

Report of the 2009 RSPCA/UFAW Rodent Welfare Group meeting – focusing on fifty years of the Three Rs and welfare assessment

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Introduction

The RSPCA/UFAW Rodent Welfare Group holds a one-day meeting every autumn so that its members can discuss current welfare research, exchange views on rodent welfare issues and share experiences of the implementation of the 3Rs of replacement, reduction and refinement with respect to rodent use. A key aim of the Group is to encourage people to think about the whole lifetime experience of laboratory rodents, ensuring that every potential impact on their wellbeing has been reviewed and minimised.

The 2009 meeting began with a keynote presentation reviewing fifty years of the Three Rs. Speakers then focussed on welfare assessment, including standardising language for describing observations of mice; communicating outcomes of welfare assessments; defining indicators of positive welfare; considering how housing, care and accommodation affect welfare; and the current welfare status of stock mice in the UK.

50 years of improving rodent welfare – where now?

Derek Fry, formerly Animals (Scientific Procedures) Inspectorate, Home Office

Fifty years on from when Russell and Burch set out the concept of the Three Rs – the replacement, reduction and refinement of animal experiments – in their book *Principles of Humane Experimental Technique*¹, is a very suitable time to review the progress made in improving rodent welfare. Russell and Burch recognised that improving welfare was not just about housing and care but included reducing potential suffering by minimising numbers of animals used in experiments and by keeping “to an absolute minimum the amount of distress imposed”.

In putting forward principles for humane and ethical practice in animal use they were not painting on a blank canvas. The physiologist Marshall Hall had set out similar recommendations over a century earlier²:

- We should never have recourse to experiment in cases in which observation can afford us the information required.
- No experiment should be performed without a

distinct and definite object and without the persuasion that the object will be attained and produce a real and uncomplicated result.

- We should not needlessly repeat experiments and we should cause the least possible suffering, using the lowest order of animals and avoiding the infliction of pain.
- We should try to secure due observation so as to avoid the necessity for repetition.

Some of the influential scientists of the time were practising according to Hall's principles and encouraged Russell and Burch in their enterprise. Some animal houses were impeccably clean, and the importance of good hygiene was recognised. Much was known about the need for animal house ventilation and temperature control, and Home Office Inspectors then as now were concerned about minimising animal use and suffering.

However, a number of us have very different memories of what it was like fifty years ago. Many scientists then seemed to regard laboratory animals solely as data generators. There was little questioning of the justification or necessity for some very painful procedures and the numbers of animals used were largely set by what the researcher could afford, rather than a reasoned justification. Knowledge of the physiological effects of environment and behaviour in the laboratory setting was limited. Cages were metal and grid floors were common, even encouraged – “the grid has some hygienic advantages, and is perfectly well tolerated by the smaller animals”³. Single housing was common, sometimes in “library” rack systems, and enrichment was rare. Heating provision was variable, with some commercial breeders providing no form of heating in their mouse rooms. Most academic departments had their own animal houses and many were of what would now be considered a very poor standard. For example, some animal care staff can remember routinely kicking the animal house door before opening it to dislodge the cockroaches!

It took some time for the Three Rs to become as widely recognised and accepted as they are today, but it is clear that a lot has changed since 1959. There have been significant advances in knowledge, skills and attitudes towards animal use, leading to improvements in animal housing and care, reductions in the severity of procedures and reductions in the numbers of animals used for comparable experimental programmes. Good practice that was exceptional in

1959 has become the norm. Rodents usually have an enriched environment that takes much better account of their species-specific requirements and animal houses are generally centralised, cleanable and cleaned, many with some form of barrier. Plastic technology has provided a wider choice of suitable caging materials.

The UFAW Handbooks on laboratory animal housing and care provide good indicators of the changes. The edition of the Handbook available in 1959 was published in 1957 and reprinted in 1959³. This second edition has eight pages on the animal house, 35 pages on equipment (including an appendix on resharpening needles), 18 pages on “pests of the animal house” (“bugs, roaches, fleas, lice, mites ... should not be tolerated”) and very little on environmental enrichment. In fact, it says that “The furnishing of ... cages with exercise wheels and other toys seems ... pointless and ... objectionable.” Almost all of the contributors had scientific, veterinary or medical degrees and few if any were animal technologists.

The edition of the UFAW Handbook available over the last few years (the seventh) dates from 1999⁴ and takes a very different approach, with 38 pages on the animal house, an entire chapter on environmental enrichment and, in the rodent-specific chapters, sections on social organisation. It states that “The environment of a mouse should include a wide range of stimuli...” and that social grouping is “preferable”. The contributors include several senior animal technologists and a laboratory animal welfarist.*

For rodent housing however, one area in which the 1999 and 1957 UFAW Handbooks are comparable is in the space allowances. The 1957 edition recommends a formula for calculating cage dimensions where the minimum area (in cm²) is (number of animals) x [(0.7 x weight in grams) + (6 x square root of weight in grams)]. For five mice weighing 29g this works out as 263 cm² (the current Home Office Code of Practice recommends 300 cm²) and for two 460g rats it is 901 cm² (700 cm² in the Code of Practice).

