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Collaborative Enrichment

Jon Coe
Jon Coe Design, Healesville, Australia
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Abstract

Environmental enrichment has evolved from remedial animal therapy to become an important element in an integrated strategy of design and management for captive and domestic animals.

How does environmental enrichment fit into the "big picture?" How should zoos, aquariums and sanctuaries evolve? What goals should they aim for and where does enrichment fit in? Long-term maintenance of physical and behavioural competence, along with genetic diversity, should be our goal. And this should be done in ways both animals and caregivers find rewarding and the public finds memorable, delightful and informative. Enrichment may be thought of as an integrated strategy for developing, expressing and perpetuating an animal's physical and behavioural competence.

Collaboration is essential to advance this evolution, not only among enrichment and training specialist, keepers, designers and managers but also collaboration between people and animals themselves. Trends giving animals from many taxa, terrestrial and aquatic, increasing social and environmental choice and self sufficiency will be illustrated. These advances are discussed with examples of fixed and changeable features and programs, both naturalistic and synthetic, and often interactive, for animals, care givers and the public.

The Competent Animal *Photo: Jon Coe*

Introduction

Reflect for a Moment: *What do you want zoos and aquariums to be like in the distant future and in your dearest dreams?*

Personally, I'd like them all to become unnecessary, extinct. I'd like to see the world as an "unzoo" (Coe 2005), where people and other animals will live in close association based upon mutual benefit, collaboration and choice, rather than captivity and coercion. Exotic animals will still be seen in large contained ex situ sanctuaries, but these would be far less behaviourally confining than anything we see today. Pristine ecosystems will be preserved, of course, and restored ecosystems restocked from zoos, aquariums, sanctuaries and preserves. Free ranging native animals, aquatic and terrestrial, also will be accommodated in and around our houses, farms, towns, cities and coastlines.

How do we prepare for that day? First we must maintain and increase genetic diversity in individual animals and biodiversity in protected and recreated ecosystems. Secondly, and here is where enrichment comes in, we must maintain and increase survival competence, both genetic and behavioural, in captive animals so they are capable of future reintroduction and release. Although regrettably very few species will ever have the opportunities for reintroduction, some a have been successful. Last year "Temara," an orangutan born and raised at Perth Zoo in Western Australia was successfully released among wild orangutans in Sumatra (Cox 2009). What if, as a management goal, we decided to operate our zoos, aquariums and sanctuaries as if all animals were destined for reintroduction? The first thing we'd have to assure is the animal's competence to take care of itself independently or within its social group.

Third we must prepare for a postmodern[1] Eden, where opportunistic species are competent to engage with us in foraging a collaborative and sustainable *accommodation* between, people, plants and animals in our daily lives.

While managing genetics and biodiversity are beyond the scope of environmental enrichment specialists, you are essential to any program to maintain and increase both natural and learned competence in animals whose descendants may some day be released into highly naturalistic ex situ sanctuaries, returned to restored in situ wilds or to post-modern garden cities. And while developing the means and methods for insuring long term behavioural competence, you will be improving the daily well-being of present generations of captive animals.

Let's redefine environmental enrichment. Young (2003 pp.1-2) offers two definitions:

a) *"…environments of captive animals can be changed for the benefit of the inhabitants."*
b) *"…changes to structures and husbandry practices … (to) draw out species appropriate behaviours an abilities, thus enhancing welfare."*

To these I would add:

> *Environmental and behavioural enrichment are strategies integrated into facility design, display and husbandry for developing, expressing, displaying and perpetuating captive animals' innate and learned competence to prosper. Prosperity should be defined in terms of quality and quantity of choices, self-sufficiency and well being; and thus competence for eventual reintroduction to appropriate natural environments.*

Let's define some terms supporting our goals. Let's talk about the **3–Cs: *competence, collaboration* and c*hoice*.**

Zoo, aquarium, and sanctuary animals should have the same evolutionary (natural) ***competence*** as their wild ancestors, but may be lacking the "learned competence" to facilitate their natural instincts and physiological systems. Keepers, trainers and "enrichers" (there doesn't seem to be a short, convenient term for what you do) can champion and teach behavioural competence.

