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ANIMAL WELFARE SCIENCE UPDATE
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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.**

COMPANION ANIMALS

Stress responses of therapy dogs in an outpatient hospital setting

The benefits of animal-assisted therapy are becoming widely recognised, and the demand for therapy dog visits in a hospital setting is increasing. Interactions with friendly animals are known to alleviate stress and has been associated with improvements in quality of life, coping ability and self-efficacy. Although there is a large amount of data to support the benefits for humans, little is known about how this form of therapy impacts the dogs involved. This pilot study investigated the effects of different frequencies of therapy visits on stress in therapy dogs.

Four handlers and their dogs (two male and two female) volunteered for this study, which took place over 5 mths in outpatient nursing units in the USA. Each therapy dog team was allocated to a nursing unit, and visited the unit at the following four frequencies (treatments): A, two visits per week for four weeks; B, one visit per week for four weeks; C, two visits over four weeks; D, one visit over four weeks. The order of the treatments was selected randomly, and there was a one week break between each treatment. Each visit lasted 15 mins, during which a nurse patted the dog and conversed with the handler. To assess the stressfulness of each treatment, a dog saliva sample was collected before and after each therapy visit, and the concentrations of stress hormone (cortisol) was compared in the two samples.

Overall, the dogs showed the lowest concentrations of cortisol in their saliva when they were experiencing the most frequent visits to the nursing unit (twice per week for four weeks). This suggests that they found this frequency less stressful, which may be due to the increasing familiarity and comfort with the nurse and location. The only treatment that caused an increase in cortisol was the weekly visits, although the small sample size used (4 dogs) means that this result is likely to be due to one dog showing an exaggerated cortisol response compared to the others. These findings suggest that therapy dog teams who visit the same area more frequently may experience a lower stress response but more evidence is needed to confirm this.

Clark SD, Smidt JM, Bauer BA (2019) Welfare considerations: Salivary cortisol concentrations on frequency of therapy dog visits in an outpatient hospital setting: A pilot study. Journal of Veterinary Behavior 30:88-91.

How responsible do cat owners feel for their cats hunting behaviour?

The potential impact of domestic cats on wildlife is the subject of growing international interest and concern. While the exact impact of cats on wildlife is unknown, there is a general consensus that large numbers of cats will kill large numbers of wild animals, and that this can threaten vulnerable species. For cat owners to voluntarily prevent their cat from hunting they must first recognise hunting behaviour to be problematic, accept responsibility for managing that behaviour, and have the capacity to manage hunting behaviour effectively. This study investigated whether cat owners perceived their cats hunting behaviour as problematic, and whether they attempted to mitigate this behaviour.

A diverse range of cat owners was recruited for this study by placing advertising flyers in pet shops and veterinary practices, as well as online through community interest groups, in the UK. A total of 48 participants took part in qualitative interviews that explored their perceptions of cat hunting behaviour, their personal responsibility for their cats hunting behaviour, and their views and experiences with possible mitigation strategies.

The participants held a wide range of views about the hunting behaviour of their cats. Some cat owners considered hunting desirable, such as in relation to hunting pest species, whereas others found it deeply concerning. A key perspective of this study was that regardless of how the owner felt about hunting, this behaviour was considered a normal and natural part of their cats' behaviour. Furthermore, many owners felt unable to control their cats hunting behaviour without compromising the welfare of their cats, as confinement indoors was perceived as causing poor welfare. The authors propose that encouraging other aspects of responsible pet ownership, such as desexing, microchipping and health care, may indirectly reduce the impact of cats on wildlife by managing cat populations, as well as fostering a culture of greater attentiveness and accountability toward cat behaviour.

Crowley SL, Cecchetti M, McDonald RA (2018) Hunting behaviour in domestic cats: An exploratory study of risk and responsibility among cat owners. People and Nature, doi:10.1002/pan3.6.

Consequences and management of canine brachycephaly in veterinary practice

Brachycephaly is a mutation that causes shortening of the skull and gives dogs such as Pugs and French Bulldogs their characteristic flattened face. This facial conformation is appealing to dog owners, and the popularity of brachycephalic breeds has been increasing. However, this popularity is concerning, as brachycephaly causes a number of health and welfare problems including brachycephalic obstructive airway syndrome (BOAS). BOAS is caused by anatomical abnormalities in the muzzle and throat, such as reduced nostril size, restriction of the airways and breathing. This Australian article reviews the health and welfare problems associated with brachycephaly and BOAS, and argues that veterinarians are ethically obliged to address BOAS as a systemic welfare problem.

Surgical intervention, such as widening the nostrils or removing soft tissue, can improve breathing and reduce the progression of BOAS. 90% of dogs show improved respiratory function after surgery, although 60% of these still have some form of breathing difficulty. In addition to airway disease, there are many other conditions that occur more often in brachycephalic breeds than in other breeds. These are often related to facial conformation, with brachycephalic breeds having difficulty thermoregulating due to their reduced

ability to pant, and increased risk of eye trauma due to their protruding eye balls and reduced ability to blink. Neurological conditions that are associated with brachycephaly include syringomyelia, in which the skull is too small for the brain, and spinal malformations associated with the screw-tail characteristic. Dermatological conditions occur due to excessive skin folds often associated with brachcephaly, and orthopaedic conditions are also prevalent. Brachycephaly also impedes the ability of dogs to behave normally, with the extreme changes to their facial conformation limiting their ability to communicate with other dogs, chew their food, sleep with their mouth closed, or tolerate exercise and hot weather.

It is concluded that the continued breeding of dogs with BOAS cannot be justified due to the substantial welfare compromise these dogs experience compared to the trivial benefits that their owners experience. The authors call on veterinarians to address these welfare issues by informing the community and actively discouraging the popularity of these breeds.