Much has been done to improve welfare by reducing the severity of procedures. For example, the highly irritant anaesthetic, ether, was widely used in 1959 (and recommended in the UFAW Handbook), and now the routine practice is a balanced anaesthetic regime with perioperative analgesia, and “ether is not

* In 2010, the 8th edition of the UFAW Handbook will be published, building on the growing knowledge gained from animal welfare research. This new edition emphasises the importance of providing appropriate environments that meet the animals' needs in order to provide both good welfare and good science. It includes chapters on: the effects of enrichment, or the lack of it, on experimental outcomes; welfare assessment; phenotyping; design of experiments; managing animal welfare in special housing systems such as IVCs and other forms of barrier; and the use of animals in field research. It also draws attention to the recent European revisions of housing recommendations and space allowances.

recommended by UFAW". In 1959, the LD50 approach (determining the dose which killed 50% of the mice or rats used) was routinely used for assessing pharmaceuticals as well as in toxicity and vaccine efficacy tests. It was even used as a pharmacology practical in undergraduate courses, which would be unthinkable today. Now, lethality is an endpoint only for some critical safety tests (principally potency evaluations) and more humane endpoints than death itself are widely accepted by regulators. The LD50 protocol is no longer a recognised guideline for oral toxicity testing in rodents. More generally, refinement has become part of the culture, with Home Office Inspectors, local ethical review processes and the researchers themselves all looking for ways of reducing the amount of distress caused to animals undergoing procedures.

There has also been welfare improvement through decreasing the numbers of rodents used for particular investigations. Between 1959 and the early 1970s, there was a year on year increase in rodent use reflecting the expansion of animal-based science. Now biomedical science continues to expand but numbers of "conventional animals" are falling, though there has been a slow overall increase in numbers over the last decade due to studies using genetically altered (GA) mice. So it seems that scientists in the UK are making comparable advances, yet using fewer animals than ever before. Increased availability and development of non-animal alternatives, more questioning of the necessity and justification for animal experiments and wider use of more efficient experimental design all play a part in helping reduce numbers. Greater transparency relating to animal experimentation, as well as external pressures, have helped to drive changes to a general approach that seeks to minimise animal use.

An interplay between advancing knowledge, technical achievements, acquisition of greater skills and development of more caring attitudes has brought about these improvements over the last fifty years in housing and care, severity of procedures and efficiency of usage. These have provided huge benefits for both animal welfare and science. Animal technologists, care staff, veterinarians and Home Office Inspectors have worked together to achieve better implementation of the Three Rs, especially standards for animal care and use. The Animals (Scientific Procedures) Inspectorate in particular has had a major influence on reducing the severity of procedures as well as encouraging more efficient experimental design. There has been positive pressure from the public and scientific Non-Governmental Organisations (NGOs) including the RSPCA, UFAW and FRAME.* Progress has also been

enabled by bodies such as the National Centre for the Three Rs (NC3Rs), the Animal Procedures Committee and by the researchers themselves. Organisations such as LASA, the IAT and LAVA† offer many opportunities for their members to meet and share good practice, and valuable fora are provided by the biennial World Congresses on Alternatives and meetings sponsored by scientific, welfare and Three Rs organisations.

The Animals (Scientific Procedures) Act 1986, with its requirements for use of non-animal alternatives when practicable, and for minimising severity and numbers, has been a key factor in driving the wider uptake of the Three Rs and improvements in rodent welfare. It gave greater opportunity for Home Office inspectors to advance the Three Rs when assessing proposed work and during visits. The associated Codes of Practice set minimal standards for housing and care, and the Act allowed for the introduction of mandatory training of researchers and a local ethical review process.

However, there is still scope for further improvement, and we should avoid complacency, always questioning how things might be done better. Here are some examples of where we might now put our efforts:

1 Improving care – reducing fear and getting the right enrichment

There is now a much better appreciation that anxiety is an important component of the distress imposed by animal experiments, and there could be wider uptake of measures to offset this by improved handling, prior training and imaginative housing. Caging should allow for species-specific coping strategies and this can be a simple matter, e.g. a deep layer of sand in the cage allows gerbils to perform their normal digging behaviour. Providing refuges and nesting material can help, but more objective scientific assessment of environmental enrichment is needed to ensure that the "right" resources are provided for each species or strain. During procedures veterinary supportive care – preventative and palliative drug regimes as appropriate, minimal disturbance environments, provision of warmth when temperature control is compromised, and so on – can reduce suffering and speed recovery.

2 Providing more information on severity

Much more could be done to publicise the severity of procedures so that where there are options an informed choice can be made. Research papers typically give little information on the nature and level of severity of the procedures involved, or how this was assessed. Greater appreciation of the signs of pain

* Fund for the Replacement of Animals in Medical Experiments

† Laboratory Animal Science Association, Institute of Animal Technology, Laboratory Animal Veterinary Association

and distress in rodents and the ongoing work on assessing severity in GA animals have still to be widely incorporated in welfare assessments. The use of GA animal “passports” should become routine but even in these there is scope for more information on severity.