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[1] I define "postmodernism" as it relates to design and operation of animal-related facilities as embodying the emphasis on functionalism of earlier "modern" facilities (example: a primate facility of the 1960s), but also adding elements of whimsy, playfulness or even irony (example: the triple tower chimpanzee habitat at the Primate Research Institute of Kyoto University or the PECO Primate Reserve at Philadelphia Zoo.)

Providing animals with relevant ***choices*** and opportunities reduces stress and improves well-being and self-sufficiency (see Young 2003 p.38 for a discussion on this) provided the animals are allowed and able to make these choices and exploit these opportunities.

Collaboration is an important strategy for helping improve animals' learned competence and ability to access enrichment choices. Collaboration between caregivers and animals includes training and conditioning, encouraging animals to become active partners in their own care. (Laule 1997) Collaboration between and among people (keepers, trainers, enrichers, evaluators, managers, designers and others) is essential to visualize, fund, implement, evaluate and sustain enrichment programs. (Coe 1992) Therefore *collaboration* is the catalyst mediating and optimizing the benefits of *competence* and *choice*. Let me expand on the **3–Cs**.

Natural Competence

All existing species have an evolutional endowment for surviving, a natural competence to find food, shelter, safety and breeding success. Without this competence they would have become extinct. We can provide environments favouring expression of natural competence by simulating environmental conditions in which the species is thought to have evolved.

Learned Competence

Of course, with so called higher species many survival skills are learned form a parent or other con-specifics as well as through trial and error. We can favour development of learned behaviour by using training and conditioning to assist animals in learning competent behaviours and by maintaining species-typical social groups and opportunities such as mother rearing. Equally important is the need to provide this training without becoming a dominant player in the animal's social life and by encouraging independent behaviour.

Encouraging Competent Independence

Animals should be allowed to mature into independence by the caregiver just as a good parent is pleased to watch its offspring mature into a fully functional, independent adult. Incompetence also can be learned. When animals are taught over-dependence, lose or never develop their natural initiative, they may develop learned helplessness. (Young 2003 p.38)

A dependent relationship is formed when animals associate critical needs (food, safety, shelter, companionship and leadership with the care giver. Of course this dominant relationship is convenient for zoo keepers, but is it best for zoo animals? If means were found for the animal to find and process its own food, satisfy microclimate and social needs and appropriate stimulation without apparent (to the animal) association with caregivers or in a kind of collaborative rather than dependent relationship, wouldn't animals benefit?

Encouraging Choice with Built-in Enrichment Features[2]

All of us (humans and other species) move through gradients of choice and opportunity, selecting that which benefits, avoiding that which is uncomfortable or threatening. These choices may be ambient, dietary, physical (both permanent and transitory) or social, to name but a few subjects in this varied universe of possibilities.

"Animals should not be isolated in sterile environments; rather they should be exposed, as much as possible, to the full range of environmental variability that they would find in their natural environment. Light cycles should follow those in the wild, and animals should be exposed to the extremes of temperature and humidity found in the will." (Snowdon 1989)

Ambient Choices: Nature is full of choices in microclimate, light levels, colours, sounds, tastes and other sensory stimuli arranged in constantly changing gradients; high to low, bright to dim, warm to cool, hard to soft and so on. In nature, if an animal is too cool and wet for example, it will move to a warmer, dryer local; if too exposed, it will seek shelter. Yet many captive facilities provide few

