



The aim of the animal welfare science update is to keep you informed of developments in animal welfare science relating to the work of the RSPCA. The update provides summaries of the most relevant scientific papers and reports received by the RSPCA Australia office in the past quarter. Email science@rspca.org.au to subscribe.

ANIMALS IN RESEARCH AND TEACHING

Time to replace animal models for human disease studies

Developing effective treatments for diseases such as Alzheimer's Disease (AD), breast cancer (BC) and prostate cancer (PC) is critically important as these conditions affect millions of people worldwide. Unfortunately, the failure rate for drug development is dismal with 99% of AD drugs and 97% of cancer drugs failing to progress from animal testing through to phase III human clinical trials and approval.

The authors of this review argue that over-reliance on animal models is contributing to the failure rate. They contend that results in animal models are not adequate predictors of results in humans leading to translational failure. For example, of the 180 mouse models of AD very few are adequate reflections of the onset, cognitive abnormalities, progression, pathology and genetics of the most common form of AD in humans. The authors question the translatability of mouse models of BC given that the limited lifespan of mice does not allow for the study of long-term disease progression and drug resistance, which are major concerns in the treatment of BC in humans. Ability to study BC spreading to other organs (metastases) is limited in animal models considering that spontaneous metastases very rarely develop in commonly used mouse models. Ability to study immunotherapies is limited as genetically modified mice with deficient

immune systems are routinely used. Similarly, animal models for PC have limited translatability given differences between animal and human PC development, gene expression, hormone receptors and histopathology. The authors provide several examples of drugs which demonstrated promising results in animal models but failed in human trials.

The authors recommend closer examination of translatability and greater investment in new approach methods (NAMs) such as patient-derived cells, 3D tumour spheroids, organ-on-a-chip technologies, next generation sequencing, integrated computer modelling and innovative imaging technologies.

Pistollato F, Bernasconi C, McCarthy J et al (2020) [Alzheimer's disease, and breast and prostate cancer research: Translational failures and the importance to monitor outputs and impact of funded research](#). *Animals* 10, 1194.

Beyond the 3Rs – a new ethic for animals used in research

The central principles for the use of animals in research are the 3Rs: replacement (consider alternatives to animal use), reduction (use fewer animals) and refinement (refine methods to prevent, alleviate or minimise harm). The authors challenge the 3Rs on the grounds that they perpetuate injustice and reinforce the domination and marginalisation of animals as disposable for human benefit.

The authors propose new principles for the use of animals in research based on the 2014 Canadian Tri-Council Policy Statement for the Ethical Conduct for Research Involving Humans (TCPS2): non-maleficence, beneficence and voluntary participation. Rather than exploiting animals as research tools, the authors propose a new paradigm where animals like human participants in research, are represented as individuals with agency. They posit that researchers and animals should be equal participants and that research should be mutually beneficial. Non-maleficence, to do no

harm, would require animals' needs and vulnerabilities to take precedence. Beneficence, to impart benefit, would require animals to gain from participation in research such as the provision of positive experiences. They argue that animals' participation in research should be voluntary not forced, for example providing opportunities to assent or dissent and assessing willingness. The issue of animals' right to privacy, that is the right to be free from interference by others, is also raised.

Recommendations are made to use these new principles as a starting point towards new animal use ethics.

Van Patter LE, Blattner C (2020) [Advancing ethical principles for non-invasive, respectful research with nonhuman animal participants](#). *Society & Animals* 28(2):171-190.

ANIMALS USED FOR SPORT, ENTERTAINMENT, RECREATION AND WORK

Comparing industry and advocacy perspectives on Thoroughbred welfare

There are increasing tensions surrounding animal welfare in the Thoroughbred (TB) horse racing industry. These tensions, in part, stem from differing views of the naturalness of racing. Naturalness is central to animal welfare including freedom of natural movement and freedom to express natural instincts. This study explores the contrasting views of senior racing industry executives and animal advocates on the naturalness of common race day scenes in TB racing.

Informers (study participants) included industry executives (n=9) from Australia, the USA and an international body, all of whom had a long history of involvement in TB racing. Animal advocates (n=7) included executives, scientific staff and consultants from Australia, the USA and the UK. All study participants were shown four images of common race day scenes where horses were displaying behavioural signs of compromised welfare: (1) A saddled TB with no rider being pushed by a handler, (2) A close up of a TB's head with a tight bit and open mouth, (3) A saddled TB with jockey being pressured by six handlers, (4) A close up of a TB with head low, neck hyper-flexed and mouth open with a tongue tie and tight bit. For each image, informers were asked 3 questions to elucidate their spontaneous, personal views: describe what you see, is this a common thing you see on the racetrack and is there anything else you'd like to say in relation to this image?

Informers confirmed that the photographs depicted common race day scenes. Generally, industry informers described the photographs as depicting 'fiery', 'spirited', 'excited', natural behaviours of TBs. They viewed TBs as athletes bred for performance and thought of them as willing and eager participants in racing. In contrast, animal advocates described all photographs as depicting compromised animal welfare involving negative horse-human interactions, lack of choice, use of undue force and stressed, agitated and anxious animals. There were outlier responses such as an industry informer expressing distaste at a horse being pressured by six handlers and an advocate downplaying that animal's panic (image 3).

Overall, industry informers normalised and downplayed the horses' behaviour while advocates appeared more concerned by poor handling and improper tack, e.g. tongue ties, harsh bits. The author proposes a Layers of Engagement with Animal Protection framework for progressing TB welfare. It is argued that racing's social licence to continue will be in increasing jeopardy if fundamental shifts do not occur in the TB racing industry's views on horse welfare.

Bergmann IM (2020) [Naturalness and the legitimacy of Thoroughbred racing: A photo-elicitation study of industry and animal advocacy informants](#). *Animals* 10(9), 1513.