3 Arguing for full consideration of the Three Rs in animal test regulations

There is a need for well-informed and up-to-date considerations on animal welfare to be an important input when reviewing and formulating regulations which call for animal-based tests. Such regulations may need to be very specific on the actual test required, but the pace of advance in non-animal alternatives and lesser severity approaches means there should be frequent reviews and updating, or provision of flexibility, to ensure suffering is reduced or avoided. Typically such testing is for human safety, such as the safe manufacture, handling and use of chemicals and pharmaceuticals, and food safety. In the latter sphere, ECVAM Workshop 55⁵ gave an example of the problems that can occur, in this case in requirements for testing for marine biotoxins.

Three Rs considerations should be incorporated into regulations when they are being drafted and there is opportunity for this in those regulations that relate to emerging technologies, of which nanotechnology is a current example. The EU and its Member States should pay “full regard to the welfare requirements of animals when formulating and implementing ... policies”⁶. However in nanotechnology, as Sauer (2009)⁷ has pointed out, the signs that the regulations will be well-informed on the animal welfare implications are not good. None of the projects listed in an EU Report on the ethical, legal and social aspects and governance of nanotechnology^{7,8} includes animal welfare. Over a period of fourteen years the EU has spent €5 billion on nanotechnology. In contrast, spend on alternative tests in the nanotechnology area is in the low millions, and over the last twenty years the EU has contributed only €200 million to the implementation of the Three Rs in all areas.

4 Planning and designing for minimal severity

At the individual experiment level there is scope for more use of efficient designs, such as factorial designs, which obtain more data from fewer animals, and for reducing severity by unequal group sizing in experiments where the suffering of treated groups is likely to be much greater than in controls. Much could still be done in setting humane endpoints, not just stopping use of an animal at a severity cut-off but also stopping an experiment as soon as its objective has

been met. More could be done in the planning of a series of experiments to minimise numbers and severity overall. Programmes can be staged to start with procedures of the least severity, and pilot experiments or those early in the series can have, as additional objectives, seeking suitable humane endpoints and observation schedules to implement them. These endpoints and schedules can then be part of the later experiments in the series.

5 Encouraging good practice and exchanging information

The UK is fortunate in having in the Inspectorate a ready route for the dissemination of good welfare ideas and information on the severity of procedures, in the NC3Rs a government sponsored platform for posting and exchanging such information, and in non-governmental organisations like RSPCA and UFAW that are active in publicising welfare issues and in researching and disseminating solutions to researchers and animal care staff. However, even here one finds researchers unaware of ways to improve welfare. More could be done to improve information exchange on the Three Rs both within the UK and globally, so that the best of the UK’s knowledge, skills and attitudes could be implemented throughout the country and elsewhere. This is especially important given the increasing globalisation of animal use. The UK can also pick up examples of good practice and welfare insights from some researchers in other countries, particularly in the EU, Australia, New Zealand, Canada, and the USA – and the contributions to the recent 7th World Congress on Alternatives provide several such examples.

Altogether we face a considerable challenge if we are to continue improving rodent welfare in all its aspects over the next fifty years!

Defining and implementing welfare assessment protocols

Penny Hawkins, Research Animals Department, RSPCA on behalf of the BVA(AWF)*/FRAME/RSPCA/UFAW Joint Working Group on Refinement

The Joint Working Group on Refinement (JWGR) was convened to facilitate refinement by ensuring that up-to-date information on refinement is readily available. Its members include representatives from science and industry, animal technologists, veterinarians and scientific animal welfare organisations. It has produced

* British Veterinary Association Animal Welfare Foundation

a series of comprehensive reports setting out good practice for a number of husbandry and care practices and experimental procedures, which to date have been published in *Laboratory Animals* (<http://tinyurl.com/yazhct6>).

This section of the Rodent Welfare Group report provides a brief overview of an ongoing project by the JWGR that aims to provide practical guidance on developing appropriate, effective welfare assessment protocols for individual research facilities and projects⁹. The current Working Group was initiated in response to an RSPCA survey of pain assessment in UK establishments, which identified a number of practical issues with monitoring animals and recording observations¹⁰. For example, there was considerable reliance on subjective indicators of suffering such as reduced social interaction or animals appearing to be “just not right”. While the judgement of experienced and empathetic animal technologists and care staff was rightly respected, respondents recognised that a more objective approach would be beneficial. They also explained how a “team approach” to monitoring welfare helped to reduce subjectivity.

The Working Group aims to facilitate more effective welfare assessment by beginning with fundamental guiding principles to help plan assessment protocols at a local level. These are:

- a sound understanding of what constitutes good welfare and a “normal” animal;
- appropriate welfare indicators that provide meaningful information and are simple to assess;
- recognition of all the potential sources of suffering throughout the animals’ lives, not just those immediately associated with scientific procedures;
- equal consideration for all species;
- a team approach, with consistency between observers;
- appropriate systems for recording observations.