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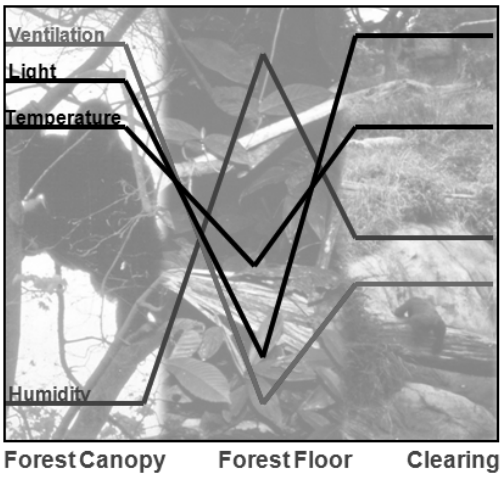
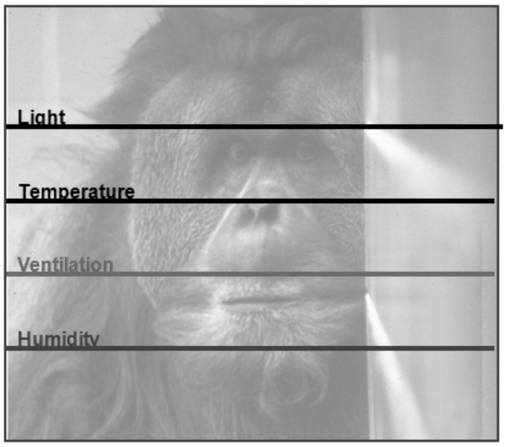
2 See details of some enrichment features Naturalistic Enrichment at joncoedesign.com

such gradients with levels of light, air and water temperatures, ventilation, elevation and hard surfaces mandated by accreditation standards.



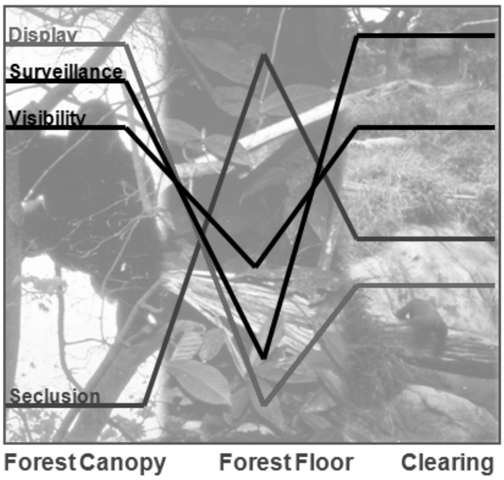
Rainforest Environmental Gradients (hypothetical)



Conventional Primate Holding Micro-Climate Gradients (hypothetical)

Environmental Choices

- Lighting
- Heating and cooling
- Ventilation
- Create gradients and choices



Rainforest Behaviour Opportunity Gradients (hypothetical)

Conventional Holding Behaviour Opportunity Gradients (hypothetical)