Slow-feeder bags reduce stress behaviours in stabled horses

Horses used in sport, recreation, work and entertainment are often confined to stables where they are unable to interact with other horses or graze. This is detrimental for horses as they are a social species that spend the majority of their time grazing. Denied the ability to perform normal behaviours, confinement is recognised as an animal welfare risk with consequences for horses' physical and psychological health. Unable to cope with the stress of confinement, horses can develop abnormal behaviours such as stereotypies (repetitive movements) and coprophagia (eating faeces). This study investigated whether a feeding enrichment device in the form of a slow-feeder bag could alleviate some of the stress of confinement.

Seven Brazilian army horses (3 males, 4 females), were individually confined in 3m x 3.2m stalls for 10 days. Their behaviour was monitored by cameras, motor activity by pedometers, heart rate by cardiac

transmitters on a chest strap and blood samples were collected morning and afternoon to measure cortisol circadian rhythm (CCR) (stress hormones). Six of the seven horses displayed behavioural abnormalities prior to the study including weaving (a stereotypy) and coprophagia (eating of faeces). After 8 days of eating hay from the slow-feeder bag, all horses reduced the time spent performing abnormal behaviours.

Though heart rate did not change and no control group was included in the study, the authors concluded that slow-feeder bags were associated with behavioural improvements as well as increased ingestion time, reduced motor activity and increased mean CCR.

Correa MG, Rodrigues e Silva CF, Dias LA et al (2020) Welfare benefits after the implementation of slow-feeder hay bag for stabled horses. *Journal of Veterinary Behavior* 38:61-66.

Taking steps to identify risks of fetlock injuries in Thoroughbreds

The joints of Thoroughbred racehorses endure high loads during training and competition, predisposing them to injuries. Injuries to Thoroughbred racehorses represent a significant animal welfare issue and are attracting increasing public scrutiny. To date, the racing industry has failed to implement effective tools to predict and prevent catastrophic injuries.

In March 2020, UK equine veterinarians and racing industry representatives held a symposium to discuss how to reduce the risk of catastrophic fractures of the fetlock joint (visually akin but anatomically dissimilar to the human ankle). Significant fetlock joint damage can develop without the horse showing any observable clinical signs which limits the ability of vets to assess injury risk on physical examination alone. For example, 90% of horses that suffered fatal injuries at the Hong Kong Jockey Club showed no abnormalities at pre-race veterinary inspection. It has been estimated that an additional 200 marginal passes would have to be withdrawn at pre-race veterinary examination to prevent one fatal injury but the racing industry would be unwilling to withdraw so many horses. Hence discussion at the symposium focused on how imaging technologies such as radiography, nuclear scintigraphy, computed tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography (PET) could be used to identify horses at risk of catastrophic fetlock injuries.

In the short-term the symposium participants recommended transparency and standardisation of risk assessment protocols to assess horses who are not fit to run and development of a data repository and imaging guide for vets. In the long-term, they recommended further research on the relationship between exercise/rest and injuries, genetic markers, injury progression and the effects of early interventions.

Colgate V (2020) [Science-in-brief: Risk assessment for reducing injuries of the fetlock bones in Thoroughbred racehorses](#). *Equine Veterinary Journal* 52(4).



COMPANION ANIMALS

Common plant toxicity in companion animals

Many popular indoor plants are toxic to companion animals. This review discusses the indoor plants most commonly associated with companion animal poisoning in Europe.

Effects of plant poisoning range from mild vomiting and diarrhoea from ingestion of glycoside containing *Aucuba japonica* (spotted laurel) to potentially fatal gastrointestinal, neurological and liver problems from ingestion of just one or two seeds of the *Cycas revoluta* (sago palm). *Anthurium* spp. (flamingo flowers), *Dieffenbachia* spp. (dumb canes), *Spathiphyllum* spp. (peace lillies) and *Zantedeschia aethiopica* (arum lillies) contain calcium oxalates that if ingested cause clinical signs including drooling, difficulty swallowing, vomiting, diarrhoea, eye and breathing problems. *Rhododendron* spp. including azaleas and *Nandina domestica* (sacred bamboo), contain glycosides that if ingested cause gastrointestinal signs, breathing, heart and neurological problems. *Cyclamen* spp. (e.g. Persian

violets) and *Dracaena marginata* (dragon tree) contain saponins that if ingested cause drooling, gastrointestinal signs, heart and neurological problems. *Euphorbia pulcherrima* (poinsettia), which are common Christmas ornamentals, contain a range of substances that can cause irritation to the eyes, mouth, throat and gastrointestinal tract resulting in signs such as conjunctivitis, vomiting and diarrhoea. *Lilium* spp. (lillies) contain alkaloids that cause kidney failure if ingested by cats. One of the most common indoor plants, *Ficus benjamina* (fig) also contain a variety of toxins that irritate the skin and gastrointestinal tract.

Given the ubiquity of these toxic plants, measures should be put in place to prevent companion animal poisoning. The authors also recommend a centralised system for reporting cases of companion animal poisoning.

Bertero A, Fossati P, Caloni F (2020) [Indoor companion animal poisoning by plants in Europe](#). *Frontiers in Veterinary Science*, 7.

Prediction of dogs' behaviour after adoption with shelter behaviour assessments

Standardised behavioural assessments (BA) are used by RSPCA shelters to evaluate dogs' behaviour, inform their management in the shelter, assess their suitability for adoption and match them with adopters. This study evaluates how well the BA predicts dogs' behaviour post-adoption.

The results of BA conducted 5 days post-arrival at the RSPCA Queensland Wacol shelter were compared to a survey asking adopters about their dog's behaviour post-adoption. The 15-minute BA, based on comprehensive research and refined over many years, includes 11 different tests aiming to assess play, friendliness, sociality, fearfulness, anxiousness, arousal, predatory behaviour, response to strangers, avoidance, aggression, displacement, appeasement, reactivity, possessiveness and separation related behaviours. One month after adoption, 123 adopters responded to the 10-minute multiple choice survey which asked questions relating to the aforementioned behaviours. Their dogs were largely mixed breed, aged 1 to 10 years, 61 were female, 62 were male.