The guidance takes a generic approach so that it will be broadly applicable to a range of disciplines, with a strong emphasis on practical implementation. It provides guidance on constructing the welfare assessment protocol at the project planning stage, using it effectively, reviewing welfare records, exchanging information relevant to welfare assessment, and training for assessors. The Working Group has submitted the resource to a refereed journal and hopes that it will be published in 2010.

Standardising language for describing mouse welfare

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The past three decades have seen an unprecedented rise in the use of mice as a model organism for the investigation of mammalian biological systems and disease. This increase is due to developments in technologies for the manipulation of the mouse genome. The ability to add, remove and substitute genes within the context of a whole animal has led to the generation of many thousands of lines of GA mice. Colonies of these mice sometimes display characteristics that present challenges for their breeding, rearing and husbandry. Effective welfare assessment and information transfer are both vital to ensure that welfare issues are identified and addressed promptly and consistently.

In recent years, large programmes of work have commenced in which many mouse genes are being knocked out and the phenotypes of the resulting mice are being catalogued and published. As the interactions between individual genes and their pathways are more extensively investigated, collaborative laboratories are sharing many strains. For example, large gene targeting consortia plan to make targeted mutations in up to 13,000 genes by 2011. In these novel mouse lines, there are no historical data and phenotypes – and health problems – can be unpredictable.

More mouse lines than ever are being used by multiple research groups, so it is important that facilities pass on any knowledge that could help to successfully rear and maintain stock, minimise suffering or improve welfare. This information needs to be stored in an accessible, searchable format for future referencing and analysis. It also should be expressed in a standard, descriptive language. To this end, MRC Harwell and the Wellcome Trust Sanger Institute have been compiling the Mouse Welfare (MW) terms to help share information about the welfare implications of genetic alteration.

Collecting welfare data is essential for a number of reasons. First and foremost, information on health and welfare is needed to assess whether the mice are fit enough to remain in the study, or whether their continued use would not be justified. Information gathered from welfare assessments can also add more detail on the phenotype when classifying a new GA line.

In addition, it can be used to study the progression of a disease for scientific purposes as well as for implementing humane endpoints.

The need for work on a standardised language of MW terms became clear when we compared terms between our two facilities. For example, an intact vaginal septum was described as “threading” at the Sanger Institute and an “imperforate vagina” at Harwell. We surveyed twenty animal care staff by showing them pictures of mice with clinical conditions and asking them what they would write on a health sheet. The range of responses was very broad indeed and in some cases there were no common terms that would have linked the two descriptions in a search. As an example, the same picture was described as “bite wound to rump” and “skin lesion at the base of the tail”.

As a result, we are developing MW terms that provide controlled language for describing what is seen at the cage side in the form of a list of terms. The terms form a hierarchy, with a glossary for (i) the health concern, (ii) the body system and (iii) components of the body system. In the case of the example above, there could be only one response to the picture: (i) wound, (ii) abdomen and (iii) coat/skin. The system is still evolving and we aim to refine the terms further, with the help of other mouse users. To this end we have launched the Mouse Welfare Terms website (www.mousewelfareterms.org), an interactive website for suggestion, corrections and developments. We also aim to develop a list of MW terms for neonates. Ultimately, we plan to influence other research partners to improve welfare assessment and information transfer, both in the EU and beyond.

Comparing and harmonising welfare assessments – the welfare illustrator grid

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It is important to reduce subjectivity when assessing animal welfare by taking a systematic approach and incorporating a range of observable or measurable welfare indicators. However, this approach generates data that need to be interpreted accurately and meaningfully. This applies to both single assessments that are carried out to evaluate an animal’s welfare at one point in time, and also to repeated assessments that can be used to track any changes in welfare. These changes may be due to the effects of procedures, refinements in procedures or husbandry, or in the case of long term studies because the animals are ageing.

Understanding and predicting how welfare can change over time can be difficult, but these judgements are essential both for planning research projects and especially for retrospective review. We wanted to develop a graphical system that could depict the outcome of multiple assessments through time, reflecting the cumulative suffering and lifetime experience of the animal. We wanted this to include the effects of factors such as transport and housing as well as procedures, to be consistent and objective, and to be clear and easy to interpret. The aim was to produce an easily understood, visual representation of welfare.

The outcome of this project was the welfare illustrator grid, which was first used to compare the welfare of animals used in different contexts such as in research, farming and as companions, in order to make judgements about their quality of life¹¹. The first version of the grid had four axes; two indicated the level of welfare with respect to clinical condition and behaviour, one represented the duration of compromised welfare in relation to the animal’s lifespan, and the fourth indicated the cause of the suffering (Figure 1). For all axes, greater harm equated to a higher “score”, so smaller polygons represent less suffering than larger ones.