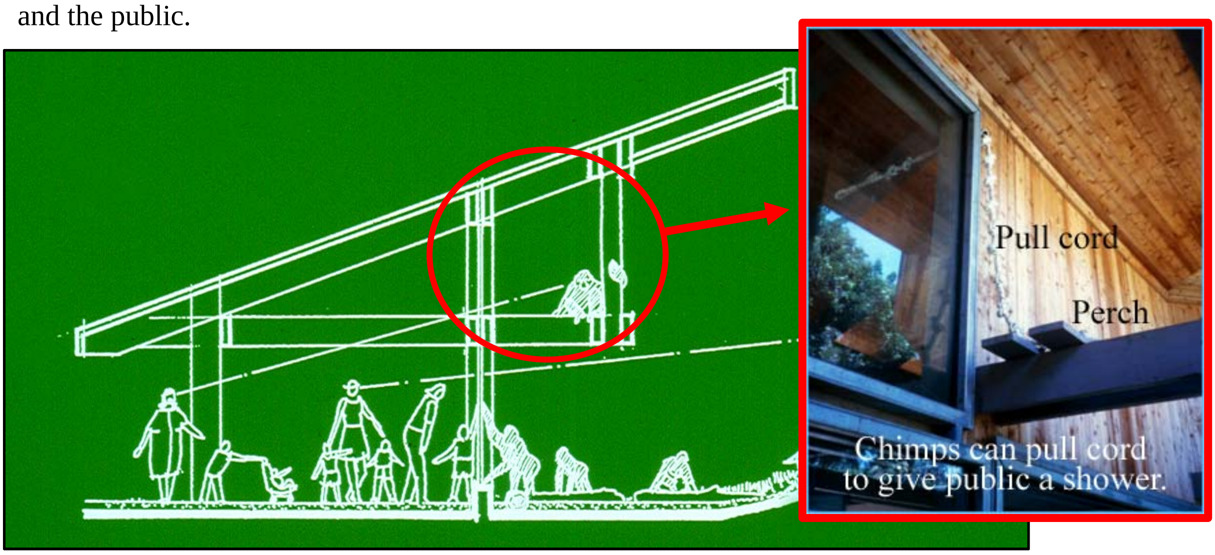
Behavioural Choices

- Display
- Surveillance
- Visibility
- Seclusion

Firstly, animal facilities must be designed to provide ambient gradients from which an animal can choose by moving to the location where the combination of ambient factors best suits its needs. I think aquarists and herpetologist have long known this, but designers of facilities for birds and mammals in zoo, laboratory and livestock industries have focused on the convenience of caregivers over the needs of their animals.

Secondly, animals can be trained to control many of the ambient features of their enclosures. They can activate lights, fans, heaters, colour or sound systems, showers or feeders. (Coe 1995, 1998) Research shows that providing animals with even modest control over their environment reduces stress (Young 2003 p.38) and seems (anecdotally) to be enjoyed by the animals.[3] (Peachey 2009)

Thirdly, animals may be given some control over ambient features of adjacent visitor areas, expanding their sense of choice and control. For a while Los Angles Zoo allowed chimpanzees to ring a bell and activate a mist spray in an adjacent public viewing area as enrichment for both the apes and the public.



At one time chimps at Los Angeles Zoo could pull a cord to give visitors a spray of mist. *Sketch and photo: Jon Coe*

Physical Features shaping the captive environment should be varied and opportunity rich. Critical resources of lasting value to the species, like basking and overlook positions, pools, shelters and food delivery systems should be built-in. They merit permanent status because they are resistant to habituation and will be used constantly. Features subject to rapidly reduced value to the animal through habituation are nevertheless essential and must be changed or exchanged frequently.

Access Choices are also important. Sometimes an animal needs access to a high vantage point to reduce stress or needs to escape from overly aggressive individuals. This need is especially important in mixed-species exhibits. Passive examples include creeps and escape zones accessible to some by virtue of their size or agility, but excluding others. Active examples could include automatic "smart doors" programmed to respond to certain individuals (perhaps reading microchip identification implants[4]) and not to others.

Photo: Jon Coe

[3] This relates to Columbus Zoo elephants activating their own shower in their night quarters.

[4] Hoy et al 2009a developed micro-chip identification technology to operate feeding devices. In rural Australia animal shape recognition software activates gates to control access to water on some ranches. Perhaps a system could be developed for zoo and aquarium animals to activate doors.

O'Line at National Zoo, USA *Photo J. Cohen*

Kyoto University "Triple" Tower Chimp Climbing Structures (15 metres tall) *Photo: Jon Coe*

Physical Fitness and Competence: Maintaining optimum levels of physical fitness for captive animals may be one of, if not the greatest challenge to maintain physical competence. Young (2003 p.127) states: *"At the very basic level, an animal's environment should challenge the animal's body to maintain its physical strength."* He goes on to remind us that many species need motivation and encouragement to exercise even when appropriate space is available. Many of us have seen animals ranging from elephants to alligators that appeared grossly overweight and unfit. Some specialists believe that lack of physical fitness is one underlying reason for general lack of breeding success in captive elephant programs in North American and Europe. (Lee and Moss 2009

Active lion at Bali Safari and Marine Park *Photo Jon Coe*

To help combat this problem I helped the Taronga Zoo in Sydney, Australia design a simulated river meander 60 meters long by 3 wide and 3 deep to provide low impact aquatic aerobic fitness training for their elephants.[5]

