 1) and dog-owner bond (Study 2).

Study 1 combined a short- and long-term assessment of the welfare of privately owned dogs (n=84) undergoing training at 7 dog training schools in Porto, Portugal (3 reward-based and 4 aversive-based). For the short-term welfare assessment, we analyzed the frequency of stress-related behaviors (e.g., lip lick, body shake) during training sessions as well as salivary cortisol levels at home and after training. Afterwards, for the long-term welfare assessment, dogs underwent a cognitive bias task. Results show that dogs undergoing training at aversive-based schools displayed a significantly higher frequency of stress-related behaviors (M=59±6) than dogs from reward-based schools (M=14±1; $p < .001$) as well as higher increases in salivary cortisol (M=0,12±0,03 and M=-0,03±0,02; $p < .005$); however, no significant differences were found in the emotional states of dogs trained with different methods, as revealed by similar performances in the cognitive bias task.

Study 2 evaluated the impact of training methods on dog-owner attachment. Dogs (n=34) recruited from 6 training schools in Porto, Portugal (3 reward-based and 3 aversive-based) were given a modified version of the Ainsworth Strange Situation Test. The presence and absence of owner and a stranger in a room with the dog was manipulated over different episodes. Dogs' behavior was then analyzed for attachment-related (proximity-seeking, separation-related and secure-base-related) behaviors. Results revealed no significant differences in attachment-related behaviors between dogs trained with different methods.

In summary, our results suggest that the training method affects short-term dog welfare but not long-term welfare or attachment to the owner, at least as measured using the current selected methodologies.

LATERAL DIFFERENCES IN EYE AND NOSTRIL TEMPERATURE: A NOVEL APPROACH TO DEVELOPING THERMOGRAPHIC METHODS TO MEASURE EMOTIONS

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Thermography has been used in several animal studies to measure peripheral temperature changes during sympathetic nervous system activity, reflecting emotional arousal but not valence, i.e. whether the experience is positive or negative. Here, we explored surface temperature asymmetry as a novel indicator of lateralised brain functioning linked to valence. Positive emotions are predominantly processed in the left hemisphere and negative emotions in the right hemisphere, with evidence also suggesting familiar stimuli and high arousal are predominantly processed in the left hemisphere and novel stimuli in the right hemisphere. We hypothesised that increased activation of a hemisphere would cause direct heat convection to the ipsilateral eye and increased olfactory nerve activity in the ipsilateral nostril.

The animals were 16 British Blacktail chickens, 20 Holstein cows and 63 Holstein calves. Experiments on chickens involved exposure to familiar vs. novel environments and attractive, mildly aversive, familiar and novel foods and objects. Observational studies on cattle involved positive and negative events caused by farming practices, e.g. feeding, agonistic interactions and seeing others being hoof-trimmed or disbudded. Thermal imaging was carried out with a FLIR T660 thermal video camera.

In chickens, moving to a familiar room elicited higher right-vs.-left nostril temperature (mean difference 0.3°C, SE 0.2) and to a novel room, higher left-vs.-right (mean difference 0.5°C, SE 0.2); t=–2.6, P<0.05. Responses to stimuli also differed in their changes over time: e.g. an attractive-novel stimulus elicited a left- but not right-nostril temperature decrease over ca. 1min (from mean 29.2°C, SE 0.5 to mean 27.5°C, SE 0.4; W=0.0, P<0.05). In cows, eye temperature asymmetry during feeding reflected adverse farm management events pre-feeding. Cows without adverse experience had a higher average left-vs.-right eye temperature (0.05°C, SE 0.03) and cows with adverse experience, a higher average right-vs.-left (mean difference 0.1°C, SE 0.07); t=2.3, P<0.05. Frequency of receiving inter-cow agonistic interactions was correlated to a higher left-vs.-right nostril temperature; r_S=0.51, P<0.05. Calves watching another calf being disbudded without having experienced it themselves had a higher right-vs.-left eye temperature (mean difference 0.4°C, SE 0.1), while calves that had been disbudded in the past had a higher left- vs. right eye temperature while watching (mean difference 0.3°C, SE 0.2); t=–2.8, P<0.05.

These findings confirm the existence of lateralised temperature effects elicited by emotional states, highlighting the multifactorial nature of different lateralised brain processes. The results open a new research avenue for studies on the dynamics and mechanisms of thermal lateralisation.

UNDERSTANDING PUP MORTALITY IN LABORATORY MOUSE BREEDING: HOW THE PRESENCE OF AN OLDER LITTER IN THE CAGE AGGRAVATES PRE-WEANING MORTALITY IN MICE HOUSED IN TRIOS AND IN PAIRS

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The use of animals in research in the EU is regulated through the 2010/63/EU directive, which embeds the 3R´s (Replacement, Reduction, and Refinement) principle. Reducing the number of animals used in research is therefore mandatory in the design of scientific protocols, as well as in other aspects of research animal management, such as breeding. Still, pre-weaning mortality is a big problem in breeding of laboratory mice, the most common species used in research. Mortality rates have been reported to average between 30 and 50% within a range from 0 to 100% (total litter loss) among distinct studies across the globe. Some risk factors for pup mortality have been suggested, but largely very little is known about how to ensure good pup survival. Using a combination of experimental and observational methods, we identified the presence of an older litter in the cage and the housing configuration (Pairs vs. Trios) as critical factors for early pup mortality. The first experiment, conducted in Breeding Facility 1 (BF1, Babraham, UK), compared C57BL/6 litters (55 in total) from breeding Trios without (L- treatment) and with (L+ treatment) the presence of an older litter in the cage. The second observational study, conducted in Breeding Facility 2 (BF2, Porto, Portugal), evaluated pup mortality as a function of a 2 (L- vs. L+) by 2 (Pairs vs. Trios) factorial arrangement of treatments, using a total of 352 litters. Pups were counted daily for 4 days post-partum with minimal cage disturbance. Pre-wean mortality tended to be lower in the L- than in the L+ treatment in BF1 (36 vs. 69%, P=0.06) and was lower in the L- than in the L+ treatment in BF2 for in both Pair (29 vs. 55%, P=0.05) and Trio (17 vs. 41%, P=0.01) configurations. Mortality did not differ between Pairs and Trios when an older litter was present in the cage (55 vs. 41%, P=0.28), but was higher in cages with Pairs when no older litter was present (29 vs. 17%, P=0.01). Although the birth of a litter with the presence of a previous litter in the cage was 45% more likely to occur in cages with trios than with pairs, the overall mortality did not differ between Pairs and Trios (32 vs. 30%, P=0.73). These results suggest that an adequate management of the cage's social environment can potentially reduce pup mortality, leading to a reduction in the number of animals generated for research.

ARE DAIRY COWS DEPRESSED AFTER CALVING?

B Lecorps, DM Weary and MAG von Keyserlingk

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Farm animals' affective states are increasingly considered when addressing their welfare. Understanding what animals feel when subjected to different management practices is likely to improve our ability to find alternatives that promote a better welfare. When considering dairy cattle, it is generally accepted that the time around calving (i.e. the transition period from gestation to lactation) is likely to be the most stressful event of their life but very few studies have explored the subjective state of cows during this challenging period. In this study, we assessed mood over an extended period using an anhedonia test. Anhedonia, considered as a reduced desire to pursue (i.e. wanting) and enjoy (i.e. liking) previously rewarding activities, is a key sign of depression in humans. In a series of studies, we measured the motivation of dairy cows to access and use a mechanical brush. Animals were provided 10 min of brush access every week before and after calving. Latency to brush and time spent brushing were used to assess motivation (i.e. wanting) and pleasure (i.e. liking). In the first experiment, we followed 30 heifers going through their first calving and explored how their use of the brush changed over time. We found that cows increased latencies and reduced time spent using the brush on day 2 after calving (Latencies: $F_{(1,24)} = 7.09$, $P = 0.014$, Brushing duration: $F_{(1,25)} = 55.21$, $P < 0.001$) but progressively recovered over the following weeks (Latencies: $F_{(1,100)} = 6.60$, $P = 0.012$, Brushing duration: $F_{(1,101)} = 9.43$, $P = 0.0027$). These results indicate that cows were suffering from anhedonia after calving. In a second experiment, we focused on the specific effect of cow-calf separation. Cows were either separated from their calves within 2h of calving ('Separated cows', n=12) or allowed continued contact for the first 24h and thereafter contact at night (from 6pm to 6am) for 30 days ('Nursing cows', n=11), after which they were permanently separated. Both groups decreased their use of the brush following calving but this decline was greatest for the Nursing cows on day 2 after the first separation (Nursing: - 40.52 ± 8.51 % vs Separated: - 11.35 ± 7.77 %; $F_{(1,20)} = 6.41$, $P = 0.02$). Similar results were found on day 30 after the second (definitive) separation (Nursing: - 29.40 ± 12.40 % vs Separated: + 5.29 ± 11.87 %; $F_{(1,21)} = 4.08$, $P = 0.056$). These results indicate that separating cows from their calf (in the day when cows were tested) causes an enhanced anhedonia response in cows that were allowed 24 h to bond with their calves and this effect could be replicated when cows were definitely separated after a month. Our results suggest that anhedonia tests can provide insights into the affective states of cows and that the post-calving period is associated with deficits in reward sensitivity, especially in cows separated after having been allowed a longer period to bond with their calves.

SCIENTIFIC PROGRAMME:

Poster Abstracts

List of posters

Poster session 1 on 3rd July. Begins at 13.20.
Poster session 2 on 4th July. Begins at 13.30.

Poster session	
1	**Armstrong E, JH Guy, T Boswell and TV Smulders** (*Newcastle University, UK)* Comparing effects of housing system and physical condition on adult neurogenesis in the hippocampus of commercial laying hens
2	**Bakony M, G Kiss and V Jurkovich** (*University of Veterinary Medicine, Budapest, Hungary)* The effect of hutch orientation on primary heat stress responses of dairy calves
1	**Bamford LA and D Iveson** (*University Centre Myerscough College, UK)* Is infrared thermography a reliable indicator of lameness and foot disease in sheep?
2	**Bell L and S Holmes** (*University Centre Myerscough College, UK)* Using vocalisations to interpret behavioural responses to environmental enrichment of African grey parrots (*Psittacus erithacus*)
1	**Bill J, C Kirschbaum, SL Rauterberg, N Kemper and M Fels** (*University of Veterinary Medicine Hannover and Technical University of Dresden, Germany)* Limits to the usage of hair glucocorticoids to detect stress in rabbits
2	**Binding S, H Farmer, L Krusin and KA Cronin** (*European Association of Zoos and Aquaria, The Netherlands; Whitley Wildlife Conservation Trust / Paignton Zoo, UK; Lincoln Park Zoo, USA)* The challenges, opportunities and status of animal welfare research in zoos and aquaria
1	**Bobadilla PE, SM Huertas, E Akkermans, H Bueno and FJCM van Eerdenburg** (*Universidad de la República, Uruguay; OIE Collaboration Center on Animal Welfare and Livestock Production Systems (Chile-Uruguay-México); University of Utrecht, The Netherlands)* Silvopastoral system in subtropical region: A tool to improve beef cattle welfare
2	**Chan M and TV Smulders** (*Newcastle University, UK)* A review of the use and husbandry of chickens used in scientific research
1	**Chincarini M, F Biscarini, S Cannas, S Mazzola, R Piccinini, C Palestrini, M Minero, E Dalla Costa, G Vignola and G Minozzi** (*Università degli Studi di Teramo and Milano, CNR-IBBA, Milan, Italy)* How different husbandry conditions influence gut microbiome, cortisol level and behaviour in lambs?
2	**Dietz L, AK Arnold, VC Goerlich-Jansson and CM Vinke** *(Utrecht University, The Netherlands)* The importance of early life experiences for the development of behavioural disorders in domestic dogs
2	**Ferreira VHB, EP Fonseca, ACCSD Chagas, LGM Pinheiro, HPAD Silva, NL Galvão-Coelho and RG Ferreira** *(Federal University of Rio Grande do Norte, Brazil)* I need a friend: Changes in capuchin monkeys' grooming network and their physiological reactions after relocation
1	**Haverbeke A, S Uccheddu and A Sannen** *(Vet Ethology, Overijse and Odisee University College, Belgium)* The effect of olfactory enrichment with *Lavandula angustifolia* on dogs in a novel environment

Poster session

2 **Heimbürge S, E Kanitz, A Tuchscherer and W Otten** (*Leibniz Institute for Farm Animal Biology, Germany)*
Evaluation of hair cortisol concentrations as a retrospective indicator for long-term stress in pigs and cattle

1 **Heppenstall R, R Austin, K Collier, P Flecknell, M Bloomsmith and CE Bergmann** (*Oxford and Newcastle Universities, UK; Yerkes National Primate Research Center, USA)*
From bench to cage-side: Integration of novel semi- automated methods for welfare assessment of group-housed rhesus macaques used in biomedical research

1 **Herzog AC, S Hörtenhuber, C Winckler and W Zollitsch** *(University of Natural Resources and Life Sciences Vienna and Research Institute of Organic Agriculture, Vienna, Austria)*
Effects of animal welfare improvement measures on the environmental impact of dairy farming – a case study for Austria

2 **Iyasere OS, JO Daramola, M Wheto, D Adeuyi, RA Alade, S Emmanuel and AV Falana** *(Federal University of Agriculture, Nigeria)*
How mating ratio compromises the welfare of Nigerian indigenous chickens

1 **Jung L, H Dirks and U Knierim** *(University of Kassel* and *CLK GmbH, Altenberge, Germany)*
Keel bone damage in laying hens – automatic measurement for long term monitoring at the slaughter line

2 **Jurkovich V, F Tóth, D Varga, OK Tóth and Á Végh** *(University of Veterinary Medicine, Budapest and Alpha-Vet Ltd, Székesfehérvár, Hungary)*
Assessment of horse welfare in a travelling circus in Hungary

1 **Kaurivi YB, R Laven, R Hickson, T Parkinson, K Stafford** *(Massey University, New Zealand)*
Identification of suitable animal welfare assessment measures for extensive beef systems in Namibia

2 **Knowles L, M Farrell and VT Montrose** *(Hartpury University Centre and ZSL London Zoo, UK)*
The effects of personality upon breeding success in Humboldt penguins (*Spheniscus humboldti*)

1 **Kopplin RI, AT Rutberg and CP Kozlowski** *(Tufts University and Saint Louis Zoo, USA)*
Chew on this: Creation of a saliva collection protocol for giraffe to evaluate welfare

2 **La Cauza GF, G Ottolini, B Regaiolli, M Possenti, C Sandri and C Spiezio** *(Parco Natura Viva - Garda Zoological Park, Arca ambulatorio veterinario, Cassano D'Adda and University of Bologna, Italy)*
How to live together: A mixed-species exhibit of Ara parrots

1 **Lange A, L Bauer, V Wisenöcker, S Lürzel, A Futschik and S Waiblinger** *(University of Veterinary Medicine, Vienna and JK University Linz, Austria)*
Differences in ear positions during gentle human-cattle interactions

2 **Lidster K, K Owen, WJ Browne and MJ Prescott** *(National Centre for the Replacement, Refinement and Reduction of Animals in Research, UK)*
An international crowdsourcing data project to investigate aggression in group-housed laboratory male mice

2 **Lloyd K, A P Wills and S Taylor** *(Hartpury University Centre, UK)*
The anxiolytic effects of valerian (*Valeriana officinalis*) on the domestic dog (*Canis familiaris*)

Poster session

2 **Louton H, A Piller, S Bergmann, A Schwarzer, J Stracke, B Spindler, N Kemper, P Schmidt, J Bachmeier, B Schade, B Boehm, E Kappe and M Erhard** *(Ludwig-Maximilians-University Munich, Stiftung Tierärztliche Hochschule Hannover, Paul Schmidt Consulting, Brüterei Süd ZN of the BWE-Brüterei Weser-Ems GmbH and Co. KG and Bavarian Animal Health Service, Germany)*
Histological validation of a macroscopic visual scheme for the assessment of contact dermatitis of the hock (Hock burn) of broilers

2 **Louton H, E Rauch, S Klein, J Mönch, I Wolff, J Bachmeier, P Schmidt and M Erhard** *(Ludwig-Maximilians-University Munich, Brüterei Süd ZN of the BWE-Brüterei Weser-Ems GmbH and Co. KG and Paul Schmidt Consulting, Germany)*
A comparison of two harvesting methods (mechanical and manual) of broilers with respect to animal health

1 **Lürzel S, K Spiesberger, M Patzl, A Futschik and S Waiblinger** *(University of Veterinary Medicine, Vienna and JK University Linz, Austria)*
Effect of play behaviour on salivary immunoglobulin A in calves

1 **Mcloughlin M, ZX Xie, ZQ Xie, Y Gao, B McCarthy, J Theobald, D Bhatta, G Wei, R Stewart and AG McElligott** *(Queen Mary University, BMCE Networks, Parc House and University of Roehampton, UK; Guangxi Veterinary Research Institute and Talent Cloud, Nanning Zhongguancun Innovation Demonstration Base, China)*
Cloud-based classification of broiler chicken vocalisations

2 **Nnenna U, E Chinedu and A Micheal** *(University of Nigeria, Nsukka, Nigeria; University of Bristol, UK)*
Evaluation of spermatic cord as an alternative ligature for surgical castration in dogs

1 **Obzerova S** *(University of Veterinary Medicine in Kosice, Slovakia)*
Positive reinforcement training in ovine orthopaedic models - Going the extra mile

2 **O'Hagan DD and TV Smulders** *(Newcastle University, UK)*
Assessing transient affective state using intracranial recordings of brain oscillations in poultry

1 **Orr B, J Norris, M Westman and R Malik** *(The University of Sydney, Australia)*
Welfare implications of hunting pigs with dogs in Australia

2 **Osorio-Santos Z, R Albernaz-Gonçalves, MJ Martins Leandro, MC Yunes and MJ Hötzel** *(Universidade Federal de Santa Catarina, Brazil)*
Is a natural system good for the chicken or for the consumer?