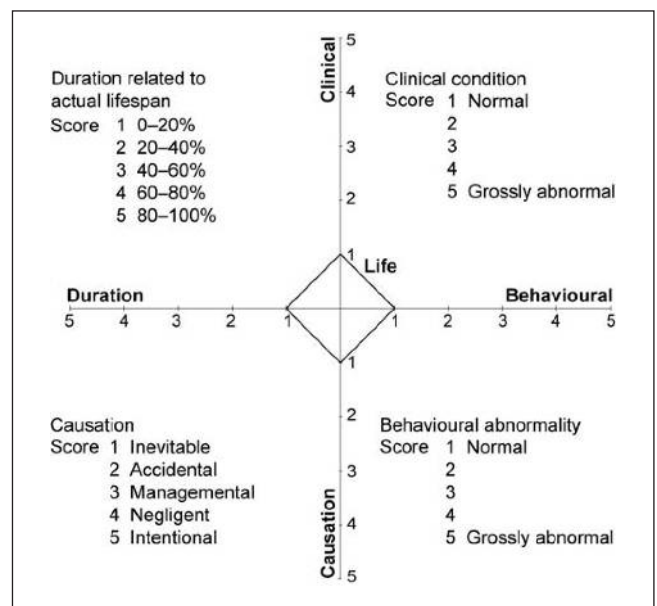


Figure 1. Welfare illustrator grid for comparing the welfare of animals used by humans in different contexts¹, reproduced from *Animal Welfare* Vol. 16 Suppl. with permission from UFAW.

We have now developed this model to be specific to animals used in research and testing and to include a third axis so that changes in welfare status with time can also be represented¹². The four axes, as shown in Figure 2, now represent:

1. *Clinical condition, or physical well being.* This

- includes such parameters as body weight, body temperature and condition score.
2. *Behavioural deviations, or psychological well being.* Appropriate parameters are time budgets, social interaction/hierarchy, incidence of abnormal behaviours (e.g. stereotypies, self injury) and aggression.
 3. *Environmental conditions.* This will reflect the animal's housing and includes assessment of space allowance, heat, light and humidity provision and environmental enrichment.
 4. *Clinical/experimental events.* This will assess the challenge to the animal arising from clinical or experimental events such as surgeries, procedures, sedation/anaesthetics etc.

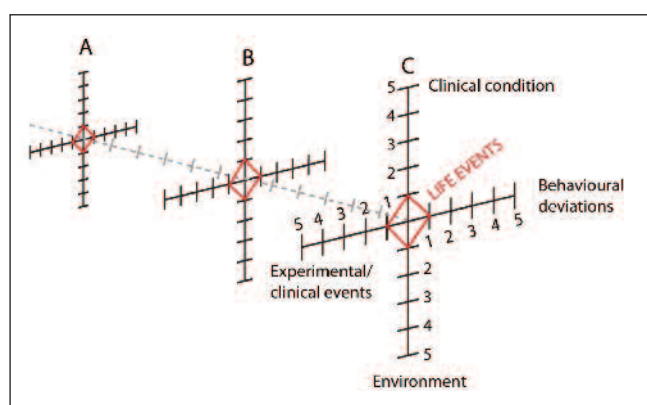


Figure 2. The extended welfare assessment grid, illustrating welfare assessments conducted at three separate time points (A, B and C). The dashed line is the time axis¹². Reproduced from *ATLA* Vol. 38(3) with permission from FRAME.

The time axis allows assessment made at different times to be represented in the same diagram and compared with one another. This can demonstrate changes that affect animal welfare, either positively or

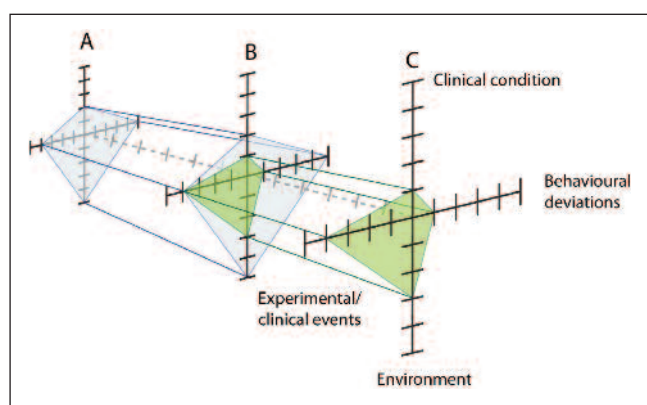


Figure 3. Application of the extended welfare assessment grid to assess welfare in a singly-housed experimental animal where environmental enrichment was provided as a refinement from time point B (this is a hypothetical case)¹². Reproduced from *ATLA* Vol. 38(3) with permission from FRAME.

negatively. For example, the matrix approach can help to evaluate the true welfare implications of research protocols, as well as the effects of refinements. To illustrate this, Figure 3 depicts the impact on welfare of a husbandry refinement implemented at time point B. The scores have decreased for clinical condition, behavioural deviations and suffering due to the animal's environment, but stayed the same for experimental events. It can be seen from the area of the polygons that overall welfare is improved.