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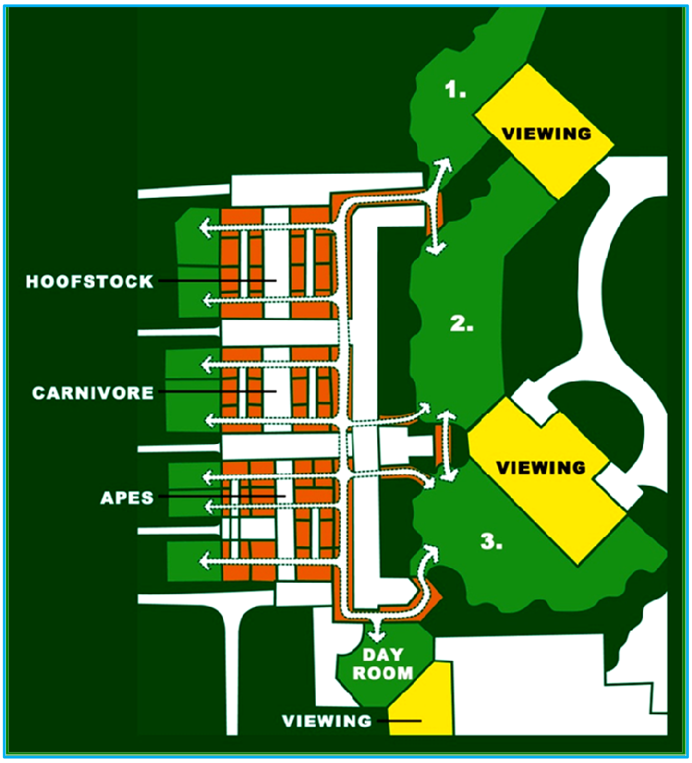
[5] See "Environmental Enrichment for Asian Elephants" for a video of elephants using these features. Click Asian Elephants from the homepage of joncoedesign.com.

Below: Rotation Diagram. *Sketch: Jon Coe*
Top right: Transfer chutes make rotation possible.
Bottom right: Training session held on-exhibit are enriching for both animals and visitors. *Photos: Louisville Zoo*



Rotation Opportunities have been developed at zoos like Louisville Zoo and Pt. Defiance Park Zoo and Aquarium in the United States. (Coe 2004, Walczak 1995) and tested at Zoo Atlanta (Lukas 1995). Animal rotation exhibits may be thought of as consecutive (as compared to concurrent) mixed species habitats. They are interlinked enclosures (numbering from two to over a dozen) in which animals or groups of animals (even compatible mixed-species groups) rotate through a series of enclosures in a "time-sharing" arrangement.

At Louisville Zoo (Herndon 1998) orangutan, siamang, babirusa, tapir and Sumatran tiger rotate through four display areas on a randomized basis in order to provide the animals with greatly expanded (collective) areas and opportunities. Long-term behavioural observations by (White et. al. 2003) show this rotation system is enriching, but activity levels are reduced by habituation over the years.

Rotation exhibits combine varied physical features with access choices. While at present access choices are made by keepers, ways are being considered to allow animals to alternately be given choice of rotation sequence and timing.

Rotation Exhibits for Fish: Gray nurse shark expert Dr. Nick Otway advocates the design of interconnected tanks for this highly endangered and iconic fish species which features prominently in international aquariums. He suggests providing separate display tanks for males and for pregnant females and their young. Otway envisions these tanks being interconnected by a lengthy aquatic raceway in a figure eight shape to be used to mimic a pelagic swimming environment. The sharks would be rotated through these environments in a managed re-creation of the grey nurse sharks' seasonal movement cycles. Of course many other marine species could share these enriched environments with the sharks. (Otway 2009).

Independent Feeding Choices: Animals directly dependent on caregiver's schedules and routines for feeding are apt to become dependent. However, independent choice is encouraged by food or treat dispensing devices which operate randomly or are animal activated. Most enrichers are familiar with simple meal worm or cricket dispensers made from perforated PVC pipe or freezer containers. Julia Hoy (2009a) and her colleagues designed an electronic treat dispenser activated by the animals' microchip identification implant. I conceptualized a food distribution system based upon common irrigation components and a buried "feeder root" for rooting pigs. (Whittaker, Whittaker and Coe 2005) Woodland Park Zoo has arrangements for food fish to "escape" randomly from holding tanks into otter pools. Bears there submerse to catch their own fish.[6] These systems encourage both physical fitness and feeding competence. Loosely hung browse feeders encourage fitness by exercising neck and shoulder muscles as well as independent feeding schedules.

