Theme 2
Laboratory Animal Welfare and Refinement

Chairs:
Heinz Brandstetter (Germany)
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Workshop 2.1
Environmental enrichment and housing standards

Poster

The development and implementation of guidelines for the housing and care of laboratory animals

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Guidelines for the housing and husbandry of animals used in research and teaching provide research establishments, Institutional Animal Ethics Committees (AECs), practitioners, government regulators and the public with benchmarks against which housing and husbandry practices can be compared. Guidelines that are regularly reviewed to include current knowledge provide evidence for and documentation of good contemporary practice. In New South Wales (NSW), the Animal Research Review Panel (ARRP), a statutory body appointed under the NSW Animal Research Act, is developing species-specific guidelines for the housing and care of laboratory animals and, to date, has published guidelines for dogs (1999), rabbits (2003) and rats (2005). Utilising resources of the NSW Department of Primary Industries and recognised external authorities on particular species, the ARRP commissions an exhaustive search of published literature relating to the behaviour, husbandry and care of the species of interest. Information is collated on enclosure design, care and management, social needs, environmental enrichment, nutrition, and environmental variables such as lighting, temperature, humidity, ventilation and sound. Recommendations are listed for each topic. Draft guidelines are circulated for three months to all accredited animal research establishments for comment, consultation and emendation and advice is sought from members of AEC's, animal house managers, animal technicians and researchers. Further, expert comment is sought from international authorities. After consultation, the document is amended, and posted on the website – Animal Ethics Info-link – www.animalethics.org.au. The acceptance of aspects of housing and care which have been recommended to promote species-specific needs will be reviewed.

Poster

Implications of the neonatal environment on comprehensive phenotyping of genetically modified mice

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Comprehensive phenotyping means that a statistically valid sample of animals is subjected to a battery of clinical, anatomical and neurological tests to characterise the phenotype of the strain. Some types of comprehensive phenotyping are sensitive enough to distinguish between different inbred strains of mice. Comprehensive phenotyping is important to detect the subtle effects transgenesis can have on the phenotype of genetically modified (GM) animals. This in turn provides information that helps to both optimise the assessment of GM animal wellness and to establish appropriate endpoints for the GM strain. Neonatal experiences (such as maternal behaviour and the cage environment) can strongly influence the resultant behaviour of offspring. This is of particular concern for GM mice that will be used for phenotyping. Since appropriate environmental enrichment promotes the expression of normal behaviour, reduces variability between animals, and promotes breeding success, this refinement could be particularly important to ensure accurate, statistically valid phenotyping using the least number of animals. We are interested in exploring the literature on the impact the neonatal environment has on GM animal behaviour since environmental enrichment in mouse breeding colonies represents a significant opportunity for refinement for large numbers of animals.

Lecture

Mandated environmental enrichment in rodents: Possible positive and negative consequences for research

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Developed as a research paradigm to study the effects of experience, and particularly of learning, upon the brain, enrichment for laboratory rodents has come to be viewed in some quarters as a potential method for enhancing animal well-being in the laboratory. Remarkably little research has attempted to measure "well-being" in a quantitative manner, although appropriate measures (e.g. of chronic stress levels) are certainly possible. The term "enrichment" presupposes the positive nature of such manipulations, such that I propose the use of the term "housing supplementation" as a more neutral description of the addition of inanimate and possibly animate elements to the housing environment. Changes that add complexity and perhaps cognitive and motor challenges to animals' environments can have dramatic effects on brain structure, gene expression and physiology as well as behaviour, including recovery from illness and injury. Here I summarise research regarding the effects of supplemented housing upon brain, peripheral physiology, and behavioural measures. In general, addition of supplemental elements beyond food, water and bedding to the housing environment is associated with changes in synapse structure and number, closely coupled macroglial changes, such as increased axonal myelination and astrocytic ensheathment of synapses, and capillary volume in various cerebral cortical and extracortical brain areas. Behaviourally, animals in supplemented environments perform better in complex, appetitively-rewarded tasks. Measurements of indices of chronic stress such as adrenal weight show little difference among groups reared in individual, social, or social-supplemented housing, although individual differences in response to stress are evident in all three housing conditions.

