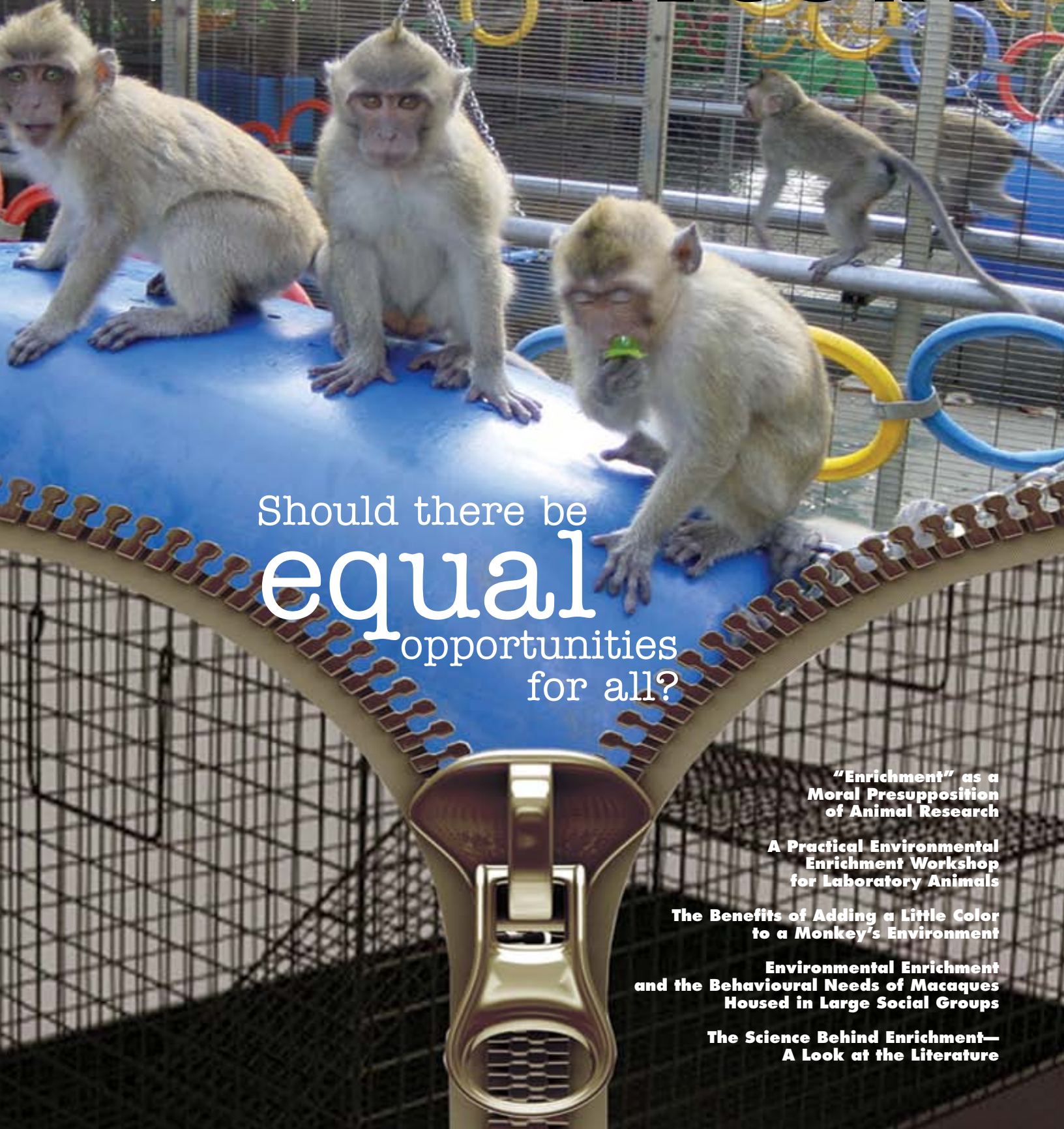


Volume 10, January 2012

THE Enrichment RECORD

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equal
opportunities
for all?

**"Enrichment" as a
Moral Presupposition
of Animal Research**

**A Practical Environmental
Enrichment Workshop
for Laboratory Animals**

**The Benefits of Adding a Little Color
to a Monkey's Environment**

**Environmental Enrichment
and the Behavioural Needs of Macaques
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WE'D LOVE TO HEAR FROM YOU!

We welcome your comments, observations and contributions to *The Enrichment Record*. Contributors include lab animal veterinarians, principal investigators, animal care staff, animal behaviorists, animal technologists and members of the bioscience community who promote the 4 Rs: reduction, replacement, refinement and respect.

Share your story ideas with Rhoda Weiner, Editor at rmbw19@verizon.net

Guidelines for authors can be accessed at <http://enrichmentrecord.com/contribute/>

Please give credit where credit is due.

Outstanding animal care is truly a team effort, and we ask you to credit colleagues, published reports, articles, and other reference materials that have contributed to your enrichment article. Great ideas don't happen in a vacuum, and we encourage you to list all sources of inspiration.

The Enrichment Record is not a peer-reviewed journal. However, the Editorial Board of this E-Zine is composed of dedicated volunteers who have extensive experience and expertise in the care of laboratory animals. Members of the Board are involved with all aspects of this publication.

The Enrichment Record is published in October, January, April and July. If you are interested in advertising in *The Enrichment Record*, please visit: <http://enrichmentrecord.com/advertise/>

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Season's greetings and warmest wishes for a satisfying 2012.

For most of us, the calendar is fast filling up with conferences, meetings, deadlines, and communications challenges. E-mail and v-mail go unanswered as the number of daily messages soars. More and more contacts are gone, leaving fewer and fewer people to talk to anyway.

Despite the bleak economic forecast and the fierce competition for time and attention, we at *The Enrichment Record* have reason to be cautiously optimistic. Environmental enrichment for laboratory animals is a passion for many people engaged in biomedical research. They care about the welfare of the animals we are privileged to use to advance science benefiting both humans and animals. With little or no budget, they are exploring ways to promote best practices and assure that their animals live in conditions that foster natural behaviors under the circumstances. They are educating themselves by attending courses, reading scientific studies and sharing strategies that work.

There are many opportunities to broaden understanding of environmental enrichment in a research setting in the coming months. The Virtual Laboratory Animal Science Conference on February 15-16 has a terrific Enrichment Track. You can register free at www.lasconference.com. Joe Garner, whose

"Enriching Profile" appears on page 21 of this issue, will keynote on February 16. MSMR will host its annual Enrichment Symposium in Boston on March 23. The Enrichment Extravaganza is heading south and offering a full-day program at Emory University on April 24.

And our New Year's resolution is to fill up the Enrichment Poster Repository with all the quality posters being generated for the various professional conferences like National AALAS and regional symposia like the Tri-Branch Symposium in Atlantic City in June.

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Sharing Tips on Starting An Enrichment Committee

Earlier this year I had posted on the COMPMED Listserv that a group of colleagues and I wanted to start an enrichment committee. I was curious if anyone would be willing to share their experiences about setting up an enrichment committee. Colleagues from academia and industry took the time to answer, and the feedback was outstanding!

Highlights

Several individuals sent me articles or links to their facility's enrichment committee as well as individual emails. These replies provided some great insight into how to develop and use enrichment committees and covered a host of important topics, including how members are selected, frequency of meetings, committee structure, budget, and interaction within the institution itself.

It seems like being part of an enrichment committee is not only great for the animals but also great for the staff too! Most commonly, staff

members are either invited to be on the committee or volunteer to join. Opportunities for staff members not directly involved with the committee include assisting in special projects or working on creating enrichment devices. Some enrichment committees even include members from areas outside of the animal care department, like housekeeping and physical plant.

In the beginning, most committees meet more frequently as they develop their goals and get started. Once the committee has been together for a while and is up and running, meetings occur on a monthly or less frequent basis. Some institutions initially set up a general enrichment committee, but then break it down into groups focusing on a specific species.

Most replies talked about using other offices like the IACUC for the development of enrichment

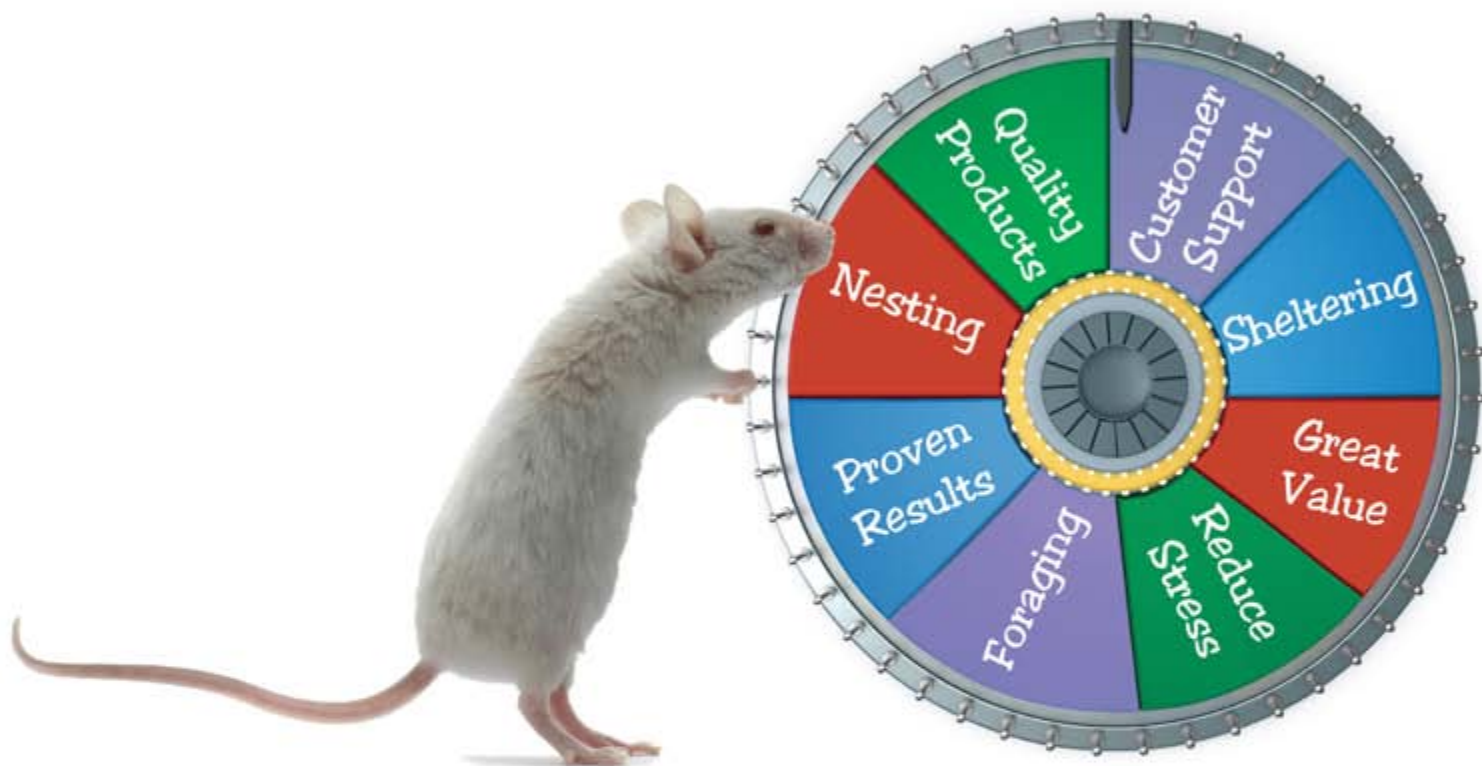
policies and making sure that this information is presented to all parties within the animal care department. Finally, many respondents stressed the importance of including the committee and its activities in the department budget. There was a recent article in *Lab Animal Magazine*, July/August 2011, pg. 11-12, about finding enrichment options that are low cost and promote the natural behaviors of laboratory animals. Still, the committee needs a budget.