1 **Pereira FC, D Enriquez-Hidalgo, ABA Torres, MF Donoso, DL Teixeira, L Boyle and LCP Machado Filho** *(Universidade Federal de Santa Catarina, Brazil; Pontificia Universidad Catolica de Chile, Chile; Teagasc, Ireland)*
Behavioral response of dairy cows to a change in environment

2 **Pierard M** *(Hartpury University, UK)*
Developing reference ethograms: A case study on horse behaviour

1 **Poirier C, CJ Oliver, J Castellano Bueno, P Flecknell and M Bateson** *(Newcastle University, UK)*
Understanding stereotypic pacing in laboratory macaques: Why is it so difficult?

1 **Quintavalle Pastorino G, M Albertini, S Bianchi, M Faustini, D Vigo and F Ferrucci** *(Università degli Studi di Milano, Italy; Manchester Metropolitan University and RZSS Edinburgh Zoo, UK)*
Horse behaviour and expected performance in show-jumping

1 **Quintavalle Pastorino G, D Nicoll, L Moffat, R Pizzi, M Faustini, G Curone and S Mazzola** *(Università degli Studi di Milano, Italy; Manchester Metropolitan University, UK)*
Do personality traits diverge in different communally housed captive penguin species?

Poster session

2 **Regaiolli B, C Spiezio and C Sandri** *(Parco Natura Viva - Garda Zoological Park and University of Bologna, Italy)*
A practical example of the use of behavioural variety index (BVI) in zoo Northern bald ibis

1 **Rose PE and LM Riley** *(Universities of Exeter and Winchester and WWT, UK)*
The application of Qualitative Behavioural Assessment to zoo animal management and individual animal welfare auditing

1 **Sangaré A, PL Simmy, AG Soumah, MCM Haba, ZMM Gbillimou and AM Baldé** *(Université de N'Zérékoré, Institut de Recherche Environnementale de Bossou and Centre de Recherche et de Valorisation des Plantes Médicinales, Guinée)*
The opinions of the population of Bossou on the progressive disappearance of their secular neighbours, chimpanzees

1 **Sharma A, G Umapathy, V Kumar and CJC Phillips** *(University of Queensland, Australia; Centre for Cellular and Molecular Biology, Hyderabad, India)*
Hair cortisol analysis in sheltered cows and its association with various welfare indicators

2 **Smid AMC, S Gulati, E McConnachie, DM Weary and MAG von Keyserlingk** *(University of British Columbia, Canada)*
Increasing cost to access a mechanical brush causes behavioural rescheduling in cows

1 **Smith LM, S Hartmann, AM Munteanu, P Dalla Villa, R Quinnell and LM Collins** *(University of Leeds, UK; VIER PFOTEN International, Austria; Istituto Zooprofilattico Sperimentale dell'Abruzzoe del Molise "G. Caporale", Teramo, Italy)*
The effectiveness, efficiency and welfare impacts of dog population management methods

1 **Soriano VS, MS Heidemann and CFM Molento** *(Federal University of Paraná, Brazil)*
Sheep farmers' perception of sheep welfare in southern Brazil: Preliminary results

2 **Sund Hagelberg S** *(Autonomous University of Barcelona, Spain)*
Horses and equitation: "Well-being as a measure for welfare"

1 **Teixeira DL, LC Salazar and L Boyle** *(Pontificia Universidad Católica de Chile, Chile; Teagasc, Ireland)*
On-farm risk factors associated with welfare conditions potentially detectable in pigs at ante-mortem inspection

2 **Tenório JPL, ECO Sans, MS Heidemann and CFM Molento** *(Federal University of Paraná, Brazil)*
Motivation for chasing behavior displayed by community dogs

1 **Tschoner T, M Behrendt-Wippermann, A Rieger, M Metzner, G Knubben-Schweizer, F Reichmann and M Feist** *(Ludwig-Maximilians-Universität Munich, Germany)*
Multimodal approach to pain management during umbilical surgery in calves

2 **Valgaeren B, D Maryns, G Meulemans, A Van Nuffel, E Struelens and J Aerts** *(Ghent University College, Ghent University and Flanders Research Institute for Agriculture, Fisheries and Food, Belgium)*
RUMIN_AAI: Optimization of small ruminant welfare in petting zoos

1 **van den Eede, B de Feyter, L Cousyn, A van Nuffel, F Deruyck and F Sierens** *(Ghent University College, Belgium)*
Making virtual a reality in on site animal-related education

2 **van der Laan JE and CM Vinke** *(Utrecht University, The Netherlands)*
Assessing adaptation to short-term challenges in sheltered dogs (*Canis familiaris*) as predictor of long-term adaptation to a shelter environment

Poster session

1 **van der Staay FJ, N Endenburg, VC Goerlich-Jansson and SS Arndt** *(Utrecht University, The Netherlands)*
DAWCon: A dynamic animal welfare concept

2 **van Eerdenburg FJCM, T Hof, B Doeve, L Ravesloot, R Nordquist and FJ van der Staay** *(Utrecht University, The Netherlands)*
The relation between hair-cortisol concentration and various welfare assessment protocols in Dutch dairy farms

1 **Vervaecke H, M Debille and P Verbeke** *(Odisee University College and BioForum Vlaanderen Antwerp, Belgium)*
Breeders' opinions about mobile-slaughter of cattle in Flanders

1 **Vervaecke H, A Verlent, CPH Moons, M Eens and E Van Tilburgh** *(Odisee University College, Universities of Ghent and Antwerp and Department of the Environment, Belgium)*
The animal welfare concept among students of animal-oriented studies in Flanders

2 **Vidal M, JP Durieux and A Viera** *(Montpellier SupAgro, France; Federal Agency for Médecines and Health Products, Belgium; University of Lisboa, Portugal)*
Educate for animal welfare by promoting learner empowerment

2 **Waley D** *(Eurogroup for Animals, Belgium)*
Perceptions of fish welfare in Europe

1 **Watteyn A, M Thys, L Stadig, G Vandepoel, B Sonck and F Tuyttens** *(Flemish Research Institute for Agriculture, Fisheries and Food and Boerenbond, Belgium)*
Animal welfare assessment tool for poultry, pig and cattle farmers via mobile application

2 **Witham CL, F Peters and DA Farningham** *(Newcastle University and MRC Harwell, UK)*
Fight injuries and productivity in Rhesus macaques

COMPARING EFFECTS OF HOUSING SYSTEM AND PHYSICAL CONDITION ON ADULT NEUROGENESIS IN THE HIPPOCAMPUS OF COMMERCIAL LAYING HENS

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Animal welfare assessment would be facilitated by a physiological marker which integrates experiences over a long time period in a valence-specific manner. In rodents, adult hippocampal neurogenesis (AHN) is suppressed by chronic stress and pain, whilst being increased by experiences associated with improved mood, such as exercise, environmental enrichment and antidepressant treatment. Our research group have similarly demonstrated that AHN levels in laying hens are suppressed by exposure to unpredictable chronic mild stress, as well as being negatively related to severity of acquired keel bone damage. We thus proceeded to investigate whether AHN also reflects the varying experiences of individual hens kept under commercial conditions in two contrasting housing systems.

In a 2x2 design, adult hens of good (n=12) and poor (n=12) physical condition, as defined by criteria including feather coverage, body mass and comb colour, were sampled both from a multi-tiered housing system with a range and a colony group-cage system (total n=48, mean age 66 weeks). Both systems were operated by the same UK production company. Body and spleen masses were quantified and samples of brain, blood, spleen and caecum were collected for further analyses. As expression of the protein doublecortin (DCX) provides a marker of immature neurons arising from AHN, we are currently using immunohistochemistry to stain DCX-positive cell bodies, which will be quantified in serial hippocampal sections.

As expected, good condition birds were heavier than poor condition birds ($p=.008$). When controlling for body mass, an interaction between housing system and physical condition on spleen mass could be observed ($p=.007$). Specifically, within the colony system alone, poor condition birds had heavier spleens than good condition birds ($p=.019$), whilst the former group had higher spleen mass than hens of equivalent condition in the multi-tier system ($p=.001$). In contrast, no difference in spleen mass was present between housing systems for birds in good physical condition ($p=.851$). We are currently measuring the gene expression of inflammatory and infection-responsive cytokines in spleen samples using real time qPCR, to explore the possible influences of chronic stress and infection history. The results of this molecular analysis, along with preliminary DCX+ cell counts, will be presented at the meeting. Collectively, the findings from this study should help illuminate how variability in key animal welfare measures between different housing systems compares to individual differences in experiences within them.

THE EFFECT OF HUTCH ORIENTATION ON PRIMARY HEAT STRESS RESPONSES OF DAIRY CALVES

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Dairy calves in Europe are predominantly housed outdoors in individual hutches during the first few weeks of life. Synthetic hutches provide good protection against cold, but are disadvantageous in hot and humid weather. Heat stress alleviation in the pre-weaning period is sadly an overlooked area on most farms, presumably due to the low cost-efficiency involved.

We hypothesized that orientation of calf hutches could affect inner microclimate and consequently the heat load of calves on sunny days. Oriented alignment of calf hutches could serve as a no-cost measure of improving calf welfare.

Measurements were made on a commercial dairy farm on a clear, summer day, from 7:00 – 19:00. Respiration rate and behavioural measures (lying vs. standing, hutch vs. pen preference, and exposure to sun vs. shade, respectively) of altogether 20 dairy calves housed in hutches oriented to north, south, east and west, respectively (n=5) were recorded in 20-min intervals. In parallel, main climatic parameters were also recorded inside and outside the hutches. Overall means of temperature curves and individual respiration curves summarizing the difference in heat load and level of heat stress response were compared between hutches of different orientation.

Average radiant and ambient temperatures were slightly higher in west-facing hutches, compared to others (39.8 °C vs 38 °C and 37.1 °C vs 35.5 °C, respectively). Respiration rate was elevated in all four groups, with that of calves in south-facing hutches being higher than other orientations (103/min vs. 90/min). Probabilities of a calf lying, being inside the hutch or seeking shade at the time of observation, respectively, were highest in the group of hutches facing south.

We have concluded that the material and thickness of the hutch greatly influences its heat absorption and dissipation properties, which was reflected in higher temperatures in west-facing hutches exposed to sun until late sunset. Highest level of heat stress in south-facing hutches is attributed to exposure to the most intense solar radiation and least amount of shade during the day. Individual calf hutches are advised to be facing north or east in the summer period.

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IS INFRARED THERMOGRAPHY A RELIABLE INDICATOR OF LAMENESS AND FOOT DISEASE IN SHEEP?

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Livestock lameness is of concern in the agricultural industry for animal welfare and production loss reasons. Early and accurate detection of lameness and foot disease is key for both monitoring foot health, and therefore overall performance, and for ensuring effective treatment is administered. The use of infrared thermography as a diagnostic tool has been utilised most commonly in the dairy and equine sector but less so in sheep production, particularly in relation to foot health. The use of thermography as a reliable diagnostic tool for lameness and foot disease in sheep is currently not fully understood thus the current study aimed to investigate external foot temperature in relation to foot health using infrared thermography. 28 lambs (aged nine months) were selected for the study based on pre-existing poor foot health, each displaying either foot disease (foot rot, shelley hoof, abscess), a lameness score above 0, or both. A control group of 20 healthy animals (aged nine months) were included for comparison with no pre-existing disease or lameness. Thermal images were taken weekly of all four feet for each animal, for a total of eight weeks using a FLIR T420bx Thermal Imaging camera. Surface temperature was recorded for four points of the foot; opening of the interdigital gland, coronary band, top of the hoof, and centre of interdigital space, and correlations between temperature and foot health and lameness score were investigated. No significant differences were observed between *foot disease* and *overall foot temperature* ($P > 0.05$) or *lameness score* and *overall foot temperature* ($P > 0.05$) however for individual points of the foot significant differences were found. Animals with a higher lameness score had significantly higher temperatures ($P < 0.05$) at the *coronary band* in affected feet, and those with an identified foot disease had significantly higher temperatures ($P < 0.05$) at the *coronary band* and *centre of the interdigital space* in affected feet. Findings suggest that infrared thermography could be a reliable indicator of lameness and foot health for specific points of the foot, namely the coronary band and centre of the interdigital space, but possibly not for the entire foot temperature.

USING VOCALISATIONS TO INTERPRET BEHAVIOURAL RESPONSES TO ENVIRONMENTAL ENRICHMENT OF AFRICAN GREY PARROTS (*PSITTACUS ERITHACUS*)

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Environmental enrichment is often presented to cognitive species to increase activity and reduce abnormal behaviours or boredom within their captive environment. Behavioural responses can be noted in response to different types of environmental enrichment with increases in desired or undesired behavioural repertoires. Vocalisations therefore, may indicate changes within the animals' mental wellbeing as well as physical activity in response to such cognitive challenges. It is questionable however, whether vocalisations performed when interacting with complex enrichment is an indicator of behavioural response and current emotional interpretation. As a complex and highly cognitive functioning parrot genus, *Psittacus* are known to possess a complex ability to problem solve. This study aimed to determine changes in vocalisation in response to puzzle feeders of varying complexity. Four captive reared African grey parrots (*Psittacus erithacus*) were observed in their home environment with three puzzle feeders of an 'easy', 'medium' and 'advanced' complexity. Each puzzle was tested five times per parrot in a random order within 2 h observation sessions totalling 120 h over the study. Behavioural responses, latency, time to solve and vocalisations were recorded to determine individual response to the differing enrichment types. Results determined no significant difference between the puzzle type, latency and time to solve despite individual differences in their interaction with the puzzle. 'Age' and 'individual' ($P < 0.01$) and whether they were 'singularly' or 'pair' housed ($P < 0.05$) variables reflected a significant difference in responses. Vocalisation and 'parrot' was found to be highly significantly different ($P < 0.05$) with 'whistle', 'accent changes' and 'reward/frustration' behaviours and 'mimic sounds', '1 word' and '2 word' phrases significant ($P < 0.05$). 'Vocalisations' and 'puzzle type' showed no significant difference although individual responses could be noted ($P > 0.05$). Despite interesting findings in this study, further research is needed to be able to fully interpret vocalisations as a response to cognitive environmental enrichment. To ensure welfare is achieved for such complex species and to maximise the benefits of such devices further research is needed.

LIMITS TO THE USAGE OF HAIR GLUCOCORTICOIDS TO DETECT STRESS IN RABBITS

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One of the great challenges in animal welfare research is finding and interpreting methods, which are suitable to detect negative affective states in animals. Measuring glucocorticoids (cortisol and corticosterone) as an indicator for the activity of hypothalamic-pituitary-adrenal (HPA) axis is a common tool in stress research. In doing so, hair samples have the advantage of being sparsely invasive and pain free and unlike other materials are considered to reflect the HPA axis activity over a much longer period. However, this method has not yet been evaluated sufficiently, in particular regarding the variability of glucocorticoid levels in multiple measurements per hair sample. In this study, hair samples of 10 nulliparous pregnant rabbit does were taken once at the outer side of the hind leg and stored at room temperature until analysis. Samples were parted and subsequently analysed blinded four times for cortisol using enzyme immunoassays and four times again for cortisol and additionally for corticosterone using liquid chromatography with mass spectrometry (LC-MS/MS). Coefficients of variation (CV) for each animal and each glucocorticoid were calculated. Cortisol ranged from a minimum of 0.04 pg/mg to a maximum of 0.82 pg/mg and was lower than corticosterone with a minimum of 1.51 pg/mg and a maximum of 3.89 pg/mg. The animal with the highest median cortisol level had the highest median corticosterone level as well. This was not confirmed in the same way for the other nine animals. The animals with the four lowest median cortisol values had the four lowest median corticosterone values, too, but were in a different order within this group. The relative variability per animal in measured cortisol levels (CV min 22.65 %; max 80.28 %) was much higher than in corticosterone levels (CV min 3.51 %; max 17.16 %). Variability might be caused by different proportions of influencing factors in the sample parts. Those might be the hair growth phase, the distance of hair segments to the skin, cross-reactions of the antibody with other hormones and dirt or contaminations of the hair with glucocorticoids from external sources such as faeces or saliva. The high coefficients of variation for the measured cortisol levels strongly restrict the interpretability of this glucocorticoid for stress research in rabbits. Corticosterone should be preferred from this point of view but further research is necessary to figure out if corticosterone levels are sufficiently correlated to other reasonably valid indicators of high or low stress levels in rabbits.