Fawcett A, Barrs V, Awad M et al (2019) Consequences and management of canine brachycephaly in veterinary practice: Perspectives from Australian veterinarians and veterinary specialists. Animals 9(1), 3, doi:10.3390/ani9010003.

Clicker training improves the welfare and adoption rates of shelter cats

It is known that the activity levels of shelter cats directly affect adoptability, with potential adopters more likely to adopt cats that appear friendly, happy, and willing to interact. Encouraging cats to display these behaviours may reduce the time taken to rehome them, thus improving cat welfare by reducing the length of their shelter stay. Positive handling can reduce fear and stress in cats, and clicker training may provide an enriching experience that could reduce stress-related behaviours in shelter cats. This study investigated the effects of clicker training on the behaviour of shelter cats.

Twelve shelter cats from a UK animal shelter were clicker trained in their enclosures during three 10-min sessions per week over two weeks. The clicker training was conducted in stages to first teach the cats that the clicking sound signalled a food reward, and then slowly teaching the cats to approach the front of their enclosure when called by name to receive a food reward. The effect of the clicker training on cat behaviour was assessed using 10-min video recordings of the cats in their enclosures on the day prior to training starting, and again two days after the training was complete. Cats were assessed by using the proportion of time they spent being exploratory, inactive, playing or 'other'. A human approach test was also conducted before and after the training period to determine whether training altered fear of humans, as indicated by whether the cat allowed an unfamiliar human to approach within touching distance or not.

The clicker training increased the amount of activity and exploratory behaviour that the cats displayed, as well as the amount of time that the cats spent at the front of the enclosure. Play behaviour was very low in both tests, possibly because the cat toys were located indoors away from the training area. Four cats showed a reduction in fear of humans, as indicated by the human approach test. These behaviours are conducive to adoption, and clicker training may be a simple and rapid way to improve welfare and adoptability in shelter cats.

Grant RA, Warrior JR (2019) Clicker training increases exploratory behaviour and time spent at the front of the enclosure in shelter cats; Implications for welfare and adoption rates. Applied Animal Behaviour Science 211:77-83.

Qualitative behavioural assessment for dogs entering the shelter

Several European countries have adopted a 'no-kill' policy for dogs in animal shelters. Extended stays in animal shelters may lead to poor welfare if the shelter is poorly managed or overcrowded, and there is a need for a quick and reliable welfare assessment for shelter dogs. This study investigated the use of qualitative behavioural assessment as a rapid and simple method of assessing shelter dog welfare.

A simple protocol was developed to assess the behaviour of newly captured dogs entering an Italian animal shelter. The protocol consisted of a single evaluation sheet that shelter staff completed on the following three topics: dog demographic and clinical information; a score from 0-5 of the dog's apparent stress level (Stress score), and a score of 0-5 for each of five behavioural traits (sociability, calmness, fear, excitability, aggressiveness). Each dog was assessed by three separate evaluators: the animal control officer, who assessed the dog immediately after capture; the veterinary officer, who assessed the dog in the consultation room within 3 days of intake, and an external tester who performed behavioural tests to rate the behaviour of the dogs, rather than performing a subjective score. The external tester tested the dogs within 3 days of intake, and again at 4 wks post-intake if the dog was still present in the shelter.

A total of 189 dogs were assessed. The veterinary officer and the external tester both attributed similar Stress Scores to each dog, whereas the Stress Score given by the animal control officer did not match. This may be due to the dogs behaving differently during capture when compared to a veterinary examination. The ratings given for the five behavioural traits did not correlate between the three evaluators. The dogs showed a wider range of behaviours after they had been at the shelter for 4 wks, indicating that their welfare had improved. This may have been due to the dogs being group-housed during this period. In conclusion, although this simple tool should not replace a multidisciplinary approach to welfare assessment, the Stress Score shows promise as a tool for rapidly assessing and managing individual dogs within the shelter.

Menchetti L, Righi C, Guelfi G (in press) Multi-operator qualitative behavioural assessment for dogs entering the shelter. Applied Animal Behaviour Science.

Shelter cats with indemnity waivers take longer to adopt than cats without indemnity waivers

Cats are the most commonly relinquished pets in Australia, and the RSPCA receives almost 60 000 cats into its shelters annually. Traditionally only 'highly adoptable' cats were rehomed from shelters, but recently some shelters are rehoming cats with pre-existing medical or behavioural issues who would have otherwise been euthanised. The new owners of these cats must sign indemnity waivers to ensure that they understand that the cat has a pre-existing condition, and that they are responsible for all costs associated with that condition. It was hypothesised that cats with pre-existing conditions would be less desirable to potential owners and would thus take longer to adopt. This study investigated the effect of indemnity waivers on the time taken to adopt shelter cats.

The adoption records for all cats admitted to an Australian animal shelter in 2017 were analysed and the following information collected for each cat: sex, breed, colour, age, the presence/absence of an indemnity waiver, how many indemnity waivers each cat had, and the length of stay (LOS) before the cat was adopted. The indemnity waivers were categorised into seven groups (Behavioural, Feline Immunodeficiency Virus (FIV), Major Medical, Minor Medical, Musculoskeletal, Dermatological, Dental Disease). The data were analysed to determine any relationships between the variables collected and the LOS of shelter cats.

The records of 249 cats were included in the study, and the average LOS was 8.8 days. The adoptability of these cats, as measured by LOS, was influenced by age, breed, presence of an indemnity waiver, and the number of waivers. The LOS was longer when cats were older, non-purebred, and had at least one indemnity waiver. The LOS increased as the number of waivers increased. The type of waiver did not influence LOS, indicating that shelters that routinely euthanase cats with FIV due to perceived low adoptability may not need to resort to these measures. To reduce the LOS for shelter cats, the authors recommend that indemnity waivers are used only when necessary, and that cats with indemnity waivers are prioritised in terms of rehoming efforts due to the negative impact of the waivers.