I would like to thank all those who took the time to send me an email or talk with me on the phone to share their experiences about how they started an enrichment committee. I am impressed by your dedication and professional commitment to the welfare of the animals in your care.



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The Benefits of Adding a Little Color to a Monkey's Environment

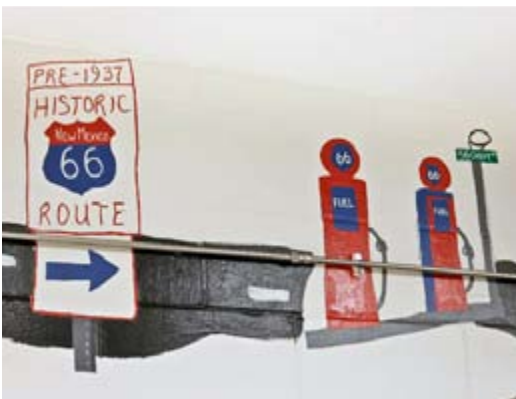
Imagine if your everyday world was boring, blah and completely sterile looking with limited amounts of color. Unimaginable, right? Here at Legacy Schering Plough/Merck, we thought the same about our nonhuman primates who look at the same bland walls each day. We wanted to "jazz it up a bit" for them, allowing them to enjoy an infusion of color in their day, especially knowing NHPs see and appreciate color, unlike many other lab animals. Although there are numerous other forms of enrich-

then made it into a reality. It was the beginning of something positive, good and fun for everyone!!!

This project has allowed us to share the results with many other individuals in the Pharmaceutical Industry interested in pursuing a similar project at their facilities. One of the many benefits of mural painting is that it allows the murals to become a permanent enhancement to the environment. While other forms of enrichment can be quite

Forest, The Farm Land, Under the Sea, Geometric Shapes, The 50's, Historic Route 66, The Garden, The North Pole and, finally, The USA Patriotic Room.

We were so pleased with the results of the project that a decision was made to present a poster of the work at the NJABR and AALAS Tri-Branch in 2011. Much to our surprise—we won first place in the NJABR poster presentation. Now there was only one decision to be



ment (TV's, radios, toys, etc.) provided daily for the monkeys, there is something to be said for the "happy feeling" you get when you look around and see a multitude of color bursts surrounding you. Positive stimulation which comes from mural paintings and colored landscapes benefit the nonhuman primates, as well as those individuals who work in the rooms.

The inception of the "Paint Project" began as an agenda item through the Legacy Schering Plough Enrichment Committee. It then became a proposal which was presented to Senior Management, who approved the idea. The Enrichment Committee

time-consuming and require advance scheduling and forethought, the paintings were of minimal expense, are self-sustained and effortless to maintain.

The finalized room paintings consisted of themes which were carefully selected to avoid any adverse affects on the animals being exposed to them. The wall surfaces were prepared and painted with paint that was non-toxic and compatible with chemicals used for cleaning. The characters and objects selected to be placed on the walls were projected with an overhead viewer and traced. The room themes were: The Nursery Rhymes, The Rain

made, "What to do with the prize winnings"? After a bit of discussion, we made a decision to share the winnings with all of those who dedicated time, interest and efforts to the project. A breakfast was hosted in their honor and, just like the paint project and the poster, the breakfast was a big success too!!!

When given the opportunity, we all have a tendency to be drawn to items and things which possess color and character. With the support of management and the dedication of personnel, the monkeys can enjoy the simple pleasures in life by adding a more colorful environment to their world.

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Report from

A Practical Environmental Enrichment Workshop for Laboratory Animals

A Practical Environmental Enrichment Workshop for Laboratory Animals was hosted in the UK from the 8th to the 10th of November 2011. This workshop was developed by Sabrina Brando from Animal Concepts, an animal welfare consultancy company based in the Netherlands but operating worldwide, in collaboration with and supported and accredited by the Institute for Animal Technology in the UK. It is a Continuing Professional Development (CPD) course which carries 15 credits.

For three days, participants from different research laboratories and universities dedicated their energy and thought to the theory and practical aspects of enriching laboratory animals' lives. Lectures on the theory and science of environmental enrichment were only a small part of this practical workshop. A separate 3-day introduction course on environmental enrichment for laboratory animals also exists as an IAT CPD course which covers much of the theory and science. The aim of this practical workshop was to implement the theory on the work floor, considering the restrictions and requirements of research laboratories, breeding centers and other research projects, but being practical, open-minded and creative in what can be done.

In small groups, participants focused their attention on beagles, marmosets, rabbits, chickens and turkeys, rotating so they worked once with each animal species. Background information on biology, ecology, behaviour, habitat, reproduction, cognition, physical adaptations and nutrition was provided to aid in the development of ideas to enrich captive laboratory animals' lives. Photos and background information on the housing of the animals they were going to work with on the third day were also provided by the hosting company.

After discussing theory on the first day, participants were asked to generate ideas for each species, using the background information as well as a framework developed by the *Shape of Enrichment*, which outlines five categories covering many enrichment opportunities including food, physical habitat, sensory, cognition and social. Participants were asked to come up with ideas for all categories and sub-categories and to think "species-specific". In total, enough ideas were generated to have a novel enrichment activity each day for a year. With this information, different enrichment schedules and plans were developed, focusing on balancing activities and categories, varying

food presentation, using all available space, technician-animal interactions and much more.

During the development phase, there were no restrictions on creativity; all ideas were allowed, as well as the use of any materials or type of enrichment. Simple to complex ideas were described in written format with accompanying drawings.

Once all the ideas were gathered, we dedicated time to developing different enrichment schedules, ensuring activities were randomized and varied on a daily basis. Standard laboratory diets were used but presentations varied, social structures and combinations were considered, options for larger play or exercise areas were identified, and all options of flexible housing structures, types of bedding, shelters and visual barriers were identified. The outcomes were flexible, varied and extensive enrichment schedules. We discussed how schedules can be developed in dynamic ways, reflecting the research projects, staff and researchers' holidays, busy and quiet times and all other information essential to having a varied but consistent enrichment program. We also discussed the need to document, evaluate and readjust the program on a regular basis, ensuring goals are met, plans are

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PROGRAM AGENDA

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MORNING PLENARY

*One size does not fit all: Taking individual differences into account
in behavioral management practices for non-human primates*

Dr. Kristine Coleman, Oregon National Primate Research Ctr, Beaverton, OR

Developing a Framework for an Environmental Enrichment Program for Laboratory Fish
Christian Lawrence, Children's Hospital, Boston, MA

*Utilizing Environmental Enrichment as a Tool to Enhance
Good Husbandry & Care for Rodents*

Dr. Karen Froberg-Fejko, BioServ, Frenchtown, NJ

Poster Award Presentations

LUNCHEON

AFTERNOON BREAKOUT WORKSHOPS

Rabbit Enrichment • Dr. Karen Froberg-Fejko, BioServ

Cognitive Enrichment for Non-human Primates

Dr. Jessica Crast, Yerkes & Dr. Bonnie Perdue, Georgia State University

Enrichment for Mini-Pigs • Michelle Salerno, Marshall BioResources

Enrichment in Toxicology – Past, Present & Future • Genny Andrews-Kelly, HLS

*Positive Re-enforcement Training for Swine to Improve Data Collection
& Promoting Nature Behaviors in Sheep through Environment Enrichment*
Cindy Evans, Baylor College of Medicine

Enrichment for Ferrets • Michelle Salerno, Marshall BioResources

Operant Training for Non-human Primates: How to Train for Research-related Behaviors
Dr. Mollie Bloomsmith, Jaime Perlman & Jennifer McMilian, Yerkes

Early Developmental Canine Socialization & Enrichment • Dr. Kimberley Cohen, Covance

Mouse Neurobehavioral Testing and Enrichment: Does Enrichment Affect Testing?
Cathryn Coke-Murphy, Vanderbilt University



To register or to submit an abstract contact:
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followed and implemented as intended. The SPIDER framework developed by Disney's Animal Kingdom served as a model for this exercise.

At the end of day two, in preparation for their work on site, all groups generated ideas in written form for the animals species they had been assigned to. These ideas would be presented to the technician and managers of the hosting facility for review and feedback.

After dinner on the second day, the hosting facility generously invited us for drinks at the hotel where we discussed enrichment, animal welfare, IAT Congresses and other topics, before most of us retreated early, exhausted after two days of hard work.

On day three, while the proposed plans were being considered suitable or not, we had a tour of the animal facilities. The managers and animal technician of the hosting facility were very helpful and directed us to the materials available for use. We also conducted the first set of behavioural observations to establish a pre-enrichment baseline. The theory of conducting behavioural research was put into practice. Participants experimented with different methods of behavioural research and spent time getting to know the animals who would experience novel enrichment activities.

The plans which were deemed safe and suitable got the go-ahead and the time came for two days of hard work and thinking to be translated into practical work. The teams started working on creating enrichment activities and a couple of hours later we were ready to go. The technicians were helpful in ensuring all enrichment was checked one last time on safety points and the participants prepared to observe again, now with the enrichment implemented.

After all activities were done, we gathered in the meeting room where

each team reported on their plans, activities and results. Some animals were easier to enrich than others, some plans worked better than others and some enrichments had not yet been implemented. All the information was used to interpret what happened. We asked the technicians to keep us informed on the progress and use of the items as animals get accustomed to them. Each team reported the pros and cons of their enrichment items, described individual differences in the animals observed and shared their thoughts on why something worked or not. After all the groups made their reports, we sat together discussing some final topics to wrap up the workshop. Emails and cards were exchanged and we agreed to gather all the information, which I took home to organize and scan into species-specific documents. A very successful 3-day workshop had come to an end and we said goodbyes to our host and to each other, safe travels and keep in touch, see you at the next IAT Congress!

As promised after the workshop, the scanned files of all the schedules, drawings, written descriptions and plans were sent to all participants, including the host—months of enrichment activities ahead for the animals under our care. The energy of three days of thinking and sharing resulted in pages and pages of ideas, opportunities to enrich animals in simple, dynamic and complex ways and consistently implement enrichment through the use of schedules every day for every species in all settings, with the goal of incorporating enrichment daily, in every professional animal care and welfare program world wide.

