

THE PLAN TO PROMOTE THE PSYCHOLOGICAL WELL-BEING OF NONHUMAN PRIMATES AT THE UNIVERSITY OF MARYLAND BALTIMORE

September 2021

Introduction

This enrichment plan has been written to address concerns and standards surrounding captive primate enrichment. This plan was written according to suggestions in The Psychological Well-Being of Nonhuman Primates, NRC, National Academy Press, 1998, and Final Report on Environmental Enhancement to Promote the Psychological Well-Being of Nonhuman Primates, APHIS, USDA, July 15, 1999.

I. Statement of Goals

A. Goals of the facility

1. **Research:** Our goal is to assist in research excellence through quality care of our non-human primates (NHPs) both physiologically and psychologically. We provide psychological well-being and opportunities for species-typical activity to insure that aberrant behaviors are not exacerbated by protocols and to attempt to prohibit the development of these behaviors. We provide remediation to afflicted animals with all the tools available to us.
2. **Breeding:** Reproductive success in NHPs is a sign of psychological health and a goal in itself. Housing breeding pairs provides social companionship.

B. Goals of the Enrichment Program

The primary goal of the program is to provide for the psychological well-being in conjunction with the physiological health of all nonhuman primates at the University. This is accomplished through understanding the natural habitats and social structures of the species with which we work and applying critical elements toward their living conditions. These critical elements include: social needs, housing structure, foraging opportunities, manipulanda and use of all five senses. They will be applied to the following specific goals.

1. *Opportunities for expressing a broad range of species-typical behaviors* such as posture, foraging, sleeping, feeding diversity, grooming, vocalization, etc., are a primary goal of the program. The individual animal's rearing history, age, previous experience, normal wild-type behavior, nature of the research and type of housing will be considered when determining what is typical behavior.
2. *Cognitive stimulation* is provided through the use of foraging situations or devices, manipulable objects or toys, companions and cage furniture such as perches or swings.
3. *Decreasing self-injurious behavior (SIB)* is accomplished through direct visual, olfactory and auditory contact with conspecifics and interaction with human caregivers when experimental goals dictate individual housing situations. Encouraging cognitive stimulation with objects that retain the animal's interest limits boredom and frustration. Some of these objects include, hanging balls filled with foraging mix, peanut butter

foraging devices, popcorn jars, challenge balls and puzzle boards with primate treats, fleece boards, etc. Medical intervention may be necessary in the event that aberrant behaviors are adding to physical trauma. See Attachment 2, SOP for addressing SIB.

4. *Decreasing stereotypies* is accomplished through the same mechanisms as SIB. They are both manifestations of the distress and boredom that intelligent animals may experience in captivity. Medical intervention is only necessary in the event that aberrant behaviors are adding to physiological stress, weight loss or physical trauma.
5. *Predictable routine procedures and events* are more necessary in animals with limited control over their environment. All of their needs such as food and diversion are from exogenous sources. Disruption of routine is likely to result in anxiety and frustration in animals already deprived of the choices related to fulfilling basic needs. Predictable housing position is also recommended such that an animal's caging location remains the same unless fear, aggression or other problems dictate a change. Cage novelty such as various manipulanda will be regularly rotated on a weekly basis.
6. *Species typical behavior is a sign of well being* and it is encouraged at all the primate locations by providing cage space that meets or exceeds AWA requirements. All animals have at least visual, auditory and olfactory communication with their conspecifics. Pair housed animals can express social behaviors through direct contact. Foraging behaviors are encouraged as previously described. Animals in the baboon reproductive breeding colony can express mating behaviors. Cage furnishings allow animals to rest in a natural position by use of perches or swings.
7. *Opportunities for animals to alter their environment* provide enrichment through self-initiated activity. Among others, this includes foraging devices that require animals to "work" for food.
8. *Training personnel* lends opportunity for a positive interface with the animals. Trained caregivers are less likely to negatively impact animals in daily maintenance and the animals have more predictable and less dangerous behavior.

II. Pertinent Information

A. Species Information

A working knowledge of the animal, its natural environment and social structure are essential premises to effective enrichment strategies and determination of typical behavior. Following is a list of species commonly used at the University of Maryland School of Medicine.

Rhesus macaque - *Macaca mulatta*

Cynomolgus - *Macaca fascicularis*

Range: Northern Africa, Asia from East Afghanistan and Tibet to China, Japan, India, Southeast Asia.

Habitat: These species occupy tropical rain forests, monsoon forests, swamps, temperate forests, grasslands and semi desert. All these species are partially

arboreal and partially terrestrial. They sleep in trees, on cliffs or in rocky places.