Pockett J, Orr B, Hall E (2019) Investigating the impact of indemnity waivers on the length of stay of cats at an Australian shelter. Animals 9(2), doi:10.3390/ani9020050.

Trialling tools to assess pet grief and veterinarian communication skills in Italy

There are approximately 60.5 million companion animals in Italy, and 92% of owners consider these pets to be family members. The loss of a companion animal can elicit a significant grief response, and there is often a lack of recognition in the community of the scale of suffering that those owners may experience while mourning their pet. The negative impact of making end of life (EOL) decisions and losing a pet can be exacerbated if the veterinarian involved is unsupportive. Improving the empathy and communication skills of veterinarians may be an important avenue for helping bereaved pet owners cope with their loss. This study investigated the use of questionnaires to assess the experiences of people who have lost pets and how this was influenced by the communication skills of their veterinarian.

Four psychological questionnaires that have been previously used to assess grief for human and pets were translated from English to Italian to allow their use for research in Italy. The four questionnaires were used to assess: the experience of pet grief; the regret of family members; the degree of shared decision making with the veterinarian during EOL decisions, and the degree of empathy displayed by the consulting veterinarian. Participants were recruited through Facebook, and 377 pet owners responded to the questionnaire.

Most respondents (55%) had experienced the death of a pet in the last two years, and the average length of pet ownership was 10 years. The questionnaires all obtained good reliability, indicating that they could be successfully adapted from human healthcare experiences to animal healthcare experiences, in another language. This study also confirmed that the negative experiences associated with human bereavement are also present during pet bereavement. Owners who felt that they were involved in the decision-making process were more likely to perceive the veterinarian as empathetic and report less bereavement distress and regrets. It is concluded that adopting shared decision-making strategies and displaying empathy should be taught to veterinarians to reduce pet grief in owners.

Testoni I, De Cataldo L, Ronconi L (2019) Pet grief: Tools to assess owners' bereavement and veterinary communication skills. Animals 9(2), 67, doi:10.3390/ani9020067.

A brief visual welfare assessment for cats

New Zealand has one of the highest rates of cat ownership in the world, with 44% of households owning at least one cat and approximately 196 000 stray cats that are indirectly supported by humans. Stray cats can be categorised as being managed strays, when they have a human carer that provides some care to the cat (e.g. feeding and sometimes veterinary attention), and unmanaged strays that receive no human care. This study trialled the use of a brief visual health-related welfare assessment for companion and stray cats in Auckland.

A 5-component visual health-related welfare assessment tool was developed in consultation with veterinarians to assess the following health indicators in cats: body condition score (1-6), coat condition score (poor - excellent), nose and eye discharge score (none - severe), ear crusting (none – severe), and injury score (none – severe). These measures could be assessed visually without needing to handle or interact with the cat and gave a general indication of the cat's health status. This assessment tool was used to conduct welfare assessments on companion and stray cats in Auckland over a 12 mth period. Companion cats were assessed in the cats' homes, and managed strays were assessed while being fed by their carers. Unmanaged strays were assessed after being trapped by cat welfare organisations. All cats were assessed from a distance of 1-5m, and cat demographic variables such as age, colour, sex, and neuter status were also collected where possible.

213 companion cats, 210 managed strays, and 253 unmanaged strays were visually assessed. The results suggest that the majority of cats in each category had reasonable welfare based on their physical appearance, and that stray cats may be able to be successfully managed in colonies without negatively impacting their welfare. However, the true welfare status of each cat could not be confirmed without a detailed examination, which was not possible as part of this study. Further validation of this visual assessment tool is needed for it to be used reliably in the field.

Zito S, Walker J, Gates MC (2019) A preliminary description of companion cat, managed stray cat, and unmanaged stray cat welfare in Auckland, New Zealand using a 5-component assessment scale. Frontiers in Veterinary Science doi:10.3389/fvets.2019.00040.

FARM ANIMALS

Topical pain relief cream does not block the pain of local anaesthetic injection in calves

Injections are commonly used to administer medicines, vaccines and anaesthesia to dairy cattle. It is recommended that dairy calves receive an injection of local anaesthetic around the horn bud (a cornual nerve block) prior to disbudding to minimise the pain experienced during this procedure. While injections are painful, the use of topical anaesthetic to relieve this pain has given inconsistent results in other species. This study investigated the effectiveness of a topical anaesthetic cream in alleviating the pain associated with the cornual nerve block injection in dairy calves.

The following experiment was conducted at a university research facility in the USA. 19 female dairy calves were allocated to receive either pain relief (lidocaine-prilocaine topical anaesthetic cream) or no pain relief prior to the cornual nerve block and disbudding at 43 days of age. All calves had the hair behind each eye clipped, and one gram of topical anaesthetic cream was applied to this area on the treatment calves. The cream was removed 25 mins later, and the cornual nerve block was applied by injecting local anaesthetic into the nerve leading to each horn bud. Calf behaviour was recorded during the injection process and for 10 mins afterward using video cameras. The physiological responses of the calves was assessed using a heart rate monitor and a thermal imaging camera to measure changes in eye temperature. The behavioural and physiological responses of the calves receiving pain relief were then compared to the control group to determine differences in pain perception.

Contrary to expectation, the calves receiving the topical anaesthetic cream displayed more escape responses during injection, and there were no other differences in the behavioural or physiological responses to injection between the two groups. This indicates that not only was the cream ineffective in reducing pain, but it may have worsened it. This may be due to the cream causing an inflammatory response. All calves showed an increase in heart rate and eye temperature, confirming that the cornual nerve block procedure causes pain in dairy calves. Other forms of pain relief should be investigated for this procedure.

Jimenez RE, Adcock SJJ, Tucker CB (2018) Acute pain response in dairy calves undergoing cornual nerve blocks with or without topical anaesthetic. Journal of Dairy Science 102:1-8.