Interactive Recreation Features: Climbing features that tilt and sway naturalistically and tugging or pulling toys that rebound because of elastic attachments somehow seem more lifelike and responsive to animals. The former may also encourage fitness for arboreal animals while the latter would seem to benefit carnivores and species where male rut combat is important.

Elephant Activated Shower at Columbus Zoo. *Photo courtesy of Columbus Zoo*

Self-Activated Recreational Features for Aquatic Animals: Aquatic environments, like terrestrial ones need complex gradients of temperature, velocity and perhaps other characteristics like salinity and oxygen content for animals to move through to meet their needs. Some of these features can be interactive as well. I've observed penguins playing in mechanically generated waves and high velocity underwater jets (tigers enjoy these as well). Other semi-aquatic species like beaver, otter, water rat and platypus may also enjoy them. Perhaps pinnipeds and cetaceans could activate underwater air jets and bubble curtains changing their shape and intensity with learned audio or other signals. Perhaps dolphins, like chimpanzees, could learn to manipulate light levels and other features on the human side of the glass as a form of interactive or even reciprocal enrichment.

It is useful to try to "see" the world as animals do when seeking enrichment opportunities. For example, would aquatic animals like platypus and some fish which sense subtle electromagnetic fields be enriched by encountering or manipulating simple devices producing minute amounts of such emissions?

What's the Message?

Enrichment specialists, like all zoo staff, are obligated to support their institution's public educational goals as well as their own. Appearances have consequences in term of educational message. (Coe 1996) Firstly, the zoo must be clear about the education messages intended for each exhibit. If the "message" (cognitive and affective) is based upon highly naturalistic exhibit

"Habitat immersion" exhibits send a message of the animal's independence and competence.
Photo: K. Andersen

[6] See a video of enrichment by clicking Brown Bears at www.joncoedesign.com

presentations such as “landscape or habitat immersion” (Coe 1985), enrichers should be familiar and sympathetic to this educational philosophy and introduce only objects or animal activities that support the extended overall visitor experience message. In these cases compatible “naturalistic” enrichment features should be used “on exhibit” (Young 2003 p.61) which can easily be accomplished without diminishing enrichment levels as described in my paper 2006 paper “Naturalistic Enrichment”. Good examples provided there include the “babirusa root feeder,” “sway branch,” “elephant river” and “horizontal bungee feeder.”

On the other hand, in off-exhibit areas and exhibits that already look artificial or where the exhibit message is about ex situ animal display and management, in other words most traditional zoos, enrichment features that appear “natural” are suitable, but not essential. For example, the US National Zoo elected to design its Think Tank exhibit around the education message of cognation. (Boda-Bahm 1997) Presenting an orangutan operating a computer to communicate with staff and visitors supports the educational and enrichment goals of the exhibit.

Collaboration with Designers

“Enriched habitats result from an enriching design process. An individual designer, no matter how well informed, cannot match the collective knowledge and creative capacity of a diversified and motivated group. Exhibit design should involve a group, including specialists in ethology, research, training, enrichment, and education, as well as designers and caregivers. Good exhibits are educational and are rich in research opportunities. Animal and staff training help them reach their full potential. Close collaboration can build lasting relationships and mutual respect, insuring the optimal management and modification of the project over time.”

“Observation and evaluation make design a continuous self-correcting process. As a result, behavioural enrichment evolves from remediation to facilitation in the creation of artificial habitats that have diversity and choice…” (Coe 1992)

The entire constructed facility, all display and service areas available to or supporting animals, should be thought of and designed as enriched environments. A fan designed by an engineer may be as enriching as a toy provided by a volunteer. Therefore enrichment specialists, as well as curators and caregivers concerned with enrichment deserve a “place at the table,” a fully collaborative role with designers and managers in the design of new and renovated facilities. However, in order to prepare for this essential role, enrichers also need to think beyond their traditional roles and recognise enrichment opportunities in non-traditional places.