We believe that this approach to representing welfare status will help with practical refinement and improve communication between a range of people with an interest in experimental animal welfare including care staff, researchers, regulators, funders, the Ethical Review Process and the public. For further information, please see the publications cited in this article^{11,12}.

Indicators of positive welfare in rodents

James Yeates, University of Bristol

Laboratory animal legislation, care guidelines and welfare science currently tend to focus on recognising and preventing negative welfare states. But there is increasing awareness that this negative approach does not fully represent the domain of animal welfare science, and that the recognition of positive states might help to promote better science and animal welfare¹³. A variety of feelings with desirable mental qualities appear to have evolved in conscious animals. Thus a rodent's welfare might vary from being extremely poor to highly desirable¹⁴, and attention should be given to identifying indicators of positive welfare in animals and providing conditions that encourage their expression (Figure 4).

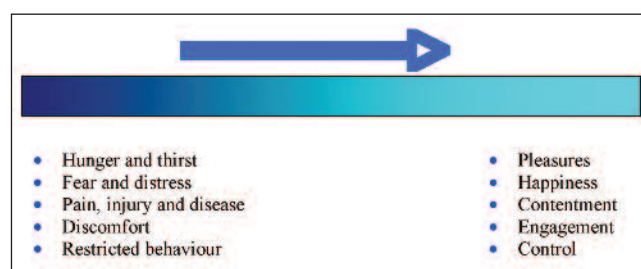


Figure 4. Traditional welfare concerns and a more positive outlook

Experimental protocols have been developed to evaluate what rodents "like", which in behavioural terms is expressed as *affect* associated with a rewarding event, and what they "want", which relates to their *motivation* towards something desirable. Motivational tests "ask" animals what they value and

how much. Some directly allow a choice and measure the relative strength of each preference. For example, rats will show preferences for the opportunity for social interactions, sucrose, social play or sex¹⁵⁻¹⁹. Other ethological studies aim to interpret anticipatory behaviour, such as increased activity and frequent changes in types of behaviour, towards an object or situation. Rodents have been shown to anticipate sexual contact, social play, food treats and access to an enriched cage²⁰⁻²².

Protocols to assess affect, include studies of vocalisation in rats which have demonstrated the presence of ultrasonic vocalisations (“chirping”) in situations that one would expect to involve positive experiences²³. Rats also display facial expressions that are analogous with human expressions in some situations, for example on tasting sugar they will protrude their tongues in a similar way to humans licking their lips^{24,25}.

Play could also be an indicator of positive welfare. Fraser and Duncan proposed that positive motivational states evolved in “opportunity situations²⁶”. In other words, if animals have the time and inclination to play, then all is well in the world. Play behaviour may be considered by some to be caused by a positive overall “mood” and/or to lead to positive mental states^{27,28}, and methods of “measuring” play are being evaluated that may provide a possible measure of welfare²⁸.

Clearly, animals need to be provided with the opportunity to express positive welfare indicators like these if positive mental states are to be recognised and monitored. These desirable outcomes for animals can be divided into three categories. **Pleasures** include eating, play, tactile pleasure, exercise, sex, sleep and warmth. The second category is **engagement** with other animals, family, humans, satisfying curiosity and interest and opportunities for variety and novelty. The third is **realisation**, in terms of a degree of control over the environment and sufficient space for all of the above.

It can be useful to consider positive inputs and outcomes for animals within a framework of “five opportunities”:

- Opportunity for selection of dietary inputs (by provision of a diet that has been preferentially selected)
- Opportunity for control of the environment (by allowing the achievement of motivations)
- Opportunity for pleasure, development and vitality (by maintaining and developing beneficial inputs)
- Opportunity to express normal behaviour (by providing sufficient space, a good quality environment and group housing for social animals)
- Opportunity for interest and confidence (by providing

conditions and treatment that lead to mental enjoyment)

Laboratory housing and scientific requirements can fail to allow some of these positive outcomes, as well as compromising the Five Freedoms, but thoughtful and creative husbandry and experimental protocols can reduce this compromise by compensating in other areas and improving the overall wellbeing of animals.

Housing, care and accommodation – an Inspector’s observations on how these can affect rodent welfare

Anne-Marie Farmer, Home Office

Over recent years there has, quite rightly, been considerable emphasis on how scientific experimentation impacts upon rodent welfare, how welfare can be assessed and recorded in a standardised fashion and – most importantly – how suffering can be minimised without compromising the science. However, I firmly believe that housing, care and accommodation can also significantly affect both rodent welfare and science. This presentation will be a very personal view of the way in which I have come to perceive how good practice begins with building design, and the essential role played by animal technologists and care staff.

Before joining the Home Office, over 11 years ago, I worked in the intensive livestock industry where housing, care and accommodation play a pivotal part in animal health, welfare and product quality. I have therefore developed a keen interest in what is likely to have an impact on the animals that we house outwith their natural environment.

Since joining the Home Office I have been involved in a large number of different projects, including new builds and refurbishments to existing designated establishments. This presentation therefore provides a distillate of my thoughts and experiences.

