SCIENTIFIC PROGRAMME:

Speaker Abstracts

THE EVOLUTIONARY ECOLOGY OF PERSONALITY TRAITS IN NATURE

JL Quinn
Edward Grey Institute, Department of Zoology, University of Oxford, UK
john.quinn@zoo.ox.ac.uk

Personality traits in humans and other animals have long been of interest to psychologists and ethologists. They can be defined as consistent behavioural differences between individuals and are particularly interesting when i) consistency is maintained across different contexts, for example risk taking behaviour in the presence and absence of predators and ii) when they involve within-individual correlations between completely different behavioural traits, for example, between aggressiveness and dispersal. Such correlations (or behavioural syndromes) have been described in an ever increasing number of taxa - fish, spiders, octopods, domestic animals and insects to name a few. Despite a growing interest in the study of personality, how such variation arises and is maintained in natural populations is very poorly understood from an evolutionary perspective. Heterogeneity in selection acting on additive genetic variation along with environmental unpredictability are central general mechanisms thought to be responsible but evidence for such processes is scarce from natural populations . Here I will give an overview of current theoretical thinking in the field, highlight results from some of the main case studies on natural populations and outline the challenges faced by workers in the field. Finally I will also suggest potential implications personality theory has for welfare issues.

DOMESTICATION, SELECTION, BEHAVIOUR AND WELFARE OF ANIMALS – GENETIC MECHANISMS FOR RAPID RESPONSES

P Jensen
IFM Biology, Linköping University, Sweden
perje@ifm.liu.se

The dominating goal for animal breeding has been increased production, and this has caused a number of undesired side-effect on welfare related traits. At the same time, this may be an important gene-level model for how evolution can cause rapid phenotypical changes in populations facing sudden changes in their selection pressures. Correlated selection therefore has a huge interest not only for welfare science, but also for evolution and domestication research. It may in principle occur from one or all of three major mechanisms: pleiotropy (whereby one locus exerts effects on several phenotypes), linkage (whereby closely co-located genes are inherited together) or common regulatory pathways (where one gene may regulate expression levels of many others). In this review, examples are given on all three from our own research on selection effects on poultry behaviour and welfare. Pleiotropy is exemplified by the gene *PMEL17*, which affects plumage melanisation and simultaneously increases the risk of becoming a victim of feather pecking. A mutation in this gene stops expression of black melanin, and causes the plumage to become white. At the same time, it protects against feather pecking. Pleiotropy or linkage may explain the occurrence of quantitative trait loci affecting several traits simultaneously, for example growth, egg production and fear-related behaviour. We have identified several such loci, and one of the most interesting is situated on chromosome 1. Modified gene regulation can explain stress-related behaviour changes. We have found that such modified gene expression can be transferred via the egg to the next generation, and affect the phenotype of the offspring of the stressed animals. Genetic mechanisms such as these may help increasing our understanding of correlated selection responses and thereby allow more welfare-friendly breeding in the future.

CHALLENGES AND PARADOXES IN THE COMPANION-ANIMAL NICHE

PD McGreevy
Faculty of Veterinary Science, University of Sydney, Australia
paulm@vetsci.usyd.edu.au

By definition, the companion-animal niche demands merely that animals must provide companionship. At first glance this may seem easy enough but the forces that contribute to success in this niche are complex. Indeed, success as a companion is rarely measured in terms of biological fitness, and empirical measures of the breeding value of stock remain elusive.

The challenges in the niche are manifold and reflect the need for companion animals to show behavioural flexibility, an attribute often labelled compliance, tolerance, and even forgiveness. The borders of the niche are blurred and there is often negligible communication between buyers and suppliers of companion animals. In addition, demand for a given phenotype is subject to considerable flux.

Paradoxically, companion animals may be victims of their own success. We value the social feedback they provide and yet often leave them alone for lengthy periods. There is an inherent tension between the desire to share the company of these animals and the reality that some humans find some species-specific behaviours unacceptable. So, the animal-sense of owners is declining along with their reduced exposure to animals in non-companion contexts, such as on farms.

Often the companion-animal niche is occupied by a breed that was developed for work. We select for conformation and movement in what were once working animals and yet generally reject animals for behavioural traits that were subject to scarcely any primary selection. Because neutering of companion animals is, for many excellent reasons, now so common, the genes of outstandingly suitable pets are routinely lost to the gene pool. Companion animals may be living longer and yet this is when the dog–human relationship can shift diametrically. As they age, dogs become less appealing to and yet more dependent on and needful of attention from their human owners.

Rates of companion-animal ownership are higher than ever but this is accompanied by a sharp fall in living space. Meanwhile, the pet industry drives positive imagery and research to promote pet ownership, even though supply generally exceeds demand. As consumers, owners are encouraged to support the pet industry. In developed nations, unfortunately, they have the resources to overfeed animals to the point of obesity.

In summary, it seems that these shifts and growing paradoxes are making the companion-animal niche more challenging than ever. Perhaps science will help make the niche more predictable but this alone will not guarantee the welfare of the animals that occupy it.

BREEDING FOR BEHAVIOURAL CHANGE IN FARM ANIMALS: PRACTICAL AND ETHICAL CONSIDERATIONS

RB D'Eath[1], AB Lawrence[1], J Conington[1], IAS Olsson[2] and P Sandøe[3]

1 Sustainable Livestock Systems, SAC, UK

2 Institute of Molecular and Cellular Biology, University of Porto, Portugal

3 Danish Centre for Bioethics and Risk Assessment, University of Copenhagen, Denmark

rick.death@sac.ac.uk

In farm animal breeding, behavioural traits are only rarely included in selection programmes despite their potential use to improve animal production and welfare. In particular in pigs and poultry, a shift to less intensive housing will increase the importance of behaviour as an influence on welfare. Breeding goals used by animal breeders that used to target a few traits relating to production and reproduction have been broadened in most farm animal species, to include health and functional traits, so an opportunity now exists to include behaviour in breeding indices.

On the technical level, breeding for behaviour presents some particular challenges compared to physical traits. It is much more difficult and time-consuming to measure behaviour in a consistent and reliable manner in order to evaluate the large numbers of animals necessary for a breeding programme. For this reason, the development and validation of proxy measures of key behavioural traits that are important indicators of animal welfare are required. Examples from both research and applied animal breeding show that it is technically possible to change behaviour through breeding. For instance, formal breeding programmes for mink have bred them to become less fearful, and ease of handling is now included in some beef cattle breeding programmes.

