Environmental Enrichment for Nonhuman Primates

360.1 Purpose

Emory University strives to ensure that all animal research activities are conducted in accordance with applicable federal and state regulations and policies governing animal research and IACUC policies and procedures. All behavioral management and environmental enrichment programs for nonhuman primates at Yerkes are subject to review by the Emory University Institutional Animal Care and Use Committee. Research protocols are reviewed by behavioral management staff as a part of the IACUC review process. Research-related exemptions are reviewed no less than annually by the IACUC. Behavioral management and environmental enrichment activities must comport with the approaches of the Behavioral Management Plan outlined in this Policy.

360.2 Applicability

This policy applies to all Emory research related animal activities that fall under the IACUC's jurisdiction.

360.3 Abbreviations and Definitions

360.3.1 Animal Welfare Act Regulations: Detailed regulations and standards for implementing the federal Animal Welfare Act of 1966 and subsequent revisions. Found in Title 9 of the Code of Federal Regulations (9CFR), Chapter 1, Subchapter A, Parts 1, 2 and 3.

360. 3.2 Social Animals: Animals are considered to be social if during the adult stages of ontogeny they are found in groups of two or more individuals under natural ecological conditions. The natural conditions for domesticated animals can be derived from the natural history of wild ancestors.

360.3.3 Enrichment: An animal management principle that attempts to enhance the quality of care by identifying and providing the environmental stimuli necessary for psychological and physiological wellbeing (Shepherdson 1998). Enrichment plans are based on the species' natural history and activity budgets, encourage beneficial species-specific behaviors and are driven by specific goals (e.g., increase foraging behavior, decrease aggression, etc.) (Mellen and MacPhee 2001).

360.3.4 Behavioral Management: A comprehensive approach to animal management which incorporates enrichment, positive reinforcement training, social housing, environmental design, and knowledge of the natural behavior of the target species with the aim of improving animal care and welfare. A premise of behavioral management is that the individual tools of enrichment, training, social housing and environmental design can be integrated to better and more completely achieve behavioral goals for captive animals than might any one technique applied in isolation (Bloomsmith, et al, 2017, Whittaker et al, 2001).

360.4 Considerations

360.4.1 Social Housing: All nonhuman primates must be housed with one or more members of the same species. Any request by investigators for exclusion from social housing must be reviewed and approved by the IACUC. Exemptions from social housing are reviewed by the Attending Veterinarian every 30 days. Alternatives to full-contact social housing include intermittent social housing, protected contact housing, individual housing and isolation housing. For all approved alternatives to social housing, additional behavioral management strategies must be provided (e.g. additional enrichment distribution each week, access to larger cage space when available).

360.4.2 Environmental Enrichment: All nonhuman primates must be provided with environmental enrichment opportunities falling within one or more of the following enrichment categories: feeding, physical, sensory and occupational. Any request by investigators for exclusion from environmental enrichment must be reviewed and approved by the IACUC.

360.4.3 Animal Training: The uses of positive reinforcement training techniques are encouraged whenever possible to facilitate the adjustment of nonhuman primates to husbandry, veterinary and experimental procedures.

360.4.4 Behavioral Monitoring: A monitoring and referral system must be in place to detect those primates exhibiting behavioral signs of distress including potentially self- injurious behaviors; prolonged withdrawal or huddling; prolonged expression of stereotypical behaviors; excessive fearful behaviors.

360.4.5 Special Considerations: Additional enrichment is provided to those NHPs that are infants or young juveniles, are exhibiting psychological distress, are individually housed and unable to see or hear conspecifics, or are great apes. Additional monitoring is provided to those nonhuman primates with restricted activity.

360.4.6 Personnel Training: All personnel who perform hands-on activities with nonhuman primates must receive training on working with nonhuman primates prior to working independently in the animal facility.

