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## The Importance of Animal Well-being for Reproduction in Captive

### Abstract

International zoos consider enrichment to be very important, with many reports in the literature confirming the efficacy of interactive techniques used with the exclusive objective of providing a better quality of life, with the consequent well-being and reproductive success of animals held in captivity. It is difficult to measure effectively well-being, but indirect measurements are considered to be reliable, such as physical health, physiological measurements of stress, and presentation of the typical behavioral patterns of the species under study. Techniques of behavioral enrichment are used to reduce the stress caused by captivity, which may manifest through inadequate physiological responses and atypical behavioral patterns for the species, considered to be stereotyped behaviors. As a quantitative parameter of the intensity of stereotypy in an animal, we can monitor the levels of fecal corticoid metabolites. The objective of behavioral enrichment is to improve the quality of care provided to captive animals by the identification and use of the environmental stimuli necessary for the psychological and physical well-being of these animals. In practice, enrichment covers a variety of original, creative and ingenious techniques to keep captive animals busy by increasing the gamut and diversity of behavioral opportunities and by offering more stimulating environments. Through enrichment we can provide choices to an individual about the types of environment to be enjoyed at a given time, the possibility of exploration, unpredictability, control of the environment or diet, socialization, and privacy.

**Key-words:** enrichment, reproduction, well-being, behavioral endocrinology.

Invited Mini-review

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The maintenance and reproduction of wild captive animals have always presented significant challenges in areas such as nutrition, preventive veterinary medicine and appropriate handling for each species. Although considerable progress has been attained in such fields, challenges frequently arise such that the institutions that maintain and help captive wild animals reproduce are prioritizing research regarding aspects of psychological well being. It is a question of global tendency concerning species kept in captivity, threatened or not with extinction.

To Boinski *et al.* (1999), psychological well being is difficult to measure but Novak & Suomi, (1988) and Newberry, (1995) have confidence in certain indirect measures such as physical health, physiological stress measures and the exhibition of behavior patterns typical of the species in focus.

According to Clarke *et al.* (1995), some recent studies examined simultaneously both physiological and behavioral parameters in an attempt to evaluate the psychological well being, for which the level of serum cortisol was the most used physiological parameter.

When the rate of serum cortisol found and the pattern of analyzed behavior present a strong correlation, it is believed that the so called psychological well being can be interpreted in a more trustworthy way than when only behavioral aspects are considered (Broom & Johnson, 1993; Stoskopf & Gibbons, 1994).

To Dantzer & Mormed (1983), enriching behavioral techniques are used to reduce the stress caused by confinement, which can be revealed through inadequate physiological responses, atypical behavioral patterns for the specie, which are considered stereotyped behavior.

Stereotype is a behavior presented in a repetitive and exaggerated manner, with no apparent function or objective, that is frequently associated with tedium, abnormal behavioral function, "sub-optimum" environmental aspects, restricted spaces or social isolation (Mason, 1991; Fox, 1965), motivational conflicts, frustrations, lack of stimulation variability, lack of control of external incentive (Almeida, 1997) and situations of well being reduction (Line *et al.*, 1987).

According to Shepherdson (1998), stereotypes can be quantitative, like hyperactivity, or qualitative, like behavior an individual would not present in nature, such as aimless walking, fake rumination, drinking water in excess, foraging after being fed (Mason, 1991), masturbation, regurgitation followed by reingestion (Gould & Bres, 1986) and fecal feeding (Mason, 1991).

To obtain a quantitative parameter representing the intensity of a stereotype in an animal, we can measure the level of fecal corticoid metabolites. In agreement with Jurke *et al.* (1997) and Whitten *et al.* (1998), we can use an indirect and non-invasive method to measure cortisol through extraction and measurement of fecal corticoid metabolites, which according to them, present a highly positive correlation with the level of plasma cortisol. The levels of plasma cortisol present a strong positive correlation with alterations in the intensity of stressing agents, as shown by Line *et al.* (1987) and

Dettmer *et al.* (1996).

According to Shepherdson (1998), the environmental enrichment results is a recent field of study and application of animal behavioral principles. Such enrichment aims to increase quality in the care of caged animals through identification and by the use of environmental stimulation necessary for the psychological and physiological well being of these animals. In practice it embraces a variety of original, creative and ingenious techniques that keep caged animals occupied by increasing the range and diversity of behavior opportunities as well as by offering a more stimulating natural environment.

Environmental enrichment for captive animals enables them to attain a behavior closer to that possible in their natural habitat, since we believe such stimulation will contribute to their well being. Through enriching we can provide individuals with choices regarding the kind of environment they can enjoy in a particular moment, as well as possibilities of exploration, unpredictability, environmental and diet control, socialization and privacy (Hare, 2000).

The program of behavioral enrichment is designed to identify the signs of stress and behavioral stereotypes shown by animals while permitting action over such alterations through appropriate techniques (Veira & Brent, 2000).