It may be seen to be a good thing when breeding focuses on solving problems for animal welfare by selecting for what appears to be appropriate behaviour. However, this approach may also give rise to ethical concerns. Thus breeding for behavioural change is often seen as a way to adapt the animals to the environment, while animal welfare interest groups and scientists for decades have argued that it ought to be the other way around.

This presentation will focus on two arguments to the effect that it is ethically problematic to breed against unwanted forms of behaviour: Firstly because focused selection on behaviour carries a risk of creating un-reactive animals ("zombies"). Secondly because it may lead to resilient animals ("stoics") that do not show behavioural signs of low welfare yet may still be suffering. It will be argued that even though many people may be worried about breeding animals that are content and amiable, this may not be a problem for animal welfare and hence need not be seen as an ethical problem either, provided that there are sufficient safeguards in place to guard against unfavourable consequences.

DOMESTICATION EFFECTS ON ANIMAL EMOTIONAL SIGNALISATION: A CONCEPTUAL MODEL

M Špinka
Department of Ethology, Institute of Animal Science, Prague, Czechia
spinka@vuzv.cz

Beside material goods and services, humans have also acquired emotional benefits from their life with domestic animals such as perceiving that the animals are content and happy in their care. Since humans derive these rewarding feelings partly from animals' active signals, they may have been, during the process of domestication, seeking and promoting positive (and suppressing negative) emotional signals from the animals. Here I present a model describing the pressures that could have altered the capacity to experience and express emotional states in the domesticated species.

The backbone of the model is the causal chain in which fitness increasing situations cause positive emotional states (PEStates) in the animal; these are expressed via vocal and visual signals; and finally, these signals are perceived by humans and because they cause positive emotional states in them, humans are inclined to behave and modify artificial selection in such a way that increases the input of positive signals from the animals. This can be achieved by acting at four steps of the causal chain: a) we can improve captive environments so that they better fulfil the needs of the animals and thus they more often experience PEStates; through selecting animals that emit most PESignals, we can unintentionally change the genetic makeup of animals so that they b) are overoptimistic in their assessment of situations, i.e. experience PEStates even in not-so-good environments and/or c) overcommunicate their PEStates, i.e. emit PESignals even when their emotional state is not positive. Finally, we can d) auto-select ourselves (through cultural or genetic processes) to overestimate the positive side of signals received from domesticated animals. Mirror wise, with negative emotions, analogous processes may lead us to removing challenges from the environment that cause NEStates, suppressing the animals' capacity to feel NEStates, decreasing their inclination to express NEStates through NESignals, and compromising our ability to perceive the NEStates emitted by the animals. Nevertheless, if signalling of a NEState can incite a human action that differentially enhances the chance of the signalling animal (or group of animals) to contribute to the gene pool of the domestic population, then (over)signalling of NEStates can be selected for. For instance, oversignalling hunger may lead to being more fed, growing faster and therefore being included in the breeding stock. The predictions of the model match some of the patchy empirical findings on domestication changes in animal emotional signalling.

BREEDING FOR PLEASURE: THE VALUE OF PLEASURE AND PAIN IN EVOLUTION AND WELFARE ETHICS

J Yeates
Centre for Ethics in Medicine and Animal Welfare and Behaviour Group, University of Bristol, UK
James.Yeates@bristol.ac.uk

Insofar as evolution has a goal, this goal is not pleasure or pain. Sentience is a mere "accident of nature" and equivalent evolution would have been theoretically possible if nature had evolved "hedonic zombies" that (are motivated to) act in ecologically rational ways but who experience no feelings of pleasure/pain.

But pleasure and pain do have indirect evolutionary value, which can be modelled in two ways. One way this value can be modelled is as part of a reward system, which promotes behaviours or outcomes that increase evolutionary fitness. On this model, pleasure and pain (so long as they are adaptive) both have *positive* value. The value of pleasure and pain can also be modelled as part of an internal signal system. Pleasure signifies states that promote or constitute evolutionary fitness; pain signifies states that represent poor evolutionary fitness. Pleasure and lack of pain are more like awards than rewards. On this model, pleasure is positive and pain negative. Pleasure does not necessarily imply fitness, for example drug-induced hedonia and stereotypies characterised by opioid release, are pleasurable but do not necessarily signify evolutionary fitness, demonstrate. Even if it did, the reverse (that fitness implies pleasure) is invalid. On both models there are only indirect reasons to assume that naturalness promotes pleasure and averts pain per se. This has important implications for husbandry: it follows that it is as important to assess the welfare of animals in natural systems as those in less natural systems.

It also has implications for the ethical breeding of animals. Natural breeding systems cannot be assumed to be welfare-friendly. Human-directed breeding strategies may go further and promote welfare; indeed to refuse this is inconsistent with welfare aims. The analysis in this talk informs our approach. We can breed animals to improve their mental states, i.e. increase pleasure and decrease pain; to improve their welfare states, as signified by pleasure and pain, which will increase pleasure and decrease pain; or to improve their reward systems so that they learn better and thereby cope better. We can breed for "improved" affective systems, by breeding animals so that they recognise as good not those states that confer evolutionary fitness, but those that confer fitness for their actual environment. In cases where reward systems are maladaptive, this might allow, or even encourage the breeding of blind or insentient animals.

THE IMPACT OF GENETIC SELECTION FOR INCREASED MILK YIELD ON THE WELFARE OF DAIRY COWS.

PA Oltenacu[1] and DM Broom[2]
[1] Department of Animal Science, Oklahoma State University, USA
[2] Department of Veterinary Medicine, University of Cambridge, UK
pao2@cornell.edu / dmb16@cam.ac.uk

In many countries, milk yield per cow has more than doubled in the last 40 years. Data from National Milk Records in the UK show an increase in average yields of dairy cows of about 200 kg/year from 1996 to 2002 and 50% of the progress in milk yield is attributed to genetics.

