Volume 13, October 2012

THE Enrichment RECORD

Publisher:Global Research Education and Training, LLC • Email: *mackta@enrichmentrecord.com* • Website: *http://enrichmentrecord.com*

ENVIRONMENTAL ENRICHMENT: A POSITIVE APPROACH

Veterinary™
Bioscience Institute

Enriching Lives through Training

- **Webinars cover over 32 topics**
- **Continuing Education Credits from the comfort of your desk**

www.vetbiotech.com
877-VET-BIOS

Popular Webinar Topics

- Fundamentals of Rodent Surgery
- Humane Endpoints
- Rodent and NHP Anesthesia and Analgesia
- Rodent Stereotactic Surgery

THE Enrichment RECORD

Please direct all inquiries to
Rhoda Weiner, Editor: *rmbw19@verizon.net*

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/

Publisher:
GR8 (Global Research Education & Training, LLC)
http://enrichmentrecord.com
Jayne Mackta, *President & CEO*

IN THIS ISSUE | FALL 2012

The Enrichment Record
is a quarterly E-Zine/Forum for:

- Discussing environmental enrichment in the optimal care of laboratory animals
- Documenting best practices and approaches for addressing challenges of implementation & assessment at every level
- Sharing data on the impact of environmental enrichmenton the science
- Building the case for integrating enrichment into research design

If you are interested in advertising in *The Enrichment Record,* please visit: *http://enrichmentrecord.com/advertise/* or contact Jayne Mackta, Publisher: *mackta@enrichmentrecord.com*

ADVERTISING DEADLINES
January Issue—*December 1*
April Issue—*March 1*
July Issue—*June 1*
October Issue—*September 1*

ADVERTISING RATES
Single Issue
1/4 page $350
1/2 page $500
Full page $1,000

4 Issues
1/4 page $1,120
1/2 page $1,600
Full page $3,200

The Enrichment Record
is an 8.5" x 11" format.
Full color; 300 dpi pdfs accepted.

Visit out website—
browse past issues:
http://enrichmentrecord.com

In Other Words

Recently, I've heard some respected colleagues complain that "Enrichment is a distraction." This simple statement drives me to distraction.

When pressed to clarify, these nay-sayers default to the narrow view that EE is all about the toys. What they don't or maybe can't do is explain in what way enrichment for captive animals interferes with their work, slows down the science or diminishes a compliant animal research program.

Way back at the end of the last century (1995), enrichment was described as an "improvement in the biological functioning of captive animals resulting from modifications to their environment." (Newberry, p. 230)[1]. The focus is not on entertainment, but rather on providing adjustments determined according to what is normal for each species under natural circumstances. It's about enhancing animal well-being through enabling the expression of instinctive species-specific behaviors.

There are challenges to be sure. However, as spelled out in an article on the history of enrichment in the ILAR *Guide for the Care & Use of Laboratory Animals* in the July issue of this E-Zine: "Development of enrichment strategies based on sound scientific data will ensure that enrichment does not become a deterrent to good science and actually promotes better science and animal welfare."

So what's the problem?
Isn't there enough time? Is it a question of resources, human and/or financial? Is it just human nature to resist change? Perhaps we need to provide a cost-benefit analysis to satisfy the die-hards who still don't get it!

I invite readers to share strategies for driving acceptance of the growing body of scientific evidence that supports the importance and value of species-specific environmental enrichment for lab animals. All comments are welcome here.

Jayne Mackta

Jayne Mackta, Publisher
President & CEO, Global Research Education & Training, LLC (GR8)

1. Newberry RC. 1995. Environmental enrichment: Increasing the environmental relevance of captive environments. *Appl Anim Behav Sci* 44:229-243.

Enrichment Record Poster Repository

QUESTION:
What's the fastest way for Enrichment to go viral?

ANSWER:
Submit your enrichment posters to The Enrichment Record Poster Repository
http://www.vetbiotech.com/posters2.php

Contact Szczepan Baran if you have any questions or problems:
info@vetbiotech.com

Subscribe to
The Enrichment Record.
Get immediate email notification
of new postings.
Comment on articles.
Announce meetings.
Share ideas.

Click here to sign up.
www.enrichmentrecord.com

LabDiet®

Your work is worth it.®

Satisfy their *needs*, enrich their *senses*.

Macro-Pack

Provides ideal method of delivering superior and constant nutrition along with animal enrichment.

200 X 75-gram packs per box • Four products available

Monkey Jumble®

A fusion of seeds, nuts, fruits and vegetables for enhanced palatability. The assortment of flavors and textures will keep primates interested over long periods of time.

Monkey Morsels

A tasty mixture of small fruits, seeds, and vegetables that are especially suited to encourage the natural foraging instincts of primates.

Health Products

Specialized products to enrich performance and well-being. Products include PriMade® Hydrating Electrolyte Replenisher, Vitamin Supplement Tablets, and PriLieve® Series medicated tablets for maintenance of health and prevention of disease.

LabTreat® Primate Enrichment Products

Primate enrichment products, perfect for reward, reinforcement, and psychological well-being. Products include Foraging Bits, Primate Crunch®, High Fat Primate Treats, Monkey Delight® Tablets, LabTreat® Enrichment Tablets, LabTreat® OmniTreat® Enrichment Tablets & Pellets, and LabTreat® Primate Enrichment Pellets.

For more information visit www.labdiet.com or email info@labdiet.com

Reporters Wanted!

In each issue of *The Enrichment Record* we report on Enrichment meetings and conferences in detail. We are seeking volunteers to write summaries of meetings, workshops, and conferences addressing any aspect of environmental enrichment for lab animals. Meeting organizers are welcome to assign a recorder. To request "Guidelines for Meeting Up Summaries," send your name, contact and meeting information to *info@theenrichmentrecord.com*

NAME_____

PHONE_____

EMAIL_____

EVENT _____

DATE_____

TIME_____

LOCATION_____

Meeting Announcement

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

ORGANIZATION_____

CONTACT NAME_____

PHONE_____

EMAIL_____

DATE OF EVENT _____

TIME OF EVENT_____

EVENT LOCATION_____

TYPE OF EVENT

Conference_____**Workshop** _____ **Lecture**__

Meeting with featured speaker _____

BRIEF DESCRIPTION OF THE EVENT_____

_____

_____

OUR READERS TELL US....

The Enrichment Record *should be listed alongside the* Guide *as required reading for anyone working with animals in a captive setting. It's a one-stop shopping superstore for information, education, philosophy, discussion, networking, and practical implementations of enrichment strategies that are essential for supporting animal well-being and valid science. It's enjoyable! It's brilliant! And, for subscribers, it's free!*
The Enrichment Record *was created for and by people who believe in compassion and respect for all living things.*
Read it. You'll LOVE it!

Cindy A. Buckmaster, Ph.D., RLATG, CMAR
Director, Center for Comparative Medicine,
Baylor College of Medicine
LAWTE Past President
AALAS Vice-President Elect

At the end of your rope looking for Enrichment Solutions™?

Bio-Serv has worked passionately for more than 20 years to develop an extensive line of Environmental Enrichment devices and treats to challenge and capture the interest of research animals.

Not only will we supply you with the products needed to set up or expand your enrichment program, our experienced staff is available to provide guidance and answer any questions you may have about our products and how they are best used as part of a successful program.

To learn more about our enrichment options contact our Enrichment Specialist:

Karena Thek

kthek@bio-serv.com
570-730-6055

Bio-Serv®

Delivering Solutions™...

