Training Techniques to Enhance the Care and Welfare of Nonhuman Primates

Margaret Whittaker, BS*, Gail Laule, MA

KEYWORDS
- Animal training
- Positive reinforcement
- Animal welfare
- Negative reinforcement
- Nonhuman primate training

KEY POINTS
- Nonhuman primates are excellent subjects for the enhancement of care and welfare through training.
- The application of positive reinforcement techniques to specific aspects of the management of captive nonhuman primates spans a wide range of species, social contexts, and housing situations (e.g., laboratories, zoos, and sanctuaries).
- There is an increased interest from regulatory and accrediting agencies to insure improved conditions for captive nonhuman primates, apparent by the various standard guidelines, accreditation standards, and protocols available for the 3 primary types of nonhuman primate holding facilities.
- PRT is an invaluable component of captive animal management when it is used to enhance husbandry and medical care, mitigate aggression and increase affiliative behaviors and improve social management, reduce fear and anxiety, and enhance environmental enrichment programs; all contributing to an overall improvement in psychological well-being.

INTRODUCTION
Nonhuman primates are excellent subjects for the enhancement of care and welfare through training. The broad range of species offers tremendous behavioral diversity, and individual primates show varying abilities to cope with the conditions of captivity, which differ depending upon the venue and housing situation. In 1987, the Animal Welfare Act mandated that facilities housing nonhuman primates must provide for their psychological well-being; positive reinforcement training (PRT) has achieved wide recognition as a valuable tool for contributing to that objective.

The application of positive reinforcement techniques to specific aspects of the management of captive nonhuman primates spans a wide range of species, social contexts, and housing situations (e.g., laboratories, zoos, and sanctuaries). There is an increased interest from regulatory and accrediting agencies to insure improved conditions for captive nonhuman primates, apparent by the various standard guidelines, accreditation standards, and protocols available for the 3 primary types of nonhuman primate holding facilities.

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contexts, and housing situations (eg, laboratories, zoos, and sanctuaries). Conditions for captive nonhuman primates vary widely depending on the situation. Housing in laboratory facilities may include small cages with a single individual, pair, or group housing, and corrals with large social groups. Zoos have social groupings of differing sizes, emphasizing natural behavior, public display, education, and reproduction. Sanctuaries typically have nonbreeding groups, which may consist of multiple species and varying numbers of individuals, and are not regularly on public display. In every venue, regardless of the institution’s mission, a primary objective is to provide excellent care while addressing animal welfare and minimizing stress. Positive reinforcement training improves care and reduces stress by enlisting a primate’s voluntary cooperation with targeted activities, including husbandry, veterinary, and research procedures. It is also used to improve socialization, reduce abnormal behaviors, and increase species-typical behaviors.1–4 Environmental enrichment programs can be enhanced and expanded when PRT is applied.

There is an increased interest from regulatory and accrediting agencies to insure improved conditions for captive nonhuman primates, apparent by the various standard guidelines, accreditation standards, and protocols available for the 3 primary types of nonhuman primate holding facilities. Laboratory facilities are held to standards outlined in the “Guide for the Care and Use of Laboratory Animals” (2011),5 which recommends that “Habituating animals to routine husbandry or experimental procedures should be encouraged whenever possible as it may assist the animals to better cope with a captive environment by reducing stress associated with novel procedures or people. In most cases, principles of operant conditioning may be employed during training sessions, using progressive behavioral shaping, to induce voluntary cooperation with procedures” (p. 64–5). In a recent 2010 report, of site visits to chimpanzee facilities in the United States, The Office of Laboratory Animal Welfare (OLAW) also supported the notion that PRT may help in reducing stress and concluded that when safe and feasible nonhuman primates should be afforded positive reinforcement training opportunities.6

The Association of Zoos and Aquariums (AZA) Animal Care Manuals (ACM) specify training and enrichment techniques to provide for improved care, welfare, and management of captive nonhuman primates. In the 2010 Chimpanzee ACM,7 it is stated that “the use of positive reinforcement training as an animal care and management tool offers many benefits for chimpanzees and staff. One of the greatest benefits is to gain the voluntary cooperation of the chimpanzees in husbandry, veterinary, and research procedures. The fear and stress associated with these procedures, as well as the need for restraint and anesthesia can be significantly reduced. Greater choice and control can be provided to trained chimpanzees, contributing to their psychological well-being.”8 And it continues with further discussion regarding specific behaviors that can be trained through PRT: “using operant conditioning techniques, chimpanzees can be desensitized to frightening or painful events, such as receiving an injection, so that the event becomes less frightening and less stressful.”8 Voluntary cooperation reduces the need for physical restraint and/or anesthesia, and the accompanying risks associated with those events.9,10