We thank the IAT for facilitating and accrediting this workshop and the hosting facility for the help and access to the animals.



<http://www.animalconcepts.eu/AnimalConcepts/Welcome.html>

<http://www.iat.org.uk>

To facilitate informed discussion about environmental enrichment, we have joined the LinkedIn Group called **Laboratory Animal Sciences.**

This group allows members of the laboratory animal science community and our readers to interact over a web-based platform to compare ideas and methods. To participate, you will need to create a LinkedIn account and then join the Laboratory Animal Sciences Group.

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In part as a result of an ideology affirming that science has nothing to do with ethics, 20th century science has enjoyed an abysmal track record in engaging issues that are of great importance to society. This is true regarding every ethical issue occasioned by scientific activity. Even in the area of research on human beings, the research community has been extremely cavalier about ethical treatment of research subjects, despite the fact that every citizen should have, by the time they reach adulthood, developed a reasonable grasp of moral obligations towards other human beings. Despite this evident truism, there was never a day during the 20th century, when some human person was not being grossly mistreated while serving as a research subject. From Walter Reed's questionable use of soldiers to study Yellow Fever; to the 40+ years of the Tuskegee syphilis experiments, wherein African-American prisoners in Alabama were told that their syphilis was being treated, when

"ENRICHMENT" AS A MORAL PRESUPPOSITION OF ANIMAL RESEARCH

in fact researchers were using them to study the course taken by syphilis, and no treatment was tendered to them at all; to the recent tragic death of 16-year-old Jesse Gelsinger in a gene therapy trial run in flagrant violation of the researcher's own protocol; to thousands of experiments conducted in total disregard of the principle of informed consent.

A similarly surrealistic disregard of both common sense and common decency may be found in the scientific community's

response to revelations of data falsification and other misdeeds in research—the president of the American Association for the Advancement of Science assured the public that any scientist behaving in that manner must be viewed as suffering from "temporary insanity."

If human beings and, indeed, moral and methodological principles presuppositional to the very nature of scientific activity could be so cavalierly abused, it is not difficult to guess the fate of moral questions arising in the course of research on non-human animals. After all, if blatantly obvious moral constraints on the treatment of people, clearly codified in consensus societal ethics could be ignored, how much more so the treatment of animals, where no moral principles appeared in social consensus ethics, other than the prohibition of deliberate, purposeless, unnecessary, sadistic *cruelty*. And tellingly, a literature search conducted for me by the Library of Congress on "analgesia for laboratory animals" in 1982 as part of my effort to convince Congress of the need for legislation protecting animals in research, yielded not a single reference.

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In the same vein, between 1976 and 1985, I and two colleagues worked on drafting the laws currently governing the use of animals in research. We searched assiduously but vainly in the scientific literature for a reasoned discussion of the ethical issues occasioned by such use. What we found was epitomized by a video entitled “Will I Be All Right, Doctor?”, a phrase uttered by a frightened child before an operation. The physician assures the child that he will be, as long as doctors are left alone to do as they wish with animals. So mawkish and irrelevant to ethics was the film, that when it was premiered at a meeting of laboratory animal veterinarians, assumed to be sympathetic to the message, and comments were solicited from the audience, the only response was “I am ashamed to be associated with a film pitched as low as the worst anti-vivisectionist clap-trap.” Advertisements defending unconstrained animal research appeared in *Time* Magazine affirming that “95% of the animals used in research are rats and mice, and you kill them in your kitchens anyway.” Needless to say, that argument did not play well with the public.

In the end, the ineffectual and clumsy way in which scientists respond to ethical issues comes from the ideology inculcated into them in the course of their education, affirming that “ethics is just emotion.” The notion of rational ethical argument is seen as oxymoronic. Clearly, any activity that harms another being, who is in some way negatively impacted by the harm and is aware or sentient, i.e., to whom the harm, be it pain, fear, or some other

First, what justifies such use of animals when we would not allow the use of humans for similar purposes, even “marginal” or “defective” humans?

form of *negative mattering* matters, raises an ethical question: what right do we have to inflict such an insult? The answer is far from clear regarding invasive research on animals, but the question is surely legitimate, particularly since our most carefully articulated and thought out ethical notions, i.e. those used in assessing our treatment of other human beings, strongly limits harming a minority for the benefit of the majority.

One can distinguish three layers of ethical questions regarding the use of animals in invasive research for the benefit of humans. First, what justifies such use of animals when we would not allow the use of humans for similar purposes, even “marginal” or “defective” humans? It is sometimes said that such use is justified by virtue of the fact that we are more powerful than animals. That, of course, is not an ethically relevant argument, because it presupposes that “might makes right,” a notion that ethics exists in large measure to oppose! It is also argued that we are “superior” to animals, or evolutionarily “higher”; therefore we can use them as we wish. This claim, too, has obvious responses. In what morally relevant way are we superior? There are animals that are stronger, swifter, more adaptable (e.g., cockroaches) than we are. Ironically, it is some-

times affirmed that we are superior because we can judge our actions in moral terms. If this is indeed the case, then we should be more, not less, morally attentive to other beings, and certainly not transgress against their interests in a cavalier way.

Let us suppose that we have answered the question of what entitles us to use animals in terms of cost-benefit emerging from animal research: that is, that the benefit to humans outweighs the cost to animal subjects. This is, in fact, a common argument. If that is the case, then the only morally permissible research would be found in those cases where the benefits to humans clearly exceed the costs in animal suffering. Certainly, some animal research meets that criterion, as when a small group of animals are used in a way that helps vast numbers of humans. But, a great deal of research, perhaps the vast majority, does not meet that standard. Toxicological testing of new cosmetics, and a whole host of similarly trivial products, which inflicts significant harm on test animals, does not seem to produce a positive cost-benefit ratio. Neither does a good deal of psychological research, such as studies of learned helplessness. Neither does weapons research. Neither do studies of animal aggression. One could proliferate a long list of research not meeting the cost-benefit test, which is nonetheless regularly performed. So, once again, we fail to adequately respond to a clear ethical challenge emerging from animal research.

Thus far, a conscientious person should be feeling uneasy about animal researcher failure to provide

first of all a sound moral justification for hurting animals in research. Second, such a person who responds by appealing to cost-benefit as a justification should feel equally uneasy about the fact that much research does not pass the cost-benefit test. Third, there is one more layer of ethical concern about animal research that we do not adequately address. That is, that we do the utmost to minimize animal suffering arising in the course of animal research, and maximize the animals' ability to live a life where the interests and needs flowing from its biological and psychological nature are respected.

Certainly, the control of pain was a fundamental moral obligation to research animals that the research community failed to meet until compelled to do so by federal law. From the zero papers I found in the literature search I conducted on laboratory animal analgesia in 1982, the literature has grown to over 11,000 articles I found a year ago when I redid the search, with of course a correlative increase in use of pain control. Equally gratifying is the fact that far fewer researchers would claim today that animals do not feel pain. But let us recall that, at least by the research community's estimate, only 15% of research protocols involve pain. Even if one mistrusts that source, we can double that estimate and still believe that the majority of research does not involve pain. Furthermore, in the majority of cases, the pain can be attenuated or controlled pharmacologically, leaving a small percentage of protocols requiring that animals suffer pain. What is often ignored, however, is the fact that almost 100% of

“Enrichment”.... represents an obvious step towards creating a decent life for research animals and minimizing avoidable suffering.

research protocols fail to keep and house the animals they use under conditions congenial to the animals' biological and psychological natures. If that is the case, then virtually all animals suffer deprivation that is probably as onerous as uncontrolled physical pain. Such deprivation includes full-time light for nocturnal animals, no opportunity to burrow for burrowing animals, lack of companionship (e.g. for dogs housed in solitary cages), food alien to what they would consume in nature, failure to respect how they are built to acquire food, and myriad other assaults upon their natures. Much of the reason for a thrust for enrichment is to rectify that wrong. It is far easier to create enriched environments in which the animals spend the majority of their time than it is to respond to the moral imperative that only research with a positive cost-benefit ratio should be performed. Respecting research animals' biological and psychological natures is more like the moral requirement of providing food than it is like providing treats.

The difficulty of achieving moral goals is often directly proportional to the profundity of the moral imperative underlying the goal in question. Enunciating the moral ideal of human equality was presuppositional to creating the

concept of American democracy, and occurred early in our history. Yet, as the cases of African-Americans and women vividly illustrate, realizing that goal has taken hundreds of years, and is far from finished. The three moral questions we have formulated regarding animal research are clear, yet we have made virtually no progress in responding to them. The first two questions strike at the heart of animal research; consequently it is not difficult to see why they have been ignored. But the third question and what it entails are currently achievable. Even if we lack full knowledge of animals' needs and natures constitutive of their *telos*, we certainly know enough to come much closer to satisfying those needs than we currently do, where design of housing and husbandry is based almost exclusively on the convenience of those who keep the animals.

“Enrichment” is therefore not the bighearted largess that much of the research community seems to believe it is. Rather, it represents an obvious step towards creating a decent life for research animals and minimizing avoidable suffering. The fact that providing proper environments that suit the animals' needs and natures has not been done historically, may be inconvenient or more expensive for research facilities, may skew baseline data, or otherwise lead to new practical issues in research management, does not mean that creating such animal management is not a moral imperative. If moral behavior was the easiest and most convenient option, everyone would be moral. The sense of moral discomfort that should arise when one reflects upon the morality of animal research should at least translate into a moral imperative to create living conditions for the animals we use that do not assure a life of misery.



ABSTRACT:

The purpose of any well-fashioned environmental enrichment programme should be to meet the behavioural needs of the species concerned. Through meeting these needs, the development of behavioural problems will be avoided and stress and aggression reduced to acceptable levels. The best environmental enrichment programmes ensure that they start from a sound understanding of the ethology of the animal in the wild and make use of safe, available materials and devices in order to release appropriate desired behaviours, eliminate undesired behaviours and enable the animals to exhibit a more natural behavioural repertoire. Inappropriate enrichment, even when safe, is not only a waste of time and money, but may also not achieve the goal of improving animal welfare. In this article, we address some of the issues surrounding the behavioural needs of captive animals and go on to elucidate some of the key aspects of the environmental enrichment strategy at Bioculture (Mauritius) (BCM) designed to balance safety, animal welfare and the practicalities of meeting the appropriate behavioural needs of over 22,000 group-housed long-tailed macaques (*Macaca fascicularis*).