◆Nutritional ◆Enrichment ◆Medicated ◆Special Needs

800-996-9908 - U. S. and Canada
908-996-2155 - International
sales@bio-serv.com
ISO 9001:2008 Certified

www.bio-serv.com

Upcoming Meetings

THE IACUC'S ROLE IN ENVIRONMENTAL ENRICHMENT PROGRAMS, a breakout session at NJABR's IACUC: The Charge & The Challenge 19
October 19, 2012
The Palace at Somerset, New Jersey
Contact Annette McCabe at 908.228-2203 or go to: *www.njabr.org*.

6TH ANNUAL INNOVATIVE ENRICHMENT SYMPOSIUM
Sunday, November 4, 2012
9am-4pm
Hilton Hotel, Minneapolis, MN
Sponsor:
Massachusetts General Hospital's Center for Comparative Medicine
Fee: $150.00: covers materials and meals
Information and registration:
http://www.virtualvivarium.com/about-us/upcoming-events/environmental_Enrichment_Symposium.asp

NATIONAL AALAS MEETING
November 4-8, 2012
Minneapolis, MN
AALAS: (901)754-8620 AALAS or *info@aalas.org*.
See website: *http://nationalmeeting.aalas.org/future_sites.asp*

Monday, November 5
Primate Enrichment and Training: Part 1
SJ Schapiro, Mollie Bloomsmith, Gail Laule, Margaret Whittaker
Room M101A. 1-5 PM
Workshop Fee: $250. Limit: 50.

Tuesday, November 6
Primate Enrichment and Training: Part 2
SJ Schapiro, Mollie Bloomsmith, Gail Laule, Margaret Whittaker
Room M101A. 8 AM—12 Noon.
Workshop.

Thursday, November 8
Environmental Enrichment: Assessing Outcomes on Animal Welfare and Research
Stephen Levin, Kathryn Bayne, James Raber, Steven Schapiro, Linda Toth, Room 2. 12:30—2PM.
Panel Discussion

FREE LAB ANIMAL SCIENCE CONFERENCE BIOCONFERENCE LIVE: ENRICHMENT TRACK
February 13-14, 2013
See website
http://www.bioconferencelive.com/events.php?event_id=2

ENRICHMENT EXTRAVAGANZA AT ELI LILLY
April 10, 2013
Indianapolis, IN
To exhibit or submit a poster abstract, contact Denise Bianco at 908-228-2203 or Email: *bianco@enrichmentrecord.com*

11TH INT'L CONFERENCE ON ENVIRONMENTAL ENRICHMENT
October 15-18, 2013
Pretoria Zoo, South Africa
For information, contact Margaret Hawkins, Committee Secretary, at *secretary@enrichment.org*

We're always looking for new ideas! Share your ideas with Rhoda Weiner, Editor at rmbw19@verizon.net

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

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.

It's easy! It's free! It's a safe and secure place where you can say what's on your mind.
Click here to get started.

www.asap1st.net

215-804-0144

ASAP

ANIMAL SPECIALTIES AND PROVISIONS

We Satisfy Your Animals' Desires.

Animal Specialties And Provisions is an ISO 9001 Certified PMI LabDiet dealer. We serve facilities around the world with environmental enrichment resources that address the need for variety, durability, safety and economy.

American Association For Laboratory Animal Science

psbr Pennsylvania Society for Biomedical Research

LAMA

Follow us on Facebook. We'll keep you informed, interested and even entertained!

Animal Specialties And Provisions, LLC · 2400 Milford Square Pike · Quakertown, PA 18951
Telephone 215 804 0144 · Fax: 215 804 0148

Options for NHP Sensory Stimulation

Thanks to Kate Shuster, D.V.M., for providing this list of stimulating responses to her online query.

Enrichment Suggestions

1. **Wheat germ grown in egg cartons—**present entire thing (dirt and plant) on foraging board
   a. *wheatgrasskits.com*
2. **Herbs** (chives, thyme, oregano, basil, mint (green), parsley, marjoram, lemon grass) presented either in frozen cubes of water or diluted juice or on foraging boards/devices
3. **Edible flowers** (marigolds, nasturtiums, carnations, pansies), bamboo, or sugarcane - given to primate on foraging board
4. **Food coloring on any food or drink item given to them** (e.g. biscuits, bread, rice cakes, juice, ice cubes)
5. **Spices**
   a. Sprinkled on fresh produce
   b. Sprinkled and rubbed into a small square of brown paper towel
   c. Sprinkled on biscuits or foraging mix
   d. Recommended spices: cinnamon, pumpkin pie spice mix
6. **Using extracts** (vanilla, peppermint, almond) on pieces of paper towel and toys or other manipulanda
   a. Make sure that it can be removed after several hours as it might become noxious to the primate
7. **Popping popcorn in the room and handing it out to the primates afterwards**
8. **Aromatherapy nebulizer placed in the room for 4-8 hours at a time**
   a. Source: *http://www.puritan.com/aromatherapy*
   b. Add distilled water
   c. Add scent: peppermint, bayberry, rosemary, eucalyptus, orange, lavender were all suggestions

Addendum—Good references

http://animalenrichment.org/
http://www.phoenixzoo.org/learn/animals/primate_enrichment_protocol_the_phoenix_zoo.pdf

Environmental Enrichment for Captive Animals
R.J. Young
Universities Federation for Animal Welfare Series, 2003, 228 pp

The book is aimed at readers who not only want to implement environmental enrichment for animals, but also to understand how animal welfare is improved by the changes. The author describes it as a hybrid between a purely practical book and a purely theoretical one, so it will be of interest to both the animal behaviour researchers and those dealing with the practical problems of welfare of captive animals. The book is relevant to companion, laboratory and farm animals; however much of the text is devoted to environmental enrichment for zoo animals. The author is a professor of animal behaviour in Brazil and has worked on environmental enrichment in zoos. The 13 chapters cover: the historical perspective; the need for enrichment; does environmental enrichment work?; proactive vs reactive use of environmental enrichment (including solving animal welfare problems using enrichment); designing an enrichment device; the enrichment programme; enrichment for the different categories of animals (companion, farm, laboratory, and zoo); food and foraging enrichment; social environment housing (including managing social behaviour, and human-animal contact); housing; furniture toys and other objects; designing and analysing enrichment studies, and, finally, information sources on environmental enrichment (including Internet resources). There is a long list of references, a glossary and subject index.

Article | **Daniel Gottlieb, Ph.D.,** Animal Behavior Graduate Group, University of California, Davis, CA

California National Primate Research Center, University of California, Davis, CA
Current address: Oregon National Primate Research Center, Oregon Health Sciences University, Beaverton, OR

Predictable Feeding:

Why Is It Beneficial, and When Is It Important?

Whether you work in a zoo, animal shelter, or laboratory, it is common to see the behavior of animals change around the times they are usually fed. Animals often become hyper-vigilant and/or reactive. If you go near an enclosure before mealtime, you will be greeted by a chorus of calls from hungry animals hoping to get fed. Noises can also trigger a similar response; if you as much as drop a pin within hearing distance near mealtime, the animals will often respond as if this were a dinner bell ringing that food is about to arrive. Unfortunately, when feeding doesn't immediately follow these noises and activities, the animals can get extremely frustrated. It is common to see animals displaying high rates of stress behaviors such as pacing, stereotypies, and displacement behaviors (such as yawning and scratching for many nonhuman primate species) around feeding time [eg. Krishnamurthy 1994; Line et al. 1991; Waitt and Buchanan-Smith 2001]. This leads to the question, how can we decrease the daily anxiety and frustration associated with animal feeding?

To begin answering this question, we first have to understand why animals are stressed around feeding times. Actually receiving food and eating is not necessarily stressful; feeding itself is usually a pretty positive experience for the animals. Rather, it is the *anticipation* of feeding that can be a source of stress, with inaccurate anticipation being particularly stressful [Bassett and Buchanan-Smith 2007]. If animals are inconsistently fed at various times throughout the day, this may increase this period of anticipation, as animals may be constitutently vigilant waiting for food to arrive. For example, if an animal is usually fed between 7AM and 10AM daily, it may become anxious and hypervigilant everyday from 7-10, and may be extremely reactive to all noises and activities occurring during this time period. Therefore, to decrease this period of negative emotional state, it may be beneficial to feed animals on a highly predictable routine, so that the animals are no longer expecting food at all times of the day.