Lecture

Importance and effects of enrichment on physiology and behaviour in mice

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The phenotype of an individual is formed by its genotype and environment. The heritability scales the genotype influence on the phenotype, thus as lower the heritability as stronger is the influence of the environment. For quality and welfare reasons (reduction) laboratory animal science focused the last decades on reducing the variability of experimental results by standardisation. Genotype (inbred strains) and environment (hygiene, diet, climate, housing) were standardised, thus the number of animal used for experimental purposes could be reduced in most countries within Europe. As welfare concerns are increasing it seems to be necessary to evaluate the necessity of changing the common standard housing of laboratory animals according their needs. Such changes are summarised by the concept of Environmental Enrichment. This term itself is confusing, as the common standard housing of laboratory animals already contains environmental enrichment items such as bedding, nesting material, social groups. So the question is, which other environmental changes are suitable and necessary. Many studies showed that changes of the environment (enrichment) will change the phenotype including the behaviour of laboratory animals. Some studies also show that a change of the environment can change the mean and often increases the intra- and inter-individual variability of phenotypic variables, thus finally more animals may be necessary to obtain valid results. Therefore changes of the environment need to be balanced against an increasing number of necessary animals. For this balance it is prerequisite to know the importance of enrichment for the animal, which can be estimated only in consumer demand and not in simple choice experiments.

There is no doubt, that housing which results in stereotype behaviour needs to be changed, like the stereotype digging behaviour of gerbils shows a clear deficiency of standard housing. This stereotype behaviour can be reduced by adding a burrowing system.

For other changes of the environment it is necessary to know the objective beneficial effect for the animal as well as the effect on the experimental result (mean and variance). Only when these two effects are known, the benefit for the animal can be balanced against the influence of the experimental result.

Poster

Using telemetry to study physiological and behavioural parameters in "companion-housed" adult male mice

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Housing laboratory mice in stable, compatible groups allows them normal social behaviours. Adult males, however, tend to fight and are therefore frequently housed individually. Social isolation induces distress affecting physiology and behaviour. As compromise, two males are kept in one cage, but separated within by a grid divider, which allows indirect social contact by vision and smell but prevents fighting. The aim of the study was to investigate the influence of such housing on some physiological and behavioural parameters related to the welfare of an animal.

Before starting experiments, in 16 adult male NMRI-mice a telemetry system was implanted, measuring heart rate (HR), body core temperature (BT) and locomotor activity (ACT). These mice showed no significant differences in body weight, food and water intake as well in HR, BT and ACT being alone or with a female as companion behind the divider.

In contrast, when an adult male served as companion, these mice showed an increase in water intake and a decrease in body weight, whereas food intake was unchanged. Additionally ACT and BT were significantly increased. HR showed the most prominent effect: A constant and significant increase over 10 days which did even not return to baseline the next 8 days, although the male companion was removed.

In conclusion, dividing a mouse Type3 cage, allowing limited social contacts between animals, may beneficially influence the well-being of an individually housed male mouse. But it seems important which gender is selected as companion, otherwise contrary effects on welfare may occur.

Lecture

Refinement alternative for animal housing-enrichment

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Revised Appendix A of the Council of Europe Convention calls for environmental enrichment and group housing for all gregarious species unless there are scientific or veterinary reasons not to do so. Enrichment is considered as refinement as it should promote animal wellbeing. Interference with an experimental outcome could be a scientific reason, and fighting between incompatible animals a veterinary reason for not implementing enrichment. Any refinement to improve animal welfare requires scientific validation to ensure it is truly beneficial to animals (efficacy) and does not detract from the scientific integrity of the study (safety). The outcome may simply be a change in the mean, and this may not matter as it should affect all groups, but changes in variance will lead to more animals being used, itself an ethical issue. While refinement aims can mostly be connected to research data, reduction alternative suffers from lack of research to base regulations on. It is obvious that changes in variance may be strain-, facility- and enrichment-specific, which makes overall guidelines difficult. Indeed, instead of trying to assess impact of enrichment on every determination, it could be more productive to look at effects on variance of welfare indicators with the understanding that low variance there is likely to show as low variance in other determinations. And at the same time aim at most uniform welfare of the animals in the study. COST Action B24 is a new scientists' network focusing on both efficacy and safety of animal housing, including environmental enrichment.