The increase in production in dairy cattle should be viewed with concern because: a) the increase in milk yield has been accompanied by declining fertility, increasing leg and metabolic problems and declining longevity; b) there are negative genetic correlations between milk yield and both fertility and production diseases, indicating that genetic deterioration in fertility and health is largely a consequence of selection for increased milk yield; c) high disease incidence, reduced fertility, decreased longevity and modification of normal behaviour are indicative of substantial decline in cow welfare.

Multi-trait selection has been successful in Nordic countries. Using balanced selection goals it has been possible to limit the decline of fertility in the Swedish Holstein breed to about half of that in other Holstein populations and to prevent it in the Swedish Red and White breed. Resistance to mastitis followed a similar trend.

For over 10 years, several breeding organisations in Europe and North America have included fertility and mastitis in their breeding objectives. Recently, several Nordic Countries added lameness. A multi-trait selection programme in which health, fertility and other welfare traits are included in the breeding objective is needed.

It is not the case that selecting for welfare traits is uneconomical. Calculation of the Profitable Lifetime Index in the UK. suggests that expansion of this to include mastitis resistance and fertility could increase economic response to selection by up to 80%, compared with selection for milk production alone.

The effectiveness of a selection programme to improve welfare is enhanced if selection acts directly on causes of poor welfare, not only on consequences. Hence research is needed to clarify the relationship between production and welfare and to identify traits directly related to welfare, such as negative energy balance, body condition score and onset of cyclicity after calving. Selection tools to improve welfare in dairy cows are important for industry economics as good welfare is regarded by the public as part of sustainable systems and good product quality.

ASSURANCE SCHEMES AS A TOOL TO TACKLE GENETIC WELFARE PROBLEMS IN BROILERS

MD Cooper and JHM Wrathall
Farm Animals Department, Royal Society for the Prevention of Cruelty to Animals, UK
mcooper@rspca.org.uk

The effects of fast growth rates on broiler welfare are well documented, and it has been reported that rapid growth rates can contribute not only to the most severe but also the majority of the welfare problems seen in today's broilers. For example, rapid growth (e.g. 57g per bird per day) can significantly contribute to the development of chronic leg disorders, ascites, and sudden death syndrome. Intense genetic selection for growth rate can also affect the breeding birds, who can be subject to severe levels of feed restriction resulting in chronic hunger. Despite this, selection for increased growth rate has been a primary focus for breeding companies and it is predicted that growth rates will continue to increase. Modern husbandry practices and developments in nutrition also further exploit the birds' genetic potential for fast growth. The competitive nature of the broiler industry, working to tight margins and the economic sensitivity of the issue makes tackling this problem extremely difficult. This is particularly so as the key driver is to produce an ever cheaper source of protein. However, there is growing consumer interest in food quality and welfare provenance. Under such circumstances, assurance schemes can be a useful tool in creating change, as they can command a price premium and be used as a channel of communication to the customer to educate on such issues. Based on discussions with broiler breeders, producers using slower growing breeds of chickens and in line with published research, the RSPCA placed a maximum limit on the genetic growth rate potential of broilers (maximum 45g per bird per day) that could be permitted for use within it's own higher welfare assurance scheme - Freedom Food. This issue was addressed within the RSPCA Welfare Standards for Chickens, which Freedom Food accredited producers are required to work to, in September 2006. Just over one year later, c.44 million genetically slower growing broilers (Hubbard JA57) were being reared under the Freedom Food scheme, which equated to c.5.2% of the total number of broilers reared in the UK. In addition, the two largest global broiler breeding companies responded to this changing market by each launching a genetically slower growing broiler, one of which was developed specifically to fulfill the RSPCA Standard for growth rate (CobbSasso150). This demonstrates that assurance schemes can have a pivotal role in creating change and tackling important welfare issues such as genetic welfare problems.

ON THE ORIGIN OF LABORATORY MICE AND CONSEQUENCES FOR WELFARE

JL Hurst
Department of Veterinary Preclinical Science, University of Liverpool, UK
jane.hurst@liv.ac.uk

House mice (*Mus musculus*) are human commensals that have adapted to exploit built environments where there are concentrated food resources and where physical structure provides protection from predators, humans and poor weather conditions. Although highly adaptable to a wide range of physical conditions and diets, their key to survival is to remain hidden and elusive to capture (by humans or predators) and to other control measures. Locally abundant food and shelter often leads to high density populations, and house mice are well adapted to compete for breeding opportunities under a wide range of social conditions. This is underpinned by a sophisticated communication system that allows animals to recognise the genetic identity of conspecifics at many different levels (species, sex, individual, kinship and heterozygosity) and to assess the current status of each individual (including social status, home area and group membership, reproductive condition and health).

Laboratory mice are hybrids of three *M. musculus* subspecies (*domesticus x musculus x castaneus*). All of the classical strains widely used in laboratories derive from the same tiny ancestral gene pool originating from the breeding and domestication of ‘fancy’ or pet mice. Genetic variation is thus extremely low or non-existent across many parts of the genome, including a key region that encodes individual genetic identity signals in urine scents. Inbreeding within strains has further resulted in individuals that are identical across the genome. The consequences for social recognition and competitive behaviour are mostly positive with respect to laboratory welfare and management, but disturbance of such a restricted social environment can lead to extreme responses. Ancestral jumping and flight responses to danger have been considerably reduced, but laboratory mice are not inherently tame to human contact and show high anxiety responses to novel situations. Handling experience has profound effects on anxiety behaviour, stress physiology and fear conditioning that can be positive or negative. Here I will show that use of appropriate handling methods and housing conditions can avoid inducing unnecessary aversion and anxiety in laboratory mice. This is likely to have substantial benefits for reducing unexplained variation in experiments as well as for improving animal welfare.

SELECTIVE BREEDING OF PRIMATES: CONSEQUENCES AND CHALLENGES

P Honess[1], M Griffiths[2] and S Narainapoullé[2]
[1] Oxford University Veterinary Services, Oxford, UK
[2] Bioculture (Mauritius) Ltd, Riviere des Anguilles, Mauritius

Primates are bred in captivity for a number of purposes from zoo-based captive breeding programmes for ex-situ conservation to breeding for the biomedical research sector. In each case breeding animals that are fit for purpose, either as viable candidates for reintroduction or as valid research models, has presented challenges and resulted in steep learning curves. The breeding of animals for biomedical research has increasingly become focused on the production of animals that are less stressed by captive (specifically laboratory) environments. This is because elevated, particularly chronic, stress responses can result in altered physiological, neurological and behaviour states that have the potential to compromise the validity of scientific results. Selective breeding in captivity to, for example, maximize production, select for temperament or specific genotypes, is likely to be counter to natural selective pressures for evolutionary fitness. Given that many natural selective pressures active in the wild are absent in captivity this presentation will discuss, with examples, the selective breeding of primates in captivity, its potential negative effects of and options that exist for ameliorating these negative effects.