PHOTO: VINCE WARREN

To test this hypothesis for captive rhesus macaques (*Macaca mulatta*), I recently performed a study on indoor-housed rhesus at the Oregon National Primate Research Center. In my study, I evaluated stress behaviors in animals before and during three food events: morning feeding, afternoon feeding and food enrichment distribution. These food events were performed either on a highly predictable schedule (i.e., occurred at the same time daily), or on a random unpredictable schedule (i.e., occurred at different times every day). I found that animals were relatively calm and showed lower rates of

stress behaviors before and during food events that occurred at predictable times. In contrast, the animals expressed higher rates of stress behaviors when daily feedings occurred on an unpredictable schedule [For full study details, see Gottlieb et al. in press].

These results were extremely promising, and indicated that it was beneficial to feed animals reliably at the same time daily. While these were our expected results, there was still some concern at the start of the study that the animals would show elevated levels of anticipatory behaviors immediately prior to predictable feedings, as the animals should theoretically know that food is about to arrive. Instead, however, I found that the animals were relatively calm as they awaited food on a predictable schedule. I believe the monkeys responded positively to the predictable feeding schedule because this routine effectively removed the "unknown" of feeding. When animals were fed at unpredictable times, they were in a constant state of "unknown." At 8:50AM, they didn't know if they were going to be fed in 10 minutes, 20 minutes, 1 hour, 2 hours, and so on. A predictable feeding schedule removed this unknown, and animals knew at 8:50 that they would be fed in 10 minutes. Even if this increased anticipation, the removal of the stressful "unknown" appeared to be overall beneficial to the animals, leading to less stress behaviors prior to feeding.

So what does this mean for how animals should be fed in captivity? Many institutions feed and give enrichment at random times, believing unpredictable feedings may be exciting and enriching. Do the results of this study mean unpredictable feedings cannot be enriching? Do these results mean you should always feed your animals on a predictable schedule? Unfortunately, one cannot conclude anything so grand with these results alone, and further research is needed to answer these questions [for a review of the effects of predictability on welfare see Bassett and Buchanan-Smith 2007]. My results pertain to rhesus macaques housed in a biomedical facility, and the optimal feeding schedule for any institution is likely going to vary depending on the species and housing environment in question. First and foremost, predictability is probably most important in highly restrictive conditions where animals generally lack control over their environment. Control over the environment is extremely important for an animal's welfare [Bassett and Buchanan-Smith 2007], and a predictable schedule of events can help animals understand, anticipate, and prepare for environments that they cannot control. The specific subjects in my study were caged indoors with relatively little environmental control; in this environment, unpredictability appeared to be particularly stressful. While it is possible that feeding at random unpredictable times would have been enriching for animals group housed with more control, I did not test this in the current study.

So what are the implications to you and your animals? Even if you do not work at a biomedical primate facility and/or your animals are housed in large enclosures where they have high levels of control, this study can still have important implications for your animals. In most animal facilities, there eventually comes a time when some animals are put in a restrictive environment with limited control. This may occur when an animal is sick, in need of medical care, removed from a group for aggression, or even simply off display (for zoos). In these conditions, in which an animal suddenly loses its sense of control, it is especially important to provide information that allows it to understand its environment. A predictable feeding schedule may be particularly beneficial in these conditions, allowing the animal to understand an environment that is otherwise stressful, and unpredictable.

References

Bassett L, Buchanan-Smith HM. 2007. Effects of predictability on the welfare of captive animals. *Applied Animal Behaviour Science* 102(3-4): 223-245.

Gottlieb DH, Coleman K, McCowan B. In press. The Effects of Predictability in Daily Husbandry Routines on Captive Rhesus Macaques *(Macaca mulatta). Applied Animal Behaviour Science*.

Krishnamurthy R. 1994. Vocalizations of captive francois langurs linked to stereotypy and possible stress. *Folia Primatologica* 63(2):91-95.

Line SW, Markowitz H, Morgan KN, Strong S. 1991. Effects of cage size and environmental enrichment on behavioral and physiological responses of rhesus macaques to the stress of daily events. In: Novak M, Petto AJ, editors. *Through The Looking Glass: Issues of Psychological Well-Being in Captive Nonhuman Primates.* Washington, DC: American Psychological Association, pp. 160-179.

Waitt C, Buchanan-Smith HM. 2001. What time is feeding? How delays and anticipation of feeding schedules affect stump-tailed macaque behavior. *Applied Animal Behaviour Science* 75(1):75-85.

Article | **Alison R. Weller, ACT, RVT, RMLAT, ZAT**

University of Toronto Mississauga, Mississauga, ON, CANADA

Use of Environmental Enrichment in Multi-Species Facilities

Abstract

Environmental enrichment is an important tool to help reduce an animal's stress, and enhance psychological and physiological well-being. By providing enrichment, there is an immediate benefit to the animal, and, ultimately, the research itself. Types of enrichment for most traditional laboratory animal species have been well established and practiced, but non-traditional animals are unique, and studies could be done to provide additional enrichment strategies. The University of Toronto Arts and Science departments house a variety of traditional and non-traditional laboratory animals that all require some form of environmental enrichment. This article describes the various enrichment strategies used for the mammals, birds, reptiles, amphibians, fish, and invertebrates under our care at the University of Toronto's three campuses.

At one time, the environments for laboratory animals were designed on the basis of economic and ergonomic criteria, with little consideration for the animal's welfare. With environmental enrichment, defined as "*additions to an animal's environment with which it can interact*" (Beaver, 1989), inappropriate or abnormal behaviours, such as stereotypies, high aggression, and boredom could be reduced or eliminated. This concept is an important tool used to help reduce an animal's stress and enhance psychological and physiological well-being. Many publications have demonstrated that there is an immediate benefit to the animal, and, ultimately, the research itself when living conditions are improved through the use of environmental enrichment. Animals are able to express species-specific natural behaviours, have cognitive stimulation, and have some control over their microenvironment.

The goal of any enrichment program is to enhance the overall well-being of the animals under your care. The first step in any program is to define the natural behaviours and the needs for the species, strain and sex, and of the individual animal who will respond to each form of stimulus. The program should be proactive. A successful enrichment program should be fully integrated into the animal management program, and supported at all levels of the institution[1].

There are many factors to consider including the animal's health status, physical ability, behavioural history, and social interactions, and the research study being conducted. The University of Toronto Arts and Science departments house a variety of traditional and non-traditional laboratory animals that all require some form of environmental enrichment.

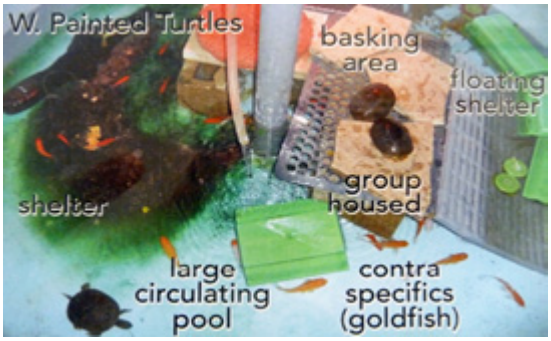
One of the main enrichment Frameworks used in many facilities, named S.P.I.D.E.R.[1] , can be used to insert ideas into the enrichment program.