The effect of virtual fencing stimuli on stress responses and behaviour in sheep

Virtual fencing is a new technology that uses audio signals and electrical stimuli to spatially control farm animals without the need for fixed fencing. The animals are fitted with collars that make a beeping sound (audio cue) when the animals approach a virtual fence, and if the animal continues to approach the fence then an electrical shock is administered. The animals learn to avoid the electrical shock by responding to the audio cue and remaining within the virtually fenced area. For the animals to successfully learn this relationship, they must not find the audio cue or electrical shock so aversive that it interferes with learning. This study investigated the aversiveness of the audio cue and electrical shock used in virtual fencing for sheep.

The response of sheep to the audio cue and electrical shock stimuli were compared to other known stressors for sheep, namely physical restraint by humans and barking dogs, to determine their aversiveness. Eighty Merino ewes were fitted with collars and exposed to one of the following five treatments: control group (no stimulus); beeping sound from the collar; dog barking sound from speakers; electrical shock from the collar; or physical inverted restraint by a human for 1 min. The response of the sheep to the treatments was assessed using their behaviour response during and after the treatment, as well as changes in body temperature and cortisol concentrations. All sheep were habituated to the testing procedure for 2 weeks prior to testing so that testing was not stressful for them.

As expected, the auditory cues (beep or bark) elicited a lower response from the sheep than the physical cues (shock or restraint), and restraint was the only treatment to elicit a physiological stress response. The behavioural and physiological responses of the sheep indicated that the treatments could be ranked in the following order: beep stimuli (largely benign); bark stimuli (minimally aversive); electrical shock (acutely aversive), and physical restraint (moderately aversive). The results of this study show that the audio cue and electric shock used in virtual fencing technology were less aversive to sheep than the commonly encountered inverted restraint procedure.

Kearton T, Marini D, Cowley F et al (2019) The effect of virtual fencing stimuli on stress responses and behaviour in sheep. Animals 9(1), 30, doi:10.3390/ani9010030.

Suckling behaviour and health parameters of sows and piglets in free farrowing pens

Commercial sows are often housed in farrowing crates during lactation. However, these systems severely restrict sow movement and welfare. It was hypothesised that sows housed in farrowing crates may be susceptible to health problems associated with restricted movement, such as shoulder lesions and poor gait, while the piglets may be susceptible to health problems associated with poor udder access and teat competition. This study compared the health and suckling behaviour of sows and piglets housed in either farrowing crates or free-farrowing pens.

This research was conducted at an agricultural research farm in Germany, using 248 sows and their piglets. Half of the sows were housed in standard farrowing crates, while the other half were housed in pens that allowed them to turn around and move freely within the pen. The health of the sows was assessed at 1 week prior to parturition and again at 4 weeks post-parturition, using body condition, back fat depth, locomotion score, and lesions present on the udder and shoulders. The health of the piglets was assessed at 1 and 4 weeks of age by scoring the lesions present on the face and knees. A subset of sows (n = 24) were observed for suckling behaviour when the piglets were four days old. These sows were selected on the basis of having litters with a high (+75%+) or low (-25%) proportion of piglets with facial lesions. The health and suckling behaviour of the pigs housed in crates and pens were then compared for differences.

The sows housed in crates had poorer locomotion and more udder lesions than sows housed in pens, and the piglets of crated sows had more lesions on their face and knees. There were no differences in body condition between crates and pens. The crated sows spent less time suckling their piglets, which may have increased the amount of competition for teat access and resulted in fighting that injured the piglets faces and sows' udders. While piglet mortality was not assessed, the study concluded that free-farrowing pens can have a positive effect on the sows' health by reducing the incidence of locomotion problems and skin lesions of the udder, as well as skin lesions of the piglets.

Lohmeier RY, Gimberg-Henrici CGE, Burfeind O et al (2019) Suckling behaviour and health parameters of sows and piglets in free-farrowing pens. Applied Animal Behaviour Science 211:25-32.

## HENNOVATION: using innovation networks to address complex welfare challenges in the laying hen industry

Many animal welfare issues are complex and have multifactorial causes. The standard method of addressing these issues has been a 'top-down' approach, in which scientists attempt to find solutions to welfare problems which are then disseminated to farmers. Recently there has been a growing interest in developing 'bottom-up' approaches that involve equal collaboration between farmers, scientists, and other industry 'actors' to develop innovative solutions to welfare problems. This study explored the value of networks of laying hen farmers that were supported by scientists to improve the health and welfare of laying hens.

HENNOVATION was an EU funded project that developed and facilitated networks between egg farmers, scientists, processors, veterinarians, technical advisors and market representatives. Each network was managed by a facilitator who had a scientific background, and who linked the different actors together and guided the members of each network through the steps of the innovation process: identifying problems, generating solutions, selecting and testing these solutions in the field, and disseminating the results to industry.

The project recruited a total of 19 multi-actor networks across the Czech-Republic, The Netherlands, Spain,

Sweden and the UK, utilising 124 active members in total. 15 of these networks were based on-farm and were focused on finding innovative solutions to welfare problems on farms. The remaining 4 networks were based off-farm and were focused on finding innovative solutions to the handling and use of end-of-lay hens. By allowing these innovations to be producer-led, rather than scientist-led, this initiative generated considerable enthusiasm in the participants, and many farmers contributed substantial time to this project. The network project was facilitated for 32 months, during which time the networks had generated technical or 'hard' solutions, such as a new trolley design for depopulating flocks of hens, as well as 'soft' innovations such as improved parasite monitoring procedures and improved relationships between pullet growers and egg producers. This project demonstrated that these networks led by farmers and guided by industry practice can generate practical and effective solutions for animal welfare problems.