GORILLA REPRODUCTION IN CAPTIVITY – TO ASSIST OR NOT

SP Redrobe and JB Carroll
Bristol Zoo Gardens, Bristol, UK
sredrobe@bristolzoo.org.uk

There are 239 female and 186 males captive western lowland gorillas (*Gorilla gorilla gorilla*) in Europe. These are managed as part of a captive breeding programme and life history data are maintained in a studbook. These data are used to analyse the genetic and demographic profile of the population and set population management targets. The most important breeding animals are identified in order to maintain maximum genetic diversity within the captive population. Female gorillas usually start reproducing around age 6 years and continue until their early 30s. There appears to be a problem in captivity of females producing young at an early age then stopping after one or two young. Very little investigation, other than offering different environments and mate choice, has been made into this phenomenon which, if allowed to persist, could lead to a crash of the population or over-representation of certain individuals and consequent loss of founder representation from other family lines.

At Bristol Zoo Gardens a female 28 year-old western lowland gorilla was investigated for failure to reproduce despite being repeatedly mated by fertile males. Her rank was 37 out of 239 females and the male was ranked 26 out of 186 hence both were important to the breeding programme. The female's previous breeding history was a stillborn infant in 1986 then a surviving infant born in 1987. Since then she has appeared to cycle and had been repeatedly mated by two proven fertile males yet failed to produce offspring. Clomiphene treatment was started in April 2004 after veterinary investigation and natural mating continued. Following two pregnancies that did not result in viable offspring, a live infant was born in December 2007 by natural birth. For the first time ever the condition known as diminished ovarian reserve – a condition also affecting fertility in humans and which is not inherited – was diagnosed and treated in a gorilla using methods and medicine that were minimally invasive and allowed for natural mating. This treatment may be appropriate for other females that present with a similar history and further investigation is warranted in those individuals.

The implications of this approach to population management are discussed in the light of both natural and artificial selection, and the welfare of the individual animals.

CONFORMING TO STANDARDS: A REVIEW OF INHERITED DEFECTS AS A CONSEQUENCE OF PHYSICAL CONFORMATION IN PEDIGREE DOGS

LM Collins, L Asher, G Diesel & JF Summers
Department of Veterinary Clinical Sciences, Royal Veterinary College, UK
lcollins@rvc.ac.uk

The issue of pedigree dog breeding and its consequences for welfare has recently been brought to the attention of the general public. The main sources of inherited defects are (i) deleterious inherited recessive traits expressed as a consequence of closed stud books and inbreeding practises; and (ii) dog breeders aiming to meet the breed standards for multiple aspects of physical conformation. Here, we focus on the latter case – how dog welfare is impacted by the physical conformations imposed by breed standards. This is part of a wider study to compile a comprehensive database of inherited defects, diseases and disorders, with information on prevalence within affected breeds, severity and age at onset of clinical symptoms, and to compare these results with the stipulated requirements of the UK Kennel Club breed standards.

We carried out a review of inherited defects in the top 50 most popular breeds of dog in the UK, according to Kennel Club registrations (2007). A literature search was carried out using specific disease/defect names and specifying breed types where appropriate. In addition, we searched the existing inherited defects databases – LIDA (Australia), CIDD (Canada), and IDID (UK).

Every one of the fifty most popular pedigree breeds of dog in the UK were found to have at least one aspect of their physical conformation which predisposes them to a heritable defect. Conformation characteristics such as short heads, short legs, excessive facial skin folds, pendulous ears, long backs and curly tails are likely to predispose, or are genetically linked in presenting breeds, to a range of physical problems such as occipital dysplasia, malocclusion of the jaws, hip dysplasia, eye ulceration, chronic otitis, intervertebral disc disease, and spina bifida, respectively.

In many cases, there is an overlap or interaction between conformation and inherited diseases. For example, the merle colouration specified in the breed standards for Dalmations has a genetic link with deafness. Certain defects were found to cluster by breed type – e.g. the tendency to develop patellar luxation is particularly common in the Terrier and Toy dog breeds, and the potentially fatal condition of gastric torsion is common to the working dog breeds such as Rottweiler, Dogue de Bordeaux, Dobermann and Great Dane.

Understanding how conforming to breed standards impacts on pedigree dogs' welfare will enable policy makers and breeders to recommend morphological changes based on utility and performance, not just aesthetics.

BREEDING AMIABLE ANIMALS? IMPROVING FARM ANIMAL WELFARE BY INCLUDING SOCIAL EFFECTS INTO THE GENETIC MODEL

TB Rodenburg[1], P Bijma[1], ED Ellen[1], R.Bergsma[1,3], S. de Vries[1], JE Bolhuis[2], B Kemp[2] and JAM van Arendonk[1]

[1] Animal Breeding and Genomics Centre, University of Wageningen, The Netherlands
[2] Adaptation Physiology Group, University of Wageningen, The Netherlands
[3] Institute for Pig Genetics, Beuningen, The Netherlands.