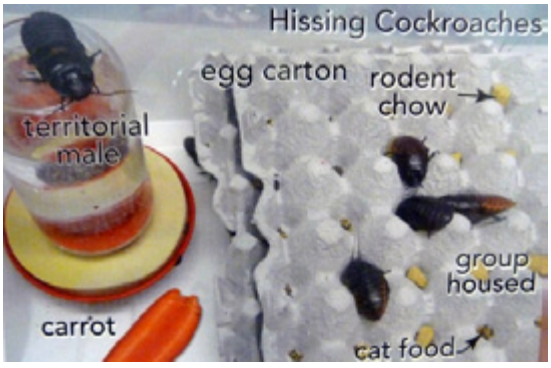
There are several ways to enrich an animal's environment. The following main enrichment categories can be used to assist in deciding what to include in the institution's enrichment program.

An example of the five main categories found in the literature include:

In order to assess if the item(s) chosen are providing any benefit (or harm) to the animal, and if an enrichment program is working and the animal is benefiting from the chosen program, one must understand the basic normal and abnormal behaviours of the species. To the right is a chart devised to show some basic normal and abnormal behaviours for the species housed in U of T Arts and Science departments, along with some enrichment ideas. Also included are photos outlining what has been successful for some specific animal species.

continued on page 14





Tips I have found that may assist in the development of an enrichment program include:

Spread out enrichment throughout the week; animals will be enriched multiple times—not just during cage changes

Place nesting sheets between wire lid bar for rodents; animals should pull them into the cage themselves, thus giving a great opportunity to see the underside and hind limb movements

Talk softly when in the room, so the animals become accustomed to voices; no whistling, high pitched sounds or shouting

Have low, soft-beat music in the animal room for background noise to drown out other sounds (especially for skittish species such as rabbits and guinea pigs)

Make routine tasks a treat…
- add foraging material to bedding during cage changes
- brushing or extra pats during transport

Prevent boredom by rotating your devices/toys

Rotate positions of rabbits on racks (they like the bottom best)

If not together, house as close as possible (same row, facing one another, etc.) for social species

Use reflective material when housed alone (mirrors, frosted glass, etc.) for social species

Use a bat "eco-locator" to listen in on ultrasonic sounds in animal rooms to hear what they do; this helps understand how frequencies change their behaviours

Learn about animals' natural behaviours

Network with other professionals

Learn all you can—attend conferences, lectures, webinars; read articles/books on environmental enrichment

Get free samples from companies to try out

Hold contests for best implemented idea with co-workers

Enrichment should be encouraged by everyone—make it fun!

When initiating an enrichment program, it is important to evaluate how each animal is responding, and if they continue to maintain interest. New things elicit curiosity; however, after the novelty effect, the objects can lose their attraction. Hence, no true enrichment value has been provided.[2] Reactions should be monitored and compared with baseline behaviour which should have been assessed before any enrichment idea was introduced. Outward factors to consider can include body condition, heart rate, and reproductive function. Objects used in your program should not only provide some sustained enrichment value for the animal, but should also be easy for the staff to remove, clean, and replace. Employees who are highly motivated to continue and modify the program as required will contribute to the likelihood that the enrichment idea has a positive effect.

The laboratory environment of research animals is clearly less complex than that of the species in the wild. We can, however, work to enhance their overall well-being once in our care. Each of these animals deserves to be understood and respected, and it is our duty as laboratory animal professionals to do what we can to enrich their lives during their time in research.

Definitions

Allogrooming: or social grooming; activity in which individuals in a group clean or maintain one another's body or appearance

Eusocial: the highest level of social organization in a hierarchical classification; a truly social group

Stereotypy: a repetitive or ritualistic movement and/or posture

Acknowledgements

The author would like to thank Mr. Xavier D'Souza, Ms. Alison Dias, Mr. Andrew Gristock, Dr. George Harapa, and Mr. Norman White from the University of Toronto; and Ms. Karena Thek from Bio-Serv.

References

http://www.nal.usda.gov/awic/pubs/enrich/birds.htm

http://www.nal.usda.gov/awic/pubs/enrich.htm

http://www.nal.usda.gov/awic/pubs/enrich/rabbits.htm

http://www.nal.usda.gov/awic/pubs/enrich/rodents.htm

http://labanimals.awionline.org/Lab_animals/biblio/atw5.html

http://chemse.oxfordjournals.org/content/26/2/223.full

http://www.bio-serv.com/Rodent_Enrichment_Devices/Mouse_Huts.html

http://www.bio-serv.com/Rodent_Enrichment_Treats/F5136.html

http://www.enrichment.org

Dukas, R. and Mooers, A. "Environmental enrichment improves mating success in fruit flies". *Animal Behaviour*. 2003. Vol. 66, pp. 741-749.

Froberg-Fejko, Karen M. "Designing enrichment strategies when considering primate behaviour". *Lab Animal.* November 2009, pp. 382-383.

Froberg-Fejko, Karen M. "Benefits of providing nesting material as a form of environmental enrichment in mice". *Lab Animal.* October 2010, pp. 326-327.

Turner, Tracy. "Enrichment of Carneaux pigeons used in behavioural learning research". *Lab Animal.* February 2010, pp. 40-41.

CCAC guidelines—various species

Enrichment SOPs from University of Toronto

1. *http://www.animalenrichment.org*
2. Reinhardt, V. and A. (2006). *Variables, Refinement and Environmental Enrichment for Rodents and Rabbits Kept in Research Institutions—Making Life Easier for Animals in Laboratories*. Animal Welfare Institute.
3. *http://issuu.com/gr8tt/docs/er2*

Author Biography

Alison R. Weller, ACT, RVT, RMLAT, ZAT is the Vivarium Supervisor at the University of Toronto Mississauga animal care facility. She graduated from the Animal Care Technician program at Sheridan College (Brampton, ON) in 1998, the Veterinary Technician program at Seneca College (King City, ON) in 2000, and the Zoological Animal Technician program from the Alberta Business and Education School (ABES) in 2010. After working in several small animal and emergency practices, Alison began her career in laboratory animal science in 1999, and received her RLAT in 2001 through the Canadian Association of Laboratory Animal Science (CALAS). One of her biggest academic accomplishments was completing her RMLAT in 2007 through CALAS. An exotic animal enthusiast from a young age, Alison has worked with many different exotic species in her career, and has had a variety of pets at home, including various mammals, reptiles and fish. Her passion and enthusiasm when working with the variety of animal species in her research career started her on the path to learn about enrichment ideas to improve the well-being of the animals under her care. Alison presented a poster on the topic of environmental enrichment at the 2011 CALAS Symposium (Toronto, ON), for which she won the Ehret Talking Poster award. Alison can be reached at *Alison.weller@utoronto.ca*.

Allison Weller and Johnny Mancini, Sales Representative, BIOSCAPE

Mollie A. Bloomsmith, Ph.D.
Yerkes National Primate Research Center, Atlanta, GA

Positive Reinforcement Animal Training in Primate Laboratories

Over the past 20 years, there has been a revolution in how we care for primates living in laboratories, and positive reinforcement training methods have been a major part of this change. Positive reinforcement training (PRT) is a refinement in animal handling methods that can improve animal husbandry, veterinary care, animal welfare, and the value of animals as research subjects.

How Does Positive Reinforcement Work?

When positive reinforcement methods are used, animals are taught to voluntarily cooperate with procedures rather than relying on coercion to get their participation. This type of training is sometimes mistaken as just teaching animals "tricks," for the fun of it. Instead, this approach teaches them to cooperate with a variety of procedures that are a routine part of life for laboratory primates. PRT involves using basic operant conditioning techniques. The animal is presented with a stimulus (such as a verbal cue, "open"), shows the desired behavior (here, opening his mouth), and is reinforced or rewarded (by being given a grape, for example). This process increases the chance that the animal will open his mouth again, when the word "open" is spoken in the future. With an entirely positive reinforcement approach, if the animal chooses not to participate, he is not coerced into participating and there is no negative consequence. In this way, the animal can exercise choice and has increased control over what is happening in his environment. Both choice and control are believed to be important ways of promoting the welfare of captive animals.