Environmental Enrichment and the Behavioural Needs of Macaques Housed in Large Social Groups

INTRODUCTION

The concept of ethological 'need' has rightly received considerable criticism in the past, particularly in the sense that it describes a situation in which an animal deprived of the opportunity to exhibit a behaviour will inevitably suffer as a result (see Dawkins 1983). There are those, however, that make a strong case for the use of such a concept to account for the development of abnormal behaviour, particularly in response to living in captivity in 'impoverished environments' (Hughes & Duncan 1988). Applied research in this area of animal welfare has demonstrated that captive animals are not equally motivated to exhibit all behaviours exhibited by wild conspecifics. Dawkins (1983) describes this variation in motivation as indicated by willingness to 'pay' a higher price (in terms of time or effort) to gain access to a behavioural opportunity. This reflects, in consumer-economic terms, the 'elasticity' of the 'need' to exhibit behaviours ranging from the less essential (in captivity), e.g. anti-predator behaviour (elastic), to the much more essential, e.g. feeding behaviour (inelastic). Dawkins introduces the important aspect of the evolutionary adaptation of the species, in which the exhibition of certain behaviours improves not only the survival chances of the individual, but also their ability to meet reproductive goals. Complex interactions between the animal's physical environment,



its anatomy, and its ecology are what produce the patterns of individual- and species-typical behaviour that we see in wild and, to a lesser extent, captive animals.

Wherever one stands on the debate about the definition and validity of ethological 'need', it might be seen as predominantly esoteric and semantic by those trying to design and implement enrichment plans. They may well ask: What does all this mean for designing enrichment programmes?

In the case of primates, there is a paucity of the type of elegant consumer-demand studies described by Dawkins (1983), studies designed to elicit the importance of aspects of environmental provision that may be of more, or less, value to the animal. More typically, studies, often beset by confounding factors, have looked at behavioural, physiological or health outcomes for animals maintained without specified provisions in their captive environment or changes in these variables when such provisions are added (Honest & Marin 2006). Despite the theoretical debate and poor availability of demand-based studies, the broad concept of behavioural needs may serve us well in identifying how to tune our housing and husbandry practices for primates. We can, indeed, make a reasonable assumption that to achieve the highest welfare in animals under our care we should work towards:

- Giving the animal a sense of control over its environment (e.g. retreat from humans/ conspecifics: visual barriers);
- Minimising boredom and undesired behaviours;
- Enabling a repertoire and frequency of behaviours that approximates those seen in natural populations in the wild.

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An enrichment philosophy led by science and safety

At BCM, we breed highest quality long-tailed macaques (*Macaca fascicularis*) for biomedical research and employ an ethological and evidence-based approach to their environmental enrichment. The company's experienced animal care and veterinary staff are guided by postgraduate-qualified primatologists in the species' appropriate, desirable behaviours and supplied with recommendations on the strategy to achieve the three key aspects listed above. Safety, both for staff and animals, is at the centre of our strategy and all proposed devices and caging modifications are subjected to considerable analysis before cautious in situ testing. Of course, we also pay particular attention to the differing behavioural needs of different age classes: younger animals require more space and structures for play as well as toys to stimulate their psychomotor development. Adults may benefit more from structural enrichment (variety of perching heights, visual barriers, etc.) that enables them to manage social, often dominance-related, priorities.

Social enrichment

For primates, it is clear that the best enrichment comes in the form of appropriate, compatible conspecifics, providing social support that reduces negative responses to many stressors (e.g. Vogt et al. 1981) and improved well-being through appropriate social activity (e.g. allogrooming: Dunbar 2010). Social enrichment is, therefore, the most fundamental component of any macaque enrichment programme (Schapiro et al. 1996).



It is also clear that the housing context provides an important factor for enrichment planning. Where animals are already group-housed, the beneficial effects of appropriate, compatible social enrichment may swamp any additional benefit offered by inanimate enrichment (Schapiro et al. 1996). However, if an animal is singly- or pair-housed in a relatively unstimulating environment, as is common at a large number of experimental facilities, then almost any enrichment stands a good chance of, at least in part, occupying the animal's behavioural void. At BCM, all animals are group-housed; even when temporarily separated for clinical reasons, they are always accompanied by a compatible group-mate. Great care is also taken

to maintain social relationships forged in the natal group by keeping weaned animals together when moved into peer groups at 12-15 months of age.

Sensory enrichment

BCM's animals live outdoors under ambient climatic conditions, with appropriate shelter available from the sun and inclement weather. They have a high level of natural sensory enrichment and stimulation with each group having good views, for example, of other groups, lush tropical vegetation and passing birds. The use of different materials in the cage environment such as wood and plastics, in addition to more traditional metal and concrete, add tactile, textural variety.

Structural enrichment

In an environment such as at BCM, in which so many social and sensory needs are met, much of the enrichment effort focuses on the provision of expansive, functional space and structural complexity. Not only do BCM cages and stocking densities typically exceed the space provision required in most of the world's testing regulations (EU Directive 2010/63/EU: EU 2010), but great care is taken to ensure that as much of the cage space is as useable as possible. A structural enrichment strategy that is informed by the species' natural use of space makes better provision for its behavioural needs (Honest In review). Adding height to cages not only allows species-typical vertical retreat when anxious, but also enables the placement of perching sites at different heights to allow species-typical, dominance-related spacing.

Thoughtful planning and use of cage 'furniture' not only creates varied travel routes around the cage, which are cognitively stimulating and can discourage excessive route-tracing (Young 2003), but also facilitates species-typical postural behaviour, locomotion (including leaping) and huddling at rest. Examples of other important structural devices that release natural behaviour are cage panels and barrels acting as visual barriers (allowing retreat from the gaze of conspecifics/humans), swinging devices (for coordination and balance) and even, when conditions allow, swimming pools (for exploratory behaviour and play). The affinity of long-tailed macaques for water is indicated by their other name: the crab-eating macaque!

Feeding enrichment

Together with travelling, feeding makes up one of the most substantial daily time allocations of wild macaques (Son 2004). Three key aspects of delivering nutrients in an enriching way include the type of food supplied, and its spatial and temporal distribution. At BCM, in addition to a nutritionally balanced pelleted food, all animals receive a daily allocation of seasonally available, varied, fresh fruit and vegetables which is coarsely chopped and spread across the caging to reduce aggressive competition or monopolisation by dominant individuals. Fresh produce is also hand-fed to all animals as part of our familiarisation programme and they receive preferred food 'treats' during positive reinforcement training. While it has been noted that a randomised feeding schedule may be the best at minimising



anticipatory stress (Waite & Buchanan-Smith 2001), in reality, with such numbers of animals, this is largely impractical and so they are fed at regular times, the next best option to a randomised schedule. Various ways exist for attempting to prolong feeding to approximate the time devoted to this activity in the wild. Concealing food in food puzzles (see 'Toys' below) or presenting small food items (e.g. seeds) in a forage substrate can result in considerable extensions to time devoted to feeding (Wolfensohn & Honess 2005).

'Toys'

In many cases, enrichment devices marketed for primates have been developed for other species and some,

such as Kong™ toys, have yet to be shown to have conclusive therapeutic benefits or to hold the monkeys' attention for long unless refilled with food items or frozen juice (Crockett et al. 1989). Of course, once filled with food/juice, these devices become food puzzles rather than simple toys. Good food puzzles test the dexterity, coordination and cognitive abilities of the animal; but, in order to achieve this, it is necessary to find the correct balance between task difficulty and reward. While many macaques are extractive foragers, the most time- or effort-consuming foraging tasks are reserved for those foods promising the greatest reward (e.g. highest calorie). A very complex puzzle with a 'cheap' reward is unlikely to maintain interest once the puzzle element has been solved. Prolonged interest can be achieved by adding high value or novel foods (Holmes et al. 1995).

Commercially available toys and puzzle feeders are typically too costly to provide, even on rotation, for large groups in the numbers necessary to avoid the aggressive competition reported by some authors (Bloomstrand et al. 1986; Maki et al. 1989_ENREF_8). To overcome the issue of cost, toys can be made in-house from cheap, readily available and cleanable materials. This approach, which we use at BCM, enables the production of numerous cheap, safe toys whose design is focused on the exploratory and manipulative tendencies of specific age classes, particularly juveniles. Although all BCM animals are extremely high health status,

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and, like all Mauritian long-tailed macaques, are free from simian herpes B-virus, SRV, SIV, STLV1, SVV care still needs to be taken against other pathogens, and so toys are frequently removed and disinfected.

Conclusion

The cost of enrichment, particularly structural modifications such as increasing cage size and configuration, either in intensive laboratory environments and/or particularly large facilities, can in some instances be daunting and lead to conservatism (e.g. Woolverton et al. 1989). If those controlling budgets for enrichment accept the principle of phased improvements, then at least some of the animals will benefit in the immediate future, rather than waiting for the funds to be available for a major refit. Some excellent resources exist to guide the interested practitioner in designing or refining enrichment strategies for primates: (Bloomsmith et al. 1991; Mellen & MacPhee 2001; Young 2003; Wolfensohn & Honess 2005; Honess & Marin 2006) and include many inexpensive, effective ideas.

At BCM, we believe that we have a well-balanced enrichment strategy that results in animals of exceptionally high welfare status; key to this is our team approach of animal care staff, veterinarians, managers and primatologists. We hope that those with interests/responsibilities in primate welfare will, like the Animal Welfare team at BCM, always strive to learn more about natural primate behaviour. This will enable the development of an enrichment philosophy and strategy grounded in addressing the animals' extensive range of behavioural needs rather than simply creating an environment that appeals to the human eye, or simply satisfies regulatory minima. Putting the animals' needs (and reasonable safety) at the centre of our enrichment strategies will not only help meet ethical commitments but will also, through reduced stress, improve research model quality and help convince an often sceptical public that we in the research sector are truly committed to the highest standards of animal welfare.

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JOE GARNER, D. PHIL.

Associate Professor, Department of Comparative Medicine, Courtesy Associate Professor, Department of Psychiatry and Behavioral Science, Stanford School of Medicine



Enrichment isn't an island. It is central to doing good science. —Joe Garner

Teacher, author, consultant, dedicated volunteer, and occasional amateur restorer of antique British race cars, Joe Garner received his doctoral degree from the Department of Zoology at the University of Oxford, Great Britain, where he studied the developmental neuroethology of stereotypies in captive animals. His postdoctoral research in animal behavior and well-being was undertaken at UC Davis. After seven years at Purdue University, Dr. Garner joined the Department of Comparative Medicine at Stanford in 2011. He was inspired to pursue his life's work by Marian Dawkins,

professor at Oxford, "one of the 3 or 4 single most important people in animal welfare."

"One of the most important goals," Dr. Garner says, "is to identify the best possible enrichment for animals used in research and then evaluate how enrichment impacts on the science that people are trying to do with animals. If enrichment is properly designed, it cannot do anything but improve the quality of the animal model; when enrichment does not improve the welfare of the animal or the quality of the science, it is because what is being done is not truly enrichment!"

Dr. Garner's research interests include the development of refined methods in behavioral research; abnormal behaviors in animals (including barbering and ulcerative dermatitis) and their relationships with abnormal behaviors in humans; mouse well-being and enrichment; and the scientific impact of well-being problems in lab animals.

Dr. Garner's lab uses an integrated interdisciplinary approach, best described as developmental neuroethology (animal behavior), to address issues in human and animal well-being. The lab has a particular focus on two closely related issues:

- 1) Developing methods and underlying psychobiological principles to predict and prevent abnormal behavior (in animals) and mental disorder (in humans).
- 2) Identifying the general reasons why animal models often fail to predict human outcomes, and providing solutions to improve the efficacy and well-being of animal models.