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

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Research into the conditions that promote positive animal welfare is essential in order for institutions to be armed with the knowledge necessary to create environments in which animals thrive. In order to determine trends and gaps in the empirical information available regarding animal welfare in zoos and aquariums, we conducted a systematic literature review of the primary peer-reviewed journals publishing zoo-based and welfare-based research: *Journal of Zoo and Aquarium Research, Journal of Applied Animal Welfare Science, Applied Animal Behaviour Science,* and *Zoo Biology*. The literature review spanned 2013-2017 and revealed that 18% of 2142 publications in these journals were zoo-based and welfare focused; behaviour was by far the dominant welfare indicator utilised. The dominant topics studied included enrichment, social conditions and enclosure design while understudied topics included the welfare of ambassador animals, and the welfare impacts of noise and lighting. Taxonomic representation in these publications was notably skewed, with 92% of studies being vertebrate-focused (great apes being the dominant taxa). We consider these findings alongside several challenges and opportunities inherent to conducting empirical research in zoos and aquaria, and hope this work helps demonstrate both the available knowledge and areas for more research emphasis moving forward.

SILVOPASTORAL SYSTEM IN SUBTROPICAL/ REGION: A TOOL TO IMPROVE BEEF CATTLE WELFARE

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In many parts of the world, cattle production is based on natural grassland. There is an extended concern regarding the welfare of cattle in these systems, due to their lack of protection from adverse weather conditions. The high number of animals, the farms' size and the access to fresh natural pastures, make it impossible to provide artificial shelters in each paddock (some of them having more than 150 ha) in countries like Australia, New Zealand, Argentina, Brazil and Uruguay. Recently a novel silvo-pastoral production system (SPS) for the subtropical/temperate region has taken hold and it seems to provide a solution to the previously mentioned welfare concern. This system showed promising results in tropical regions regarding animal production and welfare. SPS integrates cattle farming with the forestry industry, allowing the two to co-exist on the same productive surface. Three extensive beef cattle farms located in the central and southeast regions of Uruguay were selected for the study. The three farms breed herds of European beef cattle (*Bos taurus*) on an extensive pasture based production system; having paddocks of extensive, treeless, open pastures (OP) and SPS paddocks, forested with *Eucalyptus spp*, for paper pulp production. On each farm, of animals of the same sex, with similar age, weight and category were selected and randomly assigned to OP or SPS(60 on Farm A, 40 Farm B and 24 on Farm C). Welfare indicators such as absence of visible injuries, lameness, nasal/ocular discharge, panting and diarrhoea were individually recorded by a trained observer, according to the Welfare Quality® Assessment protocol for cattle adapted to local conditions. The results showed that there were no signs of deterioration of animal welfare, according to the measured indicators. The SPS provides shade for cattle, while they graze. The results found here show that the presence of *Eucaliptus spp*. planted over treeless grasslands in parts of Uruguay, did not affect the performance and welfare of certain categories of European breeds cattle allocated in commercial plantations. SPS constitutes a valid alternative for the farmers who could benefit from the additional income generated by the wood production yet maintaining their traditional cattle farming lifestyle, in addition to provide additional shelter areas for cattle.

A REVIEW OF THE USE AND HUSBANDRY OF CHICKENS USED IN SCIENTIFIC RESEARCH

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According to UK Home Office data (2017), birds make up 7% of all animals used in scientific research in the UK. In 2017, 94% of these experimental procedures, a total of 123,740, were domestic fowl (*Gallus domesticus*). With domestic fowls being the most widely used bird in scientific research, it is necessary to examine the use and husbandry status of chickens used in scientific research and how it compares with guidelines issued by the European Convention and Directive and the UK Home Office. Studies using domestic fowl (*Gallus domesticus*) published between 2000 and 2019 were identified from searches on databases Pubmed and Web of Science. Relevant articles were screened using information obtained from the title and abstract. Information such as the country, research topic, and information regarding legislation and guidelines were extracted from the relevant articles. We also extracted the age of the chickens, number of chickens used, the sex of the birds, and noted any procedures carried out on the birds. Information on Housing and Husbandry included the type of housing and size, stocking density, availability of food and water, temperature, the details of housing enrichment, and lighting. The findings from this review will be presented during the conference.

HOW DIFFERENT HUSBANDRY CONDITIONS INFLUENCE GUT MICROBIOME, CORTISOL LEVEL AND BEHAVIOUR IN LAMBS?

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The gut microbiota–brain axis is a bidirectional pathway through which the brain regulates the activity of the gut and *vice versa*. The intestinal microbiota was proven to influence and be influenced by stress-related responses caused by management conditions. The aim of this work was to evaluate whether different husbandry conditions in lambs influenced gut microbiome (composition and diversity), cortisol level and behaviour. Fifteen Sarda breed lambs, aged 6 months, were randomly assigned to three groups of 5 animals each: Isolation (tactile and visual isolation; 3 h/day for 8 weeks); Enriched (in group in a outdoor grassy pen with a new enrichment each week; 3 h/day for 8 weeks); Control (habitual farm environment). Every week, 2 video-recordings of 1-hour each were collected respectively during and after each treatment, and analysed using a scan sampling technique (60 scans per video). Every two weeks hair was collected from the right shoulder using a shave and re-shave method. Cortisol concentration was measured by means of an ELISA test conducted on hair samples and expressed as pg/ml. At week 8 faecal material was collected directly from the rectal ampulla and immediately frozen at −20°C until DNA extraction was performed using a QIAmp DNA Stool kit (Qiagen, Hilden, Germany). DNA quality and quantity were assessed using a NanoDrop ND-1000 spectrophotometer (NanoDrop Technologies, Wilmington, DE, USA). The microbiota of enriched animals was clearly different from the other two groups and showed lower within group variability. During treatment, only isolated sheep showed escape attempts (23% of scans during the first week) and freezing (58% of scans during the first week). In the home pen, after treatment, lambs did not show any stress-related behaviour. After one month of treatment, hair cortisol increased only in the isolated group. In conclusion, differences in microbiome could be related to the different stimulating enrichment and addition of grass on the diet. Although, from a behavioural point of view, sheep apparently habituated to the isolation, increase in cortisol levels could be related to experiencing a stressful situation.

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THE IMPORTANCE OF EARLY LIFE EXPERIENCES FOR THE DEVELOPMENT OF BEHAVIOURAL DISORDERS IN DOMESTIC DOGS

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Behavioural disorders, such as aggression and anxiety, are the major reason for euthanasia and sheltering of pet dogs, thus posing a major welfare problem. To treat, or preferably prevent, behavioural disorders, a better understanding of the underlying causes is necessary. Experiences during early life, such as the quality and quantity of maternal care, attachment and socialisation, have long lasting and serious consequences for the behavioural and physiological development of an individual, and its vulnerability to develop behavioural disorders. Moreover, the complex interplay between these factors is likely to have consequences for the future dog-owner bond.

We reviewed the current literature on the interactions between maternal care, attachment formation, and the sensitive socialisation period, and their potential consequences on adult dog behaviour. An increased incidence of behavioural disorders is found especially in pups bred in so called “puppy mills”, often with low regard for adequate weaning age or socialisation programs. Proper social and non-social stimulation during the sensitive period for socialisation, between 3½ and 12 weeks of age, is essential for normal behavioural development. Insufficient stimulation, as well as minimal maternal care, increase the risk of developing behavioural disorders. However, the mother-pup bond and its interactions with the subsequent socialisation period, as well as its influence on the development of behaviour, has not been studied in much detail.

Based on the findings we highlight gaps in knowledge and provide suggestions for future research that is necessary to formulate recommendations for pet dog breeding and socialisation.

Review paper
Dietz, L., Arnold, A., Goerlich-Jansson, V., Vinke, C.M. 2018. The importance of early life experiences for the development of behavioural disorders in domestic dogs. Behaviour, [Open access] 155, 83-114.

I NEED A FRIEND: CHANGES IN CAPUCHIN MONKEYS' GROOMING NETWORK AND THEIR PHYSIOLOGICAL REACTIONS AFTER RELOCATION

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For social species, group living can be both a source of stress-exacerbation and act as stress-buffering. When moving to a novel enclosure, the social structure of a group is usually disrupted and social factors are suggested to influence individual behavioural and physiological reactions. We investigated how relocation to a novel enclosure impact the grooming network and physiological responses (faecal glucorticoid metabolites - FGM) in a group of 09 captive capuchin monkeys (*Sapajus libidinosus*) housed at the Cabedelo rescue centre, Brazil. We recorded all social interactions (initiator and receptor of grooming), during 120 hours of behavioural observation and we 679 collected feces before (78h, 191 faeces) and after relocation (42h, 488 feces). Using the Socprog and Netdraw softwares, we selected three indices to analyse the grooming network: degree, indegree and outdegree for both periods (before and after relocation). For the physiological analysis, the faeces were analysed through ELISA procedures and glucocorticoid concentration values were generated for each individual. Wilcoxon analyses showed significant differences between periods for degree ($Z = -2,057$; $p = 0,040$) and indegree ($Z= -2,121$; $p = 0,034$), both showing an increase in grooming partners after relocation. When subdividing FGM values in day 1, week 1 and week 2 after relocation, Spearman correlations indicated that after-relocation indegree is positively correlated with FGM in the first day ($rho = 0,807$; $p = 0,027$) and negatively correlated with FGM in the first week ($rho = -0,780$; $p = 0,027$). We suggest that individuals increased the number of grooming partners in the first day in order to cope with the stress caused by the relocation. The calming effect of indegree increase, however, comes later, during the first week, as FGM levels decreases more for individuals having more grooming partners. As pointed by our results, relocations are not without consequences for individuals. The development of the study of social networks for captive animals may be an important key to allow better individual-based management and improvement animal welfare.

THE EFFECT OF OLFACTORY ENRICHMENT WITH *LAVANDULA ANGUSTIFOLIA* ON DOGS IN A NOVEL ENVIRONMENT

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Olfactory enrichment with essential oils is increasingly gaining attention to prevent and treat both psychological and physical discomfort in humans and animals. *Lavandula angustifolia*, mainly known for its anxiolytic effects, is one of the most studied essential oils in this field. Nevertheless, few studies have been conducted on dogs. Dogs take an important place in our Western world. Many dogs however could experience regularly stress because of impoverished environments and stressful situations. This may concern dogs spending time in waiting rooms, shelters, cars or during animal assisted interventions. Olfactory enrichment through essential oils could therefore be an interesting support to decrease dog's anxiety and offer them a better well-being. In this study, the effect of olfactory enrichment with *Lavandula angustifolia* has been studied on stress behaviours in dogs exposed to a novel environment.

22 pet dogs were exposed to an unknown room with lavender aroma (Experimental Group, diffusion of lavender essential oils). The 23 dogs of the Control Group entered the same room without any lavender aroma. During the experiment, dogs were accompanied by their owner who filled in the short version of the C-BARQ to report on their dog's temperament. Owners did not interact with their dog and dogs were allowed to roam free within a perimeter of 1,65 meter around the owner (length of the leash). Each dog was filmed during the first 15 minutes after entering the room and videos were analysed afterwards. The frequencies of three stress signals were observed: yawning, panting and tongue licking. We furthermore noted the latency time until the dog was in complete resting position for the first time and summed the total duration of these relaxed phases during the experiment. Results of the C-BARQ demonstrated no significant difference in temperament between dogs of both groups suggesting that both groups represented an equal variation of temperaments. The behavioural results showed no significant difference in the observer variables between both groups, except for yawning: dogs of the Experimental Group were yawning significantly less than dogs of the Control Group ($p<0.05$).

As literature has shown that increased yawning has been observed among dogs exposed to stressful situations, results of this study suggest that the use of olfactory enrichment with essential oils of *Lavandula angustifolia* might have a stress reducing effect on dogs in novel environments such as shelters or waiting rooms. More research should further explore the effects according to different concentrations of lavender.

EVALUATION OF HAIR CORTISOL CONCENTRATIONS AS A RETROSPECTIVE INDICATOR FOR LONG-TERM STRESS IN PIGS AND CATTLE

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There is a growing demand for the use of non- or minimally invasive stress indicators in animal welfare research and livestock husbandry. The determination of hair cortisol concentrations (HCCs) may be a promising indicator of long-term stress or increased hypothalamic-pituitary-adrenal axis activity in farm animals. Thus, the aims of this study were to investigate the effects of potential influencing factors on HCCs and to examine whether cortisol is increasingly accumulated in hair after repeated stimulation of endogenous release by ACTH applications. For this purpose, hair samples were collected from German Landrace pigs, Holstein Friesian cattle and crossbreeds differing in age, sex, reproductive cycle and hair colour, from various body regions and in winter and summer season. In addition, 38 German Landrace gilts and 34 Holstein cattle received either i.m. injections of ACTH (Synacthen Depot, 100IU per animal) or saline every second day over a period of four weeks. Native and regrown hair samples were collected at the beginning, the end, and four and eight weeks after this treatment period. All hair samples were harvested by an electric clipper, washed twice with isopropanol and ground with a ball mill. After extraction with methanol and evaporation, HCCs were analysed using a commercially available enzyme immunoassay intended for salivary cortisol. Statistical analyses were performed using ANOVA and pairwise comparisons of the least square means by Tukey Kramer tests with the MIXED procedure in SAS/STAT software. Our results show significantly higher HCCs in piglets and calves compared to older animals ($p<0.001$). In addition, samples harvested from the tail tip exhibit significantly higher HCCs than samples from shoulder, back or neck in both species ($p<0.001$). Furthermore, in pigs, hair samples representing the period of late pregnancy, birth and lactation display higher cortisol levels compared to early and mid-pregnancy. The sex of the animals, the season of collection and the hair colour in cattle have no influence on HCCs. Additionally, first results from the ACTH application in pigs show elevated HCCs in hair samples obtained at the end of the 4-week treatment period. In summary, our findings indicate enhanced HCCs after ACTH treatment, but also considerable variation and differences depending on age, reproductive cycle and body region in pigs and cattle. Therefore, it is necessary to consider these influencing factors in the use and evaluation of HCCs as stress indicators, e.g., by standardizing sampling protocols.

FROM BENCH TO CAGE-SIDE: INTEGRATION OF NOVEL SEMI- AUTOMATED METHODS FOR WELFARE ASSESSMENT OF GROUP-HOUSED RHESUS MACAQUES USED IN BIOMEDICAL RESEARCH

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Effective welfare assessment of non-human primates used in biomedical research depends on obtaining a range of appropriate physiological and behavioural measures to optimise the implementation of the 3Rs, particularly refinement. Here, we present an overview of different non-invasive, well-established as well as novel methods to capture the welfare impact of various life time events such as transport, general anaesthesia and changes in social structure for group-housed macaques. Behaviour monitoring is an integral part of welfare assessment. Here we present the application of a novel method involving placement of a soft, microfiber neck collar individually designed and fitted containing a compact, lightweight piezo- electric accelerometer. Physical activity is a well-known and important contributor to psychological and physical health; continuous measurements of an animal's activity levels and patterns could provide key insights into their welfare state. Activity budgets are highly variable between individuals; various factors such as age, body weight, social group structure and housing arrangements appear to contribute to individual animal's activity levels and patterns. In addition, behavioural model predictions were made using a novel decision tree algorithm especially developed and adapted for this species. This model allows differentiation between separate categories of behaviour such as resting, foraging/ grooming and various levels of locomotor activity. This analysis can been combined with general day and night time activity to provide a more detailed insight into animal's daily activity budgets and wellbeing. The benefits of these methods include continuous and observer -independent data collection with a high spatial resolution as well as synchronised assessment of individuals and their social partners. Accelerometry has been shown to be a powerful method to gain further insight into a captive primate's welfare and can be applied to enhance the 3Rs by improving and refining the wellbeing of macaques used in research.