Diet: They eat fruit, roots, young leaves, insects, grubs, rice, corn, potatoes, sugar cane, mollusks and crustaceans. They are known to raid plantations for crops.

Weight Range: 3.5-18.0 kg. They exhibit some sexual dimorphism depending on species and age.

Resting Posture: Sitting or quadrupedal hunched.

Social Behavior: Typically they live in large groups with more than one adult male. Clear dominance hierarchies exist within the group, especially among males, but also between females and juveniles. Social grooming is very important, especially in mother-young or same-sex grooming. Male-female grooming occurs during mating. Play behavior is preadaptive and usually within age groups and may continue through adulthood. Rhesus invent nonfunctional games. Males lead groups and settle disputes while females raise young and maintain relationships. Males may behave paternally to any young which are raised somewhat communally. Home ranges are about 3 square miles and usually overlap other groups. Intergroup relations are usually hostile. Infants are weaned by 6 months and sexual maturity is reached by 4 years. They are considered full adults by 10 years of age. A quadrupedal gait is typical for all species. Bipedalism is common for short lengths of time. Their hands are well developed. They are diurnal.

Captivity: Longevity record for Rhesus is >34 years. Stump tail is 19 years and 3 months. Pig tail is 26 years and 4 months. Cynomolgous is >20 years. They adapt well to different types of captivity which leads to their popularity as research subjects.

Olive Baboon *Papio anubis*

Range: From central to South Africa.

Habitat: They live in a wide range of vegetational zones including sub-desert, savannah, and rain forest. They sleep in trees.

Diet: They are omnivorous, eating fruit, grasses, roots, lizards, insects and occasionally meat.

Weight Range: 22-30 kg in males, 11-15 kg in females.

Resting Posture: They usually sit upright on their ischial callosities in branches.

Social Behavior: This will vary among habitats. Groups are called troops and range in size from 40-80 to 8-200 individuals. Their gait is quadrupedal with occasional bipedalism. About 30% of their time is spent in trees. Their hands are well developed with a precision grip. Dominance hierarchies in both sexes tend to be stable. Social grooming is very important. Play is important for juveniles as it helps to set adult social structure. Home range is no more than 15 square miles and usually overlaps other troop ranges. Inter-troop relations are amicable, but tense. They are diurnal and sleep from before nightfall until after daybreak.

B. Record Keeping

1. Medical Records

The rearing history and source of the animal are included with the animal health records that are delivered with the animal. This information is transferred to the medical record for each animal. Serology/ virology test results are also included.

2. Daily Enrichment Log

This is a record of food treats given to each primate Monday thru Friday. Each caretaker is responsible for distributing the daily enrichment for his/her assigned room. The date and type of food is documented by a check system and the caretaker signs his/her name/initials on each sheet. Log sheets are located on the door clipboard of each primate room. The logs are given to the enrichment tech at the end of each month, and completed logs are filed.

3. Weekly Room Enrichment Log

This is a record of additional enrichment given once a week to each primate in a room. Additional enrichment consists of the following: Audio, Visual Stimulation and outside-of-cage toy rotation. (*Audio*=soothing music played on a CD player or the technician's cell phone in the room. *Visual*= Movies played on a VHS/DVD player only on the rare occasion of a single animal housed in quarantine or isolation). The two toys located on the outside of each primate cage will be replaced with two new toys once a week). A minimum of two outside toys and one inside toy must be present on the cage at all times. The date and additional time spent in the room is recorded on the Enrichment Log. In addition, any additional enrichment given by the technician is documented.

4. Special Enrichment Log

Individual non-human primates that are on the Special Enrichment Program (SEP) receive additional enrichment along with entire room enrichment (i.e. daily fruit, vegetable, and weekly room enrichment). This enrichment is to be given only to primates on the SEP. All special enrichment primates are identified by an orange tag located next to their ID tag. See section C.1 for description of behavior constituting need for special enrichment.

Each primate under the SEP is given special enrichment twice a week in addition to the routine room enrichment. This consists of specially prepared "treats" and foraging devices that are designed to increase foraging behavior and decrease stereotypical behaviors. The special enrichment document lists the specific animal's problem/stereotypic behavior and the twice-weekly enrichment. A monthly evaluation of each animal on the SEP is documented. These evaluations will be used to modify the SEP to each primate's unique behavior and in reducing/eliminating stereotypical behavior.

5. Pairing Log

Observations for paired housed primates are recorded in the pairing log.