What Behaviors Can be Trained?

Laboratory primates have been trained to perform a wide variety of behaviors. Through PRT, they have been taught to move when asked into transfer boxes, from one enclosure to another, and into areas for research testing. This type of trained behavior can improve the ease and efficiency of husbandry and of conducting research with primates.

Primates have been trained to allow careful examination of parts of their bodies such as opening their mouths or positioning hands, feet, chest, back, etc. for visual inspection; positioning ears for examination or for using a tympanic thermometer; using a stethoscope to listen to the heart or lungs; and presenting the perineum area for parasite testing. Some primates have cooperated with having their wounds closely examined and treated with topical medications, and some have cooperated with x-ray procedures. All of these behaviors facilitate veterinary care of the animals.

Training primates to calmly tolerate restraint (such as sitting in a "primate chair") can increase the ease of conducting research studies with primates, and may improve the quality or quantity of data being collected from that subject. Many different biological samples can be collected from cooperating primates, used either for their veterinary care or for research studies. Primates have been trained to voluntarily provide urine samples, fecal samples, and nasal samples. Males have been trained for semen collection and females for vaginal sample collection (see Figure 1).

Laboratory primates have been trained to voluntarily cooperate with receiving intramuscular and subcutaneous injections for anesthesia, antibiotics, vaccinations or research compounds. Blood samples are frequently needed for research studies, and primates can be trained to cooperate with conscious blood withdrawal (see Figure 2). In one case, a chimpanzee cooperated with an astounding seven blood sample collections over a 24-hour period, including waking him up to get a sample at 2:00 AM (Lambeth, personal communication)! PRT can reduce aggression and competition within pairs or groups of primates, and decrease fear or abnormal behavior in some cases. Clearly, primates can be taught a huge range of very useful behaviors.

Can You Prove It?

As PRT has become more prevalent, a growing number of objective assessments of training have been published. These scientific studies are important in ensuring

Figure !. Rhesus monkey voluntarily presenting for collection of a vaginal sample by swabbing. She was trained through positive reinforcement techniques.

Figure 2. Rhesus monkey cooperating with a blood withdrawal procedure. One trainer is holding her leg steady for the other, who is drawing the blood sample.

that we are relying on more than just subjective impressions of how training is working, and that we have more quantified and controlled measurements of the capacities and limitations of PRT approaches. Some of this work has evaluated practical aspects of training, such as how long it takes to weigh a trained marmoset in her home cage (15 seconds is the answer) (McKinley et al, 2003), or how long it takes to teach a rhesus monkey to cooperate with a voluntary blood draw using a "blood sleeve" apparatus (an average of 257 minutes) (Coleman et al, 2008).

Other evaluations have focused on the broader influence that training can have on behavior. PRT can reduce aggression within chimpanzee groups when they are fed (Bloomsmith, et al., 1994), and can reduce macaque aggression toward humans (Minier et al., 2011). Fearful rhesus monkeys have learned to be less fearful by the application of desensitization training techniques (Clay et al, 2009). Training can reduce abnormal behavior during the period of time the trainer is working with the primates (Bloomsmith et al., 1997; Morgan et al., 1993). Training behaviors that are incompatible with stereotyped behavior may also be an effective therapy (Bourgeois and Brent, 2005). In some cases, behavior improved even outside

continued on page 18

of times the trainer is working with the animals (Bourgeois and Brent, 2005; Coleman and Maier, 2010; Pomerantz and Terkel, 2009), but not in all cases where this was tested (Baker et al., 2009; Bloomsmith et al., 1997).

PRT has been shown to reduce physiological measures of stress, and thereby improve animal welfare. Evidence includes reductions in cortisol levels, stress-related abortions, physical resistance to handling, and acute diarrhea (Moseley and Davis, 1989; Reinhardt et al., 1990; Vertein and Reinhardt, 1989). Trained chimpanzees who presented for injections of an anesthetic had significantly reduced physiological measures of stress when compared to those who were anesthetized via chemical darts (Lambeth et al., 2006). Cynomolgus macaques involved in daily PRT sessions showed decreased cortisol measures, as well as diminished hematological and cardiovascular measures of stress when compared to those not exposed to PRT (Koban et al., 2005). This growing body of scientific literature should be carefully reviewed by those who are trying to discern the value of PRT for their own primate management programs. Based on this literature, and on the increasing practice of PRT, clearly PRT is now established as a feasible means of managing and caring for primates. It can be done and it does work. However, there are real obstacles to the broad implementation of PRT.

So Why Isn't Everybody Using PRT, All the Time?

We are beginning to recognize the power that PRT has to improve the welfare of laboratory primates. There is now added incentive to develop PRT programs, as the recent edition of the *Guide for the Care and Use of Laboratory Animals* (National Research Council, 2011) includes many recommendations to incorporate positive training methods into husbandry and research procedures. Despite this, animal training is not yet widely incorporated into primate care and management programs in U.S. primate laboratories. We should ask, what is keeping this from happening?

Surely there are many reasons, but I believe one of the fundamental reasons is the complexity of developing a comprehensive PRT program. PRT itself is deceptively easy. You reward the animals after they do what you want, and they will do it again. It's that simple. One might assume that all that needs to be done is to hire a trainer, and your program would be complete. But to fully incorporate PRT into our primate management programs, many, many things have to change. Change is needed among all staff members working in animal care, veterinary care, behavioral management and research who work directly with the primates. Staff members need to learn training techniques, become competent trainers, be patient and consistent when working with the animals, and refrain from using more traditional techniques with which they are very familiar, and which might work more quickly, but rely on coercion or physical restraint. Change is needed in the way animals are moved for cleaning their enclosures, the way animals are accessed for biological sample collection, and the way they are fed (using PRT to reduce fighting over food, for example, or feeding preferred foods during training sessions rather than in feeding enrichment devices). Facilities may need to be modified to allow access to animals to facilitate training, and equipment may need to be designed, built or purchased (e.g., for collection of blood samples or tunnels for transferring animals). New positions may need to be funded and budgets expanded for training supplies and equipment. Operating systems need to allow people additional time for training, encourage people to communicate about training, and allow people to work together at certain times. New documentation needs to be put in place, with access by people from multiple working groups. Research projects and the grants that fund them may need to alter timelines and budgets to allow the use of PRT. And…IACUC members need to know enough about how PRT can be used in research protocols, so that they can require it when appropriate.

So, while the foundational concept of PRT is uncomplicated, implementing a fully-functioning training program is certainly not easy. This type of change will require time, skill, resources, and concerted efforts from several levels of an organization to be successful. There are two recent publications that describe some of these steps in developing programs and that detail models that might be useful to emulate (Perlman, et al; 2012; Prescott et al, 2005).

Ten Things You Can Do to Get Started

Because of the complexities mentioned above, it can be overwhelming to begin a PRT program. To start, I suggest you begin with some of these practical steps. Whether you are an animal caregiver, a veterinarian, an IACUC member, or a researcher studying primates, there are things you can do which will be small steps toward a fully-fledged PRT program.