EFFECTS OF ANIMAL WELFARE IMPROVEMENT MEASURES ON THE ENVIRONMENTAL IMPACT OF DAIRY FARMING – A CASE STUDY FOR AUSTRIA

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Due to its considerable impact on anthropogenic greenhouse gas emissions (GHGE), the dairy farming sector is attributed a significant share in achieving global climate goals. Among numerous measures to mitigate the environmental impact, good animal health and welfare are considered essential to keep emission levels low. However, our knowledge of effects of interventions aimed at welfare improvement on the emission potential of dairy farms is very limited. The aim of the current study was therefore to assess and quantify the impact of selected measures to improve animal welfare on a production system's potential for global warming (GWP_{100}), freshwater eutrophication (FEP) and terrestrial acidification (TAP_{100}). Three dairy production systems representing typical conditions in different production areas of Austria were modelled. Region-specific feeding regimes and corresponding yield levels, as well as housing and manure management systems were defined accordingly. We calculated total greenhouse gas and ammonia emissions based on IPCC and EMEP EEA guidelines and assessed the environmental impact potential in kg CO_2, P and SO_2 equivalents per unit of product (kg ECM) using life-cycle-assessment methodology. In a second step, we recalculated GWP, FEP and TAP, assuming that commonly suggested measures to improve dairy cow health and welfare, notably improved flooring and heat mitigation, would be implemented. The expected welfare improvement potential and respective contributions to the emission potential were modelled based on current literature. Preliminary results show that under Austrian production conditions, heat mitigation may reduce GWP_{100} and TAP_{100} by up to 0.2% and 0.5% per unit of product, respectively, while FEP may increase by up to 1.6% compared to the reference values. When taking into account uncertainty information, the differences in overall results between the reference scenario and the scenario with welfare improvement measure are not statistically significant. Similar results have been calculated regarding the implementation of rubber mats. In conclusion, our present findings confirm assumptions in the literature about welfare improvement as a means of environmental impact mitigation in dairy farming, since the emission reducing effect of good welfare seems to at least outweigh the impact of welfare improvement measures on GWP_{100} and TAP_{100} per unit of product, while slight but not significant increases in FEP can be expected.

HOW MATING RATIO COMPROMISES THE WELFARE OF NIGERIAN INDIGENOUS CHICKENS

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A baseline study to establish the appropriate mating ratio for Nigerian indigenous chickens with the aid of several welfare indices was undertaken. Sixty three 24 weeks old birds consisting of 9 cocks and 54 hens were used. The birds were assigned to three mating ratio (MR) namely 1 cock: 3hens (1:3), 1 cock: 6 hens (1:6) and 1 cock: 9hens (1:9) and each MR was replicated three times. The experiment was arranged in a cross over design, such that each cock spent only 2 weeks in a particular MR, and at the end of the 6 weeks period all cocks experienced the three MR. Behavioural observations were recorded using digital cameras in the morning (9:00-11:00 h) and evening (17:00-18:30 h), 4times/week for 6 weeks. The behaviours of the hens monitored in the morning were duration of nesting (DN) and nest seeking (DNS), number of hen-hen aggression (HHA) and frequency of visit to the next box (VNB). In the evening, mating behaviour of the cocks monitored were the number of times each cock approached the hens (NOA), attempted mounts (NAM), waltz dance (WD) and the number of successful mating (NSM). At end of each 2 week period of a cock in a particular MR, blood and semen samples were collected. Behavioural data was analysed using Kruskal-Wallis test while one way ANOVA in SPSS (version 21) were employed to analyse data on semen quality and heterophil/lymphocyte ratio (HL). The results revealed that the level of HHA was greater ($P<0.05$) in 1:9 compared to 1:6 and 1:3, and VNB was greater ($P<0.05$) in 1:9 compared to 1:3 while 1:6 was intermediate. MR had not affect DNS and DN exhibited by the hens and NOA, NAM and WD displayed by the cocks. NSM was greater ($P<0.05$) in 1:6 and 1:9 than 1:3. MR on HL were greater ($P<0.05$) at 1:3 and 1:9 compared to 1:6. The results showed that motility, concentration and live and dead sperm cells were comparable among the MR. However, 1:9 had higher ($P<0.05$) sperm abnormality compared to 1:3 and 1:6. Although the cocks had higher ($P<0.05$) successful mating at MR of 1:9, notwithstanding, the welfare of the hens (higher hen-hen aggression and frequency of visit to nest box) and cocks (increased level of stress and spermatozoa abnormality) were compromised. The findings indicated that MR of 1:6 had optimal welfare indices in Nigerian indigenous chickens.

KEEL BONE DAMAGE IN LAYING HENS – AUTOMATIC MEASUREMENT FOR LONG TERM MONITORING AT THE SLAUGHTER LINE

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Keel bone damage (KBD) is an important animal-based indicator for animal welfare in laying hens. It was repeatedly found that, nearly every flock is affected by KBD, with differing prevalences between flocks. A variety of scoring systems is used to classify the severity of KBD by visual inspection and palpation. However, palpation of keel bones is time-consuming and people have to be very well trained in order to obtain reliable results. Therefore, we are developing an automatic detection system for the assessment of KBD in laying hens at the slaughter line on the basis of 3D images of the carcasses. In a first step of the validation process, we wanted to know how well keel bone damage can be detected by mere visual inspection at the slaughter line. Therefore, carcasses of 280 laying hens were individually marked and classified by visual inspection. After dissecting the keel bones, they were scored again. The applied scoring system differentiated between score 1: intact (no callus or dislocation, no lateral, dorsal or ventral deviation of straight axis) and score 2: damaged (visible callus, dislocation or deviation) without differentiating between fractures and deviations. Agreement between both assessments were evaluated on the basis of a PABAK (prevalence adjusted bias adjusted kappa) coefficient. Only a fair agreement was reached between both assessment methods (PABAK = 0.46). More damage was detected at the dissected bones compared to the intact carcasses (83.9% vs. 62.8%). Sensitivity of the inspection of the carcass versus dissected keel bone was 0.71, specificity was 0.80. In a second step assessments of flock KBD prevalences an assessor versus automatic detection are compared. First results from one flock show deviations of 8.6% points, with the assessor scoring more damaged keel bones than the system. Therefore, it can be assumed that an automatic assessment system will underestimate the actual damage while there will be sufficient association between both methods to give an indication on possible farm problems, making long time monitoring and easy feedback for the farmers feasible. Validation of the camera system is being continued.

ASSESSMENT OF HORSE WELFARE IN A TRAVELLING CIRCUS IN HUNGARY

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There is growing public concern about animal welfare in circuses. Strict regulations in many European countries ban the use of wild animals in circuses. However, numerous domesticated or semi-domesticated species are still seen in circuses. The aim of our study was to assess animal welfare using mainly animal based measures in a Hungarian travelling circus.

The circus presents horses, zebras, camels and elephants in their show. The results of the assessment of horse welfare is presented in our abstract. Welfare of 21 horses was assessed in August 2018 using the AWIN horse protocol. The protocol is based on 4 main principles (good feeding, good housing, good health and appropriate behaviour) of the Welfare Quality method. The horses were kept in mobile boxes at performance sites.

No signs of hunger were observed. All horses had good body condition scores (3.4±0.5), and received hay ad libitum. Water was given in buckets 3 times daily. Most horses did consume water during the bucket test (5.6±3.5 litres), which may be an indicator of thirst. We found low amount of bedding (straw) and it was mostly contaminated with manure. The size of boxes (9 $m^{2)}$ was in accordance with regulations. Daily exercise included 2 trainings and a performance in the evening. Hair coat was healthy on all horses, the consistency of manure was normal, there were no swollen joints, no lameness (except one horse that received veterinary treatment), prolapses, discharges, abnormal breathing, coughing or lesions. There were only minor (<4 cm) hairless patches on the withers (on 11 horses). The horse grimace scale indicated no painful condition. The behaviour of horses also indicated good welfare. The horses were in visual and olfactory contact with their neighbours. There were no signs of stereotypies. None of the horses showed avoidance behaviour, in the voluntary animal approach test they were positive (except for 3, being indifferent). All of them could be approached and stroked in the forced human approach test. They showed no fear in the fear test.

Based on the results, we can conclude that the welfare of the horses in the travelling circus was good. There is some room for improvement in water supply and bedding comfort. This study could be a basis of evaluating animal welfare in Hungarian travelling circuses.

IDENTIFICATION OF SUITABLE ANIMAL WELFARE ASSESSMENT MEASURES FOR EXTENSIVE BEEF SYSTEMS IN NAMIBIA

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Namibia has a recent outstanding track record of gaining and maintaining access to lucrative beef export markets that demand high production standards. International trading partners for Namibia's beef are seeking assurances that national animal welfare standards are maintained. However, Namibia is still lacking concrete animal welfare legislations including a standardised validated protocol for assessment of beef cattle welfare. Simply transferring protocols developed for industrialised systems to developing countries or for intensive systems to extensive systems is not feasible, and thus the aim of this study is to identify suitable welfare measures applicable for an animal welfare assessment protocol for extensive semi-desert rangeland-based beef production systems in Namibia.

An amalgamation of the best practicable measures in the Welfare Quality® protocol and the rangeland-based UC Davis Cow-Calf Health & Handling assessment protocol, with additional measures in a protocol suitable for New Zealand beef systems will be tested on beef production systems in Namibia. Additional welfare measures that are deemed fitting for extensive beef farming assessment in Namibia will also be identified. Although similar challenges may be encountered while applying an animal welfare assessment protocol, there are specific challenges such as effects of recurrent drought, compulsory cattle hot iron branding and inadequate handling facility designs in some farming operations that may be more typical to the Namibian beef production systems.

The amalgamated protocol will be tested on 1 farm to identify indicators that can be practically assessed during a pregnancy diagnosis visit. The aim is to ensure that all yard-based indicators can be recorded in >50% of a herd's cows on a convenience basis. Observations will be made of body condition, behaviour (i.e. fearful vs. calm) and health (e.g. injuries, swelling, discharges and dirtiness). Stockmanship will be evaluated by observing cow handling (using aids, noise, hitting or poking), alongside yard design and facilities. When animals are exiting the race, exit speed, falling/ stumbling, and lameness will be observed. In addition, cows will be observed at grazing and a questionnaire-guided interview will be conducted with the cattle manager to assess cow health history and management (dehorning/castration, vaccination, antibiotics usage, disease symptoms, mortality, access to water, supplementary feeding, and wintering practices).

It is hoped that identification of suitable beef system welfare measures will result in testing and adopting a validated beef animal welfare assessment protocol for Namibia, in order to enhance the beef export sector in that country, and in turn the livelihood of the people.

THE EFFECTS OF PERSONALITY UPON BREEDING SUCCESS IN HUMBOLDT PENGUINS (*SPHENISCUS HUMBOLDTI*)

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Humboldt penguins (*Spheniscus humboldti*) are a vulnerable species commonly kept within UK zoological collections. However, in captivity, their breeding success is half that of their wild counterparts. Past research has tended to focus on determining optimal breeding conditions, however personality may also be a determinant of breeding success. The aim of this study was to determine whether personality affects breeding success in captive Humboldt Penguins. Personality profiles were created for 30 individual Humboldt penguins (15 pairs) housed at ZSL London zoo. Personality was assessed using keeper questionnaires considering interactions with conspecifics and human-animal interactions, novel object testing (via three separately presented novel objects: bamboo wind chime, glitter ball and an abacus) and behavioural observations. For the behavioural observations, each individual was observed for a total of two hours over a two-month period via continuous focal sampling. Breeding success was assessed in terms of number of eggs laid, number of eggs hatched and number of chicks fledged. Data on breeding success were obtained from the Zoological Information Management System (ZIMS) for 2014-2017. Principal component analysis was used to create personality dimensions, and individuals were rated as high/low on each dimension. Chi square tests were then used to determine if there was an association between each personality dimension and reproductive success. Three personality dimensions were identified: dominant, sociable and shy toward people. Penguins that were less sociable and shyer toward people showed greatest reproductive success and produced more eggs, chicks and fledglings. These findings suggest that personality can affect breeding success in Humboldt penguins and is a factor that should be considered in captive breeding programmes. Interventions such as providing more nest sites away from public access and reducing keeper interactions to a minimum may be beneficial in enhancing reproductive success in captive Humboldt penguins.

CHEW ON THIS: CREATION OF A SALIVA COLLECTION PROTOCOL FOR GIRAFFE TO EVALUATE WELFARE

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Visitor-animal interactions in zoos play an important role in fostering education and increasing connection between animals and humans. Limited study has been done in this area with the variety of species used in ambassador animal encounters, creating a need for better methods to evaluate the welfare of participating individuals. Giraffes (*Giraffa camelopardalis*) are a common species seen in visitor-animal interactions due to their widespread use in feeding encounters at zoos. Yet, limited measures to evaluate welfare for this species exist. Welfare, a difficult concept to quantify, requires more than one measure to gain a better understanding of the mental well-being of animals. To add to our existing understanding of giraffe welfare, a pilot study was run to design and validate a standard protocol for saliva collection to allow for the eventual collection of salivary cortisol as a welfare measure. Saliva was collected using a food incentive and taken from the participating animals either through indirect contact, collecting saliva from leaves and branches, from direct contact with the giraffe's mouth and tongue, or by a combination of both. Samples collected by both direct and indirect methods were successfully analysed for cortisol, and an assay for giraffe salivary cortisol was validated. Non-invasive saliva collection was completed at two separate locations using the developed protocol, demonstrating that the collection method created has use multi-institutionally. The protocol tested in the pilot study can be applied to use salivary cortisol as a mechanism to study hormonal response to short-term stressors. This can be helpful to better understand the impact of visitor-animal interactions around popular giraffe feeding programs at zoos, particularly when combined with additional measures of welfare such as behaviour.

HOW TO LIVE TOGETHER: A MIXED-SPECIES EXHIBIT OF ARA PARROTS

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Mixed-species exhibits are widespread in modern zoos, allowing different species to be kept together within the same enclosure. Mixed-species exhibits usually house species sharing the same habitat or geographical range, providing a valuable educational message to zoo visitors. Moreover, they can also be beneficial for animal welfare, as the presence of other species provides a dynamic and unpredictable source of stimulation. However, social housing can also be associated with competition and pressures: understanding how different species interact with each other is fundamental to ensure a good care and management of zoo animals. The subjects of this study were 8 macaws belonging to 3 different species housed in the same aviary at Parco Natura Viva (Italy): 2 blue-and-yellow macaws (*Ara ararauna*), 2 scarlet macaws (*Ara macao*) and 4 red-and-green macaws (*Ara chloropterus*). Ten daily 60-min sessions were done. Frequencies of social behaviours were collected with all-occurrences sampling method and data on space use were collected through instantaneous sampling method. Non-parametric tests were run to evaluate differences between inter- and intra-specific affiliative and social behaviours. Results highlighted that blue-and-yellow macaws spent more time in one area of the exhibit and were more selective in space use than scarlet macaws and red-and-green macaws. Data on social behaviour showed a significant difference between inter- and intra-specific behaviours. Furthermore, a significant difference was found between inter- and intra-specific affiliative behaviours, as well as between affiliative and agonistic inter-specific behaviours. Data on space use and social behaviour seem to suggest a possible role of chromatic preference in the inter-specific interactions in macaws.

DIFFERENCES IN EAR POSITIONS DURING GENTLE HUMAN-CATTLE INTERACTIONS

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Animal welfare science is showing an increasing interest in emotional states of animals, one focus being on expressive behaviour. Investigation of different ear postures of cattle might improve our understanding of their affective states.

We conducted two experiments, examining ear position in heifers (n = 28) before, during and after gentle human-cattle interactions using different auditory and tactile stimuli. We defined ten different ear positions, nine by their position relative to the head ('back up', 'centre down', …) and one as 'hanging' loosely downwards; we also recorded ear movements (changes of position, flicking), and in addition neck stretching as an indicator of positive valence. We expected lower ear positions and less ear flicking in a more relaxing and positive context.

'Neck stretching' increased during stroking in all conditions ($p < 0.001$), confirming the positive valence of the situation. In three of the four conditions used in the two experiments, tactile stimulation was applied in form of stroking of the ventral neck. In the fourth condition, the whole head and neck region were stroked in a 'reactive' way, following the heifers' preference as perceived by the stroker. In all conditions, ear flicking decreased during the stroking treatment (Wilcoxon test, $p < 0.001$), probably indicating positive affect. Unexpectedly, ears were held in positions above the horizontal for a longer time during stroking than during the pre-stroking phase in the 'ventral neck' conditions, while no difference was found in the 'reactive' condition ($p < 0.001$).

In conclusion, gentle human-cattle interactions in the form of stroking seemed to induce positive affect. The expected increase in low ear positions was not found; in contrast, the ear was mostly held 'high', depending on the body area stroked. Further investigations are needed to allow interpretation of vertical ear positions, including possible effects of arousal.

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AN INTERNATIONAL CROWDSOURCING DATA PROJECT TO INVESTIGATE AGGRESSION IN GROUP-HOUSED LABORATORY MALE MICE

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Aggression in group-housed mice is a serious welfare concern. Further understanding of the causes of mouse aggression could have a significant positive welfare impact on a large number of animals worldwide. The NC3Rs led a crowdsourcing data project for animal technicians to collect data on the prevalence and potential triggers for aggression in laboratory mice.

The crowdsourcing approach allowed data to be collected from multiple institutions and, to our knowledge, is the first time such an approach has been applied to a laboratory animal welfare problem. Technicians observed group-housed, male mice during daily routine cage checks and recorded all incidents of aggression-related. Data was anonymised and analysed to calculate prevalence and identify factors contributing towards mouse aggression.

In total, 44 facilities from nine countries participated in the study and data was collected by 143 animal technicians. A total of 788 incidents of aggression-related injuries were reported across a sample population of 137,580 mice. The mean prevalence of aggression-related incidents reported across facilities was equivalent to 15 in 1000 mice. Strain-specific differences were found in the prevalence of aggression. Key factors influencing the prevalence of aggression included the number of mice per cage; how mice were selected into a cage; cage cleaning protocol; and nesting material transfer.