C. Behavior Assessment

- 1. Baseline Behavior:** Each individual primate is assessed by the enrichment technician in order to obtain a baseline behavior. At this time the animal may be placed on the special enrichment program if their behavior is identified by either clinical or enrichment staff as fitting the following criteria:

- a. Inability to cope with routine changes in the environment (cage changing, introduction of new animals, etc.)
 - b. Inability to engage in beneficial species typical activities (foraging, mutual grooming, pair interactions, etc.)
 - c. Presence of maladaptive or pathological behaviors:
 1. Idiopathic anorexia
 2. Self-injurious behavior
 3. Aggression
 4. Circling or other stereotypic behavior
 5. Hair picking
 6. Extreme passivity or fearful behavior
 7. Abnormal facial expressions or posture
 8. Chronic signs of distress
 9. Inappropriate vocalizations
2. **Monitoring:** If an animal is on the SEP their behavior assessment is performed and recorded monthly based on the aforementioned criteria. A record of this monitoring can be found in special enrichment documentation.
3. **Remediation:** The enrichment staff documents all modalities of treatment to facilitate resolution of the behavioral anomaly in the special enrichment records. Animals are eligible for removal from the SEP when resolution of the behavior or condition documented on two consecutive monthly behavioral evaluations. The veterinarian reviews the animal's SE documentation and performs a cage-side behavioral assessment and the animal is removed from the SEP.

III. Social Interactions

A. Interactions with animal care personnel

Human NHP interaction will include reward for positive interface with the human, while insuring safety to staff. All human-animal interaction occurs under current biosafety protocol. Special treats are given as positive reinforcement. The staff routinely talks quietly to the animals while working in the rooms. Food rewards are given post procedures. Animal care schedules are strictly followed to promote behavioral synergism and avoid anxiety.

B. Other contact with conspecifics

This includes visual, auditory and olfactory contact with other primates in the room. All animals have visual contact with other animals in the room. They are all able to hear and smell the other animals in the room and group social behaviors are common when one or more individuals are disturbed or anxious. No animals are housed alone in a room unless a serious health threat to the animal or other animals exists (quarantine, isolation). This would require approval by the attending veterinarian.

C. Grooming Bar Panel Separation and Pair Housing

When experimental constraints allow continuous housing in pairs occur in our primate colonies containing Baboons and Macaques. When an investigator submits a protocol for the use of NHPs, they meet with a Veterinary Resources veterinarian to discuss pair housing as it relates to their specific research. After this meeting, the "Non-Human Primate Environmental Enrichment Plan IACUC Animal Use Protocol Addendum" form is completed which describes the level to

which their animals may be pair housed based on their particular research. This addendum is reviewed and approved by the IACUC along with their protocol. If a primate is individually housed, it is able to see, hear, and smell others of their same species by arrangement of cages around the perimeter of the room such that they face one another.

1. Baboons

The Division of Perinatal Research uses male and female baboons for reproductive studies of maternal-fetal interactions. Females are paired with males on an average five day interval cycle to enable timed pregnancies as part of the research protocol. Offspring will be kept with the adult female up to 9 months of age and then weaned to be housed with a similar aged cohort. Juvenile animals post weaning will be housed in pairs with similar age juveniles, in close proximity to mothers, or housed close to other juveniles if no similar age animal is available. At puberty, males will be singly housed as severe aggression has been seen between adult males.

2. Rhesus and Cynomolgus Macaques

Socialization cages are used for Rhesus and Cynomolgus monkeys, where allowable within boundaries of research protocols. These socialization cages have removable wire partitions between cages. The use of grooming bar panels allows animals to live in pairs or interact socially for shorter periods of time. Pairs are established according to the SOP for establishing compatible primates in pair housing, Attachment 1. With the partition in place, there is close contact and interaction through the wire mesh, but they do not share living space.

IV. Environmental Enrichment Techniques

- A. Foraging** is provided by foraging devices, food puzzles, challenge balls, foraging treats, foraging boards, etc. Foraging devices are attached to the cage front. The devices are designed so that the animal must forage for food items such as granola, seeds, nuts, raisins, popcorn, cereal, vegetables and fruits. Examples of foraging treats include toys coated with peanut butter and rolled in seeds/nut/fruit/vegetable mix, cake ice cream cones, frozen fruit juice with seeds and nut mix, fruit and nut mix, frozen fruit with peanut butter and fruit and nut mix. A wide variety of food items are offered daily to stimulate interest. These specific food items are listed in the daily enrichment log.
- B. Fresh fruit or vegetables** are given daily to each non-human primate.
- C. Manipulation** is provided through the use of inside and outside cage toys, certain natural foods, special food treats and the cage itself. Flexible but durable toys encourage digital manipulation and chewing. When hung on the cage, mirrors can provide both visual and tactile stimulation. We also use frozen juice/fruit chunks and a variety of foraging mixes in the hopper and coat toys with peanut butter and rolled in seeds/nut/fruit mix. In addition, many NHPs are fascinated with the levers and locks on their enclosures and spend hours attempting to open their doors and free the squeeze apparatus.
- D. Variation in sensory stimuli** is provided in several ways. The most frequently employed stimulation comes from the diverse food options that are offered. The variety of fresh fruit and vegetables along with the creatively engineered food