Van Dijk L, Buller HJ, Blokhuis HJ et al (2019) HENNOVATION: Learnings from promoting practice-led multi-actor innovation networks to address complex animal welfare challenges within the laying hen industry. Animals 9(1):24, doi:10.3390/ani9010024.
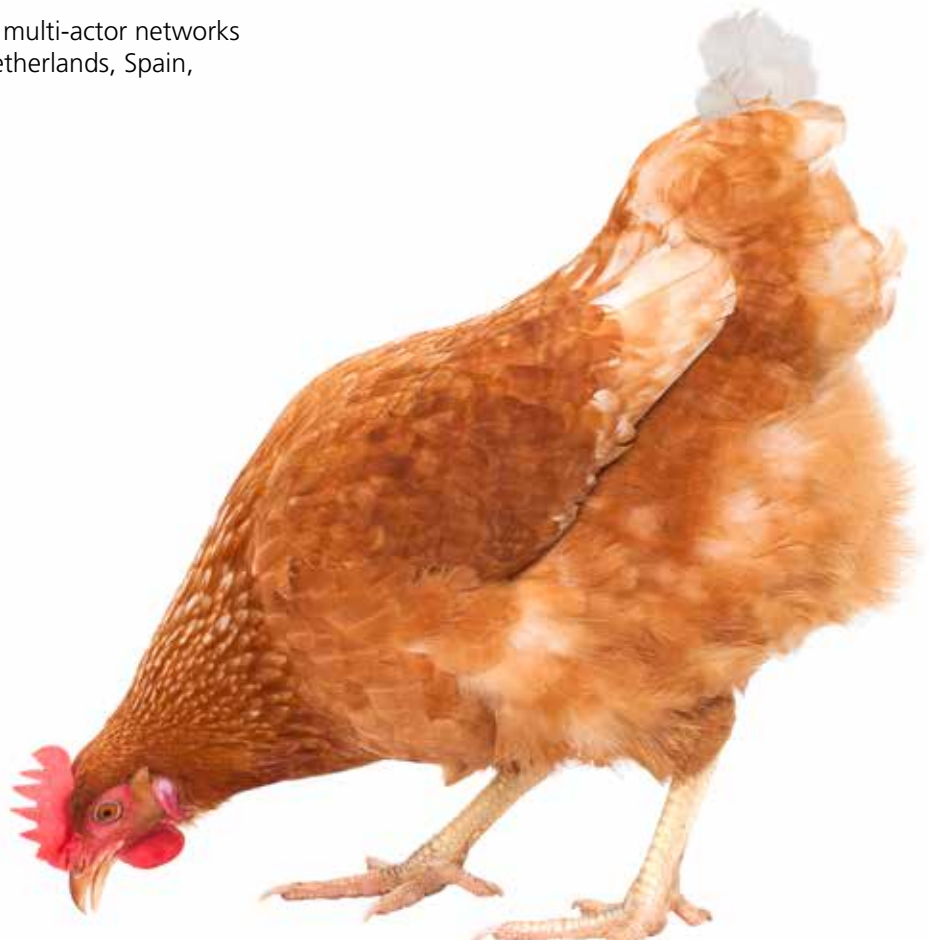
Understanding the multiple conceptions of animal welfare

There are three different concepts that animal welfare scientists use to define and study animal welfare. The first relates to the feelings and subjective experiences (affective states) of the animal, with animals experiencing good welfare when they feel pleasant affective states. The second relates to the biological functioning of the animal, with good welfare resulting from a healthy animal that functions normally. The final approach relates to the naturalness of the animal's living conditions, with good welfare resulting from animals living in natural conditions and performing natural behaviours. The authors argue that these three concepts have been unsuccessful in providing a clear unified understanding of what animal welfare is, and that animal welfare may be better defined by incorporating the views of non-specialists ('folk'). This article discusses how conclusions stemming from research ignore key areas of public concern, and that the views of ordinary people should be incorporated into animal welfare science.

The authors of this article cite several examples where the three scientific approaches to animal welfare have not agreed, and conclude that the weight given to each concept will vary with the values of the individual. When discussing what is important for animal welfare, folk place greater emphasis on animals being able to have positive welfare experiences and live in a natural environment. When asked to rank the welfare of animals in different situations, folk tend to rate a natural environment more important for wild animals (e.g. a chimpanzee), and healthy functioning as more important for domestic animals (e.g. a cow). Theses results demonstrate that folk will vary their assessment of animal welfare with the context of the scenario.

In conclusion, not all policy decisions should follow public opinion, but they should acknowledge minority voices. Folk concepts of animal welfare will likely overlap with the three frameworks used by academics in animal welfare science, but will also extend beyond this framework to include aspects such as duty of care, and painless killing. Future research should address folk concerns for animal welfare, and how they vary with different contexts.

Weary DM, Robbins JA (2019) Understanding the multiple conceptions of animal welfare. Animal Welfare 28:33-40.

HUMANE KILLING

Pre-slaughter handling and dog use is stressful for sheep in abattoirs

There is increasing public concern for the welfare of farm animals post-farm gate. While the process of transporting farm animals to slaughter is inherently stressful, there is an extensive body of research demonstrating that the way farm animals are handled can also impact their welfare during this process. When animals are stressed they release cortisol into the bloodstream, which mobilises energy reserves (glycogen) from the liver and muscles. If an animal has depleted its glycogen reserves at the time of slaughter, the quality of the meat is reduced. Thus there is an incentive to reduce pre-slaughter stress in terms of both animal welfare and meat quality. This study examined how the pre-slaughter handling of sheep influenced their behaviour and stress physiology.

400 sheep were sourced from an Australian research farm. At 3-5 days prior to transport and slaughter, each sheep underwent behavioural testing to determine their responses to novelty, humans, and isolation. Following testing, each sheep was blood sampled to assess their level of stress (cortisol) and metabolic state (glucose and lactate). The sheep were then transported 170km to an abattoir, where the behaviour of the sheep, stockpeople and their dogs

was observed using overhead video cameras while the sheep were driven from the forcing pen, up a single file race and into a V-restrainer prior to stunning. Immediately following slaughter, a blood sample was collected from each carcass to assess the stressfulness of the pre-slaughter handling.