Analyses showed that the BA was somewhat effective at predicting stable personality traits such as overall friendliness, fearfulness and anxiousness but was not a reliable predictor of complex problem behaviours such as aggression, food guarding and separation related behaviours. The authors recommend that the BA be used in conjunction with other information such as history from before the dog's entry to the shelter, veterinary clinical findings and ongoing monitoring by a behaviourist, the shelter team and foster carers.

Clay L, Paterson MBA, Bennett P et al. (2020) [Do behaviour assessments in a shelter predict the behaviour of dogs post-adoption?](#) *Animals* 10, 1225. [Author MBA Paterson is from RSPCA Queensland]

Positive applications of canine behavioural assessments in shelters

A standardised behavioural assessment (BA), based on over a decade of research and refinement, is used by RSPCA shelters to evaluate dogs' behaviour. This review discusses the benefits and limitations of BA.

Benefits of BA include improving understanding of the individual dog, attaining useful information to guide the dog's management in the shelter, assessing their suitability for adoption and matching them with suitable adopters. A BA does not result in a pass or fail. For example, a display of aggression during a BA is not an immediate trigger for euthanasia. Rather, a BA provides a holistic picture of the strengths and weaknesses in the behaviour of the dog and informs an individualised behavioural modification plan. However, no single test is sufficient to identify all desirable or all undesirable behaviours or diagnose

behavioural pathologies. Accordingly, the fate of dogs in RSPCA shelters is not decided on the basis of a BA alone. Decisions about the dog's management are made using information from the BA as well as pre-intake history, veterinary clinical findings and ongoing monitoring by a behaviourist, the shelter team and foster carers.

The authors recommend that the BA should continue to be conducted and refined by adequately trained staff and used as part of a multi-factorial decision-making process.

Clay L, Paterson M, Bennett P et al (2020) In defense of canine behavioral assessments in shelters: Outlining their positive applications. *Journal of Veterinary Behavior* 38:74–81. [Author MBA Paterson is from RSPCA Queensland]

Heat-related illness (heatstroke) is a risk all year, particularly for brachycephalic dogs and exercising dogs as well as those in cars

Heat-related illness (hyperthermia causing potentially fatal organ dysfunction) is a significant animal welfare concern. This study aimed to identify the most common triggers and risk factors of heat-related illness (HRI) in dogs in the UK.

Over 900,000 electronic patient records (EPR) on VetCompass™ for the year 2016 were reviewed and 1259 HRI events involving 1222 dogs were identified. Triggers of HRI included: exertion (exercise related) (74.2% of events with an identified trigger), environment (ambient exposure unrelated to exercise) (12.9%), vehicular confinement (5.2%), visit to a clinic/grooming salon (4.6%), building confinement for example with faulty heating (2.7%) and blanket entrapment (0.5%). Analyses revealed that cases of HRI were reported throughout the year with the highest number of fatalities recorded in July, at the peak of the UK summer. Younger, more active dogs and flat-faced breeds are at higher risk of exertional HRI. Older dogs and flat-faced breeds are at higher risk of environmental HRI.

The authors warn that without adequate mitigation strategies, the number of dogs experiencing HRI is likely to increase with climate change. To help prevent and manage HRI, they recommend that annual awareness campaigns should include warnings not just about vehicular HRI but also exertional HRI.

Hall EJ, Carter AJ, O'Neill DG (2020) [Dogs don't die just in hot cars—Exertional heat-related illness \(heatstroke\) is a greater threat to UK dogs](#). *Animals* 10(8), 1324.



Medical conditions and outcomes in hoarded cats

Animal hoarding is a psychiatric disorder characterised by the pathological accumulation of large numbers of animals and failure to provide adequate care. This study aimed to characterise the source, health status and fate of hoarded cats rescued by the Toronto Humane Society (THS), a private, 'no-kill' shelter in Canada which does not carry out cruelty investigations or seizures.

A total of 371 hoarded cats from 14 sources were included in the study. Analyses of THS records from 2011 to 2014 revealed that the main source of hoarded cats was voluntary surrender via a community intermediary such as a community volunteer (11/14 sources). The authors admit that these findings are unusual given that animal hoarders typically resist relinquishing animals. Unusually, the majority of the cats were in ideal body condition (75%). Upper

respiratory tract infection (URI) (38%), skin disease (30%) and ear infections (29%) were the most common health conditions. The majority of the hoarded cats (87%) were entire (not desexed). The hoarded cats had similar length of stay and adoption rates as non-hoarded cats in the THS shelter.

There is a large range and diversity of harm and severity in animal hoarding as indicated by the different prevalence of medical conditions in the hoarded cats in this study. Recommendations to use community intermediaries, offer desexing programs and a greater focus on hoarding masquerading as rescue, are widely applicable.

Jacobson LS, Giacinti JA, Robertson JV (2020) Medical conditions and outcomes in 371 hoarded cats from 14 sources. *Journal of Feline Medicine and Surgery* 22(6):484–49.

Cat containment behaviour in kitten and cat adopters

Cat owners are encouraged to keep cats contained on their property for the benefit of cats (e.g. reduced risk of injury, fighting, cruelty, disease, unwanted pregnancies), the community (e.g. reduced nuisance, neighbourhood disputes) and wildlife (e.g. reduced risk of predation). In order to design effective programs to encourage cat containment, barriers to cat containment behaviour must be identified and addressed.

This Australian study explores drivers and barriers to cat containment behaviour using a COM-B model: Capability (physical and psychological capacity), Opportunity (external factors such as social norms and access to equipment) and Motivation-Behaviour (internal factors such as habits and conscious deliberation). Seventy-two people who adopted cats from RSPCA Queensland's Wacol shelter from 2018 to 2019 participated in the study. At the time of adoption, participants were either provided with the standard adoption information or the standard information and a printed copy of the RSPCA Australia 'Keeping your cat safe and happy at home', which contains detailed information about the benefits and options available for cat containment. At the time of adoption, 64 (89%) of the participants expressed the intention to contain their cat.