I believe that housing, care and accommodation are three key components that, alone and in combination, can have a critical impact on science and rodent welfare. I define these three components as follows:

- *Housing* – the building in which the animals are kept.
- *Care* – the provision for, looking after and watching over of the animals.
- *Accommodation* – the immediate living quarters, including cages or pens, Individually Ventilated Cages (IVCs), isolators etc.

Why should we be interested in how these three influence rodent welfare and science? By way of introduction, take a moment to think what happens when you move animals from their natural environment to an artificial one. Those animals will need time to adjust to the new environment, during which time their wellbeing and behaviour will be affected. How long such effects last will depend on the type of environment provided and by how well the animals habituate and adapt. It is therefore our duty to ensure that we provide the most appropriate “artificial” environment that we can in order to minimise any impact on the animals.

Consider the following definition of an experiment:

“An experiment is a procedure by which we introduce variables into a controlled situation and observe the consequences”²⁹.

It follows that if housing, care and accommodation can affect both animal biology and behaviour, they could introduce experimental variables that influence the scientific validity of experiments in ways that were not intended or envisaged when the experiments were planned. This might not be important for some experiments, but I believe that as science becomes more sophisticated and exacting, the effects that these three components can exert are likely to increase. So if we accept that good practice in animal housing, care and accommodation can improve scientific validity and reduce animal wastage, let’s take the idea one step further. What about the environment provided for the staff? I believe that it is important to consider this too, since there is a risk that a poor staff environment can have direct and/or indirect effects on science and animal welfare, for example by impacting staff morale. Animal technologists and care staff who feel valued, and whose jobs are made easier, by a good quality working environment, are far more likely to think innovatively about the Three Rs and be more attentive to the needs of the animals and science.

I am pleased to say one of the most significant changes that I have witnessed in recent years is the thought and attention given to staff areas and working environments, in addition to the animal accommodation and environmental control systems. Although the former is not required by the Home Office I am now convinced of the merits of this approach. Animal technologists and care staff enter their profession because they are interested in animals and animal welfare. They do not want to spend time “fire fighting” problems arising from the building.

Poor environments can introduce experimental variables through inappropriate lighting, noise, temperature and humidity, which can also have a significant impact on the staff who are expected to work in and manage such facilities. Poor housing

quality can make the recruitment and retention of good animal staff a problem. Take a moment to think about how you would feel arriving on a Monday morning to a facility that is difficult to manage, looks old and dingy and compare this with how you would feel arriving at a modern facility where the environmental conditions for the staff and the animals are appropriate, surfaces are easily cleanable, there is light and space and modern equipment that does not break down (Figure 5).



Figure 5. (Left) Peeling paint, poor design and surfaces that can harbour pathogens are unlikely to be encountered in establishments today. If the fabric of designated rooms deteriorates the room would be either removed from the schedules on the Certificate of Designation or refurbished. (Right) modern facilities are built to a high specification making cleaning and maintenance easy.

In my view it is vitally important that scientists and management pay attention to what animal technologists and care staff have to say about the care and requirements of experimental animals. These staff are totally focused on the welfare of the animals that they look after. They take time to observe their animals, and experienced and well trained staff will know what affects the welfare of their animals. So it is hardly surprising that animal technologists and care staff are the people most likely to come up with ideas for refining and improving how their animals are cared



Figure 6. Well motivated and supported staff often initiate (and supply) enrichment ideas.

for before, during and after experiments. Just some examples of their input include methods for rodent mixing or regrouping after periods of single housing, providing peer interactions for single housed rodents, novel environmental enrichment using discarded boxes and containers (Figure 6), and the use of choice chambers to “ask” the animals which environment they prefer. Refinements to well established tests have also been developed by animal technologists, such as equipment designed to test balance more safely than the traditional wooden beam suspended between two lab benches.

There have been, and will continue to be, major advances in rodent accommodation. Although conventional caging is still used, more and more establishments are installing containment systems such as IVCs, isolators and cabinets. Additional improvements are appearing all the time – for example “flags” which make it easy to identify when cages are not correctly placed on racks, automatic watering systems, adjustable height isolators, cabinets which can maintain temperature and humidity and automatic alarm systems which dial out alarm states to staff out of hours. In the latter case some remote access systems provide functionality that allow problems to be rectified remotely, resulting in faster and easier remedy by staff and the added benefit that quicker response times can reduce the impact of the problem on the animals. Novel cage shapes and sizes are available which have space saving features and some provide added height and cage complexity. And on the horizon there are computer based monitoring systems which record animal activity 24/7.

With all these developments, I believe that any establishment considering building a new facility or refurbishing an old one should appoint an experienced, open minded and committed animal technologist to the project from the very first day. The continued involvement of that person throughout the build, and during the hand over and use of the new or refurbished facility, cannot be encouraged enough. This one key person is often overlooked or not listened to because they are seen as “only an animal technician”. In my experience, failure to listen to committed and experienced animal technologists and care staff can result in a facility that is more likely to introduce variables into the science and adversely impact animal welfare.