Both these issues reflect the interface between animal-based medical research and animal well-being. The medical research community has long recognized that "good well-being is good science," and the lab's work is directed at exploring this interface, while providing tangible deliverables for the well-being of human patients and research animals. Current projects include: (on the animal well-being side) the optimal design

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and impacts of nesting enrichments on the behavior, physiology, and well-being of laboratory mice; and (on the human health side) the development of predictive biomarkers and preventative dietary interventions in a mouse model of trichotillomania (compulsive hair pulling).

The lab also works collaboratively on farm-animal and zoo-animal well-being issues with colleagues around the world and hosts www.mousebehavior.org. This international collaborative project documents the ethogram (or behavioral repertoire) of the laboratory mouse, and includes a video library, as well as protocols for recording and scoring laboratory mouse behavior in the homepage. This work in mouse well-being was recognized recently when Dr. Garner was the inaugural awardee of the UFAW Professor William Russell Fellowship.

Dr. Garner defines enrichment (rigorous definition!) as any change in housing or husbandry that helps the animal cope with or gain control over a stressor which the animal cares about. (A stressor can be defined as anything which perturbs the animal's homeostasis).

"Animals are smart," he says. "They exist to control their world. The fundamental thing that an animal does—the thing that makes an animal an animal—is that it behaves. Every aspect of an animal is built around behavior—the most important organ—the organ that rules all others.

"Behavior allows animals to survive and reproduce in environments that are outside of their physiological range. If animals exist to behave, and behavior exists to control the environment, then placing animals in captivity—where we take control away—means that not only are we denying them the fundamental nature of being an animal, but they will do everything they can to gain control and make themselves sick doing so. If you deny an animal control, the activation of the stress response in the animal is so profound that it affects every aspect of the animal's biology. In fact this is one of the single most reproducible results in the history of physiology. So if an animal can't control its world, it is philosophically, and physiologically abnormal.

The whole idea of real enrichment is giving animals control that they crave, need and cannot be normal without. So any animal that is not enriched is just not normal, therefore compromising the results of the science.

"Personally, I think doing enrichment right is really hard, but the benefits are enormous. If you are a mouse breeder, it costs you less than a \$1 a cage to give them appropriate nesting material for the six months you would normally breed a cage of mice for, and the result is that those mice produce between \$200 and \$1000 worth of extra mouse pups that you can sell. With suitable nesting, if you are running a mouse breeding program, you need fewer animals to produce the same number of pups if they are appropriately enriched, and the entire operation is more profitable. **So not only is good enrichment good science, but good enrichment is also good business, to paraphrase Marian Dawkins.**"

Thoughts on the Future of Environmental Enrichment

"Enrichment is one very important thing we can do to reverse the trend of increasingly inefficient drug discovery. Basically, it is about understanding the world from the animal's point of view. In a John Lennonish way...I like to imagine another world, a world in which people do not become ill because we are so good at predicting and personalizing treatment that we can prevent most illnesses. We can stop diseases before they start.

"We will be so good at drug discovery that the drug companies, (comprised of incredibly caring and talented people), can develop affordable drugs for rare as well as common diseases, for everyone—no matter where people live. But right now, the single thing that is stopping us from that goal is that most drugs fail in human trials—even though they worked in animal models. If we can increase the reliability of animal tests to predict which drugs will not work in people, we can turn the economics of the drug industry on its head and benefit animals as well, because each animal is being used much more profitably."

The Science Behind Enrichment— A Look at the Literature

It's probably safe to say that most research institutions have environmental enrichment programs in place for some, if not all, of their laboratory animals. If you use nonhuman primates or dogs, the Animal Welfare Act expects these animals will be provided with an environment to enhance their well-being. However, knowing what really works, is appropriate for the species, or the effect on the science, is not always so easy to determine. I'm sure the words "literature search" will make some people cringe, but the peer-reviewed writings of investigators who are studying environmental enrichment both for its effect on the welfare of laboratory animals and for its effects on experimental outcome are the obvious place to begin. The short bibliography below is drawn from the literature published during 2011-2012. When the full-text article is available, either the web address or the Digital Object Identifier (doi) is given. The doi provides a permanent link to the article and may be resolved by going to <http://dx.doi.org> and entering the doi code (e.g., 10.1038/oby.2010.331) to retrieve the article. A special thanks to CAB International (www.cabi.org) for permission to use abstracts for citations from their CAB Abstracts database.

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Accurate Measurement of Body Weight and Food Intake in Environmentally Enriched Male Wistar Rats

Beale, K.E.L., K.G. Murphy, E.K. Harrison, A.J. Kerton, M.A. Ghatej, S.R. Bloom, and K.L. Smith (2011)

Obesity 19(8): 1715-1721. I

SSN: 19307381

Online: doi: 10.1038/oby.2010.331

Abstract: Laboratory animals are crucial in the study of energy homeostasis. In particular, rats are used to study alterations in food intake and body weight. To accurately record food intake or energy expenditure it is necessary to house rats individually, which can be stressful for social animals. Environmental enrichment may reduce stress and improve welfare in laboratory rodents. However, the effect of environmental enrichment on food intake and thus experimental outcome is unknown. We aimed to determine the effect of environmental enrichment on food intake, body weight, behavior and fecal and plasma stress hormones in male Wistar rats. Singly housed 5-7-week-old male rats were given either no environmental enrichment, chew sticks, a plastic tube of 67 mm internal diameter, or both chew sticks and a tube. No differences in body weight or food intake were seen over a 7-day period. Importantly, the refeeding response following a 24-h fast was unaffected by environmental enrichment. Rearing, a behavior often associated with stress, was significantly reduced in all enriched groups compared to controls.

There was a significant increase in fecal immunoglobulin A (IgA) in animals housed with both forms of enrichment compared to controls at the termination of the study, suggesting enrichment reduces hypothalamo-pituitary-adrenal (HPA) axis activity in singly housed rats. In summary, environmental enrichment does not influence body weight and food intake in singly housed male Wistar rats and may therefore be used to refine the living conditions of animals used in the study of energy homeostasis without compromising experimental outcome. **Source:** *PubMed*

Descriptors: adrenal glands, animal models, body weight, energy consumption, food, food intake, globulins, homeostasis, hormones, hypothalamus, iga, immunoglobulins, laboratory animals, pituitary, refeeding, stress, adrenals, energy use, energy utilization, gamma-globulins, hypophysis, immune globulins, pituitary gland, muridae, rodents, mammals, vertebrates, chordata, animals, small mammals, eukaryotes, rats, animal models, animal welfare, body wt., diet, intake, anthropometric parameters, dietary study techniques

Environmental Enrichment Reduces the Likelihood of Alopecia in Adult C57BL/6J Mice

Bechard, A., R. Meagher, and G. Mason (2011)

Journal of the American Association for Laboratory Animal Science 50(2): 171-174. ISSN: 15596109

Online: Free Pubmed Central article: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3061416/?tool=pubmed>

Abstract: Barbering (incessant grooming) is an abnormal behavior causing alopecia and commonly affects various strains of laboratory mice, including C57BL/6J. Barbering-induced alopecia is a potential symptom of brain impairment and can indicate a stressful environment. We compared alopecia prevalence and severity in mice housed in enriched or standard cages. Providing an enriched environment delayed the onset and reduced the prevalence and overall severity of alopecia in C57BL/6J mice. Husbandry methods that reduce adult alopecia are likely to promote the wellbeing of the animals. We suggest that environmental enrichment is a simple and economic way to reduce alopecia in mouse colonies. **Source:** *PubMed*

Descriptors: alopecia, epidemiology, alopecia, prevention & control, alopecia, veterinary*, animal husbandry*, economics, animals, female, grooming*, housing, animal, male, mice*, mice, inbred c57bl, prevalence, rodent diseases, epidemiology, rodent diseases, prevention & control*, stress, physiological

Notes: Author contact:

abechard@uoguelph.ca



Influence of Enriched Environment on Viral Encephalitis Outcomes: Behavioral and Neuropathological Changes in Albino Swiss Mice
de Sousa, A.A., R. Reis, J. Bento-Torres, N. Trevia, N.A. de Almeida Lins, A. Passos, Z. Santos, J.A. Picanco Diniz, P.F. da Costa Vasconcelos, C. Cunningham, V.H. Perry, and C.W. Picano Diniz (2011)

PLoS One 6(1): e15597. ISSN: 19326203.

Online: doi: 10.1371/journal.pone.0015597

Abstract: An enriched environment has previously been described as enhancing natural killer cell activity of recognizing and killing virally infected cells. However, the effects of environmental enrichment on behavioral changes in relation to virus clearance and the neuropathology of encephalitis have not been studied in detail. We tested the hypothesis that environmental enrichment leads to less CNS neuroinvasion and/or more rapid viral clearance in association with T cells without neuronal damage. Stereology-based estimates of activated microglia perineuronal nets and neurons in CA3 were correlated with behavioral changes in the Piry rhabdovirus model of encephalitis in the albino Swiss mouse. Two-month-old female mice maintained in impoverished (IE) or enriched environments (EE) for 3 months were behaviorally tested. After the tests, an equal volume of Piry virus (IEPy, EEPy)-infected or normal brain homogenates were nasally instilled. Eight days post-instillation (dpi), when behavioral changes became apparent, brains were fixed and

processed to detect viral antigens, activated microglia, perineuronal nets, and T lymphocytes by immunohistochemical reactions. At 20 or 40 dpi, the remaining animals were behaviorally tested and processed for the same markers. In IEPy mice, burrowing activity decreased and recovered earlier (8-10 dpi) than open field (20-40 dpi) but remained unaltered in the EEPy group. EEPy mice presented higher T-cell infiltration, less CNS cell infection by the virus and/or faster virus clearance, less microgliosis, and less damage to the extracellular matrix than IEPy. In both EEPy and IEPy animals, CA3 neuronal number remained unaltered. The results suggest that an enriched environment promotes a more effective immune response to clear CNS virus and not at the cost of CNS damage.

Source: *Pubmed*

Descriptors: animals, behavior, animal*, central nervous system/immunology, central nervous system/pathology, central nervous system/virology*, encephalitis, viral/immunology*, encephalitis, viral/pathology, encephalitis, viral/virology, female, mice, microglia/metabolism*, neurons, rhabdoviridae, rhabdoviridae infections/immunology*, rhabdoviridae infections/pathology, t-lymphocytes/immunology, t-lymphocytes/virology, treatment outcome

Notes: Author contact: cwpcdiniz@gmail.com

Environmental Enrichment Modulates Cortico-cortical Interactions in the Mouse
Di Garbo, A., M. Mainardi, S. Chillemi, L. Maffei, and M. Caleo (2011)

PLoS One 6(9) ISSN: 19326203.

Online: doi: 10.1371/journal.pone.0025285

Abstract: Environmental enrichment (EE) is an experimental protocol based on a complex sensorimotor stimulation that dramatically affects brain development. While it is widely believed that the effects of EE result from the unique combination of different sensory and motor stimuli, it is not known whether and how cortico-cortical interactions are shaped by EE. Since the primary visual cortex (V1) is one of the best characterized targets of EE, we looked for direct cortico-cortical projections impinging on V1, and we identified a direct monosynaptic connection between motor cortex and V1 in the mouse brain.