It is also important that all participating in the design process recognise the value of creating safe and enriching habitats and activities for zoo staff and visitors as well as animals.

Photo: Lynn Clarke

Collaboration with Animals

Animals have been exploiting and collaborating with people for a long time. Wild dolphins collaborate with fisherman in Brazil (Pryor 1994) and fraternise with tourists in Australia and the Caribbean. Wild king parrots trained me to feed them on rainy days. I’m sure zoo keepers have many stories of games their animals initiate with them or with zoo visitors. Yet zoo keeping, including environmental enrichment, is usually thought of as something “we” do for “them”. What if this idea evolved into, ”What can we do with them?” and finally into “What can they do for themselves?” Can we change our relationship with zoo animals from dependence to interdependence?

Reciprocal Enrichment

Mutual, reciprocal enrichment is at the heart of the best zoo experiences and I believe is fundamental to establishing bonds between visitors and the animal kingdom. Reciprocal enrichment opportunities can be built into exhibits or be transitory.

Postmodern Animals

Photo Courtesy National Zoological Park

To this point I have discussed collaborative enrichment to maintain fitness for eventual reintroduction. But we must not assume that only behaviours and activities found in wild animals are appropriate. Many opportunistic species have a genetic disposition to learn and adapt to new situations, including exploiting humans. (Low 2003 p.8)

The US National Zoo's Think Tank encourages orangutans to use large computers to communicate with staff and visitors using symbolic language. (Boda-Bahm 1997) As long as twenty-seven years ago, Hal Markowitz taught a mandrill to play use a simple computer to tic-tac-toe with visitors. (Markowitz 1982) Critics of the day condemned such artificial enrichment features as "unnatural" and unnecessary. (Hutchens, Hancocks and Crockett 1984) Today I would respond, who are we to judge what animals should prefer? Why not let the animals decide for themselves? While not "natural" to these species, the primates clearly seemed to find these high-tech pursuits enriching. Chimpanzees seem to thrive in fifteen metre high multistorey "triple towers" at the Primate Research Institute of Kyoto University. (Ueno 2009) If the animals seem to actively engage themselves in such environments and measurably benefit (R. Young 2003 pp.34-35) then they should be provided with opportunities to choose either naturalistic or synthetic enrichment while supporting the intended educational message. And this must be done in ways that also benefit the viewing public, again as a collaborative strategy.

So called "unnatural" activities also may contribute to fitness for eventual release into the wild by encouraging investigative and learning behaviour and contributing to overall complexity of opportunity. Moreover, such post-modern skills would certainly contribute to well-being in the opportunity-rich animal sanctuary, zoo exhibit or back-of-house environments, which are likely to be the long-term future habitats for most zoo animals.

What Went Wrong?

Sometimes seemingly wonderful enrichment features are built into animal areas, yet these are not provided to the animals or facilitated by the keepers. Why not?

Operational Obstacles: In one case chimpanzees were provided built-in food puzzle mazes where they could use small sticks to access food treats, which could be replenished easily from locked cabinets outside the animal area. These were never used, as I understand it, because of a labour union policy prohibiting volunteer enrichment workers from accessing the features.

Philosophical Obstacles: In one example, keepers objected to allowing chimpanzees to ring a bell or operate a mist spray in the public viewing area on the grounds these activities would over stimulate (become too enriching?) for both chimps and visitors.

In a second example, when discussing the design of a large habitat for bachelor gorillas, one curator said, "We don't have to do any of that enrichment stuff do we? Can't the gorillas just be left alone?"

One more example: I have designed a number of elephant displays with large pools for bathing and exercise which were never used by the elephants. In the wild young elephants are taught to swim by their mothers and aunts, yet zoo staff, as parent substitutes never taught their young elephants to use the pools.

