

animal welfare science update



Published by RSPCA Australia

June 2007 issue 17

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.

Special feature: New concepts in animal welfare

Stress and welfare: a review

Ever since the physiological underpinnings of stress were first elucidated in the mid 1930s, we have had to repeatedly modify our understanding of the relationship between stress and welfare, as new data became available. This review summarises our understanding of stress and welfare in the last few decades, and argues that both concepts, although diametrically opposed, should be used when deciding whether particular conditions are suitable for rearing animals.

The earliest research on physiological stress concluded that stress was a generalised response in animals to any kind of noxious stimulus, ranging from disease to harsh environmental conditions. Stress allowed the animal to reestablish normalcy; however, when the animal was forced to exert too much effort (e.g. too much energy) to adapt to the changed conditions, its welfare was thought to be jeopardised. This model assumed that there is a continuum in the responses exhibited by animals to various challenges, with small responses indicating 'good' welfare, and large responses indicating 'poor' welfare, or stress. The authors point out that this assumption is flawed, as certain physiological mechanisms can show opposite responses (i.e. reduced or increased secretion of a hormone) to stressful situations. Moreover, the behavioural responses of animals tend not to lie on a continuum: there is usually an all-or-nothing response, such as flight or freezing in response to a predator.

In the early 1970s, the concept of emotions came to play a central role in the understanding of stress. It was suggested that a situation would produce stress only if it was perceived as being stressful by the animal. Thus, the key concern in animal welfare should be not how the animal is, but how it feels. The most recent model states that the stress response could be modulated by prior experiences of the animal, and by the amount of control the animal has over the stressful situation. Thus, the cognitive evaluation of the situation (in terms of its pleasantness, novelty, predictability, controllability, etc.) by the animal would play a large part in determining the amount of stress generated by that situation. The authors support the Cognitive Activation Theory of Stress (CATS), which suggests that predictability and controllability, in particular, are essential for animal welfare. Welfare is higher for positive expectations (from the point of view of the animal), and lower for negative or uncertain expectations.

Veissier, I. and Boissy, A. (2006) *Stress and welfare: Two complementary concepts that are intrinsically related to the animal's point of view, Physiology and Behavior* (in press).

Positive emotions in animals

It is generally accepted nowadays that a mere absence of obvious suffering or discomfort does not necessarily guarantee that an animal is being reared under conditions that are conducive to its welfare. Instead, there is a growing awareness that the ideal welfare situation is one in which an animal is not only protected from negative experiences like hunger or pain, but also allowed to experience positive mental states or emotions. As most of the research to date has focussed on the reactions of animals to situations of poor welfare, the present review article attempts to bring together the available data on positive emotions in farm animals.

A number of signs can indicate positive experience in animals, for example, successful coping with a novel or

potentially unpleasant situation, and actively seeking out a reward. The authors present evidence that there are numerous brain regions involved in the processing of positive emotions such as 'pleasure' or 'reward', and that these brain regions have a strong influence over behaviours such as social behaviour, self grooming, sexual behaviour, play, dust-bathing and exploration. They recommend that the expression of such positive behaviours be promoted, as they tend to be reliable indicators that the animal's welfare needs are being met. As mentioned in Stress and welfare, it is preferable to rear animals in an environment with sufficient predictability and controllability. In support of this recommendation, the authors present data showing that animals, who know that a reward (e.g. food) is about to be presented, display behaviour indicative of positive emotions. Early socialisation and handling of young animals, and the provision of an enriched environment (e.g. one that promotes play and exploration) can also improve animal welfare by promoting positive emotions. The authors recommend that an on-farm monitoring system be developed, to assess animal welfare through obvious behaviours associated with positive emotions, such as play, social grooming, exploration and certain vocalisations.