The results will be used to provide recommendations to support best practice to minimise aggressive behaviour in group-housed, male mice.

THE ANXIOLYTIC EFFECTS OF VALERIAN *(VALERIANA OFFICINALIS)* ON THE DOMESTIC DOG *(CANIS FAMILIARIS)*

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Anxiety-related behaviour can have detrimental effects on the welfare of animals and their relationship with humans. Anxiety can be addressed using valerian-based treatments, such as Pet Remedy, which is advertised as a natural stress relief product for mammals. Valerian has been demonstrated to have positive behavioural effects in a range of contexts and species, however the efficacy of Pet Remedy remains relatively understudied in the domestic dog. The study aimed to investigate the efficacy of Pet Remedy in reducing the frequency of owner-reported canine anxiety-related behaviours. Behavioural responses of 28 dogs were reported using a questionnaire completed by dog owners before and after exposure to a Pet Remedy ™ diffuser for 30 days. After using the diffuser, 43% of owners reported that Pet Remedy improved their dogs' behaviour although no statistical difference was found in the frequency of anxiety-related behaviours. Future research, using a larger sample size, should investigate the anxiolytic effects of valerian when ingested versus inhaled to examine whether the way in which the herb is absorbed into the system affects its efficacy.

HISTOLOGICAL VALIDATION OF A MACROSCOPIC VISUAL SCHEME FOR THE ASSESSMENT OF CONTACT DERMATITIS OF THE HOCK (HOCK BURN) OF BROILERS

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The assessment of animal based welfare indicators plays an important role in the evaluation of animal welfare in livestock housing. In this study a visual assessment scheme for hock burn in broilers was histologically validated.

For the selection of a suitable visual scoring system an inter observer reliability test was performed. The results allowed the selection of a scheme according to a modified 5-staged scoring system by the Welfare Quality® assessment protocol for poultry (Welfare Quality®, 2009).

For the histological validation of the visual scoring system 200 hocks (40 of each visual score) of 39-42 days old Ross 308 Broilers were collected after the slaughter process. Each hock was scored visually ("macro Score", Score 0-4) and evaluated histologically ("micro Score", Score 0-3) according to a modified 4-stage scoring system by Michel et al. (2012). Micro score 0 was defined as "Healthy", micro Scores 1 and 2 as "erosions", and micro Score 3 as "ulcer".

A tendency of higher micro scores with rising macro scores was found. However, an exact allocation of macro to micro scores was not possible. Macro scores 0, 1, and 2 included different micro scores, e.g., micro scores 1 and 2 (erosions) and micro score 3 (ulcer) could be represented by the macroscopic score 1. In contrast, macro scores 3 and 4 consisted of the micro score 3 (ulcer) by 100%.

To evaluate the relationship between micro and macro scores, the conditional probability of certain micro scores for given macro scores was estimated with the use of a multinomial logistic regression model. As expected, macro score 0 coincided most commonly with the micro score 0. However, already at a macro score 1, the micro score 3 (ulcer) was the most probable. Micro score 1 or 2 (erosions) did not have the highest estimated probability at any macro score. The histological depth of inflammations of hock burn lesions increased with rising macro scores, up to the macro score 3 with an average depth of 1019µm (Score 3).

Visually more severe lesions were thus also histologically of a higher score. However, the use of a macroscopic assessment scheme does not seem to be precise enough to extrapolate to histological alterations.

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A COMPARISON OF TWO HARVESTING METHODS (MECHANICAL AND MANUAL) OF BROILERS WITH RESPECT TO ANIMAL HEALTH

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The goal of this study was to compare two harvesting methods, a “manual method” (broiler caught by two legs) and a “mechanical method” (CMC Apollo 2 harvesting machine). The health of Ross 308 broilers and variables at catching, influencing the health of the broilers, were assessed in 12 flocks of each harvesting method. 200 broilers of each of the 24 flocks were examined regarding injuries (haematoma/fractures/luxation) prior to depopulation. Environmental conditions were evaluated during harvesting and loading injuries were examined in the broilers of two fully loaded containers.

The predetermined target stocking density was maintained on average in 12% and exceeded in 26% of the drawers of the transport container with automatic loading. In the manual loading the target stocking density was maintained in 36% and exceeded in 30% of the examined drawers. The average deviation from the target stocking density was -1.16 broiler for the mechanical method and -0.11 broiler for the manual method.

On average 4.3% of the broilers were assessed with haematomas on the wing or the wing tip, irrespective of the harvesting method. Significantly more haematomas of the wing and the wing tip were detected in broilers harvested with the automatic method (7.2%) than with the manual method (1.5%). The risk of the detection of haematomas of the wing or the wing tip of broilers is thus significantly reduced if caught manually (OR: 0.164, 2.5% CI: 0.097, 97.5% CI: 0.277). Fractures or luxations of the wings were detected on average in 1.2% of all assessed broilers after loading, the majority of these (93.4%) were fractures of the epiphyseal plate of the distal humerus. Fractures or luxations were more frequently observed with the automatic method, this difference was however not significant.

Light intensity and the speed of the loading belts, among others, were relevant influencing factors on the occurrence of fractures, luxations and haematomas.

By using the automatic harvesting method, the target stocking density can easier be maintained and adapted to the weight of the broilers, this could be of advantage in fast growing broilers. However, the cause of the higher risks of haematomas during mechanical loading should be further investigated, especially considering the speed and structure of the loading belts. The effects of the examined influencing factors seem complex. Light intensity should be kept low during loading to avoid the risk of fractures and luxations.

EFFECT OF PLAY BEHAVIOUR ON SALIVARY IMMUNOGLOBULIN A IN CALVES

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As positive affective states have come into focus of animal welfare science, research is being undertaken to understand the underlying mechanisms and also identify potential indicators for them. Positive affective states are linked with good immune function, so it makes sense to measure salivary immunoglobulin A (IgA) as an indicator of immune functioning in the context of positive emotions. We investigated the effect of a high-arousal, positive situation on salivary IgA. To this purpose, we induced play behaviour in 12 calves (ten Austrian Simmental, 2 Holstein; 2 months of age) and took saliva samples before and after playing. We did not find any significant difference before and after play ($p = 0.39$) but a significant, moderate correlation of the change in IgA concentrations with the amount of play behaviour shown ($r = 0.57$, $p = 0.044$). This relationship may, however, be caused partially by decreased values in animals that had high initial values or showed little play behaviour. In addition, the variability of IgA concentrations was high. Although there might be an association of IgA and the experience of positive emotions, there is little evidence for a stable relationship between IgA and positive emotions at the moment.

CLOUD-BASED CLASSIFICATION OF BROILER CHICKEN VOCALISATIONS

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Audio analysis for monitoring animal health and welfare has mainly focussed on the development of disease classification tasks, particularly those associated with respiratory illnesses. However, it is also known that physiology and emotional state affect the vocalisations that animals produce. In chickens, vocalisations associated with body size, social isolation, fear, and pleasure have been identified through behaviour and bioacoustics research. In addition, loud distress calls are produced when a chicken is acutely stressed and thus potentially a good indicator of welfare. Most research on chicken vocalisations has been carried out in controlled laboratory environments, and therefore it is necessary to study chickens on commercial farms. Our research was carried out on intensive broiler chicken farms in Guangxi province, China. The chickens recorded were aged 1 to 35 days old. We built a database of 160 recordings of loud distress vocalisations, and 160 general recordings of barn and flock noise. After labelling these recordings, we extracted their acoustic features and used those to train a variety of classifiers such as Support Vector Machines (SVM), *k*-nearest neighbour algorithms, and classification trees. Out of all these models SVM's produced the most accurate results, correctly classifying 81% of the recordings. Finally, we developed a system that allows recordings to be collected, uploaded to the cloud, and classified online using the developed algorithm. This potentially allows flock welfare to be monitored via the types of vocalisations that are produced.

EVALUATION OF SPERMATIC CORD AS AN ALTERNATIVE LIGATURE FOR SURGICAL CASTRATION IN DOGS

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The use of ipsilateral spermatic cord as ligature during surgical castration in dogs is currently been practiced by veterinarians in Nigeria and beyond. Even though it is perceived to be faster, cheaper and more convenient, there is no information on its safety with respect to pain and knotting ability. In a previous study, spermatic cord served as a credible alternative to chromic catgut ligature in relation to wound assessment parameters. It is however not documented whether its use is associated with increased post-surgical pain, knot-slippage and surgery duration. Therefore, this study evaluated the use of ipsilateral spermatic cord as an alternative ligature for surgical castration on pain assessment parameters, knot stability and duration of surgery. Twenty client-owned Nigerian indigenous dogs (5-7 months old) presented for routine castration at the University of Nigeria Veterinary Teaching Hospital were randomly assigned to one of two groups (n=10). Ipsilateral spermatic cord and chromic catgut ligatures were used in groups 1 and 2 respectively. Dogs were pre-medicated with 1% atropine sulphate at 0.02mg/kg and 2% xylazine hydrochloride at 1.0mg/kg, both administered intramuscularly. Anaesthesia was induced five minutes post premedication using intramuscular injection of 5% ketamine hydrochloride. Surgical castration was carried out by a single trained surgeon using standard procedure. All dogs received ketoprofen (5mg/kg) subcutaneously at one-, twenty-four- and forty-eight-hours post-surgery. Pain was subjectively assessed by two independent observers blind to the treatments using the University of Melbourne pain scale (UMPS), knot stability was monitored by observing for knot slip (spurting of blood at the cut end of the spermatic vessels) and duration of surgery was recorded as the time interval from scrotal incision to closure in minutes. Results showed that pain scores were comparable between the two groups up to 72 hours post-surgery and ligature slip was not observed in any of the dogs. However, mean duration of surgery was significantly shorter ($p<0.05$) in the spermatic cord group. The findings of this study show that spermatic cord ligature effectively compared with chromic catgut as with reduced surgical duration. It is more cost effective than the use of chromic catgut and should be adopted as a standard ligature material/technique for castration in dogs.

POSITIVE REINFORCEMENT TRAINING IN OVINE ORTHOPAEDIC MODELS- GOING THE EXTRA MILE

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Ovine models are successfully used for conducting a wide range of in vivo orthopaedic studies. These studies often require intensive post-operative monitoring, application of experimental devices or dressings and other, often delicate procedures, for which the study animals has to be manually restrained or even sedated. The positive reinforcement training is recognised by the National Centre for the Replacement, Refinement & Reduction of Animals in Research and described in many publications and articles. Given the natural character of the sheep- fearful, timid flock animal, positive reinforcement training poses certain challenges that need to be addressed first. Sheep respond well to routine, therefore adaptation to anything new (such as environment, staff, or handling) was the initial step. In order to achieve more controlled, less stressful and safer manipulation of the animal, the halter training was successfully completed using combination of positive reinforcement training and desensitisation. Positive reinforcement training thoughtfully combined with adaptation and desensitisation in our ovine orthopaedic model resolved in cost-effective production of a relaxed study sheep that tolerated procedures, such as dressing application, inspection of the wound or even the more delicate and dangerous procedures- clipping the wool and shaving the implant site on daily basis. In addition, we have noticed a significant reduction in the need of the manual handling of animals, no need to use turning crate or sedation and no injuries or accidents to animals and staff. Unexpectedly, it was not just the animal welfare and the animal model that has improved. The motivation of the animal husbandry staff has risen with most of them attending specialised courses in positive reinforcement training in other animal species.

ASSESSING TRANSIENT AFFECTIVE STATE USING INTRACRANIAL RECORDINGS OF BRAIN OSCILLATIONS IN POULTRY

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The welfare of farmed animals is becoming an increasingly important and emotive factor for the public when determining what products to purchase. Consequently, the implementation and maintenance of welfare standards has been the focus of important legislation. Clearly, animal welfare is a significant research area to both the public and government.

Many welfare studies focus on the effect of chronic stressors on animals. However, it is also vital that we consider the stress which can be imposed by short term processes animals encounter throughout their lives. Traditional methods used to measure such short-term stressors, like stress hormone levels, behavioural observations, or gene expression, are sometimes difficult to implement for the assessment of an animal's transient affective state, especially during periods of restraint or inaccessibility.

Broiler chickens are exposed to many short term processes prior to slaughter, e.g. capture, loading into crates, transportation, and lairage, all of which restrict the animals' movements and the opportunity for a researcher to collect samples. Recording electrophysiological signals, including heart rate and intracranial local field potentials from key brain regions (Nidopallium Caudolaterale and Nucleus Taeniae) suspected to be involved in processing affective state, could provide potential methods to measure transient affective state during these processes. I will be presenting brain wave and heart rate data from slaughter age broiler chickens exposed to three negative and one positive experiences: being held upside-down; being separated from their flock mates; having their comb pinched; and being fed mealworms. We will discuss which signals have the potential to identify the most stressful experiences, and therefore to improve the subjective experiences of broilers.

WELFARE IMPLICATIONS OF HUNTING PIGS WITH DOGS IN AUSTRALIA

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There are approximately 24 million feral pigs (*Sus scrofa*) in Australia. These pigs are considered an invasive species and subject to government control programs including poisoning, trapping and aerial shooting. Additionally, it has been estimated that more than 80,000 people hunt feral pigs recreationally in Australia every year. Feral pig hunting is an important social and cultural activity in many rural towns, with hunting events held annually and prizes awarded for the heaviest boar. Many hunters use dogs (*Canis familiaris*) to help track, chase and hold pigs during the hunts. These dogs are often purposely bred, with types such as 'Bull Arabs' developed to help take down wild pigs.

Pig hunting dogs are generally treated like farm dogs, with prolonged kennelling, reduced emphasis on preventative veterinary medicine and minimal compliance with animal management legislation. However, unlike farm dogs which are generally exempt from requirements under animal management legislation (e.g. microchipping, de-sexing, registration), pig hunting dogs are not recognised as an exempt group of animals and consequently are often kept in breach of animal welfare and animal management laws.

The health and welfare of hunting dogs in Australia is unknown, with baseline data on the number, type, health, husbandry and welfare of hunting dogs in Australia not available. In addition, the humaneness of hunting pigs with dogs has never been assessed, due to difficulties making assessments in the field and a lack of institutional funding. Considering the paucity of data on this topic, we conducted an extensive review of the literature to determine if there are any potential areas of welfare concern. Several areas of concern became apparent, including the health and husbandry of the hunting dogs, the injury and stress to the pigs during hunts and the unregulated nature of hunting in many states of Australia.

We will discuss the findings of our review and determine research pathways forward to better understand the welfare implications of hunting pigs with dogs in Australia.

IS A NATURAL SYSTEM GOOD FOR THE CHICKEN OR FOR THE CONSUMER?

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Previous studies have suggested that Brazilian citizens value naturalness in animal production systems. "Naturalness" in this context has different meanings for different people, and may refer to factors such as housing, feeding, use of feed additives or genetics of the animals. We surveyed a convenience sample of 200 Brazilian citizens to explore their attitudes towards two of these factors, housing environment and use of antibiotics (ABX), using broiler production as an example. Participants were presented a short scenario describing broilers housed in a free range (FR) or a confined (CONF) system and provided or not with ABX during rearing (n = 50 participants/scenario, balanced by gender). This was followed by closed questions on a 5-point Likert scale to rate attitudes towards the scenarios, and towards the welfare of the broilers kept in the given scenario, followed by general attitudes towards naturalness in animal production systems (3 questions for each construct). Participants were asked to rate their support for the use of ABX for different purposes, and presented 9 statements regarding naturalness of animal production systems and asked to select those with which they agreed. Participants had more positive attitudes towards the scenarios with FR housing than the scenarios with CONF housing ($P < 0.01$) and the scenarios without ABX than with ABX ($P < 0.01$), with no interactions. Attitudes towards the welfare of broilers were more positive in the scenarios with FR than with CONF housing ($P < 0.01$), but was not associated with the use of ABX ($P = 0.2$). Participants' attitudes towards naturalness was overall high (Likert median 4.3), and were not correlated with attitudes towards the scenarios (Spearman $r = 0.06$, $P<0.5$). The most voted statements regarding naturalness were, "a natural product is good because it is healthier" (76%), "in a natural system animals are healthier" (63%), and "in a natural system animals are happier" (61%). The majority of participants supported the use of antibiotics for therapeutic purposes (89% to treat diseases in humans and 76% in animals), but not for production goals (12% to increase production and 9% to reduce production cost). Results suggest that perceived benefits to animal welfare underlie participants' positive attitudes towards free range housing. They also corroborate the importance of naturalness in animal production systems for the public and suggest that this is largely related to perceived benefits for health; this may explain the low attitudes towards the scenarios with ABX antibiotics.