The cortisol concentration of the sheep was higher when they had a previous high cortisol response to the behaviour tests on-farm, were exposed to dogs that lunged and barked at them, when they showed more jumping and escape behaviour, and when they were in the yards and race for a longer time. The metabolic variables showed a similar relationship to dog exposure and sheep escape behaviour. These results indicate that being exposed to dogs and displaying escape behaviours are associated with acute stress in sheep prior to slaughter. This may have implications for sheep welfare and meat quality, and support the well-demonstrated effect of handling on fear and stress in livestock.

Hemsworth PH, Rice M, Borg S (2018) Relationships between handling, behaviour and stress in lambs at abattoirs. Animal 1-10, doi: 10.1017/S1751731118002744.

Welfare assessment for novel on-farm killing methods for poultry

Poultry are sometimes killed on-farm due to reasons including irrecoverable sickness or injury. The industry standard method of killing poultry is cervical dislocation, where the skull is separated from the spine, rapidly resulting in death. Current EU legislation restricts the number of birds that can be killed via manual cervical dislocation to 70 birds per day per person, and these birds must not weigh more than 3kgs. This legislation creates a need for a humane and practical device that will mechanically dislocate the skull and vertebrae. This study evaluated the efficacy and welfare impact of three novel killing methods for on-farm killing of poultry.

This experiment was conducted at a research facility in Scotland using 232 female laying hens and broilers, at two different ages to represent both juvenile and production stages. All birds were lightly anaesthetized and killed using one of the following four methods: Modified Armadillo (brain-stem penetration device); Modified Rabbit Zinger (penetrative captive bolt device); a novel mechanical separation device (NMSD, a glove containing a metal insert that assisted manual cervical dislocation), and manual cervical dislocation (control group). The efficacy of each device was

assessed by the proportion of birds that were killed immediately after a single application with no signs of recovery. The welfare impacts were assessed using the presence of reflexes, latency to reach unconsciousness, and brain activity state in a subset of birds using surgically implanted EEG electrodes.

Manual cervical dislocation (control group) was the most reliable method, killing 100% of birds after a single application with no signs of recovery. Of the mechanical methods, the NMSD was the most reliable, killing 96% of birds on one application with no signs of recovery, followed by the Modified Rabbit Zinger (75%), and the Modified Armadillo (49%). The Modified Rabbit Zinger resulted in the most rapid loss of reflexes, but due to its low success rate, the NMSD was considered superior. The Modified Armadillo was not suitable for killing chickens. In conclusion, the NMSD is a promising mechanical alternative for killing poultry on farm, based on behavioural, EEG and anatomical parameters.

Martin JE, Sandilands V, Sparrey J et al (2019) Welfare assessment of novel on-farm killing methods for poultry. PLOS One 14(2):e0212872.
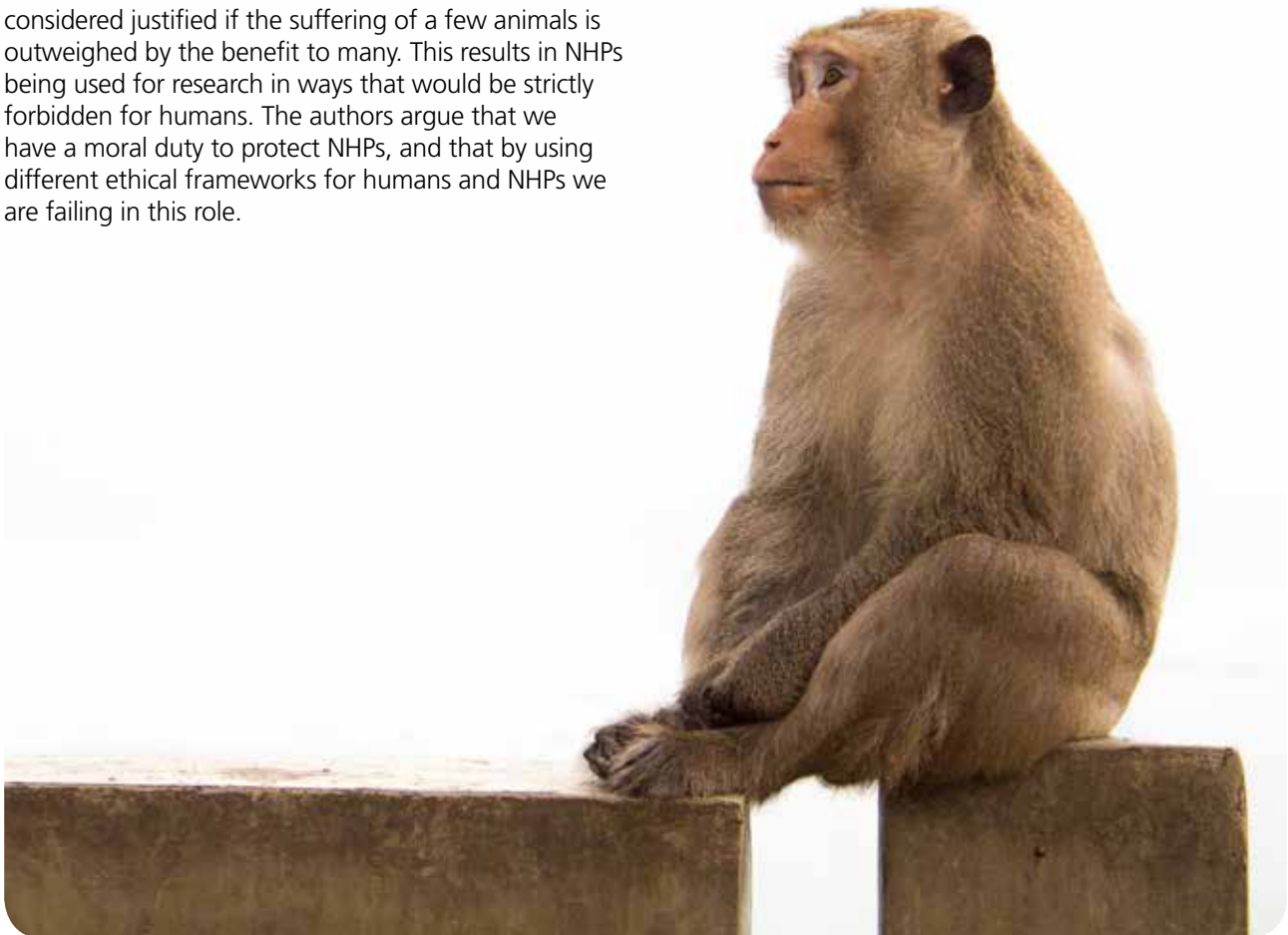
RESEARCH ANIMALS