[Boissy et al. \(2007\) Assessment of positive emotions in animals to improve their welfare, *Physiology and Behavior* \(in press\).](#)

A new model for animal welfare

Traditionally, animal welfare has been closely associated with the concept of the 'Five Freedoms' prescribed by the UK's Farm Animal Welfare Council: freedom (a) from hunger and thirst, (b) from discomfort (through the provision of suitable shelter), (c) from pain and injury, (d) from fear and distress, and (e) to express normal behaviour. The authors of this paper suggest that such guidelines unfortunately have their basis in human-centred ethical and emotional concerns about how animals should be reared, rather than in sound scientific reasoning. They argue, for instance, that having constant access to food is ultimately detrimental for an animal's well-being, compromising both mental and physical health. Fear and pain are both necessary adaptive responses. By under-stimulating an animal's stress response one may compromise that animal's ability to appropriately respond to a stressor when required.

As an alternative, the authors propose a new model of animal welfare, based on 'stability through change,' or allostasis, which takes into account recent developments in the fields of neurobiology and behavioural physiology. This concept considers the ideal state of welfare to be one in which an animal's various physiological mechanisms are allowed to operate within their normal ranges in response to changing environmental demands. This is a major break from conventional ideas of animal welfare, which value constancy (homeostasis) and freedom above all else. The authors reject this concept as old-fashioned, and state that it could be causing more harm than good, through the well-known "use it or lose it" process: for example, a lack of physical activity leads to a reduction in muscle mass. Inadequate stimulation of an individual's physiological defence mechanisms on a long-term basis could therefore lead to a range of problems when the individual is confronted with even a minor environmental stressor. In humans, for instance, under-stimulation (here termed inadequate allostatic load) has been associated with different diseases like allergic reactions, inflammatory/autoimmune disease, fatigue states and atypical depression. The authors suggest that this model may be useful in abolishing cruel husbandry practices such as beak trimming, teeth clipping and tail docking, by finding solutions that are directed towards improving the inadequate allostatic loads of farm animals and in turn preventing abnormal behaviours.

[Korte, S. et al. \(2007\) A new animal welfare concept based on allostasis, *Physiology and Behavior* \(in press\).](#)

Research papers

COMPANION ANIMALS

Puppies left home alone

Separation anxiety is a common condition afflicting newly adopted puppies and may manifest itself in the form of destructive behaviour directed at the home, self-inflicted trauma, inappropriate elimination and excessive whining, barking or howling, only in the owner's absence. These behaviours are a major cause of human-animal bond breakdown and often lead to surrender of dogs to shelters. Given a lack of data on normal puppy behaviours when left alone, the authors carried out the first videotape observations of puppies

left alone in their home environments. Eighteen puppies were observed for 90 minutes after the owner left the house. All dogs were purebreds. Twelve were adopted from breeders with the remaining being adopted from shelters, pet stores, or another person. One puppy was born at home. To assess the effect of age on behaviour, puppies were equally assigned to two age groups, either older or younger than 90 days. Puppies were videotaped under the conditions they were normally left in with most being kept in a cage.

Overall, puppies spent most of their time (77%) lying down with their head on the ground, while far less time was spent looking at or investigating their environment (12%), vocalising (7%) or playing (4%). However, not all puppies behaved in the same way when left alone. Based on their behaviours the puppies were grouped into three categories: (a) those that tended to play or explore, (b) those that exhibited passive behaviours, or (c) those that presented lip licking, yawning, scratching and vocalising. The puppies clustered in group (c) were younger than 90 days and recently adopted, and their behaviour was compatible with signs of anxiety or fear. Puppies exhibiting group (a) behaviours, on the other hand, were older, while group (b) included puppies of all ages. Passive behaviour increased significantly over time for all puppies, regardless of age.

The authors plan to carry out a longitudinal study to investigate the development of anxiety-related behaviours in puppies left home alone.

[Frank, D., et al. \(2007\) Puppy behaviours when left home alone: a pilot study, *Applied Animal Behaviour Science*, 104: 61–70](#)

Risk factors for distress and aggression in dogs

Dogs left home alone by their owners can exhibit separation-related distress (SRD), which can manifest itself as vocalisation, destruction in the owner's absence, or even unwelcome exuberance (barking and jumping up) when the owner returns. Feeding-related aggression (FRA) is another common behavioural problem; both behaviours may lead to abandonment, euthanasia or sale of the dog. The authors of this study collected questionnaire data from the owners of 690 Australian dogs in 485 households, to determine the risk factors associated with these two behaviours.