To measure the interactions between these areas under standard and EE rearing conditions, we used simultaneous recordings of local field potentials (LFPs) in awake, freely moving animals. LFP signals were analyzed by using different methods of linear and nonlinear analysis of time series (cross-correlation, mutual information, phase synchronization). We found that EE decreases the level of coupling between the electrical activities of the two cortical regions with respect to the control group. From a functional point of view, our results indicate, for the first time, that an

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enhanced sensorimotor experience impacts on the brain by affecting the functional crosstalk between different cortical areas.

Source: Pubmed

Notes: Author contact:

caleo@in.cnr.it

Does Environmental Enrichment Reduce Stress? An Integrated Measure of Corticosterone from Feathers Provides a Novel Perspective.

Fairhurst, G.D., M.D. Frey, J.F. Reichert, I. Szelest, D.M. Kelly, and G.R. Bortolotti (2011)

PLoS One 6(3) ISSN: 19326203

Online: doi: 10.1371/journal.pone.0017663

Abstract: Enrichment is widely used as tool for managing fearfulness, undesirable behaviors, and stress in captive animals, and for studying exploration and personality. Inconsistencies in previous studies of physiological and behavioral responses to enrichment led us to hypothesize that enrichment and its removal are stressful environmental changes to which the hormone corticosterone and fearfulness, activity, and exploration behaviors ought to be sensitive. We conducted two experiments with a captive population of wild-caught Clark's nutcrackers (*Nucifraga columbiana*) to assess responses to short- (10-d) and long-term (3-mo) enrichment, their removal, and the influence of novelty, within the same animal. Variation in an integrated measure of corticosterone from feathers, combined with video recordings of behaviors, suggests that how individuals perceive

enrichment and its removal depends on the duration of exposure. Short- and long-term enrichment elicited different physiological responses, with the former acting as a stressor and birds exhibiting acclimation to the latter. Non-novel enrichment evoked the strongest corticosterone responses of all the treatments, suggesting that the second exposure to the same objects acted as a physiological cue, and that acclimation was overridden by negative past experience. Birds showed weak behavioral responses that were not related to corticosterone. By demonstrating that an integrated measure of glucocorticoid physiology varies significantly with changes to enrichment in the absence of agonistic interactions, our study sheds light on potential mechanisms driving physiological and behavioral responses to environmental change.

Source: *Pubmed*

Descriptors: Animals, Birds, metabolism*, Corticosterone, metabolism*, Environment*, Feathers, metabolism*, Feeding Behavior, Reaction Time, physiology, Stress, Physiological*.

Notes: Author contact:

graham.fairhurst@usask.ca

The Effects of Environmental Enrichment in the Chick Anxiety-depression Model **Kim, E.H. and K.J. Sufka (2011)**

Behavioural Brain Research 221 (1): 276-281

Online: doi: 10.1016/j.

bbr.2011.03.013

Abstract: As a validation step of an animal simulation, the effects

of environmental enrichment were tested in the anxiety-depression model, in which socially raised chicks are placed in isolation for a 2 h test period. Isolated chicks display an initial high rate of distress vocalizations, constituting the anxiety-like phase, followed by a marked decline and plateau in rates of vocalizations for the remainder of time in isolation, characterizing the depression-like phase. Four separate groups of domestic fowl chicks were group housed under enriched, impoverished (i.e., non-enriched) or a combination of the two housing conditions for six days and tested at 7 d posthatch in the aforementioned isolation procedure. Rates of distress vocalizations in the anxiety-like (2-3 min) or depression-like (30-120 min) phases were not affected by housing conditions. However, chicks continuously housed in enriched environments and chicks housed in the enriched environments on days 4-6 displayed a delay in the onset of the depression-like phase. The beneficial effect of environmental enrichment on the depression-like phase is consistent with other stress paradigms and provides another step towards validating the chick anxiety-depression model as a clinical simulation. (C) 2011 Elsevier B.V. All rights reserved.

Source: *Pubmed*

Descriptors: Animals, Anxiety, psychology*, Chickens, Depression, psychology*, Disease Models, Animal*, Environment*, Male, Social Isolation, psychology*, Stress, Psychological, psychology, Time Factors, Vocalization, Animal.

Notes: Author contact:

pysufka@olemiss.edu

Environmental Enrichment Facilitates Long-term Potentiation in Embryonic Striatal Grafts

Mazzocchi-Jones, D., Döbrössy, M., and Dunnett S.B. (2011)

Neurorehabilitation and Neural Repair 25(6): 548-557. ISSN: 15526844.

Abstract: Housing animals in an enriched environment improves motor and cognitive performance and anatomical connectivity in rodent lesion models of Huntington disease and transplantation of embryonic striatal grafts. The authors evaluate the extent to which environmental enrichment can modify synaptic plasticity in the host-graft neuronal circuitry to try to find a physiological substrate for the observed improvements. C57BL/6 mice, housed in enriched or standard environments, received unilateral quinolinic acid lesions of the striatum, followed by embryonic striatal grafts. Then, 3 months posttransplantation, synaptic physiology and plasticity were evaluated by extracellular recording from in vitro striatal slices. Environmental enrichment had no effect on the chance of long-term depression (LTD) induction or expression of LTD from either normal or grafted striatum. In contrast, enrichment increased the chance of long-term potentiation (LTP) induction and level of expression associated with increased levels of brain-derived neurotrophic factor within both the intact and grafted striatum compared with levels in the striatum of animals housed in standard environments.

Environmental enrichment induces changes in host-graft corticostriatal LTP, thus providing a potential physiological substrate for the enrichment-induced improvement in motor and cognitive performance. The effect may be mediated by modulation of the trophic environment in which the grafted cells develop and integrate. **Source:** *Pubmed*

The Impact of Environmental Enrichment in Laboratory Rats--Behavioural and Neurochemical Aspects

Simpson, J. and J.P. Kelly (2011)

Behavioural Brain Research 222 (1): 246-264. ISSN: 01664328.

Online: doi: 10.1016/j.bbr.2011.04.002

Abstract: The provision of environmental enrichment (EE) for laboratory rats is recommended in European guidelines governing laboratory animal welfare. It is believed the EE implementation can improve animals' well-being and EE has been used to demonstrate learning and plasticity of the brain in response to the environment. This review suggests that the definition and duration of EE varies considerably across laboratories. Notwithstanding this, some EE protocols have revealed profound effects on brain neurochemistry and resulting behaviour, suggesting that EE can have the potential to significantly modify these parameters in rats. For this review, a literature search was conducted using *PubMed* and the search terms "Environmental Enrichment" and "rats". From the results of this search the most important variables for consideration in the implementation of EE are identified and

summarised, and include cage size and housing density; rat age, sex and strain; duration of EE; the EE protocol and enrichment items employed; and the use of appropriate controls. The effects of EE in a number of behavioural tests and its effects on neurotransmitters, neurotrophic factors, stress hormones and neurogenesis and proliferation are outlined. The findings summarised in the present review show the range of EE protocols employed and their effects in tests of activity, learning and affect, as well neurochemical effects which mediate enhanced plasticity in the brain. EE, as is provided in many laboratories, may be of benefit to the animals; however it is important that future work aims to provide a better understanding of EE effects on research outcomes. (C) 2011 Elsevier B.V. All rights reserved.

Source: *Pubmed*

Descriptors: Animals, Animals, Laboratory, Behavior, Animal, physiology*, Brain Chemistry, physiology*, Environment*, Exploratory Behavior, Female, Male, Maze Learning, Rats, Recognition (Psychology), Sex Factors, Swimming, psychology.

Notes: Author contact: j.simpson1@nuigalway.ie

Environmental Enrichment of Laboratory Rodents: The Answer Depends on the Question.

Toth, L.A., K. Kregel, L. Leon, and T.I. Musch (2011)

Comparative Medicine 61(4): 314-321. ISSN: 15320820.

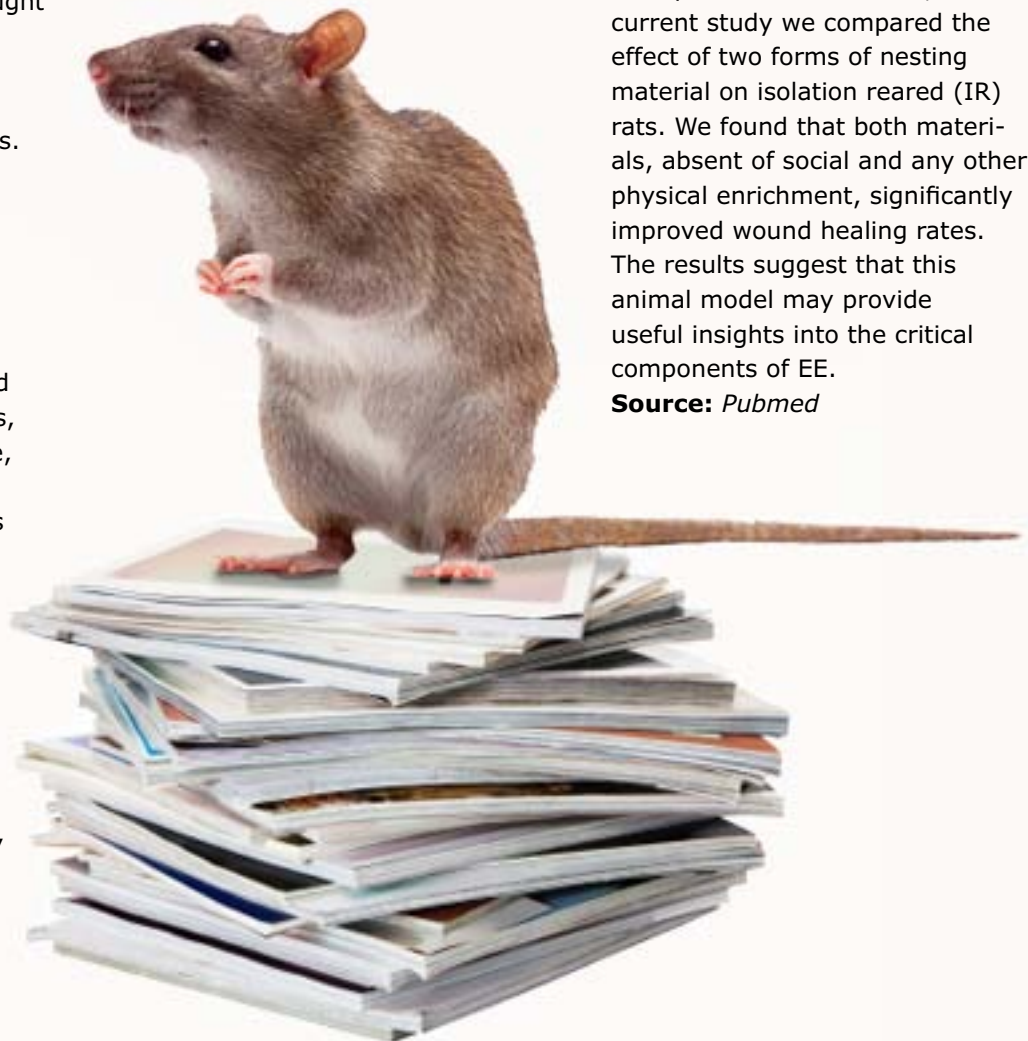
continued on page 28

Abstract: Efforts to refine the care and use of animals in research have been ongoing for many years and have led to general standardization of rodent models, particularly with regard to animal housing, genetics, and health status. Concurrently, numerous informal practices and recommendations have been promulgated with the laudable intent of promoting general animal wellbeing through so-called enrichment of the cage environment. However, the variety of housing conditions fostered by efforts at environmental enrichment (EE) complicates the goal of establishing standardized or even defined environments for laboratory rodents. Many studies over the years have sought to determine whether or how various enrichment strategies affect the behavior and physiology of laboratory rodents. The findings, conclusions, and interpretations of these studies are mixed, particularly with regard to their application across rodent species, strains, genders, and ages; whether or how they affect the animals and the science; and, in some cases, whether the effects are positive, negative, or neutral in terms of animal wellbeing. Crucial issues related to the application of EE in research settings include its poorly defined effect on the animals, the potential for increased variability in the data, poor definition across labs and in publications, and potential for animal or scientific harm. The complexities, uncertainties,

interpretational conundrums, varying conclusions, and lack of consensus in the EE literature warrant careful assessment of the benefits and liabilities associated with implementing such interventions. Reliance on evidence, professional judgment, and performance standards are crucial in the development of EE strategies.