The In Press Guenon Care Manual states that guenons “should be trained with positive reinforcement techniques for the routine modification of behavior to achieve management, husbandry, veterinary, and research behaviors, enhance socialization, facilitate introductions, and augment enrichment opportunities. Animal positioning should be achieved through the use of targets; animals should not be pushed, pulled, or coerced for routine training activities. Routine husbandry practices should include: shifting animals for activities such as daily cleaning, enrichment, exhibit maintenance, training animals to approach the cage front for close visual inspection of entire body,
and presenting various body parts for both keepers and veterinary staff. Guenons should be trained to present for various types of injections (e.g. IM for anesthesia, intradermal for Tb testing, etc.), and because they are prone to developing diabetes; individuals tending towards this condition should be trained to voluntarily accept a subcutaneous injection in order to administer insulin. If any of these injections cannot be trained, guenons should be trained to enter a squeeze cage and accept squeeze restraint to facilitate treatments or procedures.11

Sanctuary housed primates, depending on the sanctuary, are held to standards that dictate the use of PRT. Chimpanzees housed in federally funded facilities must comply with the Standards of Care for Chimpanzees Held in the Federally Supported Chimpanzee Sanctuary Systems: Final Rule (Federal Register).12 Section 9.6 Animal Care, Well-Being, Husbandry, Veterinary Care, and Euthanasia, (b) (iv) states that, “Many chimpanzees can be trained through positive reinforcement to cooperate with a variety of veterinary and chimpanzee care procedures. Efforts must be made to develop or maintain this capability for chimpanzees housed in the sanctuary to the extent possible. Trainers must use currently acceptable practices that do not include physical punishment.” In (c) (xi), it is stated that “the sanctuary must minimize the use of physical and chemical restraint. Chimpanzees in the Sanctuary shall be trained to permit certain procedures with minimal or no restraint. Such procedures may include injections, dosing or other treatments, and cage-side health observations.” Some apes may be trained to accept a manual injection for chemical immobilization, thus avoiding the stress of darting.12

The Global Federation of Animal Sanctuaries, a global nonprofit organization that verifies and provides an accreditation process for sanctuaries, has put forward the following standards for great apes and monkeys that pertain to handling and the use of certain techniques: “Where possible and appropriate, Positive Reinforcement Training is used to minimize the need for chemical immobilization and to reduce stress during procedures.”13,14 With appropriate training, many procedures can be performed cooperatively and without anesthesia, such as examination of body parts, treatment of superficial injury, heart rate monitoring—even EKGs and blood draws.” And GFAS goes on to describe that aversive techniques should be avoided by saying, “Physical abuse, deprivation of food or water, aversive spraying with a hose, and other forms of negative reinforcement or punishment-based training are never used to train, shift or otherwise handle great apes.”14

Clearly, PRT has become a recognizable component of enlightened captive animal management; with the greatest benefits seen in 4 main areas:

1. Improved husbandry and medical care through voluntary cooperation by the animals in a wide array of procedures
2. Enhanced social management and opportunity through training techniques that increase affiliative behaviors and decrease aggression
3. Improved psychological well-being through desensitization techniques that directly address fear and discomfort
4. Improved environmental enrichment programs by expanding options for enrichment strategies.

HUSBANDRY AND VETERINARY PROCEDURE TRAINING

There are many published articles on the benefits of PRT in gaining the voluntary cooperation of primates in husbandry and medical procedures. Since 1984, these authors alone have written over 25 different papers, chapters, and conference presentations on the subject.8,15–22 Husbandry training facilitates routine husbandry and management
practices, including: quick and reliable movement among all enclosure spaces thorough visual exam of all individuals, and desensitizes animals to “routine” procedures, such as water supply checks, provisioning of food and enrichment, etc, that some nonhuman primates may find frightening. Veterinary training typically includes desensitization to fear inducing procedures such as injections, venipuncture for blood sampling, urine collection, and visual exams by veterinary staff. When trained to voluntarily cooperate in these procedures, animals have a choice in how the procedure will be carried out, rather than having to submit to anesthesia or physical restraint.9,10,23