The results of the study revealed that dogs were more likely to exhibit SRD if they (a) were male, (b) had been acquired from a pet shop, (c) lived in households with more women, (d) did not usually indulge in game-playing with their owners, or (e) played with their owners within the first 30 minutes of their arriving home. In general, dogs that were reported by their owners as being excitable, fearful or anxious were more likely to have SRD. Attachment to the owner also seemed to make some contribution to the development of SRD. Dogs were more likely to exhibit FRA if they (a) were a mixed breed, (b) were acquired at a later age, (c) lived in households with more women, (d) lived in households with more dogs, and (e) were fed dog treats during the owner's dinner. Interestingly, dogs with FRA were also more likely to have SRD, suggesting that the motivation to retain possession of both food and access to owners may be aligned. The authors conclude that SRD, in particular, may not be driven purely by a dog's attachment to its owner, but might instead be associated with a range of risk factors.

[McGreevy, P. and Masters, A. \(2007\) Risk factors for separation-related distress and feed-related aggression in dogs: Additional findings from a survey of Australian dog owners, *Applied Animal Behaviour Science*, \(in press\).](#)

FARM ANIMALS

Mulesing – welfare consequences and research into alternatives

Mulesing was first developed in 1927 and has been practiced routinely on the majority of Australian Merino sheep ever since. The practice involves cutting two pieces of skin from either side of the vulva (the breech area) and two pieces of skin from either side of the tail. The purpose is to create an area of bare skin, without wrinkles and skin folds, which is less attractive for flies thereby reducing the incidence of flystrike (maggots feeding on a live animal). Research suggests that the pain associated with mulesing is similar to the immediate pain of castration but may last twice as long (up to 48 hours).

In the past, several alternatives to mulesing have been researched, including chemical mulesing, freezing, radiation, photodynamic therapy and intra-dermal collagenase treatment, all with varying degrees of success. Another alternative proposed was to increase the number of inspections and chemical treatments and, if necessary, introduce an additional crutching. The viability of this option depended, among other things, on

the size of the flock and the associated cost (see Lee *et al.*, 2007).

In recent years, public pressure to improve welfare standards in animal production has resulted in the Australian wool industry gearing up its research into alternatives to mulesing and committing to phasing out the procedure by 2010. Various studies are underway, including, for example, the use of a topical anaesthetic to reduce the pain associated with mulesing (see Paull *et al.*, 2007 and Rothwell *et al.*, 2007), the use of clips, intra-dermal treatments and longer term studies involving genetics of both the sheep and the blowfly. Mulesing and its alternatives were highlighted in the March 2007 issue of the Australian Veterinary Journal.

Lee, C. & Fisher, A.D. (2007), Welfare consequences of mulesing of sheep, *Australian Veterinary Journal*, **85** (3): 89-93.

Paull, D.R., Lee, C., Colditz, I.G., Atkinson, S.J. & Fisher, A.D. (2007), The effect of a topical anaesthetic formulation, systemic flunixin and carprofen, singly or in combination, on cortisol and behavioural responses of Merino lambs to mulesing, *Australian Veterinary Journal*, **85** (3): 98-106.

Rothwell, J., Hynd, P., Brownlee, A., Dolling, M. & Williams, S. (2007), Research into alternatives to mulesing, *Australian Veterinary Journal*, **85** (3): 94-97

Kosher slaughter of poultry

During the slaughter of poultry in Australia, birds are normally shackled upside down and stunned in an electrified water bath, before their throats are cut with an automatic rotating blade. In *shechita* (kosher) slaughter, however, the use of stunning is not permitted, and each bird is held manually, while the specialist slaughterman (or *shochet*) severs both jugular veins and carotid arteries of the neck with a knife. Unlike conventional slaughtering, the birds are only shackled once they have 'bled out', thus eliminating the possible fear and pain associated with this procedure.