360.5 Behavioral Management Program

The Yerkes National Primate Research Center has a comprehensive behavioral management program to promote the psychological well-being of the nonhuman primates in the center. The

program includes social housing, nonsocial types of environmental enrichment, animal training, behavioral monitoring, and personnel training (as described in Baker, 2016). Several categories of enhancement may be used for an individual animal, with emphasis varying according to the situation for that individual. The focus of the program is to optimize opportunities for species-typical social, locomotor, and foraging behavior in our primates, and to reduce distress related to captive housing or participation in research protocols. The techniques used have been chosen on the basis of published findings, quantitative assessments, professional judgment, experience at Yerkes, research requirements, and feasibility for implementation in a large primate colony with varied housing and facility design (Bloomsmith et al, 2017).

Since the behavioral management of captive primates relies on understanding the species-typical behavior of their wild counterparts (National Research Council, 1998), the Yerkes program takes this into consideration.

360.5.1 Housing

360.5.1.1 Socal Housing: Decades of research indicates that social housing can be an effective and powerful enrichment strategy for captive primates (National Research Council, 1998), as measured through behavioral, physiological, immunological, and clinical indicators (e.g., Baker 1996; Lutz and Novak, 2005; Schapiro 2002; DiVincenti & Wyatt 2011). The following housing approaches are available under the Behavioral Management Plan and are subject to IACUC review.

360.5.1.2 Group or Pair Housing: Since living in compatible groupings is the best means of supporting the welfare of captive primates, the social needs of most Yerkes primates are provided for by housing them continuously in groups or pairs. This is the "default" housing method.

360.5.1.3 Intermittent Social Housing: Intermittent social housing is an option for providing some social experience to animals even though they are not continuously in a social setting, and can significantly enhance welfare (Bayne, 2013), particularly in pairs with a high quality relationship (Hannibal et al, 2017). Guided by published literature, to qualify as intermittent social housing at Yerkes, primates must spend more than half of their time together (either more than 12 hours per day or more than 3.5 days per week together) (Baker et al, 2014; Oettinger et al, 2008; Roberts and Platt, 2005). Juveniles or adolescents may have more difficulty in managing repeated separations (Mineka et al, 1981), so they should be closely monitored if this type of housing is considered.

360.5.1.4 Protected Contact Housing: Protected contact housing provides an opportunity for some social contact by housing primates in adjoining cages with perforated or barred panels between the cages. Studies indicate there may be species and age or sex differences in how primates respond to this type of housing, and therefore in how beneficial it may be (Baker et al, 2012; Baker et al, 2014; Lee et al, 2012). We consider this option superior to individual

housing as it gives primates a choice to interact, so we strive to use this method if primates cannot be pair or group housed. Protected contact housing is categorized as a type of individual housing when we compile housing statistics for review (consistent with the OLAW position statement on nonhuman primate housing http://grants.nih.gov/grants/olaw/2011positionstatement_maysummary.pdf).

360.5.1.5 Individual Housing: When tactile contact between primates is not feasible, they will be housed individually with visual, auditory, and olfactory contact with conspecifics.

360.5.1.6 Isolation Housing: Isolation housing refers to a primate living alone who cannot see, hear and smell other primates. This method is rarely used at Yerkes, but if it is employed it must be justified for research or clinical reasons.

360.5.1.7 Additional Considerations: The introduction of unfamiliar primates to one another are typically managed by behavioral management or colony management staff, and in some cases they are managed by veterinary,
research and animal care personnel. Procedures are in place to conduct the introductions and to monitor animals for compatibility following the introductions. Introductions of pairs in cages are done in a stepwise manner,
typically increasing contact over several hours or days (Truelove et al, 2017).

360.5.2 Environmental Enrichment: Differing types of non-social enrichment are provided to increase different classes of species-typical behavior, and these different types of enrichment are feeding enrichment, physical enrichment, sensory enrichment, and occupational enrichment (Bloomsmith, et al, 1991). The following is a description of environmental enrichment available under the Behavioral Management Plan.