With greater accessibility to more cooperative animals comes the opportunity to initiate preventive medicine practices and to explore techniques previously seen as less practical for routine use. Included are training for assisted reproduction techniques such as ultrasound and tube insertions for artificial insemination24,25 and semen collection26; disease testing and health care practices such as Tb test administration; oral and some dental care; administration of oral and/or injectable medications and vaccinations; and wound treatment.8,27–29 Voluntary cooperation in husbandry and veterinary procedures significantly reduces an animal’s level of stress,4,30–32 and it also causes less disruption for the entire group, by reducing the need to separate an individual in order to accomplish a task.33,34

With positive reinforcement methods proven to facilitate husbandry and veterinary care for captive primates, it is increasingly difficult to defend the use of negative reinforcement or escape/avoidance techniques to achieve these same goals. Subjectively, one can compare the behavior of a primate calmly accepting an injection to that of an agitated animal racing around the cage to avoid the dart gun. Objectively, one can compare the number of anesthetic events required to collect blood from an adult chimpanzee who cooperates voluntarily (none) to the number required to collect blood from an untrained animal (1 per blood sample). Both the subjective and the objective assessments make a strong case for the positive impact husbandry and veterinary training can have on an animal’s well-being.

SOCIALIZATION

Many species of primates can be challenging to maintain in species-typical social groupings in captivity. Common problems include high levels of aggression and submission, serious wounding during introductions35 and a lack of appropriate social skills. Objectives for training to improve the socialization of primates include (a) meeting the social needs of all group members, (b) reducing aggression and submission to acceptable levels, (c) increasing prosocial and affiliative behaviors, (d) facilitating the introduction of new animals to each other or into an existing group, and (e) gaining access to all individuals within the group. Positive reinforcement training offers specific methods to achieve each of these objectives.

Target Training

Targeting can elicit both gross and fine movements and teach animals to hold a position or location. Greater access to all individuals within the group is available when all group members will come to, go to, and stay at targets. The stationing of dominant animals lessens the possibility that they will interfere when subordinate animals receive food, enrichment, or medical attention.

Shifting Between Enclosures

Training animals to shift quickly and reliably and at any time of day, ensures the safety of the staff and the animals, and facilitates sound husbandry practices, including
provisioning of regular and frequent enrichment strategies, enclosure maintenance, emergency preparedness, and ease of access to animals for training and veterinary procedures, etc. It also allows reinforcement of the group for moving simultaneously. Such reinforcement may promote a more cohesive group, which responds collectively toward a common goal.

**Separation**

Separation and temporary isolation of group-housed primates for management or veterinary purposes can cause undue stress for all members of the group and may trigger problems during the reintroduction of separated individuals. Training animals to separate voluntarily, as individuals or as subgroups, can facilitate the movement of animals into and out of the group and minimize the stress of separation. Voluntary separations also provide subordinate animals the occasional chance to escape the pressures of social housing. For species that are difficult to reintroduce following brief or more extended separations (e.g., for veterinary procedures and recovery), reintroductions are made easier when voluntary separations are trained because the group is accustomed to and accepting of this practice. Calm separations can yield calmer reintroductions.21

**Cooperative Feeding**

Cooperative feeding is a technique used to enhance positive social behavior and reduce agonistic behavior in many species, including a variety of primates.1,2,8,9,36–38 Rummel39 suggests that aggression is an acquired, instigated, maintained, and modified behavior. Success in satisfying one’s wants or needs will reward aggression, and if nonaggressive behavior is less successful in achieving satisfaction, aggression will increase. Dominant nonhuman primates receive reinforcement, both in the wild and in captivity, for managing the groups they lead, monitoring other group members, and acting as sentries. Many caregivers of captive animals have used subterfuge and distraction when attempting to provide subordinate animals with food, enrichment, or other desirable resources. However, these techniques actually exacerbate aggression, causing dominant animals to become more vigilant in order to maintain control of the desirable resources. In captivity, aggressive interactions can have serious consequences if group members are unable to escape the aggressors.

Cooperative feeding conforms to operant conditioning theory, which states that the consequences of a behavior determine whether it will recur.40 Cooperative feeding is a specific technique wherein the dominant animal is carefully and purposefully reinforced for allowing the subordinate animal to receive a resource (typically food, attention from caregiver or trainer, or enrichment). This technique requires that the trainer reinforce the dominant animal for behavior that is cooperative rather than aggressive, thus strengthening cooperative behaviors. When consistently and skillfully applied, cooperative feeding will yield 2 shifts in the animals’ behaviors: (a) the dominant animal’s aggressive behavior when the subordinate receives valuable resources (food, enrichment, attention), and (b) the subordinate animal becomes less fearful and more willing to accept these resources that were previously refused in the presence of the dominant individual(s).