This study assessed the behavioural responses of birds that had been through the neck-cutting process in one of only two kosher slaughterhouses in Australia. The researchers found that only four of the 100 birds observed showed a mild response to the cut, while the others showed no response at all. By seven seconds after the cut, almost 90% of the birds had stopped responding when their eye was touched, and all were non-responsive by 15 seconds. Birds placed upright after neck-cutting fell over in about 14 seconds, and showed strong involuntary muscular contractions almost immediately thereafter. The authors estimate that the birds had lost 40% of their total blood volume by about 29 seconds following neck-cutting. The data suggest that, on average, most birds would have lost consciousness at around 12 to 15 seconds after neck-cutting. Given that the neck cut is made within about eight seconds after the removal of the bird from the crate, and that birds are handled individually, and killed before shackling, the authors conclude that the *shechita* procedure is acceptable in terms of the birds' welfare.

Barnett, J *et al.* (2007) Behavioural responses of poultry during kosher slaughter and their implications for the birds' welfare, *Veterinary Record*, **160**: 45-49.

Ethical stockmanship

This review article summarises the research on the interactions between stockpeople and farm animals, and considers the role of the stockperson's behaviour in animal welfare. The author stresses the fact that the human-farm animal relationship is inherently an unequal one, and presents evidence that illustrates how human behaviour can affect fear and stress in farm animals. This has important economic implications as well, as fear of humans can lead to decreased livestock productivity. Fear can be caused, for example, by negative tactile interactions, such as pushing and hitting, and, in the case of chickens, by the rapid movement of humans. Animals are sensitive to even brief bouts of such interactions, as well as to acoustic stimuli, such as shouting or other loud noises. On the other hand, animals that were handled gently and regularly, or were able to observe other animals being handled, and were not exposed to sudden movements or noises, were less afraid of humans, and often showed higher productivity.

The author notes that the stockpersons' attitudes towards animal welfare not only dictate his or her behaviour towards the animals, but in turn also affects the animals' reactions to that person. In addition to having positive attitudes, the stockperson must also be motivated, and have a high level of technical knowledge and skills. The author supports the establishment of appropriate formal standards of stockmanship, based on the scientific literature, and in consultation with stakeholders such as the government, consumers, animal welfare

and animal rights groups, primary producers and stockpeople. Compliance with these standards can be verified using quality assurance programs and the auditing of stockpeople regarding their attitudes, technical skills and the completion of welfare training courses.

Hemsworth, P (2007) Ethical stockmanship, *Australian Veterinary Journal*, **85(5)**: 194-200.

Animal learning and husbandry

Over their lifetimes, farm animals are frequently exposed to a range of novel situations, such as new types of feed and housing, and contact with other unfamiliar animals or handlers. The authors of this review article raise an important, but neglected issue in animal welfare research: the ability of farm animals to learn about the salient features of a new environment and to perform various tasks accordingly, and the potential use of this ability to better design the facilities and routines commonly used in animal husbandry.

Controlled experiments have demonstrated the ability of sheep, pigs and cattle to remember the location of feeding sites over a period of a few to several days – thus, the inappropriate use of a housing system by an animal could well be indicative of inappropriate design or unforeseen factors such as unfavourable temperature gradients, the lack of suitable bedding, dampness, draughts or high (human) traffic. Some animals might have to be exposed to a particular site from an early age – laying hens, for instance, need to learn to reach elevated perches and nest boxes while still young. New feeding equipment in the housing system may also pose additional problems. However, this can be overcome through ‘social’ learning: a human could demonstrate the means of obtaining food to the animal, or the animal could be housed with older, more experienced individuals, who have already learnt the operation of the equipment.