BEHAVIORAL RESPONSE OF DAIRY COWS TO A CHANGE IN ENVIRONMENT

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Cows in research herds are often removed from their social group and housed individually for certain study designs where they experience different environmental and handling conditions. While cows are highly adaptable it is important to understand potential changes, like behavior and locomotor abilities, as they may influence research outcomes and their welfare. The objective of this study was to evaluate the effect of transferring dairy cows from a group system to individual pens on their behavior. Lactating dairy cows (n = 24) in mid lactation (222, SD 86.5 days in milking) which were kept as part of a group of 115 cows in a *compost barn,* were transferred to individual pens (6 × 3m) for 10 weeks. Behavioural recordings were conducted during three days at four stages of one week each: prior to transfer (PreTran)*;* after transfer (EarlyTran); late transfer (week 9, LateTran) and after returning to the *compost barn* (PostTran). PreTran and PostTran behaviour was recorded by direct observation using instantaneous scan sampling. The behaviour (eating, ruminating, resting or idling) of each cow within the larger group was observed every 10 min between 9:00 and 20:00h. In the individual pens (EarlyTran and LateTran), cows were video recorded and their behaviour was assessed using the same methodology. A locomotion assessment was also carried out at each of the four stages whereby five aspects of locomotion (spine curvature, tracking, ab/adduction, speed and head bob) were scored between 1 (perfect) and 5 (most impaired). The individual daily milk yield was recorded. Data were analysed using mixed models in SAS with week as fixed effect and cow as random effect. Cows in PreTran spent more time eating (42.5 vs. 33.1, SEM 1.9% of time; $p<0.001$), ruminating (24.8 vs.17.27, SEM 1,35% of time; $p<0.05$) and resting (19.6 vs. 3.9, SEM 1.3% of time; $p<0.05$) than PostTran. Cows spent more time idling during EarlyTran then LateTran (38.0 vs. 11.28, SEM 1.2% of time; $p<0.001$). Regarding the locomotion aspects, tracking and mean score were greater in EarlyTran (3.2 vs. 2.6, SEM 0.12; and 1.8 vs. 1.6, SEM 0.05; respectively $p<0.001$); and spine score was greater in PreTran (1.3 vs.1.0, SEM 0.07; $p<0.001$). Milk yield was similar in PreTRan and EarlyTran (35.9 vs.37.3, SEM 1.2 kg/day), and, also in LateTran and PostTran (30.4 vs.29.4, SEM 52.8 kg/day). Cows had their behaviour influenced by the different systems, which is expected, and adapted to the individual pens easily.

DEVELOPING REFERENCE ETHOGRAMS: A CASE STUDY ON HORSE BEHAVIOUR

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Every study or application that measures behaviour of any kind, should have clear definitions of those behaviours in its protocol. An ethogram, being the complete behavioural repertoire for a taxonomic unit or a particular study, is a fundamental tool in measuring behaviour. At this point there is little literature on methodology of ethograms and behavioural definitions are mostly left up to the individual researcher.

The ultimate goal of an ethogram for a particular species or other taxonomic unit is to provide an almost exhaustive list of behaviours and their functions. However, valid and reliable descriptive definitions of the various behaviour units are crucial for research on function, causation or ontogeny of behaviours. Working towards a descriptive reference ethogram for species that are regularly used in research, is therefore a major step forwards. It will greatly increase validity, reliability and compatibility of studies, allowing more efficient meta-analyses. Reference ethograms can and will not prevent the necessary flexibility in individual studies.

A test of the feasibility and reliability of such a descriptive reference ethogram was performed on horse behaviour. A test panel of 13 researchers in equitation science and 10 high level practitioners (veterinarians, riders, trainers, judges, people working at horse welfare organisations) were asked to score behaviours in 30 video clips, using a partial ethogram with descriptive definitions. Statistical analysis of the results with logistic mixed models showed that the variability between observers was very low (<0.0001) and much lower than the variability between video clips (variability 0.15, standard error 0.05), indicating a high reliability. Scoring by researchers and practitioners did not show a difference ($p=0.74$), but simple (one or two behaviours) and complex video clips differed significantly ($p<0.0001$). The feedback from panellists and other experts was used to continue developing this ethogram. This first test did not include training of participants and it would be useful to investigate how training focused on the interpretation and use of an ethogram influences the application of that ethogram.

This type of reference ethogram is relevant for work on laboratory animals, production animals and companion animals. Working towards optimising ethograms and their behavioural definitions will enhance quality and applicability of research, and it would also greatly improve communication among stakeholders in animal welfare. The work on horses shows that descriptive behavioural definitions can be used reliably and can be a first step in the development of reference ethograms.

UNDERSTANDING STEREOTYPIC PACING IN LABORATORY MACAQUES: WHY IS IT SO DIFFICULT?

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Stereotypic behaviours are commonly observed in captive animals and are usually interpreted as a sign of poor welfare. However, the causal factors underlying stereotypies are still unclear and mounting evidence suggests that, even within one species, different stereotypies can have different causes. Understanding the cause of stereotypies is particularly important in laboratory animals, since the use of stereotyping animals in research might compromise the validity, reliability and replicability of scientific findings. Despite this lack of understanding, stereotypies are often used as indicator of chronic or acute stress.

In this study, we investigated whether pacing, the most frequent stereotypy displayed by laboratory macaques, is reliable at detecting acute stress. To answer this question, we measured the reaction of rhesus macaques to the stressful event of witnessing spontaneous agonistic interactions between conspecifics housed in the same room but in a different cage. The behaviour of 13 socially-housed adult males was quantified before, during and after agonistic interaction exposure, based on video recordings. Displacement behaviours, which are pharmacologically validated indicators of stress or anxiety, increased after agonistic interaction exposure, confirming that the events were experienced as stressful by the focal individuals. The occurrence of pacing did not increase during or after the agonistic interactions. Instead, agitated locomotion, a non-stereotyped locomotor behaviour defined as 'moving rapidly between locations, with a stiff un-relaxed gait', increased during the agonistic interactions. These results suggest either, that pacing as an indicator of acute stress is prone to false negative results, increasing in some stressful situations but not others, or that agitated locomotion has been mistaken for pacing in previous studies and that pacing is in fact unrelated to current acute stress. Both interpretations lead to the conclusion that pacing is unreliable as an indicator of acute stress in laboratory rhesus macaques. Our data also suggest that agitated locomotion might potentially be a useful indicator of acute stress, or at least arousal, but more studies are needed to confirm this.

Combined with previous studies, these results highlight the current lack of understanding of the causal factors underlying pacing behaviour in laboratory macaques, especially whether it is due to stress (chronic or acute, current or from the past) or to something else. We will discuss the different potential causes of pacing and their implications in term of welfare and validity of neuroscientific findings coming from pacers and non-pacers.

HORSE BEHAVIOUR AND EXPECTED PERFORMANCE IN SHOW-JUMPING

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Horse performance depends on both their physical abilities and their temperament. For sport horses to become winning athletes, the combination of excellent physical abilities and a “winning temperament” is indispensable.

The present research aims at identifying a predictive method for the expected behaviour and performance of a horse in his sport career. For this purpose, 18 horses schooled in show-jumping were tested. The horses were divided into 3 different categories, depending on the level of experience in the discipline of show-jumping and on the complexity of managing the animals during a training session (expert, inexpert and problematic). Horses were tested in a novel object test, in an handling test and by a questionnaire. During the handling test each horse was equipped with a heart rate monitor and each horse-human dyad carried out a standardised show-jumping exercise. In addition, before carrying out the tests, each rider was asked to complete a questionnaire to assess the temperament of the horse he was going to ride.

The novel object test divided the horses into three categories that did not correspond to the ones used at the beginning of the study. Horses performed two opposite behaviours of approach to environment and proactiveness to exploration, so that they were split into proactive and reactive. Horses that displayed signs of uneasiness in the different situations were included in a third category: "nervous". The conduction test revealed a wide range of behavioural responses that were assumed to be excessive if compared to the small number of tested horses. Therefore, the corresponding data were deemed non-significant in the frame of the statistical analysis. Ear gestures, however, highlighted a significant difference between horses of the three different categories (expert, inexpert and problematic). Problematic horses showed higher heart rates and a reduced dispersion than the other categories. Inexpert horses exhibited a high data dispersion, which is strictly correlated with the two behavioural trends they followed. Data from the questionnaire confirmed the three categories initially proposed. The aforementioned results confirms temperament homogeneity in horses belonging to the same category.

In conclusion, we advocate that both the behavioural trends displayed by horses during a show-jumping training session and the riders’ assessment on the animal temperament present some correspondences with the heart rate physiological data. Young horses perform such behaviours similarly to the trends of adult horses, which makes possible to predict their future behavioural tendencies.

DO PERSONALITY TRAITS DIVERGE IN DIFFERENT COMMUNALLY HOUSED CAPTIVE PENGUIN SPECIES?

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Research into animal personality has grown over the last decade as its relevance to animal health and welfare has become more apparent. Personality has been used also for aspects of captive management, including decreasing stress, increasing positive health outcomes, successful breeding also in terms of infant survival. For wildlife management, determining inter-species differences in the personality traits of communally housed animals could be of great help to optimize the use of resources, in order to improve animal welfare. In group-living species, integrated decisions made by individuals result in collective behaviours which may, in turn, influence interactions between individuals and shape the resulting social system. There are evidences that animal groups may exhibit coordinated behaviour and make collective decisions based on simple interaction rules. It has been described that in a flock or a colony, birds tend to exhibit behavioural synchrony, maintaining similar behaviour at approximately the same time throughout the group, and also wild penguins have exhibited within-group synchrony.

In this study we have considered three species of penguins, housed together at RZSS Edinburgh Zoo, Scotland, UK. The exhibit houses a colony of Gentoo penguins (*Pygoscelis papua*), a bachelor group of King penguins (*Aptenodytes patagonicus*) and a small colony of Northern rockhopper penguins (*Eudyptes moseleyi).* In a mixed species enclosure, animals are far more intermingled than they would be in the wild and have a limited area in which to maintain different territories.

A keeper questionnaire (coding method) was used to produce personality profiles for each penguin. A multivariate analysis (Multiple Factor Analysis) on the mean values of the variables was used to analyse the data. The quantitative variables were all the measured characteristics; gender and species were included as qualitative variables. Results outlined a distinct personality in each animal, distinguishing each species in personality traits. The three species are almost sharply separated in the multidimensional space. In Gentoo and in Northern rockhopper penguins the prevailing components include some aggressiveness, fear, and insecurity. King penguins seem to be the “mildest” species, with components related to activity, playfulness, friendliness, and curiosity. We advocate that deeper understanding of each animal’s personality and behaviour can offer practical help to zoological institutions to facilitate daily husbandry, animal welfare, tailor training or enrichment and ultimately increase reproductive success.

A PRACTICAL EXAMPLE OF THE USE OF BEHAVIOURAL VARIETY INDEX (BVI) IN ZOO NORTHERN BALD IBIS

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The Northern bald ibis (*Geronticus eremita*) (NBI) is one of the most threatened birds in the world. Observing animal behaviour has been proved to be an efficient and non-invasive technique to assess the animal welfare, with the performance of a wide array of natural behaviours being one of the most used indicators of good mental and physical well-being. This study aims to evaluate the welfare of a flock of zoo NBI through the investigation of the variety of species-specific behaviours performed. To reach this aim, a Behavioural Variety Index (BVI) has been proposed and calculated based on previous research describing natural ibis' behaviours. This newly developed tool might allow the evaluation of the variety of behaviours performed by each individual and the monitoring of the diversity of the behavioural repertoire of zoo animals. Per ibis, twenty 10-min. sessions were carried out and a continuous focal animal sampling method was used to collect individual and social behaviours. First, the study ibises performed species-specific behaviours and no abnormal behaviour was reported. The BVI suggested a good behavioural variety in the study flock, as each bird performed approximately 80% of the natural behaviours described in the Northern bald ibis and in close relative species, in both wild and controlled environment. The reported similarities between the behavioural repertoires of the study ibises and those described in wild conspecifics suggest a good welfare of the colony. In addition, the BVI proposed in the current study seems to be a useful and practical tool to test behavioural diversity in zoo animals.

THE APPLICATION OF QUALITATIVE BEHAVIOURAL ASSESSMENT TO ZOO ANIMAL MANAGEMENT AND INDIVIDUAL ANIMAL WELFARE AUDITING

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The field of zoo animal welfare science has advanced rapidly over the past decade, with more research being presented on the need for individual animal welfare assessment, for consideration of animal-based as well as resource-based approaches, and to consider measuring welfare in a meaningful and ecologically-valid manner. Methods used in the domestic /farm animal industries have the potential to fundamentally change how we measure welfare states of zoo-housed animals, and to move forward evidence-based husbandry practices that can provide positive challenge and uphold positive affective states. Qualitative Behavioural Assessment (QBA) is a whole animal methodology for monitoring changes in an individual's emotional state based on observable behavioural signals. The terms used to define QBA take into account both what the animal is doing and how it goes about doing it. In this paper, we propose that more cross-institutional studies are used to individually monitor zoo animal welfare across all areas of an individual's life stages using a QBA approach. We surveyed the literature from 2000 to 2018 to see the scope of already published research and how this could be applied to zoo animal management. Twenty papers were reviewed, collected using the search terms "qualitative behavioural assessment" "QBA" "animal welfare" in Web of Science® covering seven domestic species overall. These studies highlight the importance of species-specific approaches to welfare measurement but that key Quality of Life outputs can be identified in individuals across populations and in different environmental conditions. We suggest a way of using Behavioural Diversity Indices (BDI) to measure changes in time allocated to important appetitive behaviours and combining such recording methods with husbandry practice that promote higher welfare states (e.g. the use of species-appropriate environmental enrichment) to provide the most ecologically-valid housing and husbandry as possible. Finally, we have interpreted the application of QBA to the key conservation, research and education roles of the modern zoo to show how directed, individual welfare assessment can play a valuable part in underpinning the long-term objectives of a zoo's animal collection. We hope to spark further thought and discussion into the methods used for multi-zoo, multi-individual yet species-specific welfare assessment that can determine Quality of Life experiences throughout an animal's time housed in captivity.

THE OPINIONS OF THE POPULATION OF BOSSOU ON THE PROGRESSIVE DISAPPEARANCE OF THEIR SECULAR NEIGHBOURS, CHIMPANZEES

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A survey related on the evolution of the population of chimpanzees conducted in 2018 in Bossou allowed to collect very homogeneous opinions. Before colonization, Bossou was a village composed exclusively of a homogeneous indigenous population living in harmony with its environment which was composed of rich and varied flora and fauna. According to the oral tradition passed down from generation to generation, the harmony, complicity and solidarity between chimpanzees and the native population originates from the exceptional and peculiar attention that a chimpanzee would have toward an abandoned baby. This act was attributed to the intervention of an ancestor turned into a chimpanzee. Over time, the exuberance of biodiversity has been severely affected by colonization, deforestation, degradation of cultural values, urbanization and immigration.

Human pressure on biodiversity has progressively led to dwindling primate habitat and, as a result, an imposed obligation to change their way of life.

Made famous by their integration and their specific relationship with the indigenous population, Bossou chimpanzees have had more or less happy days in the city. After independence, many measures were considered and more or less applied for their protection and safeguarding. Unfortunately, these have not been in keeping with the socio-cultural values of the indigenous people. Over time, human pressures on biodiversity have progressively led to dwindling primate habitat. Thus, since 1980, under the worried, helpless and sad look of authentic native people, the decline of the chimpanzee population has begun: 21 in 1976, 22 in 1996, 19 in 2003 including 7 males, 14 in 2007 including 6 males, 12 in 2010 including 5 males, 9 in 2015, 8 in 2016, and 7 in 2018 of which 2 old and a young male.

In the opinion of the population, it is mainly the economic concerns, the constant deforestation and demographic pressure, inadequate regulatory measures, the weak application of the regulations which represent inexorably that lead to the imminent extinction of these authentic primate cousins, the chimpanzees of Bossou.

HAIR CORTISOL ANALYSIS IN SHELTERED COWS AND ITS ASSOCIATION WITH VARIOUS WELFARE INDICATORS

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Hormonal variables are widely used to assess the stress levels in cattle caused by routine husbandry practices. The indices which represent the changes in the activity of the hypothalamic-pituitary and adrenocortical (HPA) axis are the most commonly used. Hair cortisol is one such biomarker of long term stress in animals and provides an objective assessment of the HPA axis activity. Hair cortisol analysis is comparatively non-invasive and is unaffected by circadian variations. It is also not influenced by the momentary stress induced by capture or restraint of the animals. A total of 54 cow shelters spread across six states of India were studied for the assessment of stress levels in the abandoned and unproductive retired cows. From these shelters 540 tail hair samples, 10 cows in each, were sampled and the hair cortisol levels estimated using the enzyme immunoassay (EIA) technique. The median hair cortisol concentration in shelter cows was 1.43pg/mg (First quartile Q_1 -1.02pg/mg, Third quartile Q -$_3$ 2.09pg/mg, IQR =1.07pg/mg). In addition, the welfare assessment of the sheltered cattle was also carried out by the measurement of various animal based and resource based welfare indicators. A multivariate analysis of the animal based measures with the hair cortisol levels revealed seven variables significantly positively correlated to the hair cortisol levels: Dirty flanks ($P<0.001$, posterior tarsal joint ulceration ($P=0.019$), carpal joint injuries ($P=0.001$), lesions on the body ($P=0.038$), skin tenting time ($p=0.001$), age ($P=0.023$) and lactation ($P=0.023$).There were three variables which showed significantly negative correlation to the hair cortisol levels: body hair loss ($P=0.001$), lateral tarsal joint swelling ($P=0.014$) and rumen fill score ($P=0.005$). The multivariate analysis of the resource based measures with the hair cortisol concentration in cows at shelter level showed three variables significantly correlated to the hair cortisol concentration. The percentage of dung in the lying area of the cowshed ($P=0.020$) revealed a positive correlation whereas dry bulb reading in the shed ($P=0.001$) and the duration of access of the cows to the yards ($P=0.015$) were negatively correlated. Hair cortisol promises to be an effective biomarker of stress in cows for conducting welfare assessment studies in field conditions.