treats provides different tastes, smells, textures, colors, sizes, shapes and densities. The frozen treats are also a temperature variant for the monkeys. Toys are rotated and replaced to prevent boredom. In addition, soothing music and nature sounds are provided to primates as an audio stimulus.

- E. Techniques to reduce self-injurious behavior (SIB)** require aggressive implementation to avoid further risk to the animal. Animals that are exhibiting SIB are placed on the SEP. Some animals will display SIB when housed in full view of an aggressive conspecific. Under this circumstance, one of the two animals is moved to a different location in room to prevent conflict. Attachment 2 outlines the SOP for animals exhibiting SIB. A veterinarian is always involved in the management and decision-making of animals with documented SIB.

- F. Techniques that require learning novel responses for reward.** Most non-human primates have been trained to cage jump so that sedation for cage change out is avoided. This is employed as positive reinforcement training by placing a food treat in the new cage. The animal crosses to the new cage and receives its reward.

V. References

1. Anderson JR, Chamove AS (1984) Allowing captive primates to forage. *Standards in Laboratory Animal Management* 253-256
2. APHIS-USDA Animal Welfare Act Standards (1991) 9 CFR Part 3, Subpart D
3. Bayne, K (1991) Providing environmental enrichment to captive primates. *Compendium on the Continuing Education for the Practicing Veterinarian* 13(11): 1689-92, 94, 95
4. Blanchard M, Gruver S, Kirk P, Maclain V, Zebrun M (2005) Look what's hanging around! Forage feeder cup puzzles for cynomologus macaques. *Tech Talk* (10)3
5. Brown MT (1999) Mature primate enrichment. *The Shape of Enrichment* (14)1
6. Final Report on the Environmental Enhancements to Promote Psychological Well-Being of Nonhuman Primates (1999) APHIS, USDA
7. Jorgensen MJ et al (1996) Correlates of self-injurious behavior in monkeys. *XVIth Congress of the International Primatological Society Abstract* 767
8. Lam K, Rupnaik NMJ, Iversen SD (1991) Use of a grooming board and foraging substrate to reduce cage stereotypies in macaques. *Journal of Medical Primatology* 20:104-109
9. Line SW et al (1990) Risk factors for self-injurious behavior in captive rhesus monkeys *Macaca mulatta*. *Journal of Primatology* 45:abstract 187
10. PHS Guide for the Care and Use of Laboratory Animals – Eighth Edition (2011)
11. Reinhardt V (1993) Promoting increased foraging behavior in caged stumptailed macaques. *Folia Primatologica* 61:47-51
12. Sapolsky RM (2005) The influence of social hierarchy on primate health. *Science* 308
13. Spector M, Kowalczyk MA, Fortman JD, Bennett BT (1994) Design and implementation of a primate foraging tray. *Contemporary Topics* 33(5): 54-55
14. *The Psychological Well-Being of Nonhuman Primates* (1998) NRC. National Academy Press
15. Wolfensohn S, Honess P (2005). *Handbook of primate husbandry and welfare*. Blackwell Publishing Ltd
16. Young RJ (2003) *Environmental enrichment of captive animals*. Universities Federation for Animal Welfare

Appendix 1

SOP for Pair Formation in Nonhuman Primates

Pair housing is an established method of providing psychological well-being to naturally social nonhuman primates (NHP). Such pairing can lead to serious fighting between incompatible animals. This SOP attempts to avoid aggression during and after pair formation. This SOP is primarily designed for pairing adult and juvenile macaques but can be used for other species as needed.