360.5.2.1 Feeding Enrichment: Variation in foods, increasing meal frequency, and providing foraging opportunities that require manipulation and extended periods of time to gather food are ways to elicit natural feeding behavior in primates (Chamove et al. 1982; Anderson and Chamove 1984; Tripp 1985; McKenzie et al. 1986; Bloomsmith et al. 1988; Bryant et al. 1988; Boccia 1989a, b; Byrne and Suomi 1991; Baker 1997). At Yerkes, all primates over four months old are fed foraging material (e.g., grain or cereal mix) three to seven times weekly. All primates over eight weeks old receive fresh produce as enrichment at least four times per week; a wide variety of produce is included for novelty. Other approved enrichment foods (e.g., rice cakes, pretzels, popcorn, applesauce, ice cubes) are occasionally provided, as well as browse (once weekly for caged monkeys) and edible plants from approved sources. All primates living in cages and over four months old have a foraging device to encourage longer bouts of feeding and foraging behavior

(Reinhardt, 1993). A variety of devices are used to provide novel challenges. Primates living in runs receive scheduled foraging devices, and primates living in compounds occasionally receive foraging devices as additional enrichment. Chimpanzees are given foraging devices that require tool use, simulating natural feeding behavior (Goodall, 1965; McGrew, 1994). A list of approved foods and devices are located on the YWEB ("Approved Enrichment Options" document, an addendum to SOP 4.19).

360.5.2.2 Physical Enrichment: Species-typical exploratory, manipulative, postural, play, and locomotor behaviors can be promoted by increasing the complexity of the environment through providing manipulable objects and other structural enhancements such as climbing, resting and nesting areas (Reinhardt et al. 1987; Bryant et al. 1988; O'Neill 1988; Reinhardt and Smith 1988; Wolff 1989; Reinhardt 1990; Eichberg et al. 1991; O'Neill et al. 1991). At Yerkes, physical enrichment is employed for all primates. All have access to a manipulable object such as Kong toys®, Nylabones®, PVC objects, metal triangles, wooden blocks and branches, or mirrors. All monkey cages include a perch or resting board, and some have a visual barrier (e.g., opaque panel) on the cage front. Some singly- housed monkeys are released into activity cages on occasion, where they have more space and additional enrichment items (Griffis et al, 2013). Destructible enrichment (e.g., paper, cardboard) is provided at least once per week. Nursery-housed infants in isolettes have a fleece toy and a blanket. Older nursery infants have swings, hanging fleece, and/or moving surrogates inside their cages and some squirrel monkeys have swings inside their cages. Run- or compound-housed monkeys and all chimpanzees have physical enrichment to increase usable space, stimulate natural locomotion, and provide escape opportunities. Examples include culverts, barrels, swings, fire hose, hanging toys, climbing structures, shade structures, rotating poles, milk crates, perches and resting boards. For some groups, privacy is provided in the form of visual barriers or by providing them with multiple runs to allow more separation within their groups. In the summer (when temperatures exceed 85 degrees F) some areas are equipped with sprinklers or small pools for water play. Chimpanzees are given nesting material such as paper, cardboard boxes, blankets, hay, excelsior or browse (e.g., river cane, sweet gum branches), and they have elevated spaces suitable for building nests. Chimpanzees living temporarily in single cages (typically for clinical reasons) receive a mirror, destructible and nesting materials, human interaction daily, television and/or radio regularly and a room companion when possible.

360.5.2.3 Sensory Enrichment: Sensory enrichment can stimulate primates by giving more variety to what they can hear, smell, touch or see. For example, adding scents to items can extend the manipulation time of common enrichment materials, as well as encourage species-typical behavior such as scent-marking

in New World monkeys (Truelove and Perlman, 2006). The visual stimulation of providing mirrors has been investigated for chimpanzees (Lambeth and Bloomsmith 1992; Brent and Stone 1996) and rhesus (Lutz and Novak, 2005; DeGroot and Cheyne, 2016). Certain types of music and other sounds have been shown to benefit primates by reducing agitated and aggressive behavior (Alworth and Buerkle, 2013; Howell et al 2003; Videan et al, 2007). At Yerkes, augmentation of sensory stimulation is provided by some use of videotapes, music, scents and soft objects. For example, chimpanzees and some monkeys living individually or indoors are provided with a variety of recorded movies or television shows. Some indoor primate areas are equipped to allow playing of music or other sounds for enrichment. Approved spices or other scents are sometimes applied to pieces of paper, particularly for squirrel monkeys because of the olfactory orientation of these New World primates. Paint rollers and fleece are sometimes provided as soft objects for caged primates.

