

Environmental Enrichment

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It is likely that every research/animal use review committee in the world currently gives some consideration to environmental enrichment. We have come a long way, but we are not there yet!

This topic is indeed timely for *ILAR Journal* readers. However, not too many years ago, it would have been unlikely that readers of a publication from The National Academies would have been interested in the subject. Finding authors with expertise who were willing to devote time preparing manuscripts would have been equally unlikely. Nevertheless, we have been gratified by the positive responses of a plethora of respected authors who have contributed manuscripts. In addition, even with 12 contributions, we necessarily risk omitting timely topics because the field of environmental enrichment has grown to enormous proportion. Although the field of animal behavior is quite old, its application to research animals has evolved only in very recent times. To describe this time frame in more detail, I provide the following personal anecdotal background.

In the early 1960s, I was assigned to an Air Force primate facility in Texas. We imported, used, and bred primarily rhesus monkeys. I vividly remember telling the care staff that the monkeys were not pets and should not be named. Using names, I thought, was unprofessional. The colony was therefore composed of such names as K21 and M14 (with the exception of our two NASA space celebrities, Mr. and Mrs. SAM), hardly names with which to become endeared.

I now reflect on a presentation I gave to the inaugural meeting of the Texas Branch of the (then) Animal Care Panel. I remember it for two reasons: (1) President Kennedy's assassination, in Dallas; and (2) the topic of my presentation, "Monkey Eyes." We mourned Kennedy's death, but we respectfully continued with the program. Monkeys' eyes, I argued, revealed important information about the well-being of the animals. With practice, it was possible to know whether the animal was fearful or ill. To

look at a monkey's eyes, it was logical and necessary to be close enough to the animal to observe behavioral or physical changes, a process that enhanced the probability of identifying health changes or stress. I am certain that I belabored the point, but I now realize that although I argued against naming animals, I also argued for observing them very closely.

In subsequent years, I became aware that my two convictions were contradictory. Had I paused to read the eyes of care staff members, I could have read their stress in the matter. To be a good husbandman, as any dairyman or rancher knows, one must become intimately aware of the subtle differences in behavioral expressions among the animals. Furthermore, to gain such awareness, one must spend time with the animals, which increases the opportunity and likelihood of establishing a positive rapport, or bond.

Unfortunately, by holding to my ill-conceived conception of professional ethics and not allowing monkeys to be given names, I helped to prevent the establishment of bonds between the animals and the care givers and thereby unknowingly prevented the care staff from providing the conscientious observations that I prescribed at the Animal Care Panel meeting. It is also unfortunate that my thoughts about this matter during the 1960s and -70s did not differ significantly from those of other veterinarians, scientists, or administrators. Our job was to house and use animals humanely, as we then knew it; and we worked to avoid the formation of any type of emotional bond between animals and people. In fact, it was commonly thought that such emotionality could jeopardize the science in which the animals were used.

The "logic" described above reflected the prevailing public sentiment in 1966, when Congress passed the Animal Welfare Act (AWA 1966). The early Act, which focused primarily on stolen dogs and cats, was not considered a threat to most research facilities. However, as time progressed, amendments and regulations were added, which began to encroach on research programs. By 1985, with the added mandates regarding exercise for dogs and psychological well-being for nonhuman primates (AWR 1985), Congress became deeply involved with the behavior and well-being of research animals, a fact of life not accepted well by many research entities.

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In this issue, authors Kulpa-Eddy, Taylor, and Adams (Kulpa-Eddy et al. 2005) place these events in historical perspective and develop the foundation for further discussion of environmental enrichment of all research animals. As indicated above, the federal requirements for exercising dogs and housing to enhance their respective psychological well-being (PWB¹) did not immediately settle well with researchers. The terms “exercise” and “PWB,” as applied to research animals, were foreign and many thought ill conceived. That feeling persists to a certain extent because the terms are relatively undefined, different research facilities view them differently, and some reports have even documented that enrichment programs designed to address these requirements have been harmful. Animals have been hurt through strangulation and entrapment in such “enriched” environments, and research has also suffered in some cases.

The invited manuscript of authors Benefiel, Dong, and Greenough (Benefiel et al. 2005) leads the discussion of enrichment in this issue. These authors provide the unique perspective of investigators, who argue both that variability can be very difficult to control between laboratories and that small environmental differences can have significant effects on research results. Because changes in the environment induce changes in the behavior of the animals, it is pertinent and necessary to question the degree to which variability affects the research. We must question whether we have given sufficient consideration to the impact of potentially major changes on the research. The authors provide valuable insight and urge caution.

Another perspective is provided by Garner (2005), who cautiously argues that enrichment might have beneficial, rather than negative, effects on scientific outcomes. The benefit might be possible, he suggests, when enrichment is provided that allows the animal to perform species-typical behaviors that return control over the environment and aid homeostasis. When such environments avoid the formation or expression of stereotypical/repetitive behaviors, the result might even involve increased scientific validity, reliability, and replicability. This tantalizing paper utilizes an understanding of human brain function changes in people with abnormal behaviors as a model to study repetitive behaviors of captive animals. Garner concludes this analysis by stating, “Thus, the interrelationships between ARB [abnormal repetitive behavior], brain function, enrichment, and (potentially) other behavioral measures provide a powerful system for exploring the argument that good welfare is good science.”

The need for designing animal facilities that provide the basic needs of shelter, food, water, and a degree of environmental stability has long been appreciated. Currently, however, it is recognized that science also has an ethical responsibility to house animals according to their species-specific needs, and that responsibility invokes the concept

of behavioral and environmental enrichment. Authors in this issue provide different perspectives on the meaning of environmental enrichment, but they all generally agree that it is important for each institution to formulate and accept a meaningful workable definition of the term. Such formulations cannot evolve in a single office because a broad range of players have a stake in the outcome. Players include scientists, animal review committees, care staff, veterinarians, and of course, financial administrators. Balancing the desires of these stakeholders with the well-being of the animals is often a very difficult task. Authors Weed and Raber (2005) reflect on these ongoing discussions and provide valuable insight into this process at the National Institutes of Health.