A similar strategy could be used to induce animals to accept new types of feed. Calves, piglets, heifers and sheep, all learn to accept new types of food much faster if housed with other individuals that are already eating that food. More importantly, the authors note that the change of feed should be gradual (a familiar feed component could also be incorporated into a new feed), and that the switch to a new feed should not be accompanied with a change in feeding location. Animals can also learn about other group members and the humans that handle them. There is evidence that larger group sizes lead to fewer aggressive interactions, at least in the case of hens and piglets. Animals also respond well to repeated, gentle handling by humans (and can even learn to differentiate a regular handler from a stranger). Such prior interactions can help reduce the trauma of procedures such as castration or tail docking.

The authors suggest that much can be learnt about the design of optimal housing systems for farm animals, by simply observing and taking into account their innate behavioural preferences. Thus, depending on the type of animal being housed, the enclosure could include a soft surface to lie on, enough room for the animal to move its head normally, loose material that can be moulded with the feet and body and appropriate levels of lighting in the feeding, transit and nesting areas. In general, animals are less stressed if they are given the opportunity to adapt to a novel situation through gradual introduction to a new routine or environment.

Wechsler, B and Lee, S. (2007), *Adaptation by learning: its significance for farm animal husbandry*, *Applied Animal Behaviour Science* (in press).

ANIMALS IN RESEARCH AND EXPERIMENTATION

Early weaning of rodents

Laboratory rats and mice are routinely weaned early from their mothers at around 21 days of age, in order to increase productivity by inducing a second litter as soon as possible. This could have adverse effects on the young animals later in life, as in nature, maternal care by the mother (involving grooming, suckling and extensive physical contact) may last as long as 33 days in rats and 35 days in mice. The authors of this review summarise the available evidence on the behavioural and physiological effects of early weaning on laboratory rodents. Several studies have shown that normal play behaviour among siblings is significantly reduced in early-weaned rodents. There is also evidence that the onset of a regular diurnal rhythm is delayed, suggesting that the mother's activity patterns play a major role in dictating the behaviour of rodents at an early age. Early-weaned rodents also display higher levels of anxiety than normal-weaned individuals: this has been

verified by means of a range of behavioural tests, as well as through the measurement of physiological (neuroendocrine) responses to stress-inducing situations. The latter result supports the hypothesis that early separation from the mother is an intense stressor that can permanently alter key physiological mechanisms in the brain. Behavioural studies suggest that the early separation of rodents from the mother can also adversely impact normal social interactions later in life. For example, early-weaned rats exhibited lower than normal levels of territorial aggressive behaviour against unfamiliar rats. Early-weaned mice, when housed together, also failed to form the normal social hierarchies typical of the species (where the largest individual becomes dominant, and fights quickly decrease over time), and fought each other. The authors conclude that early separation from the mother seems to reduce rodents' ability to adapt to social groups. Finally, female rodents weaned early also tended to show significantly less maternal care towards their own offspring, suggesting that reduced care behaviour could be continually transmitted across generations, with negative effects on animal welfare.

Kikusui, T. (2007) A review of the behavioral and neurochemical consequences of early weaning in rodents, *Applied Animal Behaviour Science*.(in press).

Training laboratory primates

The training of laboratory primates can improve their welfare by reducing the impact of potentially stressful laboratory protocols, such as cage change, injection or drug delivery. A simple training procedure such as habituation can be used, for instance, to allow a primate to become accustomed to equipment to be used during an experiment. This can have the twofold advantage of reducing and minimising the possibility of spurious experimental results due to the animal's non-cooperation.

The authors of this study, which was partly funded by the RSPCA, surveyed a number of primate rearing and breeding facilities in the United Kingdom, including universities, government and pharmaceutical organisations, contract research companies and primate breeding facilities, to determine whether primate training programs were implemented in these places. Most establishments were found to practice at least some form of training, the most basic being the socialisation of primates to their human handlers. However, only half of these organisations had a formal training program where records were kept. The most often cited constraints on organisations' ability to train their primates included a lack of information on how to train (the authors insist that such information *is* available, but that the organisations might be unable to find it), a lack of staff, a large time investment, the short period of time between the arrival of the primates and the start of data collection, a lack of assessment of the benefits of training and a lack of confidence in the organisation's ability to train the animals successfully. Of the organisations that did train primates, most used a combination of positive (e.g. verbal praise or a food treat) and negative (e.g. cage squeeze-back mechanism) reinforcement, while a minority used negative reinforcement only. Of the organisations surveyed, only half included a 'primate training' module as part of their staff development training. Most training was done by word of mouth, and very few organisations relied on the scientific literature.