I. Familiarization Period (*duration: at least 24 hours*)

- A. Potential pairs are separated by a grated cage dividing panel, which allow auditory, visual, and olfactory communication for at least 24 hours.
- B. Animals are observed for 30-40 minutes for establishment of dominance-subordination relationship and compatibility. Signs of rank-indicative behaviors and compatibility are also observed in this time frame.
 1. Rank-indicative behaviors (must be unidirectional)
 - a. Fear grinning or yielding when being look at by neighbor
 - b. Withdrawing and or looking away when approached by neighbor
 - c. Enlisting: threaten against observer and glancing back at neighbor
 2. Signs of compatibility
 - a. spending time near divider and showing interest
 - b. lip smacking
 - c. presenting
 - d. mimicking
 3. Signs of incompatibility
 - a. overt aggression: i.e. open mouth threats, attempts to grab partner
 - b. extreme fearfulness
 - c. no clear hierarchy established

II. Pairing Period

- A. All pairing is done early in the morning after the a.m. feeding.
- B. Once a potential pair has been deemed compatible during the familiarization period, the grated cage divider is removed.
- C. The pair is then observed for 30 minutes after formation for signs of a successful match.
 1. Behaviors of a successful match
 - a. perch sharing
 - b. cage sharing
 - c. grooming
 - d. acquiring and eating food
 - e. team behaviors i.e. tandem cooperative behaviors such as defensive vocalizations and postures
 - f. no serious wounds requiring veterinary care
 2. Behaviors of an unsuccessful match
 - a. serious wounds requiring veterinary care
 - b. excessive disturbance of either pair
 - c. depression
- D. Once a pair has been successfully match they will be observed three more times during the first day and twice a day thereafter for 5 days to evaluate their compatibility.
- E. Once a pair is formed they will be housed together during their quarantine period (13 weeks) and on, unless due to illness or study requirements.

III. Incompatible Pairs

- A. A pair that has been deemed incompatible based on the above criteria will be separated and re-paired with different partners.
- B. An individual animal is given three attempts at pairing with different animals. If all attempts at pairing are unsuccessful that animal will be deemed "unfit for pair housing".

IV. Documentation

- A. Documentation of each individual animal pairing history will include two sections:
 - 1. Observations During Pairing
 - a. includes notes on both familiarization period and pairing process
 - 2. Previous Pairing
 - a. dates of paring
 - b. outcome (successful/unsuccessful)
 - c. possible reasons for unsuccessful pairing

V. Post-Pairing

- A. Successful pairs' IDs are placed on the pairing record. These records include all documentations and observations and are placed in the pairing binder located in G-06. Documentation is added to the individual animal's file should animal require separation.
- B. Animals are continually monitored by husbandry and enrichment staff for any signs of incompatibility.
- C. Any problems such as aggression and/or food competition are listed on the pair summary sheet.
- D. In the event that an individual must be separated from the pair due to illness or study protocols, the partner should have visual contact with their partner if possible within the boundaries of experimental protocol and physical plant limitations.

Appendix 2

SOP for Nonhuman Primates Exhibiting Self-Injurious Behavior (SIB)

Self-injurious behavior is a potentially serious condition that occurs in caged macaques. It requires prompt, effective treatment.

Steps to eliminate SIB

1. Examine animal history if available to determine if early separation may be part of the etiology. This carries a poor prognosis for complete recovery.
2. Examine the animal's housing situation. Protocol restriction to social housing requires individual targeted enrichment directed by the enrichment specialist which is specific methods tailored to the individual.
3. Examine the animal's interaction with neighbors. Aggressive interaction with adjacent animals may lead to redirected aggression. These animals should be separated.
4. Try topical negative reinforcement and consider pharmaceutical intervention as a last resort.
5. Reevaluate response to therapy on a weekly or longer basis depending on severity. Improvements can be gradual and small.
6. Consider euthanasia for those animals whose quality of life is poor due to lack of response to therapy.

Appendix 3

Primate Behavioral Scores

The Enrichment Staff will evaluate the NHP's behavior for the given calendar month and score their problem behavior (*such as repetitive abnormal behavior or hair loss*) on a 1-5 scale with 1 (being mild) through 5 (severe) to describe the severity of the problem.

Behavioral Score 1: Mild 1-5 minutes of continuous abnormal behavior per hour.

Behavioral Score 2: 5-10 minutes of continuous abnormal behavior per hour.

Behavioral Score 3: Moderate 10-15 minutes of continuous abnormal behavior per hour.

Behavioral Score 4: 15-20 minutes of continuous abnormal behavior per hour.

Behavioral Score 5: Severe over 20 minutes of continuous abnormal behavior per hour.

Hair Loss Score 1: 1-2 small patches of bare skin on normally haired monkey.

Hair Loss Score 2: Extensive patches of bare skin, often bilateral in presentation, interspersed with normal hair.

Hair Loss Score 3: Substantial hair loss in various body regions.

Hair Loss Score 4: Substantial whole body hair loss.

Hair Loss Score 5: Essentially full denudation of all body hair