The perspective and wisdom of those who have worked in both camps are integral contributions to these discussions. For example, approaches that are appropriate for and benefit an animal might not benefit the investigator, and vice versa. No one could help us understand this complexity better than Kathryn Bayne. The author reviews the literature and questions the potential for negative consequences. Her broad, hands-on experience serves her well as she argues both from the perspective of an animal ombudsman and a scientist concerned about the inherent variability caused by changes in environmental conditions (Bayne 2005).

One of the more important considerations of environmental enrichment must extend beyond nonhuman primates and dogs to questions regarding its applicability to other animals (e.g., rodents and rabbits). Because it appears that changing (i.e., “enriching”) the environment of an animal can lead to important behavioral/biological changes, we must question whether these changes factor into the ethical cost:benefit ratio of using these animals in research. Within a research study, change is often a precursor to variability in results; and statisticians teach us that increasing the number (“N”) will reduce the effect of individual variability. Unfortunately, this approach may be very costly and very much at odds with the common goal of reducing the number of animals in research to a minimum.

To address such often-contentious issues with which animal review committees must deal, three sets of authors describe species-related approaches at their respective institutions. Authors Smith and Corrow (2005) discuss many practical issues that should be considered in developing enrichment programs for rodents and rabbits. They not only describe rodents’ chewing and nest-building preferences, but also relate such simple issues to the complex and costly matter of the relationship of enrichment to space. It soon becomes clear that enrichment can be costly. However, when it is managed properly, environmental enrichment is perhaps the ethically humane cost of doing research.

Yet what if the results of enrichment are less beneficial for the animals than we have assumed? Studies have demonstrated that rodents and rabbits choose or “prefer” one environment over another. These preferences may be similar to those of children who choose candy. Children may

¹Abbreviation used in this Introduction: PWB, psychological well-being.

have strong preferences for items that are not good for them. Likewise, it is important to consider the effect of an animal's chosen enrichment on body organs and systems (e.g., the immune system, thymocytes, growth rate, and litter size). Authors Hutchinson, Avery, and VandeWoude (Hutchinson et al. 2005) argue persuasively for learning more about these parameters as we attempt to make ethically responsible enrichment decisions. Author Baumans adds an important European perspective to the enrichment of rodents and rabbits.

To develop enrichment programs and to assess the effectiveness of such programs, it is critically important for all staff members involved in the care and use of the animals to understand the behaviors of the individual species that are housed. Although this concept is simple to write, it is often difficult to apply because it requires an unusual degree of communication and cooperation among the animal review committee, investigators, veterinarian, and animal caregivers. Authors Nelson and Mandrell (2005) provide a logical, team approach for such a program, developed from their own extensive experience with nonhuman primates and from an excellent selected review of the literature. The authors' passion for achieving an ethically driven balance between humane care and quality science is evident as they caution readers to forego the temptation to think anthropomorphically and to construct hypotheses derived from behavioral research.

There can be little doubt that species-specific enrichment strategies would benefit from hypothesis-driven approaches. To accomplish this goal, one must first have data from which to develop a hypothesis and have sufficient knowledge of the species to evaluate positive changes in well-being. One might ask the following questions:

- Is the enrichment actually used, and to what extent does it "benefit" the animal?
- Does it lower or increase abnormal behavior?
- Are these changes transitory or permanent?

Authors Lutz and Novak (2005) address these and other questions in their informative article, which seeks the balance between theory and application.

The use of chimpanzees in research poses numerous unique challenges. Possibly because of the similarity of chimpanzees to humans, an exceptionally high moral code is imposed on the few institutions that house and use these animals for biomedical research. Chimpanzees have been studied extensively in the wild, and those data have provided a wealth of information for application in captive colonies. Most chimpanzees are housed socially, which is consistent with perhaps the single most important aspect of their very social life. In addition, it has been clearly demonstrated that chimpanzees, like aquatic mammals, can be trained to assist in veterinary procedures and routine physical examinations. This information, together with decades of studies in captivity, provides an excellent opportunity for achieving an unparalleled level of health

and well-being for these very special animals. Yet there is still room for improvement. Authors Bloomsmith and Else (2005), both highly skilled primatologists, focus on the state of the science in their essay on behavioral management.

Not to be forgotten, dogs and cats merit special consideration when one discusses enrichment. Based on more than 10,000 yr of social interaction between these species and humans, one would think that few issues would remain unexplored. However, that conclusion is false! Both dogs and cats share the following rare combination of characteristics: They not only are commonly used in laboratory animal science, but they also are the most common household pets. These characteristics serve both as a benefit and as an obstruction to quality care and well-being. Both species receive an abundance of human compassion, and they benefit from considerable human attention in research colonies; however, human "household" knowledge about dogs and cats can be vastly deficient from the ability to provide optimal care for them in research colonies. In this context, authors Overall and Dyer (2005) provide new avenues of thought about enrichment. Here again, they highlight information from a different perspective—in this case, from clinical veterinary medicine. Although they focus on dogs and cats, they also provide a unique perspective regarding other laboratory animals.

This issue of *ILAR Journal* provides valuable points of view about achieving high levels of well-being for animals used for research. The authors provide their analyses based on years of study and on international interactions with others in their respective fields. Collectively, they represent the best in their respective fields of study. We thank them for their thoughtful presentations, which will serve as benchmarks for enrichment for years to come.

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