Eight weeks later, participants completed an online survey about their cat containment beliefs and behaviour and engagement with the information

provided. The majority (92%) of participants who expressed the intention to contain their cat were doing so. Sixty-three (87%) of adopters were containing their cat, including 59 who intended to contain their cat and 4 who had not. Participants who were containing their cat were more likely to agree with the benefits of containing their cats. Participants who were still not containing their cat 8 weeks post-adoption, were motivated by their dislike of the smell of urine inside the house and their belief that cats need to roam. Demographic factors (age, gender, locality, dwelling type etc.) did not affect adopters' cat containment behaviour except adopters who contained existing pet cats were more likely to contain the newly adopted cat.

Survey results indicated that not every participant accessed the information provided, confirming that providing information alone is insufficient for behavioural change. To encourage cat containment, the authors recommend personalised training and support for cat adopters, prompts, subsidised low-cost cat containment structures and demonstrations by cat owners who are successfully containing their cats.

McLeod LJ, Evans D, Jones B et al (2020) [Understanding the relationship between intention and cat containment behaviour: A case study of kitten and cat adopters from RSPCA Queensland](#). *Animals* 10, 1214. [Authors D Evans, B Jones and S Zito are from RSPCA Australia; author M Paterson is from RSPCA Queensland]

Investigation of 'breed loyalty', reacquisition and owner recommendation of Bulldogs, French Bulldogs and Pugs

Brachycephalic (flat-faced) breeds are increasingly popular despite a significantly shortened lifespan and severe breed-related health problems including brachycephalic obstructive airway syndrome (BOAS), eye, skin and spinal problems, difficulty giving birth and high risk of heat related illness. The tendency to prioritise aesthetics over health is a concerning animal welfare trend. This study investigated 'breed loyalty', that is positive attitudes towards a specific breed leading an owner to want to buy that breed again in the future and recommend others do the same.

Owners of pugs (n= 789), French bulldogs (n=741) and bulldogs (n =638), predominantly from the UK, USA and Canada, were sampled via online forums and social media. Despite many of the dogs having severe health problems, the majority of owners would still buy the breed again. The majority (93%) of participants would choose to own their current breed again (reacquisition desire) in the future and 65.5% would recommend their current breed to a first-time dog owner. Breed loyalty was associated with beliefs about positive behavioural traits, entertainment value, lifestyle factors and emotional closeness. Very low proportions of owners appeared concerned by breeding practices and health problems. The authors suggest that brachycephalic dog owners' understanding of what is normal dog function may be skewed. For example, increased breathing noise was perceived as 'funny' or 'cute' rather than indicative of BOAS, a significant health problem.

Odds of reacquisition decreased with expense of ownership, maintenance requirements, undesirable behaviours, increasing awareness of BOAS and number of conformation-related surgeries. The authors recommend that information about the drivers and barriers to brachycephalic dog acquisition and breed loyalty be incorporated in behavioural change programs.

Packer RMA, O'Neill DG, Fletcher F et al (2020) [Come for the looks, stay for the personality? A mixed methods investigation of reacquisition and owner recommendation of Bulldogs, French Bulldogs and Pugs](#). PLoS ONE 15(8), e0237276.



FARM ANIMALS

Dairy calves experience ongoing pain after disbudding

Disbudding, the removal of horn-producing cells in young calves, is an invasive husbandry procedure routinely performed in the dairy industry. While it is well-established that the procedure is immediately painful for calves, this study investigated whether calves experience ongoing pain following hot-iron disbudding.

At the University of California's Davis Dairy Teaching and Research Facility, female dairy calves, Holstein (n=19) and Jersey (n=5), aged between 24 and 38 days were hot-iron disbudded with the aid of a local cornual nerve block (2% lidocaine subcutaneously) and a non-steroidal anti-inflammatory (1mg/kg orally). To investigate whether the calves were experiencing ongoing pain 11 days after disbudding, their behaviour was observed before and after a local cornual nerve block (treatment group, n=13) or saline (control group, n=11) which temporarily removes local sensation.

Consistent with pain relief, calves in the treatment group shook their heads and flicked their ears less than the controls. Approximately 90 minutes after the treatment, head scratches and head shakes increased, indicating sensation was returning to the painful area. Other behaviours such as tail flicks, transitions from between standing and lying and grooming, did not differ between treatment and control calves but these behaviours can be inconsistent.

The authors concluded that calves experience ongoing pain after disbudding and long-acting pain relief or non-painful alternatives to disbudding are needed.

Adcock SJJ, Cruz DM, Tucker CB (2020) Behavioural changes in calves 11 days after cautery disbudding: Effect of local anaesthesia. *Journal of Dairy Science* 103, 8525.

Enrichment during rearing improves free-range laying hen welfare

In Australia, pullets (young hens before lay) bred for free-range egg production are not provided with outdoor access creating a potential welfare concern when they must then adapt to free-range housing. This study tested whether enrichment during pullet rearing could improve the welfare of free-ranging hens.

Pullets up to 16 weeks of age (n =1386) at a density of ~9 birds/m², were raised in three groups: control (no enrichment), weekly rotated novelty enrichment (e.g. buckets, brushes, toys) and structural enrichment (custom made H-shaped perching structures). At 16 weeks of age, the pullets were moved to a free-range facility (9 pens, 154 hens per 3.6m x 4.8m pen). From 25 weeks of age, two pop-holes per pen were opened allowing hens access to an outdoor area (31m x 3.6m for each pen) during the day consisting of concrete, river rock and grass. At 44 to 45 weeks of age, an experimental stressor was imposed by reducing the outdoor area by 20% for 11 days. Hens ranging activity was measured via microchips on leg bands and radio-frequency identification (RFID) readers at the pop-holes. Each hen was individually assessed at five time points for weight, feather loss, footpad

lesions, comb wounds, toenail length, keel damage and other injuries. At three time points, egg albumen corticosterone concentration (stress hormones) and a variety of egg quality measurements were also measured.