360.5.2.4 Occupational Enrichment: Occupational enrichment allows primates to use their problem-solving capacities in a variety of ways. Some examples of occupational enrichment are activities such as painting, providing troughs of water with tool use opportunities (Parks and Novak, 1993) or providing computer-based tasks that encourage learning (Grunauer and Walguarnery, 2018. At Yerkes, some research procedures, such as offering primates the opportunity to solve problems using a computer interface or manipulating objects to achieve some kind of experimental goal, will be considered occupational enrichment. However, if food or fluid regulation, scheduling or restriction (see policy on Food and Fluid Regulation of Research Animals for definitions) is used in the research paradigm to motivate subjects, these procedures will not be considered occupational enrichment.

360.6 Animal Training Program: Animal training, especially positive reinforcement training can improve care and reduce stress experienced by primates by rewarding their voluntary cooperation with targeted behaviors needed for husbandry, veterinary, and research activities (Bloomsmith et al, 1998; Perlman et al, 2012; Veeder et al, 2009; McMillan et al, 2014). It can improve social relationships, reduce abnormal behaviors, and reduce stress (Bloomsmith et al. 1994; Bloomsmith et al. 2007; Coleman and Maier, 2010; Lambeth et al, 2006; Laule et al. 2003; Schapiro et al. 2003). At Yerkes, an animal training program coordinated through the behavioral management unit is in place to enhance the efficiency, quality and consistency of animal training. Consistent cues, shaping plans, and documentation are used when training the animals. The Animal Training Committee establishes animal training goals to implement across Yerkes, which include striving to maximize the use of positive reinforcement training methods, and the appropriate use of other training methods. A primate training specialist instructs staff on training methods and works with select individuals from animal care, veterinary, colony management, research services and research staff to implement training

when practical. Reinforcer preference is measured prior to some training sessions to improve performance (Martin et al, 2018). Animals are selected for training based on research, animal management and health care needs, and to focus on situations that will lead to greatest animal welfare benefits. Trained behaviors range from movements such as shifting between areas and entering transport boxes to meet animal management needs; to body examination behaviors and cooperation with medication delivery to meet veterinary needs; to more specific research-related behaviors such as conscious biological sample collection (e.g., blood, urine) and cooperation with restraint (Bloomsmith et al, 2015; McMillan et al, 2014).

Desensitization training is used when appropriate to help primates overcome stress associated with novel procedures or for animals exhibiting generalized fearful behavior (Clay et al, 2009). The personnel conducting the training include animal care staff, veterinary staff, colony management, research services, research staff, and behavioral management staff.

360.7 Behavioral Monitoring Program: Behavioral observations are conducted on each caged primate multiple times weekly. If rates of abnormal behaviors exceed a threshold, the animal will be evaluated to determine the extent of the problem. These data are then analyzed to determine the level of care that the animal will receive based on the severity and frequency of the behavioral problem. Each primate is placed in one of four levels of care. Treatments are provided based on the behavioral problem and level of care, and are evaluated for effectiveness. Behavioral treatments may include additional enrichment devices, evaluation of social housing situation, and positive reinforcement training. Pharmacological intervention is also used in some cases in consultation with a veterinarian. Primates will also be referred for behavioral evaluation by animal care, veterinary, research services, colony management, and research staff, and there is a written mechanism for this reporting. Since some primates have hair loss due to plucking of hair and this can be associated with chronic stress or subordinate status (Heagerty et al, 2017; Novak et al, 2017), we have a quantified system for scoring hair loss and each caged primate is scored quarterly. Hair loss can lead to behavioral interventions (e.g., additional feeding enrichment) depending on severity. If a threshold of hair loss is exceeded, the appropriate veterinarian is notified to determine if there may be a medical basis for the hair loss.