Ethical and scientific pitfalls concerning laboratory research with non-human primates

Non-human primates (NHPs) have been extensively used in biomedical research under the premise that their similarity with humans makes them the most appropriate model for human medicine and cognition trials. However, critical examination of these studies reveals that they have not contributed substantially to the advancement of human medicine, and there is no robust evidence that we need to use NHPs to model specific human diseases. This article reviews the use of NHPs in research and the ethical principles that could be used to guide future research to reduce NHP suffering.

When research on humans is conducted, there are strict rules and regulations that must be followed to ensure that the human participants are not harmed by the research. This is because the morality of human research is guided by a deontological ethical framework, in which moral rules must be followed no matter what the consequence (i.e. humans must not be harmed even if it will benefit other humans). In comparison, the ethical rules that guide animal experimentation follow a utilitarian ethical framework in which the research is considered justified if the suffering of a few animals is outweighed by the benefit to many. This results in NHPs being used for research in ways that would be strictly forbidden for humans. The authors argue that we have a moral duty to protect NHPs, and that by using different ethical frameworks for humans and NHPs we are failing in this role.

The authors propose that research with NHPs should only be carried out if it follows the same deontological ethical framework that guides research with humans. This could include NHPs having legal 'guardians' who will advocate for their wellbeing, and who can make a rational judgement about whether to consent to participate in research. The authors also propose that disorders that affect both humans and NHPs should ideally be studied and treated in NHPs that suffer naturally from that disorder, rather than artificially inducing the disorder under experimental conditions. By complying with these high standards, NHPs will receive greater respect and protection and the quality of research protocols will be improved.

Carvalho C, Gaspar A, Knight A et al (2019) Ethical and scientific pitfalls concerning laboratory research with non-human primates, and possible solutions. Animals 9(1), 12, doi:10.3390/ani9010012.

Avoiding mortality in animal research and testing

This report discusses ways to minimise or abolish mortality in animal research by refining research methodologies, encouraging humane endpoints, and challenging requirements for 'death as an endpoint'.

Improving the quality and frequency of animal monitoring will help identify when animals move from a point of acceptable suffering to unacceptable suffering or imminent death during research, and all staff should be trained in humane euthanasia practices for animals that require it. Improvements in technology and our understanding of biological processes allow for more subtle measurements to be collected from animals, for example in relation to toxicity studies, and this often removes the need to continue observations until the time of death. More accurate methods of predicting mortality should be investigated to prevent animals progressing into a state of unacceptable suffering. These methods can be investigated by conducting pilot studies to search for biomarkers of imminent death, training staff to recognise known indicators of death so that animals may be euthanised before reaching this point, analysing existing records to establish baseline mortality rates and to determine any correlations between welfare measurements and subsequent death, and encouraging open discussion about the fates of animals to share knowledge and improve awareness.

In addition, regulatory or publishing requirements that require studies to use death as an endpoint should be challenged, as these are no longer considered a necessary component of research. Ethics committees can also play an important role in advising researchers how to reduce avoidable mortality.

There are practicalities to consider when adopting the above strategies. The stressfulness of increased welfare monitoring procedures should be minimised, particularly in already sick or distressed animals. Furthermore, the costs and benefits of monitoring neonatal mice should be objectively assessed in terms of pup mortality. Adopting increased monitoring of research animals will require additional resources, as well as difficult decisions in regard to balancing the need to alleviate suffering with the need to collect sufficient amounts of data. In conclusion, those involved in animal research should make a commitment to review mortality and see whether action is needed, and to challenge the concept of an 'acceptable rate' of mortality.

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WILD ANIMALS

Animal welfare, social licence and wildlife use industries

The term 'social licence' refers to the community's tacit consent for a business, industry or project to exist. This consent is based on prevailing public values, and an industry that previously had social licence to operate may lose that licence in the face of changing public values. The loss of social licence is a real threat for industry and can rapidly lead to regulatory bans or lost market access for practices that have caused public outrage. For this reason, social licence has recently become an important focus for many natural resource management fields. This article reviews the importance of maintaining social licence for industries that manage wildlife.

Many wildlife management activities, particularly those devoted to conservation, enjoy high levels of public support. However, consumptive wildlife management activities, such as those that rely on lethal harvesting of mammals, are experiencing diminishing support. An Australian example is the kangaroo harvesting industry, which is at risk of losing its social licence if it does not address the animal welfare concerns of society. The kangaroo harvesting industry has responded to opposition from animal activists by maintaining a culture of secrecy, a lack of transparency in terms of

animal welfare outcomes, an absence of independent inspection and reporting, and little engagement with stakeholders. These actions are unlikely to win the public's trust, and the kangaroo industry must modernise their approach to animal welfare by accommodating the concerns of society, or risk losing their social licence to operate.