An assessment of laboratory mouse welfare in UK animal units

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A welfare “benchmarking” project was set up in the UK,

to provide a process by which establishments can carry out their own in-house assessments of welfare and then compare their results with other facilities. In the initial stages of the project, an expert-defined welfare assessment protocol containing 119 measures of mouse welfare was developed (for an explanation of how this was conducted, see Leach et al. 2008³⁰).

The approach to benchmarking involves measuring the resources provided for the animals as well as assessing the animals’ welfare. In practice, this means obtaining information about the staff levels, housing, husbandry, diets and environmental provisions and also looking at the behavioural, physiological and pathological reactions of the animals, e.g. behaviour, health and presence of any injuries. All of these elements are critical for a comprehensive and holistic assessment. Each establishment that participated in the project was presented with their own results plus an anonymous summary of the results from their peer group, so that they could see how they compared.

The completed protocol was used to assess conventional (as opposed to GA), stock laboratory mice in 46 UK animal units, using a questionnaire and observations made during a one day visit to each facility³¹. The results were fed into a rolling national database of welfare performance that only participating institutions could access. This is a powerful motivational tool to improve welfare in itself, so the project did not set its own “minimum standards”.

So far, the standard of mouse welfare has been found to be good overall, with space allowances that were, in most cases, well above the minimum recommended levels set out in the UK Codes of Practice.

There are a number of other positive findings as listed below:

- Litter was provided in ~98 % of cages and nesting material in ~92 % of cages, so the vast majority of mice are provided with both.
- Mouse health and welfare were frequently assessed by animal care staff using daily inspections and observations, health records, and health monitoring schemes.
- In general, indicators of poor health and welfare, such as aggression, were observed at low levels.
- Mice were reported to exhibit a wide range of positive natural behaviours.
- Education and training was available and encouraged within the majority of animal units.

Other results highlighted areas that could be improved:

- A number of environmental conditions (humidity, noise and light intensity) were outside the recommended ranges in some animal units.

- The provision of cage resources such as shelters, gnawing material, forage feed and other enrichment items was variable.
- A high proportion of units (78 %) housed at least some of their mice – mainly males – singly. CD-1 mice were most likely to be singly housed.
- Handling of mice by care staff varied between units.

A number of interesting correlates were found between stereotypies and potential indicators of abnormal health or welfare. For example, there were positive correlations between stereotypy and climbing, and the provision of gnawing material, but stereotypies decreased if mice had a shelter. Of course, these findings do not mean that climbing or gnawing are undesirable, or that all mice should have a shelter. There is still much to be learned about stereotypic behaviour and further investigation is required.

The full protocols are freely available to those interested in using them to monitor and improve the husbandry conditions of animals. In farm animals, welfare assessment protocols have been used by both voluntary quality assurance schemes and enforcement agencies. The same opportunities are available for laboratory rodents.

Update on resources from the RSPCA Research Animals Department

Nikki Osborne, RSPCA Research Animals Department

The number of GA mice used in scientific procedures within the UK and internationally has risen significantly over the last fifteen years and continues to do so. This raises scientific, ethical and logistic challenges with respect to applying the Three Rs.

With this in mind, the RSPCA has set up three expert working groups to identify and promote contemporary best practice in relation to (i) GA animal passports, (ii) training in transgenic technology and (iii) sharing and archiving GA mice. These groups have recently published three new resources for the mouse genomics community:

- A booklet on *Sharing and Archiving of Genetically Altered Mice: Opportunities for Reduction and Refinement*, which discusses why it is good practice to archive and share resources; what, when and how to archive; and how to share.
- A pair of posters entitled *Transgenics and The Three Rs – What's it all about?* which provides an overview of current best practice in the production, care and use of GA mice.

- A resource on *GA Passports: The Key to Consistent Animal Care*, which explains what a GA passport comprises, why and when to use one, and what to include.

For further information on the expert working groups, or these GA resources, email GA@rspca.org.uk

The RSPCA Research Animals Department has also produced a number of new resources to help with the implementation of the Three Rs in general. These are:

- *New resource book for lay members of Ethical Review Processes* – the RSPCA's handbook for lay members has been completely revised and updated to include additional material on each of the seven functions of the ERP. Email erp-laymembers@rspca.org.uk
- The RSPCA's husbandry and care sheets for commonly used species have been reviewed and redesigned. Email research_animals@rspca.org.uk, or visit <http://tinyurl.com/yfxvkqxx>
- *Refining rabbit care – a resource for those working with rabbits in research*, which provides practical guidance on improving rabbit husbandry. Email rabbits@rspca.org.uk or visit <http://tinyurl.com/yzmtlmc>
- *Guidance on the care and housing of the African clawed frog Xenopus laevis* – this can be downloaded at <http://tinyurl.com/yfq17nf>

UFAW has recently published the 8th edition of the *UFAW Handbook on the Care and Management of Laboratory and other Research Animals*. Please contact hubrecht@ufaw.org.uk for further details or see <http://www.ufaw.org.uk/>.

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