1) Read the two articles noted above (Perlman, et al; 2012; Prescott et al, 2005) about the organization and implementation of PRT programs.
2) Send a staff member to a workshop or conference to develop training skills. Support that person in implementing changes.
3) Begin training some of your primates using PRT for some behaviors, even if you can't train all of your primates for everything that would be useful.
For example, perhaps you don't think you can initially train them for voluntary blood collection, but maybe you can train them to be less afraid of the restraint process used in that procedure.
4) Make time in staff members' schedules to do some training, and check up on how it is going. One person's accomplishments can be an important example of how PRT might work at your facility.
5) Document the training that is begun, so you can later answer questions about how long the training required, and what was accomplished.
6) If you have trained primates for research procedures, present your findings to your colleagues. It is especially important that investigators present this information to other scientists working in their own field.
7) Include a plan for PRT in your next grant proposal and as research studies are being designed. Include a description of training techniques used in your next publication.
8) Determine whether your IACUC is reviewing protocols from a training perspective, and, if not, determine a way for that to begin.
9) Assess the current state of primate training at your facility, and map out a plan to expand the program.
(10) Reward someone who has taken the initiative to begin training to improve animal welfare. PRT works on people too!

Conclusion

I believe the value of PRT has been firmly established. A huge variety of behaviors can be trained, and the training can have beneficial effects on animals' welfare, veterinary care, husbandry, and research projects conducted with primates. The next challenge is to figure out how PRT can be used in a more widespread and effective manner. As the laboratory primate community, we need to embrace this challenge and make rapid progress on this very important refinement in caring for primates.

References Cited

Baker, K., Bloomsmith, M.A., Neu, K., Griffis, C., Maloney, M., Oettinger, B., Schoof, V., Martinez, M., 2009. Positive reinforcement training moderates only high levels of abnormal behavior in singly-housed rhesus macaques. J. Appl. Anim. *Welf. Sci.* 12, 236-252.

Bloomsmith, M.A., Lambeth, S.P., Stone, A.M., and Laule, G.E., 1997. Comparing two types of human interaction as enrichment for chimpanzees. *Am. J. Primatol.* 42, 96.

Bloomsmith, M.A., Laule, G.E., Alford, P.L., Thurston, R.H., 1994. Using training to moderate chimpanzee aggression during feeding. *Zoo Biol*. 13, 557-566.

Bourgeois, S.R., Brent, L., 2005. Modifying the behaviour of singly caged baboons: evaluating the effectiveness of four enrichment techniques. *Anim. Welfare* 14, 71-81.

Clay, A.W., Bloomsmith, M.A., Marr, M.J., Maple, T.J., 2009a. Habituation and desensitization as methods for reducing fearful behavior in singly housed rhesus macaques. *Am. J. Primatol*. 71, 30-39.

Coleman, K., Maier, A., 2010. The use of positive reinforcement training to reduce stereotypic behavior in rhesus macaques. *Appl. Anim. Behav. Sci.* 124, 142-148.

Coleman, K.L., Pranger, L., Maier, A., Lambeth, S.P., Perlman, J.E., Thiele, E., Schapiro, S.J., 2008. Training rhesus macaques for venipuncture using positive reinforcement training techniques: A comparison with chimpanzees. *J. Am. Assoc. Lab. Anim. Sci.* 47, 37-41.

Koban, T.L., Miyamoto, M., Donmoyer, G., Hammar, A., 2005. Effects of positive reinforcement training on cortisol, hematology and cardiovascular parameters in cynomolgus macaques (Macaca fascicularis). *Am. J. Primatol*. 66, 148.

Lambeth, S.P., Hau, J., Perlman, J.E., Martino, M., Schapiro, S.J., 2006. Positive reinforcement training affects hematologic and serum chemistry values in captive chimpanzees (Pan troglodytes). *Am. J. Primatol.* 68, 245-256.

McKinley, J., Buchanan-Smith, H.M., Bassett, L., Morris, K. 2003. Training common marmosets (Callithrix jacchus) to cooperate during routine laboratory procedures: Ease of training and time investment. *J. Appl. Anim. Welf. Sci*. 6, 209-220.

Minier, D.E., Tatum, L., Gottlieb, D.H., Cameron, A., McCowan, B., 2011. Human-directed contra-aggression training using positive reinforcement with single and multiple trainers for indoor-housed rhesus macaques. *J. Appl. Anim. Behav. Sci.* 132(3-4), 178-186.

Morgan, L., Howell, S.M., and Fritz, J., 1993. Regurgitation and reingestion in a captive chimpanzee (Pan troglodytes). *Lab Animal* 22, 42-45.

Moseley, J.R., Davis, J.A., 1989. Psychological enrichment techniques and New World monkey restraint device reduce colony management time. *Lab Animal* 18, 31-33.

National Research Council, 2011. *Guide for the Care and Use of Laboratory Animals*, eighth ed. National Academies Press, Washington, DC.

Perlman, J.E., Bloomsmith, M.A., Whittaker, M.A., McMillan, J.L., Minier, D.E. and McCowan, B. (2012). Implementing positive reinforcement animal training programs at primate laboratories. *J. Appl. Anim. Behav. Sci.* 137(3-4): 114-126.

Pomerantz, O., Terkel, J., 2009. Effects of positive reinforcement techniques on the psychological welfare of zoo-housed chimpanzees *(Pan troglodytes).* *Am. J. Primatol.* 71, 687-695.

Prescott, M.J., Bowell, V.A., Buchanan-Smith, H.M., 2005. Training of laboratory-housed non-human primates, part 2: Resources for developing and implementing training programmes. *Animal Technology and Welfare* 4, 133-148.

Reinhardt, V., Cowley, D., Scheffler, J., Vertein, R., Wegner, F., 1990. Cortisol response of female rhesus monkeys to venipuncture in homecage versus venipuncture in restraint apparatus. *J. Med. Primatol*. 19, 601-606.

Vertein, R., Reinhardt, V., 1989. Training female rhesus monkeys to cooperate during in-homecage venipuncture. *Laboratory Primate Newsletter* 28, 1-3.

Tiffany Holberg, RVT
Animal Emergency & Referral Associates, Fairfield, NJ

Guinea Pig Housing and Enrichment

The Guide for the Care and Use of Laboratory Animals states "All animals should be housed under conditions that provide sufficient space as well as supplementary structures and resources required to meet physical, physiologic, and behavioral needs." It continues to say that if these needs, as well as having an enriched environment to stimulate species-specific behaviors, are not met, it may lead to "abnormal brain development, physiologic dysfunction, and behavioral disorders that may compromise both animal well-being and scientific validity." Since the welfare of the animals is always the main concern of any laboratory setting, it is important to understand what type of environment and species typical behavior guinea pigs exhibit.[1]

The *Cavia porcellus*, commonly known as guinea pigs, are social animals and prefer close contact with others; therefore, pairing or group housing is ideal. Communication occurs through a wide range of vocalizations that express contentment, presence of food, anger, anxiety, or potential threats. Most of a guinea pig's time is spent grooming, feeding or exploring their environment. If a threat is perceived, they will employ one of two defense mechanisms: either they will flee to a hiding place or they will stand completely still until there is no longer a threat.[2]

The Guide for the Care and Use of Laboratory Animals gives specific space requirements for guinea pigs, but does not give restrictions on the type of caging guinea pigs should be housed in; therefore, this gives facilities the opportunity to explore different caging systems. The question of whether anyone has experience housing guinea pigs on the floor was posted on three different LinkedIn groups and received numerous helpful insights. Several people were successful in housing guinea pigs on the floor or knew colleagues who had been successful. There were also suggestions of using kiddie pools which were inexpensive but not easily sanitized[3], Rubbermaid containers that were inexpensive but could be difficult to sanitize[4], racks designed specifically for guinea pigs which could be costly if not already available at a facility[4], or the traditional shoe box cage system, which is most commonly used in the research industry. Each system has its pros and cons for sanitation and cost, which would need to be weighted to what the facility needs.