The behavioral enrichment consists of a series of procedures that modify the physical or social environment, increase the quality of life of captive animals, provide them with conditions to meet their ethological needs (Boere, 2001), permit the measurement of their well being, as well as consider environmental effects on their growth and development in captivity (Line *et al.*, 1987).

Newberry (1995) defines behavioral enrichment as an improvement in the biological function of captive animals resulting from modification in their environment. Evidence of improvement in biological functions can be observed through increased life span, reproductive success, aptitudes developed or improved overall health of an individual.

Environments that remind animals of their natural habitat encourage reproductive success and promote the development of specific behavior of species that live in captivity (Hemphill & Mc Grew, 1998).

The environmental complexity of exhibits and the newness introduced have been considered basic elements of enrichment to reduce adverse reactions. Simple structural modifications, changes in daily routines and the socialization itself are measures sufficient to improve psychological status and well-being (Coe, 1985; Boere, 2001).

Modifications in the environment are made in order to improve animal well being; some methods include engaging these individuals in harmless activities instead of repressing them, promoting opportunities that avoid aggression, reducing runaway responses during the handling, diminishing the risk of harming and promoting more activities in order to improve the muscular conditions (Newberry, 1995).

Brent *et al.* (1989) suggest that in order to diminish stereotypes and increase

the behavior of environmental exploration, the following are necessary: social interaction, enlargement of exercise area, introduction of toys and objects. Such measures reduce the stress and minimize the action of external stimuli detrimental to the psychological well being of animals.

According to Newberry (1995), captive animals are generally kept with a limited selection of food types in contrast to the patterns of their natural habitats. Foraging behavior is a predominant activity in free-range animals but is absent in captive animals (Reinhardt, 1993).

In captivity, food stays in an easily accessible place thus minimizing search time and the need to manipulate food. Notwithstanding, the food is served once or twice a day in limited quantities. Such conditions of serving food contribute to the development of some stereotypical behavior pattern in captivity (Newberry, 1995).

Food enrichment consists of making difficult the access to food (Lindburg, 1988), providing smaller amounts of meal more often, dispersing and hiding the aliments in different places pushing the animal to exercise their perceptual and cognitive capacities, increasing the time and skill necessary to obtain or extract the food, obliging them to exercise in order to get nourished; it also consists of varying the food offered in order to maintain animal interest (Newberry, 1995), which is also an efficient way to improve the life quality in captivity (Mckenzie *et al.*, 1986).

According to Bayne *et al.* (1993), toys can be used for behavior enrichment, constituting an economical method of increasing the environmental complexity and diminishing stereotype behavior. The presence of an enriching item can provoke different effects in behavior among individuals, which can vary according to species, age and sex of the animal.

The intelligence and great manipulative capacity of chimpanzees require a complex environment for them. Wild chimpanzees confront several changes that work as environmental stimuli. The lack of environmental complexity or stimuli in captive environments produces inactivity and abnormal behavior in such primates (Clarke *et al.*, 1982).

Social interaction serves to develop and improve animal interrelation with people who take care of them (veterinary, biologist, caretaker) and with the public as well. The professional-animal relationship must be praised and stimulated through training and conditioning which generates a close bond between parties that eases the handling and the clinical procedures (Reichard *et al.*, 1998; Boere, 2001).

By means of enriching techniques the animal can be conditioned to cooperate spontaneously with the veterinary team, facilitating the work and diminishing the stress to animals and caretakers (Reichard *et al.*, 1993).

As indicated by Maki *et al.* (1989), there are a vast number of studies showing degrees to which chimpanzees, gorillas and orangutans are capable of accomplishing complex cognitive operations that approach the reasoning and linguistic faculty of human

beings. Environmental enriching aims to stimulate such processes that provide tasks containing a potential challenge to animal ratiocination.

Boinski *et al.* (1999) demonstrated in brown capuchins (*Cebus apella*) that the introduction of simple environmental enriching techniques reduced significantly the patterns of abnormal behavior or stereotypes and increased normal patterns. Besides that, the author showed that behavior pattern measures and fecal cortisol are recommended as useful and non-invasive techniques to be incorporated in protocols that monitor the psychological well being of such captive animals.

It is well known that most international zoos consider enriching to be very important, corroborating numerous studies found in the literature that affirm the efficiency of interactive techniques used with the sole objective of providing a better life quality and consequently the well being and reproductive success of captive animals.