bas.rodenburg@wur.nl

Since Darwin, kin selection theory developed by Hamilton is one of the most important theoretical advancements in evolutionary biology. Kin selection theory explains how cooperative behaviours can evolve that are costly to the individual performing the behaviour but have a benefit for the population as a whole. Current genetic improvement programs in agriculture, however, largely ignore the implications of kin selection theory for the design of breeding programs. This increasingly limits the potential for genetic improvement of welfare, because housing systems are evolving to larger groups in which positive and negative social interactions have greater impact. Kin and group selection theory provide a stepping stone for animal breeders to reduce negative social interactions and improve welfare by means of genetic selection. Recently, we have developed theoretical and empirical tools to quantify the magnitude of heritable social effects in livestock populations, and to utilize those effects in genetic improvement programs. Results in commercial populations of pigs and chickens indicate large heritable social effects, and the potential to substantially increase responses to selection in traits affected by social interactions. In pigs, including social effects into the genetic model affected aggressive behaviour: pigs with a high social breeding value for growth rate, expected to have a positive effect on the performance of their penmates, were more aggressive at mixing than pigs with a low social breeding value and tended to be less aggressive at 6 weeks post mixing. This indicates changes in the way dominance relationships are established. In laying hens, we used a combination of kin and group selection to reduce mortality due to cannibalistic pecking. This resulted in a considerable difference in mortality between the low mortality line and the unselected control line in the first generation (20 vs. 30%). We also studied how this selection method affected behavioural and physiological traits of these birds. It was found that combined kin and group selection for low mortality leads to animals that are less fearful, more social and more active in a range of behavioural tests. Furthermore, differences were found in peripheral serotonergic activity, possibly reflecting brain serotonergic neurotransmission, which has been related to the predisposition of a bird to develop damaging behaviour. These results indicate that including social effects into breeding programs is a promising way to reduce negative social interactions in farm animals, and possibly also to increase positive social interactions, by breeding animals with better social skills.

A THEORETICAL ANALYSIS OF THE EVOLUTION OF FEAR

PC Trimmer[1], JAR Marshall[1], JM McNamara[2] and AI Houston[3]
1 Dept of Computer Science, University of Bristol, UK
[2] Dept of Mathematics, University of Bristol, UK
[3] School of Biological Sciences, University of Bristol, UK
trimmer@compsci.bristol.ac.uk

Animal behaviour has evolved in a world in which sub-optimal actions may result in death. Being slightly more bold than 'optimal' may result in some extra food, thereby increasing the likelihood of reproductive success in the long-term, but it may, in the short-run, result in the animal being killed by a predator. We discuss mechanisms which are able to perform well in such a world by using a general response that involves a variable that can be identified with fear. We show that if animals use these mechanisms in the environments that they encounter in labs and farms (i.e. environments with a regular supply of food and no predators) there may be deleterious consequences.

BREEDING FOR EASIER-MANAGED SHEEP

J Conington and C Dwyer
Sustainable Livestock Systems Group, Scottish Agricultural College, Edinburgh, UK
Jo.conington@sac.ac.uk

Selection of sheep over time for certain physical characteristics that fit well with the farm environment has served the sheep industry well for many decades, and is the backbone of the UK sheep industry. Matching genotypes to the right environment can minimise some potential welfare problems, such as hunger and disease susceptibility, and has important implications for farm productivity. However, when alterations in the farm environment occur, such as a reduction in the number of farm workers due to high cost of labour in relation to the value of the animals produced, then a genotype that is highly dependent on man for nutritional and reproductive success may experience poorer welfare within that environment.

In the past 30 years or so, the number of sheep flocks has declined by 26% and the average flock size has nearly doubled to 280 ewes. Flocks of over 1000 ewes managed by one stockperson are now commonplace. The inevitable reduction in the ratio of stockpeople to sheep is of some concern for animal welfare, with less time for specific tasks such as health care and inspection of stock. It has also led to a surge in interest for the development of new genotypes that are better able to look after themselves. Selection and management of sheep to promote the expression of behaviours associated with survival, and selection of robust animals that require less human intervention to retain good welfare, are desirable breeding goals. This includes the use of wool-shedding breeds to avoid shearing, sheep that require little to no intervention at lambing, breeding for resistance to disease and breeding for high ram libido. In addition to producing animals that require less direct human intervention, they should also experience improved welfare by the reduced need for stressful interactions between man and sheep (e.g. human intervention at parturition). Importantly, this should not be interpreted as providing no care to these animals, and the means by which these genotypes are produced also need to be carefully managed to avoid at least transient welfare problems where genotypes and environment (e.g. lower shepherding) are mismatched. For example, the identification of lambs at birth with high neonatal vigour and their use as breeding replacements for the next generation will go some way towards ensuring that sheep continue to fit with changes in modern farming practices and hence avoid unfavourable interactions of genotype with environment.

OPTIMISATION OF BREEDING STRATEGIES TO REDUCE THE PREVALENCE OF INHERITED DISEASE IN PEDIGREE DOGS

***TW Lewis*[1], *JA Woolliams*[2] *and SC Blott*[1]**
[1] Kennel Club Genetics Centre at the Animal Health Trust, UK
[2] The Roslin Institute & Royal (Dick) School of Veterinary Studies, University of Edinburgh, UK
Tom.Lewis@aht.org.uk

Pure-breeding animal populations, in the absence of migration, can be regarded in evolutionary terms as closed populations or genetic isolates. The limited population size can lead to a faster accumulation of inbreeding over time than might be expected for larger, out-breeding populations. The genetic load associated with a reduced effective population size and the large contributions of some individuals can also lead to a higher prevalence of inherited disease, which in turn becomes a cause for welfare concerns. Recent attention has focussed on pedigree dogs as an example. Many dog breeds are derived from a small number of founders and have been selectively bred over more than a hundred years. The prevalence of inherited disease in some breeds has become a significant problem.

One option for improving the welfare of pure breeds is to implement health breeding programmes, which allow selective breeding to be directed against known diseases while controlling the rate of inbreeding to a minimal level in order to maintain the long-term health of the breed. The aim of this study is to evaluate the predicted impact of selective breeding against disease in two breeds: the Cavalier King Charles Spaniel (CKCS) and the Labrador Retriever. These breeds are two of the most popular in the UK, with around 11,000 (CKCS) and 45,000 (Labrador) individuals registered with the Kennel Club each year. Mitral valve (heart) disease and syringomyelia, a neurological condition, pose a serious welfare threat to the Cavalier King Charles Spaniel with prevalences estimated to be between 5-30%. In the Labrador Retriever, hip dysplasia is recognised as a significant debilitating disease. These diseases have been shown to be complex or polygenic, which makes the implementation of successful selective breeding against them more difficult.