Examples of wildlife harvesting industries that have lost their social licence to operate are the whaling industry, and the harp seal harvesting industry. The harp seal industry had been harvesting seals for fur for 500 years but lost the social licence to operate when the industry failed to engage with changing community values. The authors recommend that industries at risk of losing their social licence proactively engage with stakeholders, establish a shared vision for how their industry should operate, and support this vision by transparently monitoring animal welfare. Proactive management of community expectations surrounding animal welfare is essential for the maintenance of social licence for wildlife use enterprises.

Hampton JO, Teh-White K (2019) Animal welfare, social licence, and wildlife use industries. The Journal of Wildlife Management 83:12-21.

Welfare impacts of dolphin hunts in Japan

Drive hunts are used in Japan and the Faroe Islands to hunt small cetaceans (dolphins and small whales). Drive hunts use flotillas of boats to herd cetaceans into shallow coves where they are killed for meat or selected for use in marine parks, with over 2000 small cetaceans being killed in this manner every year. This article reviews the impact of the drive hunt process on the welfare of small cetaceans.

During the initial phase of the hunt, cetaceans are herded using boats and an aversive 'wall of sound' that is created by banging on purpose-built metal poles that extend from the boats into the water. These poles can generate sound at 174-205 dB, and cause an immediate avoidance response in nearby cetaceans. Because cetaceans rely on sound to navigate and communicate, overwhelming them with sound is likely to be extremely stressful. Once the cetaceans have been herded into a shallow cove they can remain there for up to 5 days before individuals are selected for slaughter. These individuals are towed to the killing area by their tails. As cetaceans are air-breathing mammals, towing them with their heads under water can lead to drowning or asphyxiation, and at the

very least is a significant stressor that would not be permitted during the slaughter of terrestrial animals. Cetaceans that are not slaughtered are subject to rough handling and injury, and the extreme stress of capture can result in exertion myopathy (muscle fatigue and damage). In addition, the psychological impact and social disruption caused by the death of other group members is likely to be significant.

In conclusion, there is compelling scientific evidence that the process of chasing and capturing small cetaceans in drive hunts is inhumane. This process causes a high probability of physical injury, as well as physiological and socio-psychological stress in survivors which can have enduring impacts on populations. The handling, restraint and transportation of cetaceans violates the recommendations of the OIE guidelines for animal slaughter and should cease on the grounds of being inhumane.

Vail CS, Reiss D, Brakes P et al (in press) Potential welfare impacts of chase and capture of small cetaceans during drive hunts in Japan. Journal of Applied Animal Welfare Science.

Spatial considerations for captive snakes

There is a common belief amongst the snake owning community that snakes do not require large amounts of space, and it is common for snakes to be housed in small enclosures or racking systems. Common reasons cited for using minimalistic enclosures are that snakes are considered sedentary, that large open spaces make snakes uncomfortable, and that snakes will not use large spaces if they are provided. These kinds of belief systems are referred to as 'folklore husbandry', and are based on often unscientific, anecdotal information shared between snake owners using online forums, magazines, hobbyist groups and industry care sheets. This article reviews the behavioural and physical characteristics of snakes and how current husbandry practices can negatively impact snake welfare.

Observations of wild snakes show that these animals can have extensive home ranges (0.24-1528 ha), and that even sedentary snakes will show periods of high activity when appropriate space is available. The ectothermic and nocturnal nature of snakes may also contribute to the perception that they are sedentary. The ability of snakes to fully stretch out their bodies (called recti-linear posture, RLP) is limited in many snake enclosures, and as this behaviour forms a natural part of snake locomotion, preventing this behaviour

may result in poor snake welfare. To investigate the frequency of RLP behaviour in captive snakes, the posture of snakes at eight zoological parks in the UK and Canada were observed for one hour each. Only snakes that were housed in enclosures that were long enough to allow RLP were observed. Of the 65 snakes observed, 24 (37%) showed RLP behaviour. Given the short observation period and the diurnal observation time, this result indicates that NLP is prevalent among different snake species and is likely to be important for snake welfare.

In conclusion, there are many challenges faced by snakes in captivity, including minimalistic, barren environments, malnutrition, poor thermal regimes and health problems. The normalisation of numerous misperceptions, beliefs, false-facts and bad practices in snake keeping constitute a major obstacle to good welfare in captive snakes.

Warwick C, Arena P, Steedman C (2019) Spatial considerations for captive snakes. Journal of Veterinary Behavior 30:37-48.

Development of a tool to assess the welfare of captive elephants

The welfare of captive elephants in Europe and North America has often been criticised, and in 2008, a report was published that raised specific concerns about elephant welfare in the UK. In response to this report, a government advisory committee recommended that 'evidence of welfare improvements were needed in order for zoos to continue keeping elephants in captivity'. While previous studies have measured elephant welfare over short periods, there are currently no tools available for the long-term monitoring of captive elephant welfare. This study developed a valid and reliable method of routine welfare assessment in captive elephants.

A list of unique behavioural measurements of elephant welfare was created by reviewing the scientific literature and conducting focus groups with elephant keepers. These measurements were developed into a prototype welfare assessment tool consisting of three sections: a qualitative behavioural assessment, in which keepers scored the perceived feelings of the elephants based on their body language; daytime behaviour observations; and night time behaviour observations. The prototype tool was then tested at five UK zoological institutions using 29 elephants. Both keepers and researchers completed the welfare assessments on three occasions, and these results were tested to ensure that the measures were reliably measured over time, and that the scoring system correctly captured the behaviour of the elephants by comparing the keeper observations to video recordings of the elephants. From this information the welfare assessment tool was refined in terms of accuracy and practicality, and a finalised version was developed for dissemination to elephant keepers.

To date, the finalised welfare assessment tool has been used by 11 organisations across the UK and Ireland to assess the welfare of their elephants. This tool is designed to measure the welfare of individuals through time and should not be used to compare welfare of elephants at different organisations. In conclusion, this novel behavioural welfare assessment tool can be used by elephant-holding facilities for routine behavioural welfare monitoring, which can inform adjustments to individual welfare plans for each elephant in their collection.

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