The authors recommend that the possibility of training primates to cooperate with experimental procedures should always be considered when planning a research project. Facility managers and principal investigators should be receptive to recommendations for training from animal technicians, and regulators should take an active role in promoting training. Positive reinforcement should be the preferred method of training primates, and organisations should keep a record of all human-primate interactions.

Prescott, M and Buchanan-Smith, H (2007) Training laboratory-housed non-human primates, part 1: a UK survey, *Animal Welfare*, **16**: 21-36.

WILDLIFE

Issues in immun contraception

Immun contraception is the vaccination of an individual with an agent that will disrupt its normal reproductive cycle. This is considered by many to be a humane way of bringing populations of wild animals under control. In Australia, a number of species has been experimentally targeted by this method, including the koala, the feral donkey, the European red fox, the feral cat, the feral pig and the rabbit. However, several

hurdles need to be overcome before immunocontraception can be considered a useful and efficient means of checking the population growth of wild animals.

First, the results of experimental trials have been very mixed, and in most cases, significant proportions of animals are found to be unaffected by the contraceptive. This problem is compounded by (a) the need to administer the contraceptive to each animal on more than one occasion, and (b) the need to administer an accompanying agent to give the treatment any chance of success; this agent often has undesirable side effects. Second, there is the very real possibility that the animals left unaffected by the immunocontraceptive are genetically 'immune' to the treatment, and that they will pass on this trait to their offspring, thus rendering the treatment unusable in the future. Finally, if resistance to the treatment does have a genetic basis, it is likely that the unaffected individuals will be genetically closely related, with the consequence that future generations will be inbred. There is evidence that inbred animals can act as reservoirs of infection - this is yet another possible outcome of the use of inappropriate treatments. The authors conclude that the theoretical basis of immunocontraception might have to be re-examined, and that future research programs should take into account possible changes in the genetic structure of populations caused by such treatments.

Cooper, D. and Larsen, E. (2007) Immunocontraception of mammalian wildlife: ecological and immunogenetic issues, *Reproduction Review* (in press).

A precautionary approach to protecting wildlife from owned cats

Given the lack of unequivocal scientific evidence regarding the impact of owned domestic cats on wildlife mortality, the authors of this paper propose use of the 'precautionary principle' which provides grounds for implementation of precautionary measures in the absence of scientific certainty.

The Western Australian state government is yet to introduce state-wide regulations governing cat ownership. This study was instigated by the Armadale City Council, southeast of Perth, to identify perceived risks to wildlife and gauge support for a range of practices amongst residents. Surveys were sent to 2000 names randomly selected from the residential database. The survey covered issues such as the impact of cats on wildlife and cat control and included questions regarding the gender, residential code (urban/rural) and cat-ownership status of respondents. Approximately 35% of respondents owned cats, which corresponds to national cat ownership figures. Cat owners reported sterilisation rates greater than 90% with 32% of owners keeping their cats indoors from dusk until dawn. Significant differences were identified between men and women and cat owners and non-owners regarding cat control measures and concern for wildlife. However, all groups strongly agree that cats killing wildlife is a problem. The survey proposed a range of precautionary practices and measured agreement from each group. There was strong support for sterilisation from both cat owners and non-owners. Owners were less enthusiastic than non-owners regarding other measures such as registration, restricting cat numbers per household and prohibiting cats from nature reserves, however both groups ultimately supported these practices. Full time cat confinement and cat exclusion zones were more divisive, with little support from cat-owners. The authors comment that the precautionary measures found to be most acceptable by owners have obvious welfare benefits for both wildlife and owned cats.