Source: Copyright CAB Abstracts, used with permission.

Descriptors: animal behaviour, animal housing, animal physiology, animal welfare, cages, enrichment, laboratory animals, standardization, standards, animal behavior, animal rights, behavior, environmental enrichment, mammals, vertebrates, chordata, animals, eukaryotes, rodents.



Environmental Enrichment with Nesting Material Accelerates Wound Healing in Isolation-reared Rats
Vitalo, A.G., S. Gorantla, J.G. Fricchione, J.M. Scichilone, J. Camacho, S.M. Niemi, J.W. Denninger, H. Benson, M.L. Yarmush, and J.B. Levine (2012).

Behavioural Brain Research 226(2): 606-612.

ISSN: 18727549.

Online: doi: 10.1016/j.bbr.2011.09.038

Abstract: Early enrichment (EE) programs provide a well-established approach to mitigate the deleterious effects of childhood adversity. To better understand the therapeutic features of EE, in the current study we compared the effect of two forms of nesting material on isolation reared (IR) rats. We found that both materials, absent of social and any other physical enrichment, significantly improved wound healing rates. The results suggest that this animal model may provide useful insights into the critical components of EE.

Source: *Pubmed*

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Keynote: *New Ways of Doing Science: International Efforts to Develop Novel 3Rs Approaches*
Dr. Belen Tornesi, U.S. Representative, European Partnership for Alternative Approaches, Platform on Science, Abbott Laboratories

AM Panel: *Challenges of Capturing & Communicating 3Rs Progress*

- *Challenges of Moving Beyond Animal Models to Qualify as Drug Development Tools*
Suzanne Fitzpatrick, PhD, Food & Drug Administration
- *Non-animal Techniques: Designing out Drug Safety Liabilities in Drug Discovery*
Oliver Flint, PhD, Bristol Myers-Squibb
- *Collaborative Efforts to Track 3Rs Trends & Progress*
Jeff Everitt, DVM, GlaxoSmithKline
- *Using Awarding Winning Innovation as a 3Rs Key Performance Indicator*
J. Barry Wright, PhD, AstraZeneca

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mccabe@njabr.org or 908.228.2203
New Jersey Association for Biomedical Research



Responses to the article noted below:

Environmental Enrichment of Laboratory Rodents: The Answer Depends on the Question

*Toth, Linda A.; Kregel, Kevin; Leon, Lisa;
Musch, Timothy I.,
Comparative Medicine, Volume 61, Number 4
August • Pages 314-321*

Commentary

By Karen Froberg-Fejko, VMD

I was disappointed by "Environmental Enrichment of Laboratory Rodents: The Answer Depends on the Question." I expected a much-needed article championing reasons why it is essential to provide environmental enrichment for rodents. To my dismay, the authors chose to weigh in on the side of those who see little value in providing EE for rodents. I offer my opinion as a lab animal professional who sees the glass as half full as opposed to half empty.

First, we must ask: **what is enrichment?** Definitions vary widely; however we must accept that the intention of EE is to allow the expression of normal species behavior. Although there are wide variations in rodent species and strains in the response to EE, the dominant behaviors in rodents such as sheltering, nesting, foraging, and gnawing are hard-wired. Attempts to allow what is normal should be offered and noted, specifically in the materials and methods sections of publications to provide evidence supporting introduction of EE.

Mice respond differently to different environments, and the difficulty for us is to identify individual needs. The number of rodents used in research can present an overwhelming, but potentially rewarding challenge to animal caretakers. Instead of adopting a herd mentality, we need to carefully evaluate what is going on at cage level. We must recognize that "one size does not fit all," and I would argue that the responsibility of monitoring the effects of EE must be placed upon the human caregivers. I have confidence in the honest evaluation by daily caregivers because they have hands-on experience and know what is effective. I realize human emotion has a finite role in a study design; however, because we are discussing the needs of rodents, there is no black and white, so we must rely upon observations of what appears appropriate until more research in this area has been conducted.

In my travels, investigators frequently state that their mice "LOVE their shelters." I interpret this to mean that the sheltering option they have provided to their mice is having a positive effect. I believe that it is essential to validate the effects of different types of EE upon rodents, but due to fiscal challenges and other priorities, it is not happening. If we have to wait to validate EE, then the rodents will suffer. In the interim, I believe we should rely on our caregivers and investigators to accurately monitor and note changes on different types of EE offered to rodents.

Second, **who should determine whether enrichment interventions benefit or harm the animal or the science?** The authors of the article maintain that EE should not be imposed unilaterally or arbitrarily by any stakeholders. I submit we have a responsibility to impose best practice stipulations since rodents are not

covered by the Animal Welfare Act. Rodents are the most utilized animal species in research, and there are no federal regulations to protect them. This makes the *GUIDE* an essential document, promulgating best practices that address the needs of rodents as opposed to settling for minimum standards of care.

The authors state that complex and unexpected effects of EE on research variables are possible. No one would argue that research variables must be minimized in order to collect valid data, and this concern is magnified in a tox or GLP environment due to the nature of this type of research. There is concern in a tox and GLP environment that providing environmental enrichment could potentially affect the outcome of a study. However, not offering the opportunity for animals to express species-specific behavior through enrichment can lead to the most important variable of all, stress. A barren environment is stressful. Stress affects every physiologic function of the body, and we must strive to minimize it.

There are many uncontrolled variables within a research environment including personnel rotations, differences in HVAC and caging systems, monthly fire alarms, vibrations, and changes in light levels. We must recognize them as an inherent part of lab animal research. I have had dams cannibalize their young because of building renovations. This behavior dissuaded with the addition of EE. My point is that EE can be extraordinarily beneficial to achieve a desired outcome. There are numerous published research articles and plentiful testimonials supporting the positive effects of EE. But it is important to recognize that institutions must invest in EE programs and staff training. A successful EE program requires careful planning, controlled implementation, close observation and frequent re-assessment. Performance goals should be planned and close evaluation must be documented. A well-managed EE program will undergo continual assessment. It requires time, money and commitment.

There is no doubt that the article has generated discussion surrounding the implementation of EE for rodents. It is our responsibility to stay close to ongoing research and support more studies in the future. Providing EE is good animal welfare, and we must strive for the delicate balance of good data collection conducted in

the least stressful environment. I wanted to share a comment by an anonymous author which emphasizes the importance of EE: ***“For those who pledge to take responsibility for the welfare of animals and vow to use scientific knowledge and skills for the advancement of medical knowledge, the wise composer of this oath sees no conflict between relieving animal suffering and advancing science. Indeed there is none!”***

The Standardized Environment Must Be Enriched

By Emily G. Patterson-Kane, Ph.D.

Toth et al (2011) musters a number of arguments against willy-nilly environmental enrichment. And my issues with them, spelled out below, are more a matter of attitude than fact. But when it comes to environmental enrichment, attitude may be more important than many people realize....

1) Environmental enrichment is not well-defined

No abstract concept is uniformly defined. Environmental enrichment aims to create environments for animals that don't suck. Each person proposing a definition has their own idea about what sucks the most about the captive environments they are working with, and honestly, there is a lot to choose from. Thus, the diversity in definitions reflects just how badly environmental enrichment is needed. (I and quite a few others are not, as it happens, a fan of the term "environmental enrichment". I am, however, a huge fan of designing captive environments that don't suck.)

2) Environmental enrichment can take many forms

Because there are many deficits, there are many solutions; we don't always know what they are, so we have to try different methods before we strike the right one. Even a solid floor can be enriching to an animal that previously lived on a wire floor. Hanging wire-floored cages were the very model of scientific standardization, as long as you didn't care that your rats were miserable, had sore feet, underdeveloped brains and compromised immune systems. It may seem like a small gain now, but environmental enrichment as a concept and rallying cry played a large part in achieving it, for the benefit of animals and science. (Actually, there are still a substantial number of labs that cling to

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their hanging cages, out of a sheer unwillingness to adapt to the new standard of care and shift their baseline.)

3) Varied housing impairs standardization

“Enrichment” is essentially an argument for a transitional period during which we determine the optimal environment, moving us from housing that causes suffering and impairs scientific validity to housing that supports good welfare and good validity. I have to say that most areas of research suck at standardization, so it is entirely a valid area of concern. I once read pretty much every study that used an open field with rats, and the only ones that used a field of the same size, shape and color seemed to be the ones actually using the same piece of equipment. The number of studies that even report home cage parameters are negligible to this day. I also read almost every study that ran a rat through a Hebb-Williams maze, an admirably standardized piece of equipment. So standardized, in fact, that we haven’t the slightest idea what it actually measures—and even more dangerously, we think we do. (If it measures intelligence-or-some-euphemism-for-intelligence, how does extreme hunger or foot shock make animals more “intelligent”?)

4) Evidence that enrichment is beneficial is mixed

Evidence of gravity is mixed if you stand near the edge of the Grand Canyon and there is a good updraft. Serious and learned reviews since at least the 1970s have shown that barren housing impairs nearly all of the structures and functions of an animal (yes, even a domesticated one) and thus its ability to serve as a model of normal function. The only real question is: how do we fix this?

5) Housing type effects research outcomes

Well, duh. Housing is important and housing is part of the research model. The role housing plays is 1) it makes the animal normal except in an area where deviations from normality are an explicit part of the model, 2) it occurs in a manner that is well-defined and reported to the point of allowing replication, 3) housing is standardized to the extent that the need for unnecessary replication is minimized. If housing is not a large part of the model, minor to moderate changes should not have major outcomes unless the model is poorly understood, the model has poor validity, or standard conditions introduce major abnormalities. (I am not suggesting making changes arbitrarily. But I am rejecting any notion that they should not be made at all just because they can affect your data.)