Novelty and structural rearing enrichment were found to provide welfare benefits in respect to indicators including body weight, comb wounds, toenail length and footpad condition. Ranging activity and albumen cortisone concentration suggested that structural enrichment may have improved hens' ability to adapt to the experimental stressor. While rearing enrichment did not significantly affect egg quality, the stressor treatment reduced egg quality across all groups of hens. Overall, the results suggest that rearing enrichment during rearing and range access improve laying hen welfare.

Bari MS, Downing JA, Dyal TR et al (2020) [Relationships between rearing enrichments, range use, and an environmental stressor for free-range laying hen welfare](#). *Frontiers in Veterinary Science* 7, 480.

Social challenges facing cultured meat

Cultured meat grown from animal cells has the potential to prevent the animal, environmental and public health issues associated with conventionally produced meat. However, there are a range of social factors that must be considered in the development of the cultured meat industry. In this invited review, a representative of a not-for-profit organisation aiming to accelerate the commercialisation of cultured meat, summarises media, religious, regulatory and economic concerns that the industry must navigate.

Positive media coverage is seen as key to promoting the cultured meat industry. Barriers to positive media coverage include the 'unnaturalness' of cellular meat, appealing to vegetarians rather than meat eaters and emphasising novel technology rather than the familiarity and similarities to conventional meat. For the cultured meat industry to grow, it must understand the views of different religious consumers. The author

cites a survey of people from the US, India and China (n = 3030) that found the majority of religious consumers were open to eating cultured meat except from species not allowed in their religion. In terms of regulation, it remains unclear whether cultured meat would be considered 'meat' under existing definitions in the European Union or United States and these uncertainties would have to be navigated by the industry.

While there are potential issues associated with cellular meat causing a potential decline in agricultural employment and increase in economic inequality, the author recommends that production decisions should be made to optimise the benefits and minimise the risks to communities.

Bryant CJ (2020) [Culture, meat and cultured meat](#). Journal of Animal Science 98(8), 1.

Providing more space benefits sow welfare after farrowing

Pregnant sows are routinely confined in farrowing crates for around four weeks to farrow (give birth) and feed the piglets (lactation) until weaning. The extreme physical and behavioural restriction, discomfort, barrenness and boredom of farrowing crates results in poor sow welfare. This study is the first to employ behavioural, physical and physiological measures to assess the welfare of sows in open compared to closed farrowing crates and assess how sows use the slight increase of space following the opening of a hinged farrowing crate.

This study was conducted at the University of Pennsylvania's Swine Teaching and Research Centre. At gestation day 110, a few days before farrowing, 36 sows were moved into 4.2m² farrowing pens (2.1 x 2m). Each farrowing pen had a hinged crate that when closed, confined the sow to 0.64 x 1.73m. At day 113, the hinged crates were closed. The control sows (n=13) had the hinged crate remain closed until weaning (piglets aged 28 to 35 days). One experimental group (n=12) had the hinged crate opened 4 days after farrowing and remain open until weaning. The other experimental group had the hinged crate opened 7 days after farrowing and remain open until weaning. Behavioural (time spent engaged in different activities and postures and interactions with the environment and piglets), physical (udder and body lesions) and physiological (salivary cortisol) measures were recorded.

While salivary cortisol was not found to be a useful measure for sow's chronic and post-farrowing stress, behavioural and physical measures indicated that opening a hinged farrowing crate improves the welfare of sows compared to keeping them in closed crates for the duration of lactation. Where the hinged crate was open, sows spent more time active, engaged in motivated behaviours, changing positions, standing, exploring and interacting with their piglets compared to controls. Even with greater sow activity and position changes, there were no differences in nursing behaviour or piglets' access to the udder. Sows in the experimental groups also had fewer teat injuries three weeks after farrowing compared to controls. Overall, these results support the idea that providing sows with more space, such as through opening a hinged farrowing crate, is beneficial for sow welfare after farrowing.

Ceballos MC, Gois KCR, Parson TD (2020) The opening of a hinged farrowing crate improves lactating sows' welfare. Applied Animal Behaviour Science 230, 105068.

Pre-weaning socialisation and enrichment helps mitigate stress in piglets

Commercially-reared pigs are routinely regrouped (mixed) throughout their life including at weaning, finishing and slaughter. Regrouping can compromise animal welfare as it is associated with a number of stressors including handling, transport, removal from familiar individuals, exposure to unfamiliar individuals, novel sensory stimuli and aggressive interactions. This study, carried out on a commercial pig farm in Spain, aimed to investigate whether behavioural and social enrichment could alleviate some of the stress experienced by pigs at regrouping.

Soon after birth, 661 piglets were assigned to either control (n= 324) or enrichment groups (n=337). The enrichment groups were given enrichment items (e.g. toys, ropes) and the barrier between two adjacent farrowing pens was removed permitting the piglets from different litters to socialise until weaning at 25 days of age. Opening the barrier between pens also increased the amount of space available to piglets. The control groups received no enrichment and were not permitted to socialise as per status quo management. Behavioural (time spent engaged in different activities), physical (skin lesions) and physiological stress (salivary cortisol, chromogranin A, α -amylase) measures were recorded before and after regrouping until slaughter. By slaughter, almost half the pigs were lost to follow up (319/661).

The results of this study found that enrichment in early life improved the welfare of the commercially-reared pigs. Physiological indicators confirmed that regrouping is stressful for all pigs, but enriched piglets were faster to recover compared to controls. Before weaning, piglets who received enrichment spent more time exploring than controls. After weaning, pigs who had received enrichment earlier in life displayed less negative social behaviour and more active behaviours. The authors acknowledge that enrichment alone was insufficient to alleviate the multitude of stressors experienced by commercially-raised pigs. For example, there was no significant difference in the number of skin lesions or incidence of ear biting between the control and enrichment group. However, the provision of physical and social enrichment for piglets may be one low-cost and practical way to provide piglets with likely life-long welfare benefits.

Ko H, Chong Q, Escribano D et al (2020) Pre-weaning socialization and environmental enrichment affect life-long response to regrouping in commercially-reared pigs. *Applied Animal Behaviour Science* 229, 105044.