## References

- Almeida MIF. Estereotipias comportamentais em macacos-aranha no cativeiro. MSc Thesis, Instituto de Psicologia, University of São Paulo, Brazil 1997.
- Bayne KAL, Dexter SL, Hurst JK, Strange GM, Hill EE. Kongâ toys for laboratory primates: are they really an enrichment or just fomites? *Lab Animal Sci* 1993;43(1):78-85.
- Boere V. Behavior and environment enrichment. In: Fowler ME, Cubas ZS (eds). *Biology, Medicine and Surgery of South American Wild Animals*. Iowa: University Press; 2001;263-6.
- Boinski S, Swing SP, Gross TS, Davis JK. Environmental enrichment of brown capuchins (*Cebus apella*): behavioral and plasma and fecal cortisol measures of effectiveness. *Am J Primatol* 1999;48:49-68.
- Brent L, Lee DR, Eichberg JW. The effects of single caging on chimpanzee behavior. *Lab Anim Sci* 1989;39(4):345-6.
- Broom DM, Johnson KG. *Stress and animal welfare*. London: Chapman & Hall 1993.
- Clarke SA, Juno CJ, Maple TL. Behavioral effects of a change in the physical environment: a pilot study of captive chimpanzees. *Zoo Biol* 1982;1:371-80.
- Clarke AS, Czekala NM, Lindburg DG. Behavior and adrenocortical responses of male cynomolgus and lion-tailed macaques to social stimulation and group formation. *Primates* 1995;36:41-56.
- Coe JC. Design and Perception: making the zoo world real. *Zoo Biol* 1985;4:197-208.
- Dantzer R, Mormed P. The arousal properties of stereotypical behavior. *Appl Anim Ethol* 1983;10:233-44.
- Dettmer EL, Phillips KA, Rager DR, Bernstein IS, Fragaszy DM. Behavioral and cortisol responses to repeated capture and venipuncture in *Cebus apella*. *Am J Primatol* 1996;38:357-62.
- Fox MW. Environmental factors influencing stereotyped and allomimetic behavior in

- animals. *Lab Anim Care* 1965;15:363-70.
- Gould E, Bres M. Regurgitation and reingestion in captive gorilla: description and intervention. *Zoo Biol* 1986;5:241-250.
- Hare VJ. Environmental Enrichment Advancing Animal Care. Universities Federation for Animal Welfare 2000.
- Hemphill J, McGrew W. Environmental enrichment thwarted: food accessibility and activity levels in captive western lowland gorillas (*Gorilla gorilla gorilla*). *Zool Garten* 1998;6:381-94.
- Jurke MH, Czekala NM, Lindburg DG, Milliard SE. Fecal corticoid metabolite measurement in the cheetah (*Acinonyx jubatus*). *Zoo Biol* 1997;16:133-47.
- Lindburg D. Improving the feeding of captive felines through the application of field data. *Zoo Biol* 1988;7:211-8.
- Line SW, Clarke AS, Markowitz H. Plasma cortisol of female rhesus monkeys in response to acute restraint. *Lab Prim Newsletter* 1987;26(4):1-4.
- McKenzie SM, Chamove AS, Feistner ATC. Floor-coverings and hanging screens alter arboreal monkeys behavior. *Zoo Biol* 1986;5:339-48.
- Maki S, Alford PL, Bloomsmith MA, Franklin J. Food puzzle device simulation termite fishing for captive chimpanzee (*Pan troglodytes*). *Am J Primatol* 1989;1:71-8.
- Mason GJ. Stereotypies: a critical review. *Anim Behav* 1991;41:1015-37.
- Newberry RC. Environmental enrichment – increasing the biological relevance of captive environments. *Appl Anim Behav Sci* 1995;44(2-4):229-43.
- Novak MA, Suomi S. Psychological well-being of primates in captivity. *American Psychology* 1988;43:765-73.
- Reichard T, Shellabarger W, Laule G. Behavioral training of primates and other zoo animals for veterinary procedures. *Proceedings American Association of Zoo Veterinarians* 1993;65-69.
- Reichard T, Shellabarger W, Laule G. The veterinarian's role in enrichment. *Journal of Zoo and Wildlife Medicine* 1998;29(4):369-70.
- Reinhardt V. Foraging enrichment for caged macaques: a review. *Laboratory Primate Newsletter* 1993;32(4).
- Shepherdson DJ. Tracing the Path of Environmental Enrichment in Zoos. In: Shepherdson DJ, Mellen JD, Hutchins M (eds). *Second Nature: environmental enrichment for captive animals*. Washington: Smithsonian Institution Press 1998;1-12.
- Stoskopf MK, Gibbons EFJr. Quantitative evaluation of effects of environments parameters on the physiology, behavior and health of animals in naturalistic captive environments. In: Gibbons EF, Wyers EJ, Waters E, Menzel EWJr (eds). *Naturalistic environments in captivity for animal behavior research*. Albany: State University of New York Press 1994;140-60.
- Veira Y, Brent L. Behavioral intervention program: enriching the lives of captive non human primates. *American Journal of Primatology* 2000;51(1):97.
- Whitten PL, Stavisky R, Aureli F, Russel E. Response of fecal cortisol to stress in captive chimpanzees (*Pan troglodytes*). *American Journal of Primatology* 1998;44:57-69.