Patrick and His Toys

Butters and Dibby

Photographs courtesy of Jennifer Fullam

The LinkedIn groups also had great suggestions for enriching the environment of whichever cage system a facility might choose to use. Other than the typical toys that are sold on toy company websites like plastic dumb bells and guinea pig huts, other suggestions included adding alfalfa hay[3], wooden blocks[3], PVC pipe cut into different lengths[3] and altered mouse cages with openings to a hut[3]. The most important aspect is to try and mimic the natural environment and encourage species typical behavior; therefore, creativity should be encouraged. As long as all regulations and guidelines are being met, the possibilities for enrichment and caging systems are endless.

References

1. National Research Council of the National Academies. *The Guide for the Care and Use of Laboratory Animals*, Washington, D.C.: The National Academies Press, 2011. Pages 50-51

2. Hixon, Jordan. "Cavia Porcellus: Guinea Pig." Animal Diversity Web. Accessed September 10,2012. *http://animaldiversity.ummz.umich.edu/site/accounts/information/Cavia_porcellus.html*

3. "Laboratory Animal Science" LinkedIn Group

4. "Enrichment Record" LinkedIn Group

Darren Minier, John P. Capitanio, Daniel Gottlieb, Brenda McCowan

California National Primate Research Center, University of California, Davis

One Size May Not Fit All:

The importance of Taking an Individual Differences Approach to Behavior Management

The idea that a captive animal's behavioral and psychological needs are important, not only for the animal's own well-being but also for increasing the validity of the data contributed by that animal, forms the basis for the field of behavior management. Historically, the field of behavior management has tended to focus on mitigation, or the elimination of specific unwanted behavior in captive animals. Though strategic in its practices and effective in reducing many forms of stereotypy or aberrant forms of behavior, provision of environmental enrichment (Figure 1) and use of techniques like behavior modification and conspecific socialization, have not been able to ameliorate all unwanted behavior in all animals. Because of this, increased focus has been placed on preventing the development of aberrant and self-injurious behavior. Regardless of whether the focus is mitigation or prevention, however, the biopsychological mechanisms driving aberrant behavior are not always clear, and even when they are, variation in such mechanisms (e.g., neurotransmitter levels) may be outside the detection capacity for typical animal managers. Most often, our decisions must be made only on the animal's observable behavior (e.g., presence of stereotypic behavior), and on what we know to be risk factors for abnormal behavior (nonsocial housing).

Photo courtesy of K. West

Figure 1: An indoor housed rhesus monkey receives feeding enrichment via a puzzle tube.

Just as a given treatment may not be effective in mitigating abnormal behavior in all animals that display it, it is clear that not all animals exposed to certain conditions are equally at-risk for development of aberrant behavior. For instance, some animals appear to cope well with situations commonly encountered in captivity, whereas others seem to be prone to exhibiting poor health and behavioral problems [Mason and Rushen 2006]. Identifying the individuals most likely at risk for poor welfare would allow managers to target and customize behavior management methods. Over the past decade, we, at the California National Primate Research Center, and others at other primate facilities, have had a growing focus on identifying individual difference factors in primate physical characteristics and behavioral dispositions (i.e., personality) that can be used to further refine behavior management practices. The following summary of our (and others') work attempts to identify an "individual differences" approach to behavior management.

By far, the most enriching contingency we can offer our animals is species-appropriate social companionship both during development and later in life (Figure 2). For example, we have found that rearing infants with their mothers or with multiple conspecifics can reduce the development of deleterious behavior (e.g., self-injurious behavior) by 90% compared to monkeys reared by humans in nurseries [Rommeck et al. 2009]. However, this practice of social rearing is not a panacea, as early social deprivation (e.g., nursery-rearing) is not the only cause of abnormal behavior in primates. Normally-reared adult monkeys, transferred into individual housing where they have visual, auditory, and olfactory contact, but not physical contact with conspecifics, can develop aberrant and deleterious behavior even if they were socially reared [Novak et al. 2012]. In general, our findings show that social rearing and

continued on page 22

continued from page 21

Photo courtesy of K. West

Figure 2: Two adult male rhesus monkeys experiencing daily socialization; note the open door between the two cages.

conspecific interaction are the best, but not perfect, mitigators of abnormal behavior.

As suggested above, however, not all animals respond equally to social and nonsocial housing situations. For example, monkeys housed individually are much more likely to develop both motor stereotypy and self-injurious behaviors compared to monkeys housed socially, with individuals at increasing risk for developing the behaviors with each year of their life spent in individual housing [Lutz et al. 2003; Shapiro et al. 1996]. But there are well-known individual difference factors such as sex and age that influence the development of abnormal behavior: Females are less likely than males to develop stereotypy [Lutz et al. 2003; Novak 2003; Rommeck et al. 2009], and rate of stereotypy has been shown to decrease with age [Lutz et al. 2003]. Almost certainly, other factors, including differences in genetics and physiology (e.g., HPA axis) will be found to influence which animals might be at greater risk than others.

But again, even within homogenous categories of sex or age (or even genotype), why do some individuals fail to normalize even when they have been socially reared in complex environments, and have few other risk factors? We believe the next step in refining the management of captive animals involves understanding the role played by broad psychological dispositions (often referred to as temperament or personality) in well-being. In some cases, we expect that there may be simple relationships between particular characteristics (e.g., anxiety) and negative behavioral outcomes. We suspect, however, that outcomes are more likely to be a joint function of the individual's characteristics and the individual's experiences.

For instance, in a recent study, we examined records of animals that had been noted to display motor stereotypy (e.g., pacing, flipping, twirling) when housed in indoor cages, and compared them to animals that did not display stereotypy. We tried to determine whether, after statistically accounting for known risk factors (e.g., age, sex, amount of time spent in single housing, early rearing environment), temperament was an additional explanatory variable in determining which animals displayed stereotypy and which did not. By itself, temperament was not a significant explanatory variable. However, there were significant interactions between temperament and early rearing. For example, animals that had a "nervous" temperament (characterized as fearful, nervous, timid, not calm, and not confident) had a significantly increased risk of displaying motor stereotypy, but only if they had also been reared indoors (either in a nursery or individual with mother) for their first several months of life. Equally "nervous" animals that had been reared in our outdoor colony did not show an increased risk of developing stereotypic behavior [Vandeleest et al. 2011]. In other studies, we've shown that animals with a nervous temperament tend to respond to challenges (especially human challenges) with negative emotional behavior (Capitanio et al., 2011), and indoor animals in particular tend to show considerable fearful behavior in response to a human "intruder". It's possible that with continued indoor housing, animals with a nervous temperament try to manage their emotional behavior through display of potentially anxiety-reducing behavior such as motor stereotypy [Mason and Latham 2004].

Further evidence of the role of temperament comes from a recent investigation that evaluated both environmental and individual level predictors of aberrant and deleterious behavior. This study found that given an animal's environmental history (e.g. rearing condition, years socially housed, sex), personality measures further predicted the expression of stereotypy [Gottlieb et al, in preparation]. Together, these studies inform us that individual differences in temperament are an important consideration in behavioral management, and with further investigation can help explain why only some individuals in captivity develop high rates of stereotypy. It is worth noting a significant aspect of these studies: the assessment of temperament was conducted when the animals were infants—at 3 to 4 months of age—but the measurement of abnormal behavior took place years later. Temperament is a component of an individual's psychological make-up; it is present early in life and, for the most part, "remains" with the animal as it ages. Knowing that an animal is at-risk for development of a poor behavioral outcome, because it possesses a particular personality trait, can be useful information when making management decisions.

Lastly, how an individual responds to human interaction can be as important as how they interact with conspecifics, and, with continued investigation, may be able to inform an individual's risk for poor well-being. In another recent study, we looked at how an individual's behavioral profile, assessed in infancy, corresponded with their responses during two types of training, positive and negative reinforcement [Minier et al. Submitted], administered when animals were adults. In general, monkeys characterized in infancy as "active" were more responsive to training overall; whereas monkeys characterized as "emotional" exhibited behavioral extremes (such as high aggression or fear) during training sessions. Individuals characterized as emotional in infancy also responded aggressively when confronted with a novel person outside of the training context. These results suggest that individual traits influence the quality of human-animal interactions, and likewise the efficacy of an operant contingency, as animals characterized by different behavioral profiles show differential responses toward familiar or unknown humans. (We note that, regardless of the interaction between personality and the training conditions, our results indicate greater willingness to cooperate with people when positive reinforcement methods were employed.)