The survey aimed to determine public opinion on these issues and as such the results do not necessarily reflect the actual impact of domestic cats on wildlife. However, in the absence of certainty, the survey indicates that the community perceives cats to be a threat to wildlife and find some precautionary measures acceptable. The authors note that they do not mean to imply that action should only be taken when there is public support but point out that the survey identifies which measures may be adopted whilst awaiting explicit research results upon which new legislation may be based.

Lilith, M. *et al* (2006) Protecting wildlife from predation by owned domestic cats: Application of a precautionary approach to the acceptability of proposed cat regulations, *Austral Ecology* **31**, 176-189

Other articles of interest

Burman, O.H.P *et al* (2007) Ultrasonic vocalizations as indicators of welfare for laboratory rats (*Rattus norvegicus*), *Applied Animal Behaviour Science*, **104**: 116-129.

Chomel B.B., Belotto, A. & Meslin, F. (2007) Wildlife, Exotic Pets, and Emerging Zoonoses, *Emerging Infectious Diseases*, **13**: 6-11.

- Danylchuk, S.E. *et al* (2007), Effects of recreational angling on the post-release behavior and predation of bonefish (*Albula vulpes*): The role of equilibrium status at the time of release, *Journal of Experimental Marine Biology and Ecology* (in press).
- Dybdall, K., Strasser R. & Katz, T. (2007) Behavioral differences between owner surrender and stray domestic cats after entering an animal shelter, *Applied Animal Behaviour Science*, **104**: 85-94.
- Gupta, S., Earley, B. & Crowe, M.A. (2007), Effect of 12-hour road transportation on physiological, immunological and haematological parameters in bulls housed at different space allowances, *The Veterinary Journal*, **173**: 605-616.
- Gupta, S., Earley, B. & Crowe, M.A. (2007), Pituitary, adrenal, immune and performance responses of mature Holstein x Friesian bulls housed on slatted floors at various space allowances, *The Veterinary Journal*, **173**: 594-604.
- Marinell, L. *et al* (2006) Quality of life of the pet dog: Influence of owner and dog's characteristics, *Applied Animal Behaviour Science*, (in press).
- Melches, S., Mellema, S.C., Doherr, M.G., Wechsler, B., & Steiner, A. (2007), Castration of lambs: A welfare comparison of different castration techniques in lambs over 10 weeks of age, *The Veterinary Journal*, **173**: 554-563.
- Mormède, P. *et al* (2007) Exploration of the hypothalamic–pituitary–adrenal function as a tool to evaluate animal welfare, *Physiology and Behaviour* (in press).
- Newberry, R.C. & Swanson, J.C. (2007) Implications of breaking mother–young social bonds, *Applied Animal Behaviour Science*, (in press).
- Niel, L., Stewart, S.A. & Weary, D.M., (2007) Effect of flow rate on aversion to gradual-fill carbon dioxide exposure in rats, *Applied Animal Behaviour Science*, (in press).
- Pineiro, M., Pineiro, C., Carpintero, R., Morales, J., Campbell, F.M., David Eckersall, P., Toussaint, M.J.M. & Lampreave, F. (2007), Characterisation of the pig acute phase protein response to road transport, *The Veterinary Journal*, **173**: 669-674.
- Scott, P.R., Sargison, N.D., & Wilson, D.J. (2007), The potential for improving welfare standards and productivity in United Kingdom sheep flocks using veterinary flock health plans, *The Veterinary Journal*, **173**: 522-531.
- Smith, J.J. *et al* (2006) Objective measures of health and well-being in laboratory rhesus monkeys (*Macaca mulatta*), *Journal of Medical Primatology* (in press).
- Von Borell, E. *et al* (2007) Heart rate variability as a measure of autonomic regulation of cardiac activity for assessing stress and welfare in farm animals — A review, *Physiology and Behaviour* (in press).