360.8 Special Consideration: These categories of primates are provided special attention regarding enhancement of their environment:

360.8.1 Infants and Young Juveniles: Some infants are removed from their mothers due to maternal or infant illness, or maternal neglect or abuse, and others to meet requirements for nursery-reared infants for experimental protocols. When possible, infants removed from their mothers are placed with another conspecific for rearing (cross fostering). Infants in the nursery receive human attention with personnel following all safety stipulations. Peer socialization of infants is begun while still in the isolette and as early as 2 weeks of age for some. The final goal is pair or group housing, except where prohibited by research protocol requirements or veterinary concerns. Nursery

caging is enhanced by toys, swings and/or moving surrogates, and perches. Animal training techniques are used with the infants when needed to prepare them for social separation and boxing for cagewash (see 360.6). Those infants who cannot be socialized due to experimental protocols or illness continue to receive additional enrichment and human attention with personnel following all safety stipulations.

360.8.2 Monitoring and Treatment for Animals Exhibiting Psychological Distress: A monitoring and referral system is in place to detect those primates exhibiting behavioral signs of distress including potentially self-injurious behaviors; prolonged withdrawal or huddling; prolonged expression of stereotypical behaviors or excessive fearful behaviors. Animals displaying these behaviors at above threshold levels are placed in our highest care level and receive the routine monitoring as well as more detailed quantitative behavioral data collection, and multiple behavioral interventions (e.g., assessment of their social housing situation, use of additional enrichment devices, positive reinforcement training sessions). The Emory IACUC policy, "Guidelines for Management of Severe Behavioral Problems in Nonhuman Primates" describes the strategy for treating primates assigned to research protocols and displaying concerning behaviors. Each animal exhibiting such distress is assessed by veterinary and behavior management staff and there is further collaboration among behavioral management, veterinary, animal care, and research staff members in the treatment of these cases.

360.8.3 Restrictive Activity Due to Research Protocols: Primates with restricted activity include those monkeys involved in research protocols requiring temporary chair restraint. It is strongly suggested that these monkeys are trained using positive reinforcement and acclimation, and that they are fully trained before they are restrained in a chair for extended periods of time. Chair-restrained animals are closely monitored and receive special attention throughout the entire restraint period (see Yerkes SOPs 5.7 and 5.11 for more detail).

360.8.4 Individually Housed Primates Unable To See or Hear Like Species: This situation has only arisen for short-term research or clinical reasons. Primates are provided mirrors when beneficial, so that the animals can see themselves, are provided human attention and positive social interaction when beneficial, supplementary food treats and foraging tasks, and/or additional cage enrichment objects. Videotape viewing is provided when possible.

360.8.5 Great Apes weighing over 110 lb.: The Yerkes Primate Center has a number of adult chimpanzees that fall into this category. Those weighing over 110lbs, as well as those who weigh less, are housed in appropriately-sized enclosures, generally with indoor and outdoor access. Chimpanzees are housed in groups whenever possible, or in compatible pairs. Food and enrichment devices (described above) are designed to meet the behavioral needs of the chimpanzees. Chimpanzees are prioritized for positive

reinforcement training.

360.9 Personnel Training Related to Primate Welfare: All personnel who perform hands-on activities with nonhuman primates receive an orientation on working with nonhuman primates. The orientation includes online AALAS modules, a didactic presentation and an instructional tour of the NHP facility. The didactic instruction covers topics including welfare regulations, natural history, personnel conduct around primates, identifying sick individuals and Yerkes NHP staff. Primate animal care personnel receive instruction on the behavior, training and enrichment for primates throughout their work experience. Information covered includes basic primate behavior, natural history of primates, personnel etiquette working around primates, why and how enrichment devices are provided, proper sanitization of enrichment, documentation of enrichment applications, animal training techniques, identifying behavioral problems, and the process for notification and documentation when behavioral problems arise. Additional forums for continuing education on primate behavior and welfare include lectures, brief presentations at internal meetings, one-on-one instruction, daily conversations, an internal behavior management certification program and attending regional or national conferences or workshops. Staff from veterinary, colony management and research groups may also receive this type of instruction. Consultations are available with behavioral management staff for assessments of individual animals or situations.

360.10 References

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