Much of the information presented here shows not only the dynamic relationship that personality maintains with an individual's environment, but the daunting task behavior managers have in identifying efficacious methods of preventing aberrant and unwanted behavior. Our focus, then, is to continue to identify character traits which most likely place an individual at risk for poor welfare, and to create accessible tools which would allow managers to easily identify such animals, and target and customize preventative management methods.

References

Capitanio, J.P., Mendoza, S.P., Cole, S.W. Nervous temperament in infant monkeys is associated with reduced sensitivity of leukocytes to cortisol's influence on trafficking. *Brain, Behavior, and Immunity*, 2011, 25, 151-159.

Gottlieb DH, Capitanio JP, McCowan B. In Preparation. Risk factors for stereotypy and self-abusive behavior in rhesus macaques (Macaca mulatta); evaluation of how abnormal behaviors are predicted by an animal's history, current environment, and personality.

Lutz CK, Well A, Novak MA. 2003. Stereotypic and self-injurious behavior in rhesus macaques: A survey and retrospective analysis of environment and early experience. *American Journal of Primatology* 60(1):1-15.

Mason, G.J., Latham, N.R. 2004. Can't stop, won't stop: Is stereotypy a reliable animal welfare indicator? *Animal Welfare* 13: 57-69.

Mason G, Rushen J. 2006. *Stereotypic Animal Behavior: Fundamentals and Applications to Welfare, 2nd Edition*. Cambridge, MA: CAB International.

Minier DE, Capitanio JP, Hannibal D, Sharpe N, McCowan B. Submitted. Preliminary effects of individual behavioral profiles on two types of behavioral conditioning in rhesus monkeys. *Applied Animal Behavior Science*.

Novak MA. 2003. Self-injurious behavior in rhesus monkeys: New insights into its etiology, physiology, and treatment. A*merican Journal of Primatology* 59:3-19.

Novak MA, Meyer JS, Lutz CK, Tiefenbacher S. 2012. Deprived Environments: Developmental Insights from Primatology. In: Mason G, Rushen J, editors. *Stereotypic Animal Behavior: Fundamentals and Applications to Welfare, 2nd Edition*. Cambridge, MA: CAB International. pp. 153-189.

Rommeck I, Gottlieb DH, McCowan B, Strand SC. 2009. The effects of 4 nursery-rearing strategies on infant behavioural development in rhesus macaques (Macaca mulatta). *American Association for Laboratory Animal Science* 48:395-401.

Shapiro SJ, Bloomsmith MA, Suarez SA, Porter LM. 1996. Effects of social and inanimate enrichment on the behavior of yearling rhesus monkeys. *American Journal of Primatology* 40(3):247-260.

Vandeleest JJ, McCowan B, Capitanio JP. 2011. Early rearing interacts with temperament and housing to influence the risk of motor stereotypy in rhesus monkeys *(Macaca mulatta). Applied Animal Behavior Science* 132:81-89.

Author contact: *jpcapitanio@ucdavis.edu*

Casey Coke-Murphy, M.A., RLATG

Vanderbilt University Medical Center—Environmental Enrichment Coordinator, Division of Animal Care
PrimGen—Nonhuman Primate Behaviorist, Consultant

I look forward to the day when Environmental Enrichment Coordinators will become obsolete, because Environmental Enrichment will be the norm, no questions asked!

Award winning author, presenter, trainer, consultant, half-marathon runner and ice hockey player, Casey Coke-Murphy is totally dedicated to developing, implementing, and supervising Environmental Enrichment Programs for all lab species housed at Vanderbilt University Medical Center (VUMC). She also develops and implements all associated SOPs, consults for VUMC IACUC on enrichment, behavior and social housing for all species, assists principal Investigators, and trains animal care and research personnel as well as laboratory animals.

As Nonhuman Primate Behaviorist and Consultant at PrimGen, LLC, Illinois, Casey develops environmental enrichment plans for Nonhuman Primates, environmental enrichment SOPs, species-specific training materials and assists with client development & IACUC semi-annual inspections.

Casey's independent research projects focus on rodents, canines & nonhuman primates. She has worked with macaques (rhesus, bonnet & cynos), squirrel monkeys, owl monkeys, marmosets, galagos, tree shrews, cats, dogs, pigs, ferrets, small animals and rodents and is committed to providing the best animal care, giving animals some measure of control over their environment, reducing the number of animals used and increasing the validity of data.

Casey began her undergraduate studies at the University of Colorado, majoring in Molecular and Developmental Biology. Because her Mom died

of cancer when Casey was 16, she decided to pursue a career as a doctor. But…her plans and major were changed by Dr. Michelle Sauther, a professor who enlightened Casey about primate behavior, "I was taken with the subject from that moment on," she says.

Casey was also inspired by Dr. Carol Berman, her advisor at SUNY Buffalo, who recommended she pursue a career in enrichment and behavior of lab primates after completing her Masters. In 2002, Casey received her Masters degree in Anthropology, focusing on *Alloparental Care in Nonhuman Primates: An Integrated Approach*.

And then…she was ready to experience animals in the wild. Casey accepted the position of Field Research Assistant in Madagascar. For 7 months, she studied and worked with Silky Sifaka Prosimians at Marojejy National Park.

Prior to accepting her current positions, Casey was a Behaviorist & Applied Behavior Workshop leader at Primate Products, Inc. in Immokalee, FL. In this position, she worked with rhesus and cynomolgus macaques, squirrel monkeys, and owl monkeys, developed, implemented and supervised Environmental Enrichment Programs for Nonhuman Primates and created and led the Applied Primate Behavior Workshop, acclaimed by specialists in the field who said her workshop was memorable.

In 2010, Casey and her colleague, Gregg Stanwood, Ph.D. received an AAALAC International Special Projects grant to study the effects of enrichment on neurobehavior in mice. She presented the data, *Environmental Enrichment and Anxiety State in Laboratory Mice*, at the *2012 Enrichment Extravaganza* in Atlanta. Her next presentation will be at the AALAS national meeting in November. Conclusions will be published in 2013.

Casey's enrichment work improves animal welfare by helping animals and animal care technicians to interact positively and establish good rapport. With good rapport between animals and technicians, both animals and personnel benefit. "I'm also a facilitator," she says. "I rely on my background in research, clinical services and operations to help facilitate conversations between researchers and animal care personnel to ultimately reach the research goals. Collaboration pushes us in the right direction—increased scientific validity through increased animal welfare."

When she's not totally focused on environmental enrichment, Casey enjoys spending time with her husband, Ryan, who works for the National Predators hockey team as a member of the ice crew, son Jack, 2, who is also a hockey-lover, especially of pucks and a net, and Folsom (as in Johnny Cash's *Folsom Prison Blues*), a basset hound, who is a dear member of the family.

The Enrichment Record

The Enrichment Record is a quarterly E-Zine created by the Laboratory Animal Research Community as an online forum for:

Discussing environmental enrichment in the optimal care of laboratory animals

Documenting best practices

Sharing data on the impact of environmental enrichment on the science

Building the case for integrating enrichment into research design

HAVE YOU HEARD?

The Enrichment Record is now delivered directly to 30,000 animal research professionals around the world.

Thanks to VBI's generous commitment to open discussion about environmental enrichment for laboratory animals, *The Enrichment Record* can greatly expand its reach and ability to increase community engagement at every level.