Lack of open water access negatively impacts the health and welfare of farmed ducks

China produces 75% of global duck meat slaughtering 3.2 billion ducks a year. Traditionally, farmed ducks in China were provided with at least some access to open water to undertake essential behaviours including swimming, preening and feeding. However, recent biosecurity restrictions have prohibited the provision of open water for ducks and the Chinese duck industry is moving towards a 'dry-feeding system'.

This study, conducted at a poultry breeding farm in Guangdong Province, China, investigated the health and welfare implications for farmed ducks raised without access to open water. On the day of hatching, 120 Sanshui white ducks were assigned to either a traditional system with a water pool (WP) or a dry-feeding system without a water pool (LWP). Preening behaviour, live body weight and daily feed intake were recorded until slaughter at 6 weeks of age. Preen gland and thymus measurements were taken post-mortem.

Feed intake, live body weight, food conversion rate, eviscerated weights, abdominal fat and leg muscle density were significantly higher in the WP group provided access to a water pool. Frequency of preening behaviour and mean preen gland weight were significantly reduced in the LWP group that did not have pool access suggesting lack of water access had a negative effect on preen gland development, feather integrity and thermoregulation. The thymus, where essential immune cells mature, was smaller in the LWP compared to WP group suggesting lack of open water access may also affects ducks' immune function. Overall, this study found that lack of open water access negatively affects preen gland development and behavioural expression of natural preening behaviours of farmed ducks.

Mi J, Wang H, Chen X et al (2020) [Lack of access to an open water source for bathing inhibited the development of the preen gland and preening behavior in Sanshui White ducks](#). Poultry Science (in press).

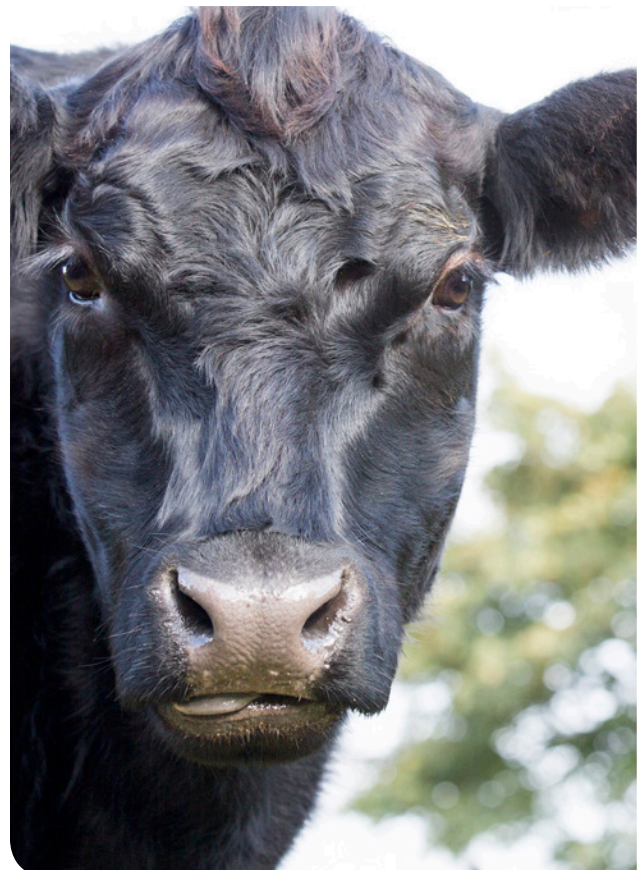
What is the meaning of 'positive welfare'?

Animal welfare science is increasingly focused on the concept of positive welfare. However, multiple definitions of positive welfare exist in the literature and terms such as good welfare, quality of life, a life worth living are often used interchangeably. Similar to debate in the field of positive psychology in humans, this perspective piece aims to clarify positive welfare in animals.

The authors identify three distinct views of positive welfare: (1) 'hedonic positive welfare' focused on likes and wants, (2) 'positive welfare balance' focused on positive experiences outweighing negative ones and (3) eudaimonia focused on longer lasting satisfaction with one's life, a view that is so far exclusive to human positive psychology.

The authors recommend that animal welfare scientists state their view for clarity. They propose a framework ("Vienna Framework") for future research on positive animal welfare. They encourage researchers to consider the frequency and duration of positive experiences, level of arousal, context specificity, the animals' previous experience, current welfare state, individual differences, sense of agency and long-term benefits.

Rault J-L, Hintze S, Camerlink I et al (2020) [Positive welfare and the like: Distinct views and a proposed framework](#). Frontiers in Veterinary Science 7, 370.



Welfare of beef cattle in Australian feedlots

At any one time, over one million beef cattle are being finished in one of Australia's 400 intensive feedlots. Aspects of the feedlot environment may compromise the physical and psychological welfare of cattle as they are exposed to a multitude of stressors including: transport, handling, regrouping (mixing) with unfamiliar people and animals, inability to express the full range of natural behaviours (e.g. grazing), injury, disease, thermal challenges and abrupt dietary change from pasture to high energy concentrates. This review summarises the animal welfare risks to cattle in Australian feedlots and proposes measures to address those risks.

Common health risks to cattle in Australian feedlots include bovine respiratory disease, lameness, heat stress and metabolic disorders particularly acidosis associated with a diet of high-energy concentrates. With cattle changing hands throughout the supply chain, the authors recommend that feedlots prioritise staff training for early identification of sick cattle and purchase direct from producers who keep accurate health records. Exposure to extreme heat, cold and the elements compromises the welfare of cattle in feedlots. This review confirms the need for shade and shelter and other options such as wetting in hot, dry conditions and improving drainage in wet conditions.

Cattle require dry, comfortable places to lie and ad lib access to water of appropriate temperature at all times of the year. Pregnant cows must be prevented from entering feedlots due to the stress on mother and calf and lack of capacity to address dystocia (birthing complications) in feedlots.