INCREASING COST TO ACCESS A MECHANICAL BRUSH CAUSES BEHAVIOURAL RESCHEDULING IN COWS

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Motivation testing is a valuable tool to assess the importance of certain resources for an animal. Most motivation studies use demand curves or its derivatives such as consumer surplus and/or reservation price to quantify and compare animals' motivation for different resources. An important limitation of demand curves is that the test subjects can reschedule their behaviour, especially as the workload to access the resource increases; maximizing their benefit while minimizing their workload. Behavioural rescheduling has been described in detail in mink, mice and hens but not yet in cows. Given that cows are highly motivated to use a mechanical cow brush to groom themselves, the aim of this study was to describe how cow behaviour (i.e. visits to the brush as well as interaction with the brush) changes with increasing workload required to access a mechanical brush. A total of 10 lactating, pregnant cows were trained to open a weighted push-gate to access a mechanical cow brush. After an initial training period, cows could access the brush from their home pen through the weighted push gate. Every 3 days, weight was added to the pulley system of the push gate. Using continuous video recordings, each visit to the mechanical brush was recorded, as well as the duration of individual brush interactions per visit. We analyzed the data using Stata, employing a panel data regression framework with a fixed effect for each cow to account for cow specific un-observables, including unchanging preferences for brush time. For each weight phase, the total number of visits to the brush, the total brush time per visit and the average brush time by weight phase were calculated. With increasing weight attached to the gate, the number of visits per phase decreased ($P < 0.01$) while average brush time per visit increased ($P < 0.01$). In addition, average brush time during the first visit after the weight change increased by almost 40% compared to the baseline brush time ($P < 0.01$). Average brush time in subsequent visits in the same weight phase was equal to the baseline brush time. This study shows that cows re-schedule their behaviour when workload to access a resource is increased. The results of this study are important to consider when designing and interpreting the results of a motivation test conducted on cows or other animals.

THE EFFECTIVENESS, EFFICIENCY AND WELFARE IMPACTS OF DOG POPULATION MANAGEMENT METHODS

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Domestic dogs (*Canis familiaris*) are one of the most abundant species of canids in the world, with total population estimates of up to 700 million. Around 75% of this population are classified as "free-roaming", indicating their ability to roam and reproduce freely. Where free-roaming dogs exist in high densities, there are important implications for public health and the environment, in addition to issues for the welfare of the dogs themselves. The management methods applied to control the population sizes involve: 1) culling; 2) reproductive control and/or 3) the use of shelters to house unowned or unwanted dogs. Each of these approaches has associated animal welfare concerns. Methods to cull dogs are often inhumane, including poisoning, electrocution, carbon monoxide or drowning. Additionally, the methods of physical restraint often cause laceration or tissue damage. The welfare implications of reproductive control methods are poorly documented, but may be of concern in cases where animals are released shortly after surgery or through the stress associated with capture. Long-term sheltering may also be a welfare concern due to the lack of space, social contact and other enrichment, especially when dogs spend prolonged periods in this environment. Assessing dog population management is important to determine whether these methods are effective and efficient, and to evaluate their long-term sustainability and impact on animal welfare.

The impact of dog population management methods is often evaluated by their direct effect on dog population size. This is commonly estimated using simple counts or mark-recapture methods, which fail to consider the influences of dog movement, reproduction or mortality. Here, we present a robust mark-recapture method to incorporate additional information about the rates of recruitment to the population (including births, abandonment and immigration) and removal from the population (deaths, adoption and emigration). This information helps in identifying the dominant factors that maintain or change the dog population size, which has implications for the efficacy of dog population management methods. The robust mark-recapture study was conducted in Pescara, Italy and Lviv, Ukraine, between April 2018 and June 2019. This presentation reports the results of this study and discusses the importance of gathering additional information on recruitment and removal.

This work forms part of the STRAYS project developed under the coordination of the University of Leeds (UK), the Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "G. Caporale" (IT) and VIER PFOTEN International.

SHEEP FARMERS' PERCEPTION OF SHEEP WELFARE IN SOUTHERN BRAZIL: PRELIMINARY RESULTS

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The aim of this study was to describe the perception of sheep farmers regarding sheep welfare, through a survey in Southern Brazil. Fifty-nine farmers answered a questionnaire either online or on paper, from September to November 2017. There were three open and three multiple-choice questions. Some questions were not answered by all farmers since respondents could choose to skip part of the questionnaire or quit participation at any point. Most respondents considered sheep and beef cattle systems (63%, 22/35) as the best in terms of animal welfare, followed by dairy cattle (29%, 10/35). When asked what are the conditions in their farms which improve sheep welfare, 71% (42/59) answered that sheep had free access to pasture and 69% (41/59) free access to a source of water, followed by calm management (54%, 32/59), access to shadow (51%, 30/59), experienced shepherd (47%, 28/59), good forage quality and quantity (46%, 27/59) and immediate veterinary care (32%, 19/59). Concerning on-farm welfare challenges, 40% (23/59) mentioned untrained dogs stressing sheep during handling, lamb mortality (36%, 21/59), inexperienced shepherds (32%, 19/59), forage scarcity at certain times of the year (25%, 15/59) and the absence of shadow (14%, 8/59). The top answer regarding welfare problems which farmers feel no autonomy to solve was the low value attributed to sheep meat chain (43%, 18/42), followed by predation (26%, 11/42) and stolen animals (14%, 6/42). As for suggestions and demands to improve sheep welfare, 35% (6/17) cited the need of support for the meat chain and profit from animal welfare as a value, 35% (6/17) requested help to mitigate predation and robbery problems and 29% (5/17) asked for more information and training regarding sheep welfare. In relation to animal abuse, answers listed first physical aggression (56%, 19/34) followed by not feeding the animals (32%, 11/34). Other answers were associated to fear (18%, 6/34), health problems (18%, 6/34), stress and suffering (12%, 4/34), animal isolation (9%, 3/34), thirst (9%, 3/34), low animal welfare (6%, 2/34), pain and injury (6%, 2/34), thermic stress by cold (3%, 1/34), restriction to natural behaviour (3%, 1/34) and killing the animal (3%, 1/34). Thus, farmers presented an interesting perception of animal welfare aspects of their activities and expressed relevant requests, mostly regarding more information on sheep welfare and the need for the attribution of higher value to sheep production.

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HORSES AND EQUITATION: "WELL-BEING AS A MEASURE FOR WELFARE"

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In response to the increasing questioning of the equestrian world and growing interest and concern for animal welfare, the last years have shown an increment in research focusing on equine welfare and in the development of codes of conduct and best practices for the equestrian world.

The effect of this investment and labour is barely visible as evolution in horse riding and keeping has hardly changed in the last 2000 years.

The aim of this study was to identify where the difficulties for implementation and promotion of change can be found within the equestrian world and what could be the possible causes. Subsequently the review of literature regarding the definition of the word "welfare" and research into the codes of conduct of the equestrian world, uncovered significant problems in lack of coherence and inconsistencies. This questions what people mean when talking about animal welfare and if they even know themselves.

To investigate the process of change of awareness, a survey was designed to analyse the growing segment of horse owners and enthusiasts who are questioning the ethics behind the current use of horses in the Western world. This target group was chosen in the initial work to minimize, as much as possible, the effect of cognitive dissonance when answering questions on equine welfare and to acquire a better understanding on the process of change from seeing horses as sports equipment to sentient beings. Consensus was found defining equine welfare and which indicators can be used to measure this. The results come much closer to the definition on quality of life and a life worth living and is a lot more similar to the definition on human welfare.

Unexpectedly the survey raises doubts to what extent offer meets demand in the equestrian world and to what degree riding teachers are academically prepared to take on the education of children in horse-human relationships.

ON-FARM RISK FACTORS ASSOCIATED WITH WELFARE CONDITIONS POTENTIALLY DETECTABLE IN PIGS AT ANTE-MORTEM INSPECTION

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Conditions relevant to pig welfare on farm such as ear, tail and skin lesions, hernias, rectal prolapses, bursitis and severe lameness have potential for inclusion in welfare assessment protocols conducted ante-mortem in the slaughterhouse. Before this hypothesis can be tested it is necessary to know the prevalence of such conditions in finisher pigs on farm and associated risk factors. The aim of this study was to determine the prevalence of the aforementioned conditions and to investigate risk factors. Descriptive analysis was performed in Excel. A single commercial farm was selected in which pigs from two genetic lines (maternal and terminal) were kept together in one of the facilities housing 18,000 pigs. In this facility 241 of 344 pens containing finisher pigs were assessed for the presence/absence of the conditions. The pens were selected randomly while ensuring that different environmental and pen characteristics were equally represented. The prevalence of each condition was registered from outside of the pen. Genetic line, lying area (presence/absence), floor type (slatted/solid) and ventilation (proximity) were also recorded. Overall, the mean percentage of pigs affected by the different conditions in each pen was low (tail lesions = 0.4, ear lesions = 2.35, bursitis = 4.03, rectal prolapse = 0.01, skin lesions = 0.03, severe lameness = 0.08, hernia = 0.17% pigs affected/pen. The proportion of pigs with tail lesions was higher in females (0.51 vs 0.32%), in pens without lying area (0.44 vs 0.07), in solid floor pens (0.79 vs 0.22) and in pens without ventilation (0.55 vs 0.30 and 0.34). The proportion of pigs with ear lesions was higher in pens of females (3.24 vs 1.13), maternal genetic line (2.81 vs 1.63), in pens without lying area (2.59 vs 1.38) and without ventilation (2.08 vs 1.59 and 0.92). The proportion of pigs with skin lesions was higher in females (0.04 vs. 0.02), in pens with lying area (0.06 vs. 0.03) and solid floor (0.31 vs. 0.10). The proportion of pigs with hernia was higher in solid floor pens (0.33 vs. 0.16). The proportion of pigs with bursitis was higher in pens without a lying area (3.59 vs. 2.17), solid floor (5.53 vs. 3.29) and with ventilation (4.15 vs. 3.64 and 1.94). The proportion of pigs with lameness was higher in pens without lying area (0.08 vs. 0.04) and with solid flooring (0.31 vs. 0.10).

MOTIVATION FOR CHASING BEHAVIOR DISPLAYED BY COMMUNITY DOGS

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Many dogs are living as stray animals due to the difficulties in dog population management. Some of these dogs are recognized by the community and receive care from local residents and may be called community dogs. Some Brazilian cities are maintaining a Community Dog Program to improve both the welfare of the free-ranging dogs and their reproductive control, with positive public health benefits. One challenge of this strategy is the occurrence of chasing behaviour. Dogs that exhibit chasing behaviour are in greater risk of suffering mistreatment, such as being kicked, stoned or beaten. Furthermore, the behaviour may be harmful to other animals, including humans. The purpose of this research was to study the behaviour of chasing objects or individuals by community dogs, to understand its motivation. Six mixed breed dogs were observed and recorded for three chasing events. Four male dogs, three of them neutered, and two spayed females were studied. Dogs were aged between three and ten years old and have been living in the study area from three to eight years. Three videos of each dog, obtained during 6-h daily field observations per animal, were analysed by descriptive statistics considering body language, aspects of the context and other behaviours relevant to the identification of the motivation. The dogs exhibited chasing behaviour motivated mostly by territorialism in all studied events. In 72% of the events, the dogs presented offensive body language, and in 28% of the events their behaviour suggested that they may have experienced fear and discomfort in addition to territorialism, since there was defensive body language. The existence of fear as a motivation for chasing was evidenced by the hesitation during chasing, the exhibition of appeasement signals and the avoidance of contact with the target. In 56% of the events, the chasing started in front of the caretaker's house and none of the community dogs chased beyond the street where the caretaker lives. Therefore, the results suggest that the motivation for chasing behaviour in those occurrences was territorialism, which may be associated to fear. Our results on the territorialism aspect of the motivation coupled to further research detailing the reasons behind fear may shed light on the development of successful intervention strategies to mitigate chasing behaviour and its associated risks to the welfare of animals and humans.

MULTIMODAL APPROACH TO PAIN MANAGEMENT DURING UMBILICAL SURGERY IN CALVES

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Evaluation of pain in cattle is difficult, as cattle are very stoic animals that strongly mask their pain, so as not to be recognized as possible prey to predators. Pain assessment based on behavioural criteria is not easy and objective pain markers are desirable. Plasma cortisol is well described as an indicator for pain, fear and especially stress in cattle. Cortisol levels are not only dependent on the stressor, but also on individual, anxiety-related behaviour. Substance P (SP) is believed to be a more sensitive biomarker for pain. Various studies published in the last years described SP concentrations during pain- and stressful procedures such as dehorning, castration or electroejaculation, but never in calves undergoing umbilical surgery. The aim of this study was to describe the plasma substance P concentrations (PSPC) in calves undergoing umbilical surgery with two different analgesic protocols and to evaluate the effectiveness of metamizole administered additionally to meloxicam before the surgery. The study was conducted as a randomized controlled double blinded trial. Ten calves (CON) were treated with meloxicam alone, and eleven calves (MET) with meloxicam and metamizole as an add-on. Surgery was performed on both groups under general anaesthesia with isoflurane and blood samples were taken 60 minutes before surgery (baseline concentration) and 5, 15, 30, 45, 60, 90, 150 and 510 minutes after the start of surgery. PSPC increased in both groups after the start of surgery, but were lower in MET at all time points, but not significantly so. In CON, PSPC were significantly higher 5, 30 and 90 minutes after the start of surgery compared to the baseline concentration. Calves of MET reached baseline PSPC 60 minutes after the start of the surgery (541.1 pg/mL) whereas calves of CON did not reach baseline concentrations during the trial. A linear mixed model showed that mean PSPC were 214.5 pg/mL lower in MET than in CON (95% confidence interval: -509.7 to 80.8 pg/mL). Mean total AUC for PSPC was 548,935.7 pg/mL*min in CON and 354,031.1 pg/mL*min in MET. The difference was not statistically significant ($p = 0.25$). The results of this study show that multimodal pain management results in lower nociception during surgery in calves and should be performed routinely to reduce pain and improve welfare of animals during and after a painful procedure such as a surgery. It also indicates that SP might be used as a suitable biomarker for nociception in calves.

RUMIN_AAI: OPTIMIZATION OF SMALL RUMINANT WELFARE IN PETTING ZOOS

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The beneficial effect of human-animal interaction on human mental health is widely recognized, however, these interactions can have potentially negative effects on animal welfare. Sheep and goats are commonly kept in petting zoos and care farms due to their social nature, calm disposition and low maintenance cost, though misconceptions regarding their needs and quality of social interactions prevail. In particular, lacking the possibility to avoid this 'forced' interaction with humans can lead to a violation of the so called 'fourth freedom', i.e. 'Free of fear and stress'.

Farm management including housing and feeding practices were evaluated at 9 petting zoos by trained veterinarians and animal caretakers. The incidence of stress-related as well as itching behavior was recorded 15 min before, during and 15 min after visitor interaction, respectively, on a total of 29 sheep and 31 goats, and was expressed as the percentage of minutes in which a specific behavior was observed.

A broad variation in herd composition was observed, with an average of 10 goats (range 2-16) and 6 sheep (range 1-11) per farm. Hereby, both species were co-housed on 4 farms in a single enclosure. Also housing conditions varied, ranging from permanent enclosure in a plain straw box to free outdoor access with extensive enrichments. The duration of human interaction was on average 13.56 ± 11.35 min. While goats showed no significant difference between the incidence of stress-related behavior before (10.8 ± 17 %), during (16.9 ± 18%) nor after (11.8 ± 17,0 %) visitor interaction, sheep showed significantly more stress-related behavior during (20.2 ± 27,0 %) than before (4.8 ± 13,0 %; P-value = 0.002), but not after (9.7 ± 19 %) visitor interaction. Goats showed a significantly higher incidence of itching behavior (21.1 ± 20 %) than sheep (6.3 ± 12 %; P-value < 0.001).

The significant increase in stress-related behavior in sheep during visitor interaction could imply that sheep are more prone to experience these human interactions as 'stressful' when compared to goats. However, herd composition as well as quality and duration of the interaction differed greatly across farms, and as indicated in some farms, the interaction between sheep and visitors did not result in more stress-related behavior. Within all, a thorough sensibilization of the farm personnel and visitors, hereby taking into account the needs of the animals, is pivotal in obtaining a highly sustainable human-animal interaction in petting zoos, benefitting all involved.