Poster

Harmonisation of the care and use of fish in research

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This presentation gives a report from an international consensus meeting held in Oslo in May 2005. The meeting is part of work conducted at the Norwegian School of Veterinary Science in collaboration with the authorities to establish a National Platform for Alternatives along the lines of the model developed by ECOPA (http://ecopa.vub.ac.be). Fish account for 95% of all research animals used in Norway. The current revisions of the Council of Europe's Convention ETS 123 and the EU Directive 86/609, and in particular the new guidelines on the care and use of fish, have created an acute need for the exchange of current knowledge on fish welfare. There are many areas requiring more research before a consensus on best practice can be reached. Researchers spent three days discussing key topics such as welfare and ethics, pain assessment, anaesthesia and analgesia, health monitoring, handling and procedures, reporting fish experiments and guidelines for implementing the Three Rs in fish research. Ways of extrapolating from experience with the care and use of terrestrial animals to fish research were also explored in detail. A wide range of fish species, living in very different environments, were discussed during the meeting. A website containing all the reference material from the meeting has been established and will be further developed in the future: http://oslovet.veths.no/fish.

Poster

Effect of single versus pair housing on the behaviour and physiology of rats

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The effects of single versus pair housing were investigated on behaviour and physiology of 24 male Sprague-Dawley rats. Animals were housed on a reversed light cycle in minimally enriched environments either alone (n=8) or as a pair (n=16) over a 10 week period. Body weight (BW) and food consumption were measured weekly, and liver, paired adrenal gland and brain weights were collected at necropsy. Locomotor activity over a 30 minute test period was measured following administration of saline at three timepoints throughout the study or a stimulatory dose of heroin (0.3 mg/kg) at the end of 10 weeks. Faeces (light and dark cycle samples) were collected at 3 timepoints throughout the 10 week period (baseline, mid-study and 10 weeks) for faecal corticosterone evaluation 24 hours following exposure of each rat to a novel environment for 30 minutes. Faecal corticosterone levels were determined by ELISA. At necropsy, minor bite wounds were noted on 3 of the pair-housed animals. There were no differences in BW, food consumption, or liver:BW ratios between single or pair housed animals. Paired adrenal gland:BW ratios were significantly increased and brain:BW ratios were decreased in singly housed rats. Singly housed rats appeared to be more sensitive to the stimulatory effects of heroin, however, no differences were noted at any time in faecal corticosterone levels between single vs. pair-housed animals. Our results suggest that housing paradigm does not affect rat response to a novel environment; however, housing paradigm may affect rat responsiveness to stimulants and may alter specific physiologic processes, leading to organ weight variations.

Lecture

Environmental enrichment, standardisation and animal welfare

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Laboratory mice are raised under highly artificial conditions. Current housing standards have been associated with impaired brain development, overt behavioural disorders, and an anxiogenic behavioural profile, all of which can be attenuated by environmental enrichment. However, concerns have been raised that enriched housing might disrupt standardisation, thereby affecting the precision and reproducibility of results from animal experiments. We recently tested this assumption using mice of three inbred strains that were raised in standard or enriched cages in three different laboratories and tested in a series of standard behavioural tests. Enriched housing increased neither individual variability, nor the risk of obtaining conflicting results in replicate studies. These findings indicate that the well-being of laboratory mice can be markedly improved by environmental enrichment without disrupting the standardisation of animal experiments. However, environment and genotype may interact in non-additive ways. Therefore, systematic environmental (and genetic) variation is needed to determine the external validity of experimental results.