Heritabilities for mitral valve disease and syringomyelia in the Cavalier and hip dysplasia in the Labrador have been estimated to be 0.64 (0.070), 0.32 (0.125) and 0.35 (0.016) respectively and will allow the estimation of breeding values (EBVs) for all dogs in the UK populations of these breeds. Although using data from disease databases can introduce problems due to bias since individuals and families with disease are usually over represented, the information presented is a step forward in providing information on risk. EBVs provide the basis of a proper genetic evaluation system, allowing breeders to distinguish between dogs of high and low risk when selecting animals for breeding, after removing the influence of life history events. Analysis of the current population structure, including numbers of dogs used for breeding, average kinship and average inbreeding will provide a basis from which to compare optimised breeding strategies. Predictions can then be made about how many generations it will take to eradicate disease, the number of affected individuals that will be born during the course of selective breeding and the benefits that can be obtained by using optimisation to constrain inbreeding to a pre-defined rate.

GENETIC PARAMETERS FOR LAMB BIRTH DIFFICULTY, VIGOUR AND SUCKING ABILITY IN SUFFOLK SHEEP

JM Macfarlane, SM Matheson and CM Dwyer
Sustainable Livestock Systems, Scottish Agricultural College, Edinburgh, UK
Jenny.Macfarlane@sac.ac.uk

Traditionally genetic selection in meat sheep has focused on growth and carcass traits with little specific emphasis on health, welfare or easy-care traits. Given the recent trend towards lower input systems, the range of traits considered in genetic selection is now increasing to try to meet commercial sheep producers' demands for sires that contribute favourably to these systems. Thus it is timely to investigate the genetic basis of lambing difficulty, lamb vigour and sucking ability. This study estimated genetic parameters for these neonatal lamb behaviour traits in Suffolk sheep.

Scores for lamb birth difficulty, vigour and sucking ability were collected shortly after birth on 1520 lambs born in 2006 in 19 different member flocks of the UK Suffolk Sire Referencing Scheme. Scores were recorded by the flock owner following guidelines on a scoring system that evaluated each trait on a scale of 1 to 4; 1 being no assistance given either during birth or to suck, or excellent vigour, through to 4 where a large degree of assistance was required, or poor vigour. Genetic parameters (heritabilities and genetic correlations) were estimated by fitting an individual animal model using ASREML. The linear mixed model included the significant fixed effects. For vigour this included birth difficulty score and for sucking ability included vigour score. Random effects fitted were direct additive and maternal effects and the residual. Variance components obtained from univariate and bivariate analyses were averaged to provide genetic parameter estimates.

Heritabilities for birth difficulty (0.206; s.e. 0.053) and vigour (0.335; s.e. 0.141) were moderate but heritability for sucking ability was not significant (0.030; s.e. 0.051). The genetic correlation between vigour and sucking ability was positive and high (+0.734; s.e. 0.147), that between vigour and birth difficulty moderately negative (-0.396; s.e. 0.097), and that between birth difficulty and sucking ability not significant (0.184; s.e. 0.217). Phenotypic correlations were in the same direction but of smaller magnitude than genetic correlations. Birth difficulty and vigour could be included in Suffolk breeding programmes to help reduce health and welfare problems associated with these traits in Suffolk sheep, and potentially also in commercial flocks producing crossbred slaughter lambs sired by Suffolk rams. Genetic variation in sucking ability is largely explained by vigour suggesting that a reduced recording protocol including only birth difficulty and vigour may be sufficient to improve all three traits. Further work is required to evaluate correlations between these traits and performance traits.

IS (WAS) EMPATHY FOR ANIMALS AN ADAPTATION?

JWS Bradshaw and ES Paul
Anthrozoology Institute, University of Bristol, UK
J.W.S.Bradshaw@bristol.ac.uk

Evolutionary psychology may provide a useful framework for examining why humans feel empathy for certain animals but not others. Phobias towards noxious animals such as snakes and spiders have been explained in terms of gene-culture co-evolution, but the possibility of an analogous "biophilia", directed towards potentially beneficial animals, has received less attention. For example, the redirection of primarily intraspecific nurturant behaviour towards the young of other species may have been a first step in the domestication of some species, and the products of domestication have proven highly advantageous for human reproductive success. Empathy towards domesticated food animals may either be an exaptation, or a true adaptation if it enhanced productivity historically, as it appears to do today: empathy contributes towards stockperson behaviour that both reduces fearfulness in farmed animals and also enhances yields.

The possible relationship between an evolved "biophilia" and hunting is less clear; it has been proposed that during human evolution, an ability to empathise with animals may have been adaptive in leading to more effective hunting techniques, but it is also self-evident that very highly nurturant, empathic sentiments are not compatible with the killing of animals for food.

The ultimate expression of human empathy for animals is seen in pet-keeping. Pets consume resources, but unless they are also working animals, provide none in return: the hypothesis that pets benefit mental and physical health, apart from through joint exercise such as dog-walking, has not been fully supported by recent research, and so is unlikely to have contributed greatly to human reproductive fitness. By analogy with brood parasites, certain visual features of animals may trigger nurturant behaviour in humans, as exemplified by the "evolution" of both the teddy bear and Mickey Mouse. However, the hypothesis that animals may actually interfere with human reproductive success may not be fully supportable, although the cat-owner bond has been found to diminish in women during pregnancy and the early years of child-rearing, when empathic and nurturant behaviour is focussed intraspecifically. It is possible that pet keeping, rather than being a misdirection of parental emotional responsiveness, should be better regarded as the result of a generalised tendency to empathise and nurture, which may have proven adaptively advantageous both in the care of human infants, and in the care of productive and working domestic animals.

In conclusion, while empathy for animals is undoubtedly influenced by culture, it may be underpinned by evolved human traits.

NEW GENOMIC DEVELOPMENTS IN DAIRY CATTLE BREEDING – THE RISKS AND OPPORTUNITIES FOR HEALTH AND WELFARE

T Mark & P Sandøe*
University of Copenhagen, Faculty of Life Sciences, Denmark
* *pes@life.ku.dk*

This paper discusses the effect of dairy cattle breeding on the welfare of dairy cows. It focuses on future developments of DNA-based breeding methods.

For many years milk yield has been the main preoccupation in the breeding of most dairy breeds. In the period between the early 1960s and the late 1990s milk yields in most dairy cow breeds have more than doubled. It has become evident, however, that excessive focus on raising milk yield leads to animal health problems. These problems are ethically challenging and costly to most farmers. In response to such problems, breeding for so-called functional traits in dairy cattle was introduced. This started in Scandinavia in the 1980s and has recently spread to other countries.