MAKING VIRTUAL A REALITY IN ON SITE ANIMAL-RELATED EDUCATION

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Whilst equestrianism is becoming increasingly popular across the world, scientists and equine professionals alike report a lack of equine-realted knowledge amongst equestrians. In addition, the latter tend to overestimate their capabilities, which results in overconfidence (the Dunning-Kruger effect).

Combined with the nature of the horse as a large flight animal, this can compromise and even endanger both equine and human (mental and physical) welfare and safety. Thus, it is imperative to provide equine educators with appropriate 21st century tools to aid instruction. To allow for 'on site' learning, these tools should be easy to use anytime, anywhere and should appeal to a broad public of especially young and novel equestrians.

As confucius already knew: 'I see and I remember'. Indeed, one of the main drawbacks when teaching with animals 'in the field', is the absence of user-friendly visual aids. Therefore, this project focuses on the application of 3D imaging and virtual reality in equine 'on site' learning.

To enhance basic anatomical and saddle fitting knowledge when training equestrians in the field, two augmented reality applications were created. Using the Unity 3D game engine™ (Unity Technologies) and the Vuforia™ augmented reality plugin® (PTC Inc.), two 3D models were anchored to a HOGENT student card as a target. One 3D model was a demonstration of equine skeletal structures, the other the postitioning of a saddle on a horse.

Anchoring these 3D models to a target (e.g. membership card), means they become virtual objects related to the real world target, when the latter is viewed through the camera of a mobile device (phone/tablet). Consequently, the 3D model can for instance 'be rotated'/viewed from different angles by changing the position of the camera relative to the target. In addition, it can be viewed by multiple people at the same time by using several mobile devices and similar targets.

In conclusion, these cases demonstrate that is possible to summon virtual 3D models during training in the field, as long as a mobile device (phone/tablet) and appropriate target are available. It is wise to further investigate the hypothesis that these visual aids will enhance both the the students' learning as well as the comfort of the teacher. Furthermore, the potential application of this protocol to different fields of on site animal-related education warrants attention.

ASSESSING ADAPTATION TO SHORT-TERM CHALLENGES IN SHELTERED DOGS (*CANIS FAMILIARIS*) AS PREDICTOR OF LONG-TERM ADAPTATION TO A SHELTER ENVIRONMENT

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On admission of a dog to a shelter environment, early insight on the individuals' coping abilities would benefit shelter personnel to support the dog during the acclimatisation phase (and thereafter) by adjusting the environment accordingly by management and training. A validated and feasible test that evaluates a dogs' ability to cope with stressors ('adaptability profile') may be a good 'entree tool'. The present study aims to answer whether a test with short-term challenges evoking short-term responses in a dog (e.g. the pro- or reactive coping style and recovery after the introduction of some acute challenges) can give insight into long term individual adaptability in shelter kennels.

In this study, two short-term challenges were used to observe shelter dogs' acute responses the first days after intake at a shelter: I) a vet table test, an observation at the shelter veterinarian before the first routine health check, and II) a novel object test. During the observation at the veterinarian, dogs were placed on the vets' table and observed for 5 minutes before the clinical examination started. Observations included both behavioural and non-invasive physiological (pre- and post-test salivary cortisol and infrared thermography during the test) variables, focusing on changes in variables over time to study stress responses and recovery. For the novel object test, an inflatable killer whale was placed in the outside enclosure of the dog's kennel. The behaviour of the dog was scored to observe anxious behaviour, pro- or reactive coping behaviour and recovery of stress responses to the object. Responses during the short-term challenges were compared to stress responses of the dog on the longer-term i.e. during the first two weeks of kennelling in the shelter. Longer term responses to kennelling were studied using behavioural (stress-related behaviour and nocturnal activity) and physiological (urinary cortisol/creatinine ratio's) variables. Preliminary results will be presented at the poster.

If such a feasible 'entree tool' provides predictors for adaptability of shelter dogs during the acclimatization period of two weeks, this tool can help employees to more adequately decrease stress levels in individual dogs, thereby improving welfare and making the animal more apt for the future.

DAWCON: A DYNAMIC ANIMAL WELFARE CONCEPT

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Conceptual approaches towards animal welfare from different angles may help to direct attention to relevant aspects of this issue that might be overlooked if only one view were used, i.e. they may help to extend our manner of assessing and improving animal welfare (Fraser, 2008). Scientists often address a limited range of aspects which only inadequately deal with the multivariate and multidimensional nature of animal welfare (Rushen, 2003). Clearly defined concepts help to formulate (new) research hypotheses and direct animal welfare research.

We propose a **D**ynamic **A**nimal **W**elfare **Con**cept (DAWCon), which incorporates this aspect and may extend/supplement other welfare concepts, such as the 'Five Freedoms' or the 'Five Domains' (e.g. Mellor, 2017). Our framework revolves around the concept of the (limit of) adaptability of an animal and the combined actions/effects of sporadic or constitutional adverse internal and extrinsic factors and defines welfare as a state that the animal perceives as positive.

In comparison to other welfare concepts, our concept explicitly distinguishes between:

- **the capacities and abilities** of an animal to deal with its environmental appetitive and aversive conditions;
- **sporadic and constitutional influences**, i.e. distinction between appetitive and adverse factors that have short term effects on animal welfare, as opposed to factors that have long term effects on animal welfare. Solutions for improving effects of sporadic adverse factors that impair animal welfare may be different from solutions for improving effects of constitutional factors;
- **intrinsic and extrinsic factors**, where appetitive and adverse intrinsic factors most likely are constitutional. Extrinsic factors are in the majority of instances under stronger control of the owner.

All these elements can be identified and distinguished as separate parameters in animal welfare research and help to formulate exact research questions and hypotheses.

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THE RELATION BETWEEN HAIR-CORTISOL CONCENTRATION AND VARIOUS WELFARE ASSESSMENT PROTOCOLS IN DUTCH DAIRY FARMS

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Many protocols have been developed to asses farm animal welfare. However, the validity of these protocols is still inconclusive. This study aimed to validate the welfare assessment protocols Welfare Quality©, an modified version of Welfare Quality, KoeKompas, WelzijnsWijzer, a new Welfare Monitor, Continue Welzijns Monitor, Cow Comfort Scoring System and the Welfare Index by correlating them to hair cortisol concentrations in cows. All the protocols were executed at 58 dairy farms spread over the Netherlands. Hair samples were taken from 10 randomly selected cows from each farm. The mean cortisol concentrations in the hairs were correlated with the welfare assessment protocols outcomes. Because cortisol is a stress indicator and could therefore be a welfare indicator, a negative correlation between cortisol and the result of the welfare protocol scores was expected. Koekompas was the only protocol that showed a negative correlation ($R= -0.26$; $P<0.05$) with cortisol. Besides this, the Modified WQ protocol parameters housing ($R= -0.30$) and health ($R= -0.23$), milk yield ($R=-0.33$) and mastitis (WW) ($R=-0.28$) had negative correlations with cortisol. Because only five out of all the parameter scores from the welfare assessment protocols showed a negative correlation with cortisol, the protocols might not be reliable and should be re-evaluated. Or cortisol levels, as measured in hairs, are not a good indicator for stress in dairy cattle.

BREEDERS' OPINIONS ABOUT MOBILE-SLAUGHTER OF CATTLE IN FLANDERS

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Most meat-animals are confronted with the stresses of manipulation, transport and slaughter. Transport results in stress, increased potential for injuries, and for subsequent lower meat quality and quantity. The European legislation allows for national initiatives that investigate animal-friendly alternatives of live transport to the slaughter-house such as the development of a mobile slaughter unit. This could result in significant welfare amelioration by decreasing transport time and by eliminating transport-associated stressors such as loading and unloading, the shocks and sensory stimuli of driving, injuries, fatigue, waiting time, deprivation of water, inadequate micro-climate. We carried out several focus group-meetings to reveal the opinions on mobile slaughter among on-farm meat processing cattle breeders, cattle farmers and American bison breeders. The perceived benefits of mobile slaughter for the animals were: the low-stress, respectful, relaxed, familiar, quiet context for the animal, translating in higher meat quality. The farmers appreciate the possibility to follow up the treatment of the animal from birth till death, with a maximal transparency. They consider a respectful death of high importance. Parallel with the decreased animal-stress, the farmers expect to stress less themselves. On-farm mobile slaughter offers an attractive marketing story. Some breeders see a potential for on-farm education concerning slaughter. Most breeders trust that the consumers will be willing to pay a higher price; for some, the profitability is the biggest open question. Most on-farm marketers are confident that their current customers of conventionally slaughtered animals will continue to buy on-farm slaughtered meat. The practical concerns relate to the organization, timing, price, subsequent meat temperature and conservation, transport to the meat processing place and waste treatment. Most farmers think mobile slaughter is or will be feasible, some think it will practically not be feasible; most farmers "just want to do this", they need political support and they want a dialogue with the food safety services. The majority of the breeders is positive towards the functioning of a mobile slaughter unit in Flanders.

THE ANIMAL WELFARE CONCEPT AMONG STUDENTS OF ANIMAL-ORIENTED STUDIES IN FLANDERS

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The definition of animal welfare and its application is intertwined with ethical concerns. The differential importance adhered to different aspects of animal welfare and what is acceptable as minimal welfare threshold varies within and among groups and individuals. We studied the interpretation of the commonly used three-fold welfare definition based on the biological, affective and natural functioning of the animals. We examined to what extent Flemish students of specific animal-oriented studies differed in the importance they adhere to the biological, affective and natural functioning component of this three-fold welfare definition. Final year students of veterinary science, biology and animal management studies (total n=291) were asked to fill out an online questionnaire in which they scored the relevance of statements pertaining to multiple aspects of either biological functioning (e.g. how important is it for an animal to function well biologically?), affective welfare (e.g. how important is it for an animal to feel emotionally well?) or natural functioning (e.g. how important is it for an animal to express its' natural behaviour?) Additionally, several expressions linked to these respective aspects were scored (e.g. "Absence of illness and abnormal behaviour equals sufficient welfare", "It is an ethical imperative that animals experience positive emotions"). In order of increasing importance, the respondents scored the basic needs highest such as no hunger and thirst, no pain, good treatment, space, resting comfort, natural behaviour, thermic comfort, biological functioning, emotional wellbeing, play and exploration, non-harmful social interactions. Mere absence of a negative condition was perceived as insufficient welfare; emotional well-being was considered important. The students were asked to identify their ethical viewpoint as being relatively more zoocentric, anthropocentric or ecocentric. We examined the relationship between the relative importance the students adhered to the different components of welfare, their expressed ethical viewpoint and the type of animal-oriented study they had undertaken.

EDUCATE FOR ANIMAL WELFARE BY PROMOTING LEARNER EMPOWERMENT

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The scientific literature shows different points of resistance to the implementation of animal welfare education in animal husbandry. However, as confirmed by the European Union Strategy for the Protection and Welfare of Animals 2012-2015, farmers are not aware of alternative production practices and often create resistance themselves to change what could improve animal welfare.

Taking into account animal welfare requires not only knowledge, but also specific transversal skills not generally considered by educators, such as assertiveness, congruence between feelings, purpose and action, empathy with other stakeholders and with the animal. We have tested an educational approach that is part of a socio-constructivist epistemology, related to a peer-to-peer pedagogy. It is based on the principles of professional didactics and the didactics of socially acute questions. While the first one invests the real practices of a professional and the knowledge, objectives, ethics and affectivity related to these practices, the second one aims to pedagogically value the controversies surrounding scientifically and socially controversial issues such as those arising from the concern for the welfare of animals in breeding. The didactic approach envisaged aims to subtract the automatisms of perception established by habit and to allow reflexivity and a possible change in the learner's representations and practices based on the principles of "estrangement". By observing and debating the professional practices of breeders from different countries in a caring and engaging framework inspired by the Delphi method, learners are invited to confront their conceptions, ethics, affectivity and thus develop their empowerment. The method combines individual steps of reflexivity and group steps of debates concerning a professional situation-problem. The approach has been tested with veterinary students and future farmers. The analyses are on going. The first ones show that the question of the animal's suffering is experienced as a taboo and that when expression is allowed, learners develop an ethical reasoning that respects both the animal and the breeder.

PERCEPTIONS OF FISH WELFARE IN EUROPE

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The welfare of fish is receiving increasing attention among researchers, animal advocates, policy makers, fish producers, labelling schemes, and in civil society. Attitudes towards animal welfare are regularly explored, and so are the purchasing choices of fish consumers, but rarely has fish welfare been a part of those investigations.

A survey was carried out with 1,000 respondents in each of 9 EU countries; interviewees were asked 21 questions concerning their understanding of fish welfare, their expectations around providing for the welfare of fish, and their purchasing and consumption habits. Seventy-three percent of respondents believe that fish feel pain, with varying majorities also believing them to be sentient, intelligent, capable of negative emotions, and capable of positive emotions respectively. Respondents ranked clean water, health, and exhibiting natural behaviours as the most important factors for the welfare of fish.

Seventy nine percent of respondents believe that the welfare of fish should be protected to the same extent as the welfare of other animals we eat, and seventy nine percent would like to see fish welfare information on product labels. In an exercise ranking the importance of a range of sustainability factors, the possibility to exhibit natural behaviours was considered as important for sustainability as avoiding over-fishing, and was ranked higher than labour conditions. This is particularly important because to this day the discourse on the sustainability of fish has not addressed the expectations of civil society in terms of animal welfare.

In ranking the product characteristics that shape purchase decisions, and the product characteristics that are expected to result from higher welfare systems, 'animal welfare' labelling on fish products means to consumers that this product has all of the most highly sought after product characteristics. However, concern for the experience of the fish doesn't rank highly.

The results of this survey clearly indicate that consumers consider fish welfare to be as important as the welfare of other farmed animals/animals reared for food. However, considerations of quality characteristics are still more important for consumers than is their empathy for the experience of the fish. This demonstrates a clear divide between the interests of people and the interests of fish, a divide that may widen or narrow as the needs of fishes are uncovered.

ANIMAL WELFARE ASSESSMENT TOOL FOR POULTRY, PIG AND CATTLE FARMERS VIA MOBILE APPLICATION

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Monitoring animal welfare is valuable for farmers to pinpoint points of attention. Having tools to self-assess the welfare status on farm would offer several advantageous, as self-scans are flexibly incorporable in routine farm management, are less threatening and are raising awareness about the benefits of closely inspecting the animals. Hence, a mobile application has been developed to allow farmers to assess the animal welfare of their livestock.

Similar to the Welfare Quality© and KTBL Protocol, the scan primarily covers animal-based 'outcome' measures (e.g. directly related to body condition, health, injuries, behaviour). Animal welfare indicators were carefully selected to make sure that the main welfare issues are addressed, and can be evaluated for a limited but illustrative number of animals in a fairly short time-span. The uptake by the sector will be restricted if the self-scans are too time-consuming and/or cumbersome. Additionally, key questions on farm management, housing and production parameters are included to allow for automated benchmarking with other, comparable farms.

Currently, self-scans are available for broilers, layers, sows and piglets, weaners, finishing pigs, beef cattle, lactating cows, dry cows and young stock. Within each animal category, separate tools are provided based on type of housing/milking system (e.g. free stall with/without cubicles or tie stall barns for dairy cattle; enriched cages, floor housing or aviary for layers; robotic milking system or milking installation with high or low milking pipeline for dairy farms). Farmers can assess different production groups at different time-slots. After online submission of a completed scan, a report is automatically generated calculating scores for each key welfare indicator. In addition, these scores are benchmarked anonymously with those of comparable farms. Moreover, farmers will be able to follow up the animal welfare status on their farm over time.

The main challenge was to develop tools which are both inviting and feasible for a farmer to include in his routine farm management without compromising the value of the data collected. Therefore, scans were tested by groups of farmers on multiple occasions.

By scanning and benchmarking animal welfare periodically, farmers will be encouraged to take action to address identified points of attention, and will be able to monitor effects of the measures taken over time. As the self-scans are carried out by farmers not trained/experienced in animal welfare evaluation, comparability of data between farms is expected to be less robust compared to welfare audits performed by trained auditors.

FIGHT INJURIES AND PRODUCTIVITY IN RHESUS MACAQUES

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Thousands of rhesus macaques are bred each year around the world for use in research. One of the major welfare concerns in breeding groups of macaques is the high rate of traumatic injuries due to within group fighting. In this study we examine 10 years of colony records to see what factors contribute to fight injuries and productivity. The colony consists of small breeding groups with one breeding male and 3-12 breeding females (and juveniles) housed in indoor enclosures. Initial analysis showed that the majority of injuries are sustained by adult females. We have focussed on this subset of the population and investigated how factors such as group size, female kinship and age of breeding male affect the injury rate in different groups. One concern is that there may be a positive relationship between the number of fight injuries within a breeding group and the productivity (i.e. factors that could influence productivity such as younger males having more offspring could also affect the number of fight injuries within that group). To investigate this further we fitted generalised linear mixed effect models to both the injury rate and productivity data. We will discuss the results of this analysis and their welfare implications.