These examples illustrate a common philosophical divide. In my experience, zoo staff that most favour highly naturalistic animals displays also favour a "hands-off … just leave them alone" approach to enrichment, as if large naturalistic enclosures were sufficient to insure animals' wellbeing. This philosophy was strongly supported by Hancocks (1980) in the early days of immersion exhibits. But Forthman Quick (1984) showed that both large complex habitats and active enrichment are needed to optimise animal wellbeing.

Budgetary Obstacles: Julia Hoy interviewed enrichment staff and managers in thirty zoos in Australia, the USA and Europe and found that enrichment staff mentioned budgetary constraints more often than their managers did (Hoy 2009b). Is it possible you are limiting yourselves? Or perhaps enrichment funding applications are submitted as special cases or variations, rather than as integrated, embedded programs.

In 1998 the Zoological Society of Philadelphia launched a highly successful fundraising campaign to build their Primate Reserve project. Their US$24,000,000 target included a US$2,000,000 endowment to generate about US$150,000 per year to supplement lifetime operational costs, including support of training and enrichment budgets. Incidentally the campaign also included a US$500,000 primate conservation endowment. (Zoological Society of Philadelphia 1998)

What Is Next?

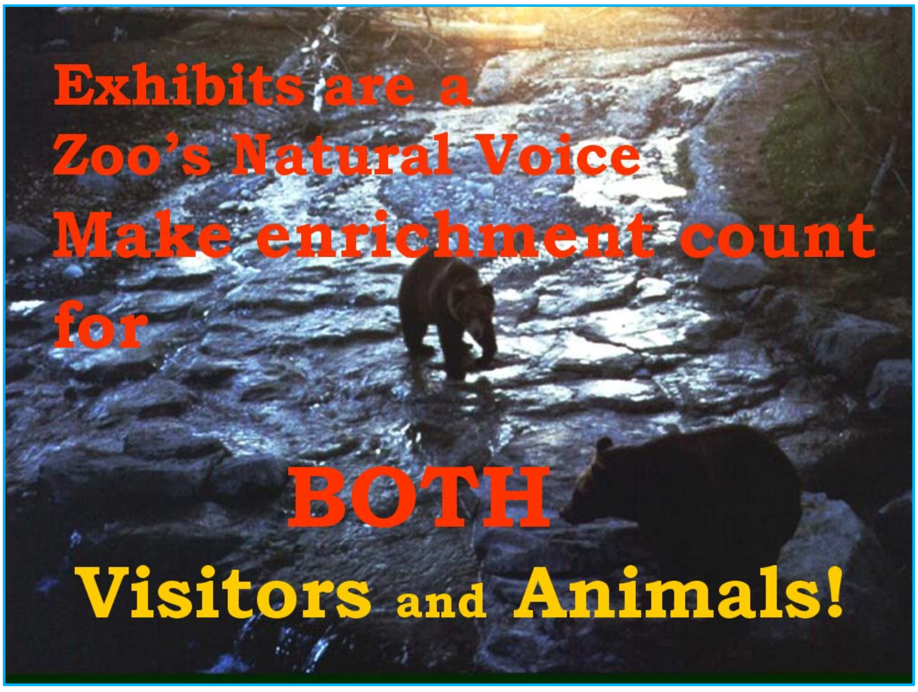
Firstly, animal enrichment specialists should continue along the successful paths being illustrated at this conference.

- Expanding the benefits of enrichment to other taxa like aquatic animals, pets and livestock.
- Organize enrichment activities into coherent, integrated long-term programs including evaluation and publication.
- Network with each other and allied professions.

Secondly, enrichment workers need to become more collaborative.

- Interact more with other staff, managers and designers in the design of new and renovated facilities so that both more built-in enrichment features and better access for changeable features are provided.
- Look more broadly at all aspects of the built and management environment for enrichment opportunities.
- Expand the concept of behavioural and environmental enrichment to encourage not only captive animals but also enrichment for caregivers and visitors.

Lastly, see your important work within the context of a multi-generational strategy to prepare animals and caregivers for a world in which competent animals will be successfully returned to restored ecosystems, near-natural sanctuaries or a new, hardly imaginable generation of zoos and aquariums.



Woodland Park Zoo brown bears fishing for their dinner. *Photo: L. Sammons*

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