However, dramatic changes are likely to take place with the introduction of new DNA-based methods for dairy cattle breeding. These methods allow accurate selection to take place with young animals, and even embryos, provided that reproductive technologies used are refined. Such selection will shorten the generation interval, and it may prove especially advantageous for health and welfare traits, which are difficult to improve using traditional methods. However, it may also increase the risks involved in selection because there will be less natural selection against "forgotten" traits (e.g. diseases occurring later in life that do not appear on the selection index) and because the selection will be less accurate for bulls than it is in current progeny test scheme.

Genomic selection in dairy cattle is already being introduced, and extreme breeding schemes that take advantage of methods of growing cells in the lab may be fully developed within one or two decades. Before this happens it will be important to consider potential negative side-effects regarding animal welfare. While genomic selection offers the opportunity to enhance breeding for health and welfare traits, the paper indicates two possible concerns about side-effects: (1) The first is that there will be an increase in the centralisation of dairy cattle breeding through nucleus herds. Such centralisation may make dairy cattle breeding less accountable to farmers, who will have their own concerns about the health of their animals. (2) The second, more important concern is that, in very rapid breeding cycles, important side-effects (primarily forgotten traits) may be overlooked.

INDIVIDUAL DIFFERENCES IN BEHAVIOURAL RESPONSE STYLE IN DOMESTIC CATS

RA Casey and JWS Bradshaw
Department of Clinical Veterinary Science, University of Bristol, UK
Rachel.Casey@bristol.ac.uk

There is good evidence that analogous personality traits occur across many vertebrate species, and are subject to complex selection pressures that maintain genetically based polymorphisms over many generations. A 'shy-bold' continuum has been described in humans, and field studies suggest that such a continuum is also a characteristic of natural populations from a wide range of taxonomic groups.

Cats show different styles of reaction to novel events and towards people, suggestive of a 'shy-bold' spectrum of response. We have compared the observed responses of 142 cats in 7 standard tests with their owner's reports of their breed, age, gender, and behavioural responses to different contexts. A total of 91 behavioural measures were recorded and subjected to Principal Components Analyses (PCA) in order to suggest which measures might be combined. Reliabilities of grouped variables were calculated as Cronbach alpha. Between one and three scales were derived from each test, together with 3 individual behavioural signs that correlated across rather than within tests. Further PCA was conducted on the derived scales and variables to identify any underlying patterns in the data indicative of possible personality traits.

Four factors were identified, which were interpreted as representing 'active friendly - active unfriendly', 'inactive friendly – inactive unfriendly', 'investigating novelty - anxiety' and 'active response to cat scent' dimensions. The variables contributing to the factors suggested that each represented contrasts between behavioural phenotypes resulting from a combination of response styles and environmental factors. Significant differences in mean scores on factors were found between male and female cats, and between cats of different breeds. In addition, a relationship was found between factor scores and the occurrence of owner-reported behavioural signs in different contexts. For example, cats showing aggression (but not avoidance) across contexts, and cats which showed neither aggression nor avoidance across contexts, both tended to score high on the 'active friendly – active unfriendly' factor. This may suggest that cats with an 'active bold' style of responding tend to become either friendly towards people, or aggressive towards them, depending on the learnt outcome of previous interactions, which subsequently modulates their emotional response to people.

This research suggests that underlying characteristics of response style may act as risk factors for the development of particular behavioural responses in domestic animals, but are strongly modulated by specific learning experiences. Mechanisms by which this interaction might occur, such as synaptic plasticity, and plasticity in neurotransmitter receptors, will be briefly discussed.

SELECTION AGAINST PIG AGGRESSIVENESS AT REGROUPING; PRACTICAL APPLICATION AND IMPLICATIONS FOR LONG-TERM BEHAVIOURAL PATTERNS

SP Turner, R Roehe, RB D'Eath, SH Ison, M Farish, MC Jack and AB Lawrence
Sustainable Livestock Systems, Scottish Agricultural College, UK.
simon.turner@sac.ac.uk

Post-mixing aggressiveness in pigs is common and compromises growth performance and welfare. Effective management methods of reducing aggression are financially costly. However, phenotypic variability in aggressiveness between pigs has been described, making selection against aggressiveness a possibility. Using 1660 pigs, this study estimated the heritability (h^2) of aggressive behaviour. As such behaviour is labour intensive to record, we then used genetic correlations (r_g) to validate skin lesion counts (LC) 24h post-mixing as a rapid predictor of involvement in aggression that could be used in selection. The study also examined the implications of selection for reduced aggression on activity in the home pen (active v. lying) and LC 3 wks after mixing and behavioural responses to a handling stressor (weighing) at 3 and 15 wks post-mixing. Duration of involvement in reciprocal fighting (h^2=0.43) and delivery of unreciprocated aggression (h^2=0.31) were moderately to highly heritable, whilst receipt of unreciprocated aggression was lowly heritable (0.08). The LC 24h post-mixing was moderately heritable (0.21-0.26). Lesions to the front of the body were associated with reciprocal fighting (r_g=0.67±0.04) and receipt of unreciprocated aggression (r_g=0.70±0.11) whilst those to the centre and rear were associated primarily with receipt of unreciprocated aggression (r_g=0.80±0.05, 0.79±0.05). Positive correlations (r_g=0.28-0.50) between the LC 24h and 3 wks post-mixing were found, indicating that a reduction in the number of lesions post-mixing is likely to reduce the number received under stable social conditions. Activity in the home pen was weakly heritable (h^2=0.05±0.02) but showed no significant genetic association with aggression or response to handling. Handling scores at weighing were also weakly heritable (h^2=0.03–0.17). Pigs which fought and delivered unreciprocated aggression to others moved into and out of the weigh crate more rapidly 15 wks post-mixing (r_g=0.19-0.60), but showed more vigorous movement when held in the crate. Pigs which received unreciprocated aggression at mixing vocalised more in the crate (r_g=0.78±0.08). Aggressive behaviour is heritable and a genetic merit index including lesions to the front, centre and rear body regions as separate traits should offer a feasible way of selecting against animals involved in post-mixing fighting and the delivery of unreciprocated aggression. This should also result in a long-term reduction in LC. Evidence was found at the genetic level that aggressiveness is associated with the response to a non-social challenge (handling test) making it likely that selection against aggression will alter behavioural strategies for coping with stress, potentially with consequences for animal welfare.