Conclusion

Standardization cannot be considered in isolation from

validity. And, I would argue that in most cases, animal research has disappeared up its own uniformity and is now rather unwilling to come out. Normal animals make valid models, and barren environments make abnormal animals. Thus, the standardized housing for any species must be free from any factor that causes deviations from normal function. The standardized environment must be enriched.

And, if we do not yet know exactly how to properly house every kind of animal we use, perhaps it is damn well time we figured it out. The authors state that developing enrichment that prevents stereotype is “a complex task”. And giving enrichment to large colonies of animals can be challenging. Well... tough. Using these animals carries with it the absolute duty to use the most effective and humane methods. If we admit ourselves incapable of knowing what these methods are, then maybe that is the very first research question we should answer. Do not pass go, do not collect two hundred dollars. If we are merely unwilling to ensure the task is carried out... well, expect no sympathy.

That said, we need to admit that this is a difficult time for many researchers. We do not yet have an array of accepted, proven enrichment cages suitable for standardization. Baselines need to be shifted, which is not an easy task and can’t be done every time someone wants to toss a new toy in the cage. And yes, standardization has become harder to achieve. It is reasonable for researchers to require that enrichment of *proven worth* be implemented according to a scientifically responsible protocol that is respectful of the primary research goal—that being the reason everyone is there in the first place.

Why is this not always happening? Perhaps it is because a lot of researchers have dug their heels in and are essentially not allowing enrichment, even when it does meet these criteria. Thus technicians who are with the animals all day want to sneak in any small enrichment they can. Administrators make rules that you must enrich, because enrichment is good and they want to make sure that you do it. You see, if you want a careful and measured—a scientific—approach, when you do finally make a change, it needs to be large, proactive and effective. Not just a toy, but a whole new cage type, or room, or building. “Adequate” is not enough. You have to be willing to embrace and create a *new standard*. Only then will you be accepted as the leader, the boss, the rule-maker when it comes to working out how to get there.

There's an old saying that "You can't dance at two weddings at once."

You also can't attend all the meetings and conferences taking place that offer the latest information in the field of laboratory animal science. **Meeting Up** will provide summaries of panels, workshops and symposia covering topics relevant to Environmental Enrichment. If you want more information about any of the presentations described or want to contact the presenters, let us know and we will be happy to connect you: info@theenrichmentrecord.com

Innovative Enrichment Symposium 2011

The 5th Annual Innovative Enrichment Symposium was held on Sunday, October 2nd at the Marriott Hotel & Marina in San Diego, California. This annual event, hosted exclusively by the Massachusetts General Hospital's Center for Comparative Medicine and led by organizer Jennifer Camacho, seeks to present innovative and advanced concepts of evidence-based environmental enrichment and to interpret a practical approach towards implementing such designs in a laboratory vivarium.

Attendants to the symposium were given table assignments and grouped by position and species of interest in order to maximize the effectiveness of collaborative conversation. Immediately following each presentation, conversation was encouraged, allowing attendants an opportunity to translate presentation material into practical plans for implementation and refinement. The symposium venue consisted of speakers representing the latest information on animal welfare and lab animal care cutting edge practices while addressing hot topics and information in demand, by a collection of individuals who represent experts in their work and science of animal care. A brief overview of the presentations and a feedback comment or two from attendants is included:

Rodent enrichment: an eustress model for cancer and obesity research was presented by Lei Cao, a Scientist from Ohio State University Medical Center. Dr. Cao presented fascinating information from her publications in the *Cell* journal regarding the relation-

ship between enrichment and the science. One attendant commented that the presentation was "translated into lay terms to describe the links between physiology and behavior and the impacts to environmental interaction—a whole animal paradigm!" This presentation proved insightful and was an excellent example of the science applied to enrichment.

Systematic Assessment of Enrichment Items was presented by Darcy Hannibal, a primatologist research associate from UC Davis. This presentation provided the audience with a detailed statistical review on assessing effectiveness of environmental enrichment, including what's important to look at, how many? and for how long?. For an often overlooked component of animal care and enrichment, Dr. Hannibal did a "great job taking statistics to a practical place—allowing individuals to implement objective assessments at home". One attendant even commented "I can even imagine implementing this without having dedicated behavioral staff."

Socially housing laboratory rabbits: taking a cue from wild rabbit behavior to improve introduction success was presented by Annie Valuska who shared her Ph.D. work in Animal Behavior as a student in Joy Mench's laboratory at UC Davis. Ms. Valuska's presentation on social housing in rabbits offered insights into establishing animal care & environmental enrichment programs by looking at the individual species natural behaviors & environment. Several attendants agreed that Ms. Valuska's presentation was "the most interesting rabbit enrichment talk I have ever heard."

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Animal learning: theoretical insights and practical implication for animal welfare in the laboratory

was presented by Sabrina Brando, an animal care and welfare consultant through AnimalConcepts. Ms. Brando presented clever ways to illustrate the individual animal experience and how to use animal training techniques to improve welfare and science. Several attendants commented that they “enjoyed tremendously” this presentation, valued the “basic science” application to enrichment and “wished there was more time to go over all types of animal learning theories.”

Socialization methods: Strategies for success with nonhuman primates in a laboratory environment

was presented by Dawn Abney who manages the behavior and enrichment program at the Charles River Laboratories-Nevada primate facility. Ms. Abney presented valuable information on strategies to social house colonies of adult male macaques, including the success and failure rates of such attempts. Attendants felt that Ms. Abney presented a “good plan! from regulations-to-methodology, with results” and for a topic in demand attendants were “glad to have someone rallying around the point of adult male populations.” Ms. Abney’s presentation was followed by an overview from Charles River Laboratories, Director of Enrichment and Behavioral Medicine, Dr. Christina Winnicker. Dr. Winnicker presented efforts being made from the vendor perspective to aid in the longevity of social housing programs for research clients.

In addition, for the first time this year, the Innovative Enrichment Symposium has combined efforts with www.animalprofessional.com to offer online availability of presented materials. The founders of animalprofessional.com have launched an initiative to archive presented material in a format that can be searched for future reference or used to increase viewer availability for a variety of animal professions. Because of the potential security threat and sensitivity of information, this has not been possible for the lab animal profession. However, Massachusetts General Hospital’s Center for Comparative Medicine website, www.virtualvivarium.com, will explore a secure access portal that will allow individuals to access information from past symposia. This availability is currently under construction and will start with available access to the 2011 symposia during the 2012 year.

Overall, the agenda offered an excellent “overview of current enrichment advancements” and “relevant topics,

thoroughly described in a format that allowed individuals to make a comprehensive take home plan”. The symposium also offered attendants the opportunity to make contact with industry experts, collaborate with peers and take home literature, including copies of the newly revised *Guide for the Care and Use of Laboratory Animals* and a variety of enrichment and behavior publications from the Animal Welfare Institute.

For 5 years, attendants have benefited from an exciting venue, all day symposia with elaborate resources and lunch included (human enrichment, free of charge). The symposium has been supported by Massachusetts General Hospital in hopes of advancing the field of environmental enrichment, improving the quality of care to laboratory animals and ultimately impacting scientific achievement. In order to support the continued efforts of the symposium and advancement of environmental enrichment in the laboratory animal industry, a small registration fee will apply to future symposia—starting with 2012 in Minneapolis, MN on November 4, 2012.

For more information or to sign up for future symposium announcements please visit: www.virtualvivarium.com

Meeting Announcement submission Form

Please submit the following information to Rhoda Weiner, Editor rmbw19@verizon.net

ORGANIZATION _____

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DATE OF EVENT _____

TIME OF EVENT _____

EVENT LOCATION _____

TYPE OF EVENT

Conference _____ Workshop _____ Lecture _____

Meeting with featured speaker _____

BRIEF DESCRIPTION OF THE EVENT _____

Virtual Laboratory Animal Science Conference

February 15–16, 2012

Keynote speaker:

Dr. Joseph Garner

Feb. 15: 8–9AM

Enrichment Track Presenters:

Dr. Emily Patterson-Kane

Dr. Lei Cao

Dr. Christina Winnicker

Dr. Annie Valuska

Dr. Robert Hubrecht

Dr. John Capitanio

Register for free

www.lasconference.com

TRACKS: Housing; Enrichment; Pain/distress/pleasure

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For more information contact:

Annette McCabe: 908-228-2203

Email: mccabe@njabr.org

4th Annual MSMR Enrichment Symposium

March 23, 2012

Colonnade Hotel, Boston, MA

To register, contact Lynne Walsh

msmr@att.net

978.251.1556

Enrichment Extravaganza

April 24, 2012

Emory University, Atlanta, GA

8:30am–4:00pm

The Enrichment Extravaganza is a forum for new ideas and strategies on integrating innovation enrichment methods into the daily care of laboratory animals to enhance their welfare. This full-day event consists of a morning plenary session, posters and afternoon break-out workshops.

For more information, contact .

Denise Bianco at 908.228.2203 or

mccabe@gr8tt.com

Event Organizers:

The Enrichment Record, an online E-zine

at <http://enrichmentrecord.com>

Yerkes National Primate Research Center

Animal Behavior Management Alliance 2012 Conference

May 6-11, 2012

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Join us in the Golden State of California to discover Behavioral Management Gold!

The 2012 ABMA conference will be held May 6-11th in beautiful San Francisco and will feature a keynote address by Dr. Hal Markowitz, enrichment pioneer and author of *Behavioral Enrichment in the Zoo*. A 3-part enrichment workshop will also be presented by Dr. David Shepherdson, editor of the ground breaking book, *Second Nature*.

Please visit our conference site for information on registration, submitting presentation and poster abstracts, and additional conference details. See you in San Francisco!

http://theabma.org/index.php?option=com_content&view=category&layout=blog&id=62&Itemid=154 --

If additional information or action is required, please feel free to contact Darren E. Minier, 2012 conference Chair, Animal Behavior Management Alliance deminier@ucdavis.edu or Margaret Rousser margaret@oaklandzoo.org.

Recent advances in animal welfare science III

UFAW Animal Welfare Conference

June 21, 2012

York Merchant Adventurers' Hall

York, UK

As part of its on-going commitment to improving the way we understand and care for animals, the Universities Federation for Animal Welfare (UFAW) is pleased to announce the third of its series of unthemed one day conferences on 'Recent advances in animal welfare science'. The conference aims to provide a forum at which the broad community of scientists, veterinarians and others concerned with animal welfare can come together to share knowledge and practice, discuss advances and exchange views. In keeping with this aim, registration for this meeting has been kept low—£25.00 (lunch not included).

Further details, including a registration form can be found on the UFAW website <http://www.ufaw.org.uk/conference2012.php>

REMEMBER: Please send notification of your Upcoming Meetings to Rhoda Weiner at rmbw19@verizon.net

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- Discussing environmental enrichment in the optimal care of laboratory animals
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