Knowledge gaps are identified including the need for further research on the effects of human-animal interactions and selecting for temperament, the incidence of stereotypies and factors influencing cattle's emotional state in feedlots. The authors recommend future research employs animal welfare indicators including stress physiology, Qualitative Behavioural Assessment (QBA), flight speed, crush score, motivation tests, judgement bias, heat-load index, accumulated heat load model and US Beef Quality Assurance Feedyard Assessment model for handling. The authors believe that steps can be put in place to prevent, manage or mitigate the significant factors that can compromise welfare of cattle in feedlots but this will require proper monitoring and management.

Salvin HE, Lees AM, Cafe LM et al (2020) [Welfare of beef cattle in Australian feedlots: A review of the risks and measures](#). Animal Production Science 60(13), 1569.

HUMANE KILLING

Comparing aversion levels of different stunning systems in poultry

Over 50 billion broilers (meat chickens) are slaughtered for meat production every year worldwide. Controlled atmosphere stunning (CAS) is one type of system used to stun broilers immediately prior to slaughter. Currently, the most common gas used in CAS is carbon dioxide (CO₂). CO₂ is known to be highly aversive and cause painful acidic burning to the eyes, nose, mouth, throat and airways of poultry. Inert gases such as nitrogen (N₂) have been proposed as a non-aversive alternative to CO₂ in CAS systems. Low atmospheric pressure stunning (LAPS), lowering oxygen partial pressure to cause unconsciousness by hypobaric hypoxia (oxygen deprivation) has been proposed as an alternative to CAS systems. This is the first study to directly compare LAPS with CO₂ and N₂ CAS systems in poultry.

In this Swiss study, the researchers attempted to train female breeder broilers to express aversion by foregoing food (placed on the left side of a chamber) and transitioning to a safe zone (on the right side of the chamber) when exposed to aversive stimuli.

Unfortunately, only 3/40 animals made the transition when exposed to LAPS, CO₂, N₂ or medical air (control) possibly due to confusion, inability to localise the source of the aversive stimulus or extinction of the training. Nevertheless, aversion was measured using other behavioural indicators including cessation of eating, gasping and headshaking.

Aversion to CO₂ was greater compared to LAPS and N₂ as indicated by cessation of eating, gasping and headshaking. LAPS resulted in the shortest time to motionless (141.2 ± 2.7 seconds), and N₂ took the longest time to render birds motionless (399.4 ± 7.9 seconds). Overall, this study found that LAPS, and to a lesser degree N₂, are less aversive and may provide a welfare improvement compared to CO₂ stunning of broilers.

Gent TC, Gebhardt-Henrich S, Schild SA et al (2020) [Evaluation of poultry stunning with low atmospheric pressure, carbon dioxide or nitrogen using a single aversion testing paradigm](#). Animals 10(8), 1308.

MISCELLANEOUS

Anticipatory behaviour in animals

Anticipatory behaviour is behaviour that occurs following a conditioned stimulus (CS) prior to a reward, also known as an unconditioned stimulus (US). Anticipatory behaviour has been used to draw inferences about animals' affective state (emotions) and assess animal welfare. This review critiques the use of anticipatory behaviour as an animal welfare indicator.

Interpretation of anticipatory behaviour as an animal welfare indicator is problematic. In the literature reviewed, there appeared to be three prevailing hypotheses in regards to anticipatory behaviour as an animal welfare indicator: (1) Animals with poor welfare will be *more* motivated to seek a reward and therefore will display *more* anticipatory behaviour, (2) Animals with poor welfare will be *less* motivated to seek a reward and therefore will display *less* anticipatory behaviour, (3) The relationship between anticipatory behaviour and an animals' affective state follows an inverted 'U' function, that is reduced anticipatory behaviour occurs when welfare is very poor or very good and peaks at 'medium welfare'.

The authors outline the limitations of using anticipatory behaviour as an animal welfare indicator and make recommendations for future research. For example, they raise concerns that animals may be unintentionally trained to associate other behaviours with the US (superstitious learning). To counter superstitious learning, they recommend that researchers document behaviours at the beginning of training. The authors question whether some anticipatory behaviour may in fact, be indicative of frustration which is a negative affective state. They raise concerns that the anticipatory interval, time between the CS and US, has the potential to cause frustration and may influence results. To address these problems, the authors recommend measuring how behavioural responses change over time, using short initial anticipatory intervals and developing validated, species specific behavioural measures.

Anderson C, von Keyserlingk M, Lidfors LM et al (2020) [Anticipatory behaviour in animals: A critical review](#). Animal Welfare 29, 231.

Development of online animal welfare resource to benefit veterinary students

The Online Welfare Learning and Teaching Portal (OWP) is a resource developed by the eight Australian and New Zealand vet schools to support veterinary students to become leaders in animal welfare and ethics (AWE). This review outlines how OWP content was developed via surveys of the AWE priorities of teachers and students.

Survey participants were asked to rank the importance of Day One competencies (required from day one after graduation) for vets overall, in companion animals, production animals, wildlife, research, sport and aquatic industries. In companion animals, students prioritised desexing, husbandry, euthanasia and behaviour as the most important Day One competencies. In production animals, strategies to address painful husbandry procedures was ranked the most important. Vets' duty of care to wild animals, euthanasia and disaster preparedness were the most important wildlife welfare issues. Animal ethics committee procedures, the 3Rs (replacement, reduction, refinement) and humane endpoints were ranked as the three most important competencies in research. In regard to animals in sport and

entertainment, pushing animals to their limits was the topic of most concern. In aquatic animal industries, understanding aquatic animal welfare, farmed fish husbandry and pain associated with fishing were amongst the topics of most concern.

Overall, teachers and students ranked triage, professional ethics, euthanasia as important Day One competencies. These and other findings were incorporated to develop OWP which includes research papers, interactive scenarios, AWE essays and a 'toolbox' for vet students to discuss end-of-life decision making.

McGreevy PD, Fawcett A, Johnson J et al (2020) [Review of the online One Welfare portal: Shared curriculum resources for veterinary undergraduate learning and teaching in animal welfare and ethics](#). Animals 10, 1341.