THE 'COMPARATIVE APPROACH': USING INTER-SPECIES VARIATION TO TEST EVOLUTIONARY AND ECOLOGICAL HYPOTHESES ABOUT ANIMAL WELFARE

G Mason
Animal Sciences, University of Guelph, Ontario, Canada
gmason@uoguelph.ca

Some species (eg Norway rats, brown bears, ring-tailed lemurs) typically thrive in captivity, while others (eg red squirrels, polar bears, brown lemurs) do not. But why do species vary in their reactions to captive life, and in the stimuli that they find stressful? Furthermore, faced with known stressors, why do behavioural/physiological responses vary with age, sex and species? These questions still need fundamental answers, and 'comparative analyses', using multi-species datasets, are the ideal tools for potentially generating general, predictive principles. For instance, they should be able to reveal which aspects of natural behavioural biology pre-adapt some species to faring well in captivity. They could also poinpoint aspects of life history and ecology that explain why hypothalamo-pituitary-adrenal responses sometimes sensitize but sometimes down-regulate; why stress-induced immunosuppression sometimes occurs but sometimes does not; why threats are usually avoided, but instead sometimes approached and investigated; and so on. I review recent papers from other fields to illustrate the potential power and value of this approach. These new examples include identifying the correlates of social stress in subordinates, across multiple primate species; the prediction and possible function of neophilia across diverse parrot species; and, amongst wild, free-living vertebrates, the traits that predict which species successfully adapt if moved to new habitats. I discuss the latest methodological advances in controlling for 'phylogenetic signal', and end by suggesting several hypotheses about the causes, correlates and consequences of poor welfare that beg investigation using comparative techniques.

SELECTIVE BREEDING IN FIGHTING DOGS: WHAT HAVE WE CREATED?

FD McMillan and PJ Reid
Best Friends Animal Society, Utah, USA
dr.frank@bestfriends.org

The twentieth century saw the pit bull terrier change dramatically from a working dog used to help handle large food animals and being a model family dog (epitomized by "Petey," the dog in the American movie serials The Little Rascals) to the undisputed champion combatant in the dogfighting world. In the process, the breed has been vilified and even demonized, engendering intense public fear and emotionally-driven legislation banning the breed in many areas.

Selective breeding by those who literally wanted to create a killing machine led to numerous changes in the dogs over the years. The most evident reputed changes are an increased aggressiveness toward conspecifics, a drive to continue fighting in spite of the severest injuries, a loss of aggression inhibition through ignoring an opponent's signs of submission, and an increased propensity to bond with, and show no aggression toward, humans.

Yet, because of the illegality of dogfighting, breeding records of the professionally bred fighting dogs are rarely available for scientific study. Moreover, to this day pit bull breeders have been notoriously secretive about how they breed their best dogs. Accordingly, the genetics of fighting dogs are very poorly understood.

This presentation will examine the selective breeding of fighting dogs. Using the rehabilitation of the dogs seized from the property of American football star Michael Vick that we now have at our sanctuary, the genetic history of this breed will be traced backward to help us understand what the breeding practices have produced. We will see that the pit bull is neither a vicious uncontrollable ticking time bomb with an irrepressible instinct for the kill nor an angelic teddy bear cuddle-companion. It is something in between.

What, exactly, has selective breeding created? How do pit bulls differ from other breeds? What are the welfare implications for the dogs? Are they mentally healthy? Do they have special emotional needs and can they be fulfilled? If not involved in fighting, can they live enjoyable lives and function happily and peaceably in human society? Is the widespread public fear a justified response to the genetic changes in the dogs? What welfare consequences does the public's fear have for the dogs? If selective breeding has produced harmful changes, is selective breeding the way to correct the problems? The answers to these questions will dramatically illustrate the immense power—for both the good and the bad—that selective breeding of animals can have.

WELFARE CONCERNS ASSOCIATED WITH PEDIGREE DOG BREEDING IN THE UK

NJ Rooney[1] and DR Sargan[2]

[1] Animal Welfare and Behaviour Group, University of Bristol, UK

[2] Department of Veterinary Medicine, University of Cambridge, Cambridge, UK

nicola.rooney@bristol.ac.uk

In the UK, numerous pedigree dogs of different breeds experience compromised welfare due to the direct and indirect effects of selective breeding practices. Many breeds are selected to have physical conformations which although perceived by some to be desirable, have direct negative effects upon their welfare. Dogs are regularly bred whose heads are too large, and pelvises too small, to birth naturally (English Bulldog) or whose faces are so flat that they can not breathe or exercise normally (brachycephalic breeds; e.g. English Bulldog, Pug and Boston Terrier). The indirect effects of selective breeding for appearance include significantly elevated prevalence of specific diseases within particular breeds. For example, studies have shown breeds whose relative risk of inheriting a heart problem (often leading to fatal heat attack), is 88 times that in the general population (Newfoundland). Current selective breeding practices can therefore result in pain, disability, behavioural problems and thereby unnecessary suffering.

It has previously been claimed, by Arman, that society and the veterinary profession have become "desensitised to the welfare issues to such an extent that the production of anatomically deformed dogs (and dogs heavily predisposed to illnesses) is neither shocking, nor considered abnormal". This balance was recently addressed by a sensational and far-reaching BBC documentary, the repercussions of which have been substantial.

In this paper, we summarise and review the current scientific evidence, and difficulties associated with assessing the effects of current breeding practices. Limited record keeping, lack of transparency in the breeding and showing world, and the absence of sufficient research, mean that the full extent of the problem is difficult to assess. What's more the collection of data is currently unsystematic, and although there are specific case studies of individual breeds and particular disorders, relatively few have been conducted in the UK.

Individual breeds each suffer from their own array of problems, and although many of these are essentially effects of the same root causes, each breed's survival and improvement (in terms of health and welfare) is likely to rely on a different specific course of action. With 209 breeds currently registered in the UK this makes the situation complex. We collate and present a range of suggestions which may help to improve pedigree dog welfare significantly, and prioritise these based on expert opinion.