WILD ANIMALS

Reducing impact of zoo visitors on captive little penguins

In response to zoo visitors, captive little penguins have been observed displaying behaviours consistent with fear including huddling and avoidance. This study investigated whether covering the main window of four viewing windows at the Taronga Zoo (Sydney, NSW) penguin enclosure could make little penguins more comfortable with the presence of visitors.

The behaviour of penguins and visitors were observed with and without the main window covering. Noise levels were also monitored. While overall visitor numbers at the penguin enclosure did not change when the main window was covered, the proportion of visitors at the main window decreased by 85% as did the amount of noise, tapping and movement. There was no change in noise, visitor behaviour or number of visitors at the other windows. When the main window was covered, a greater proportion of penguins spent more time near the main window. The authors suggest that when the main window was covered, the area near it was more attractive

to penguins because they had no visual contact with visitors, there was less exposure to other visitor associated stimuli or due to the novelty of the window covering. When the main window was covered, penguins appeared less vigilant and spent more time preening, a behaviour associated with comfort, than when the main window was uncovered. Whether the main window was covered or not, penguins preferred area was the corner of the enclosure where the water was deepest and they were not visible to visitors.

These results suggest that captive little penguins may be fearful of stimuli associated with zoo visitors. The authors recommend that little penguin enclosures incorporate one-way glass, barriers to limit visitor contact and an area for animals to retreat.

Chiew SJ, Butler KL, Sherwen SL et al (2020) [Effect of covering a visitor viewing area window on the behaviour of zoo-housed little penguins \(*Eudyptula minor*\)](#). *Animals* 10, 1224.



Impact of aerial surveillance devices on whales

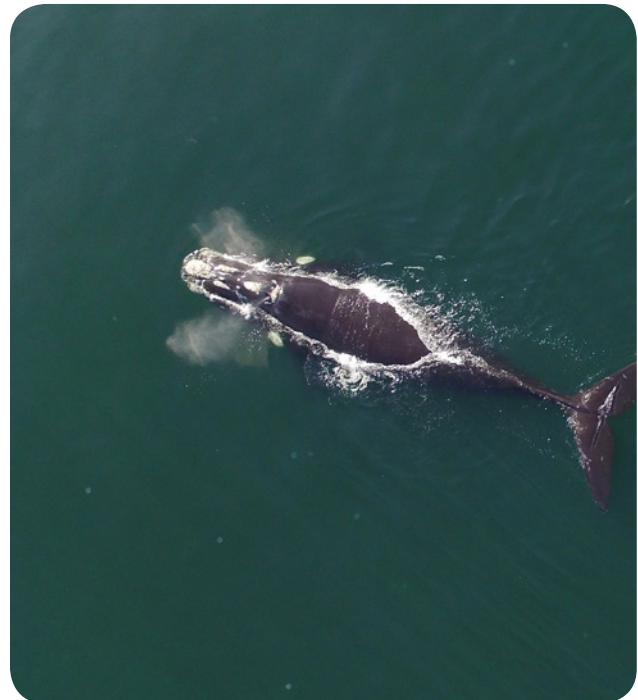
Unmanned aerial vehicles (UAVs), commonly known as drones, are increasingly used in research on wildlife including cetaceans (whales, dolphins, porpoises). UAVs are often assumed to be non-invasive research tools but their effects on the target animals are rarely measured. This study investigated the effects of flying a UAV (DJI Inspire 1 Pro) close to southern right whales in inshore waters off the South Australian coast.

Behavioural observations including respiration rate and inter-breath intervals ($n=8$), swim speed and turning angle ($n=9$), were collected before and during exposure to a UAV flying 5m above the whale's head for 10 minutes. Power analysis indicated that these sample sizes were sufficient to detect $\geq 40\%$ change (increase or decrease) in swim speed, $\geq 20\%$ change in turning angle, $\geq 50\%$ change in inter-breath interval and $\geq 10\%$ change in respiration rate. No behavioural responses (in excess of the aforementioned minimum thresholds) were identified. Complementary measurements of received noise (of the UAV) and ambient underwater noise were made using acoustic tags (DTAGs) attached to whales. These noise measurements led the authors to suggest that the absence of detectable behavioural responses to a UAV is due to the whales being unable to distinguish the drone from ambient underwater noise, which is high in inshore waters.

Regulations concerning the use of UAVs largely focus on altitude or distance of the drone away from the animal but these findings suggest that noise must also be considered. While this study provides some

evidence to support the use of UAVs as non-invasive research tools for southern right whales, the authors recommend further investigation on the effects of UAVs on these and other cetaceans using a range of metrics such as stress physiology indices.

Christiansen F, Nielsen M, Charlton C et al (2020) Southern right whales show no behaviour response to low noise levels from an unmanned aerial vehicle. *Marine Mammal Science* 36:953-963.



Quantifying native wildlife killed on Queensland highways

Roads and highways represent a potentially fatal hazard to wild animals. This six-year study surveyed roadkill annually along 390km of highway in south-east Queensland between Roma and Moura.

The study found 612 medium to large vertebrates of more than 18 taxa predominantly kangaroos and wallabies (313/612) who had been killed. Projected annual roadkill along this stretch of highway is estimated at over 5000 vertebrates per year. This is likely to be an under-estimation considering that the survey concentrated on roadkill seen 5 to 10m of the verge on either side of the highway. Some injured animals would have died away from the verge or their carcasses decomposed or scavenged before they could be recorded. Interestingly, increasing traffic volume

did not correlate directly with wildlife mortality and roadkill numbers varied year on year.

A hotspot was identified and authors recommend further investigation into the animal, human and environment factors contributing to the risk of animal-vehicle collisions. Given the roadkill found were predominantly macropod marsupials, the author encourages animal-vehicle collision mitigation measures to target the behavioural ecology of these species.

Matthews RW (2020) [Patterns and composition of medium and large vertebrate roadkill, based on six annual surveys along two adjacent highways in south-eastern Queensland, Australia](#). *Australian Mammalogy* 42:171-175.

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