It is important to note that when cooperative feeding is used, the dominant animal’s position in the hierarchy is not diminished. In fact, quite the opposite is achieved. Dominant animals are reinforced for allowing subordinates to have resources, and thus maintaining their position of dominance. They are typically provided with a higher quality or magnitude of reinforcement for allowing the subordinate to have something of lesser quality. Therefore, it becomes worthwhile for the dominant animal to allow the subordinate to have something in order to be reinforced with a preferred food item.
Gentle Touch and Proximity

“Gentle touch and proximity” behaviors are those that teach the concepts of touching gently and being close to another. This is introduced to the animals by first teaching the individual to touch the target gently. Directing this behavior toward another animal facilitates proximity (for which all animals are reinforced) and can elicit behaviors such as touching, grooming, mounting, and breeding. Gentle touch may be especially helpful in managing introductions, encouraging affiliative behaviors, and decreasing abnormal levels of affiliation. Desmond and Laule reported positive results using this technique during the introduction of a silverback gorilla to a group of adult females, infants, and 1 hand-raised juvenile female. Additionally, in the first study examining the effects of socialization training, Cox documented increases in all forms of affiliative behaviors after gentle-touch training sessions with a group of drills (Mandrillus leucopehus).

Collaborative Training

The authors use the term “collaborative training” to describe the latest concept in socialization training. This concept involves rewarding collaborative efforts in order to train animals to work together toward a common goal. The technique began with the training of cetaceans to perform group show behaviors requiring a coordinated effort, and it involves reinforcing the animals as a group. Therefore, if even 1 animal fails to perform the behavior to criterion, the group may not receive reinforcement. Purposefully using behaviors that require animals to share a common goal to create social ties may enhance overall socialization. At one oceanarium, during a group “high bow” behavior, a hydrophone recorded vocalizations from multiple bottlenose dolphins during their underwater swim, then 1 single voice just before all the animals broke the surface of the water at the same time (T. Desmond, personal communication, May 16, 2006). Group-behavior training seemed to result in the formation of alliances between dolphins from different subgroups that then began to socialize more with each other outside of training and show times (W. Philips, personal communication, May 20, 2006). Similar results might be possible with primates, using such collaborative behaviors as retrieving an object too cumbersome for one animal to handle, passing objects between or among animals, and procuring desired food items under conditions requiring cooperation.

ADDRESSING FEAR AND DISCOMFORT

Forthman and Ogden have cautioned animal managers never to presume, without supporting data, that animals have become habituated to routine procedures and handling. Their concern stems from studies on primates in laboratories, conducted nearly 20 years ago by Line and Markowitz and their colleagues. These studies found prolonged alterations in heart rates and cortisol levels after such routine procedures as cage cleaning. In 1950, Hediger suggested that fear of humans could be 1 trait that predisposes some species to poor captive welfare. Therefore, it is reasonable and logical to conclude that reducing fear in captive animals would improve their welfare.

Desensitization

Desensitization is a very powerful, versatile, and valuable training technique for reducing anxiety when an animal demonstrates fear or discomfort associated with a particular event, person, situation, location, or object. This training process pairs positive reinforcers with the frightening event or object. Establishing a direct relationship
between the fear-inducing stimulus and positive reinforcers causes the fear to diminish over time. In 1 study, Clay and colleagues\textsuperscript{48} demonstrated that desensitization was more effective at reducing fear in laboratory housed macaques compared to other experimental conditions. The rate of stress-related behaviors and cringing behaviors directed towards humans were reduced, as well as the duration of cringing directed toward humans.

The necessity of desensitizing an animal to all aspects of a veterinary procedure is apparent. An animal will not cooperate voluntarily if a procedure induces fear. Analyzing the physiological responses to voluntary and involuntary injections in chimpanzees, Lambeth and colleagues\textsuperscript{4} found that cortisol was significantly higher in the involuntary condition and hypothesized that the voluntary condition reduced anxiety by giving the animal greater choice and control.

Desensitization may also provide significant assistance in managing social behaviors. For example, Brain and Benton\textsuperscript{49} divided aggression into categories such as self-defensive behaviors and parental-defensive behaviors, and Moyer\textsuperscript{50} characterized types of aggression as fear-induced, territorial, and maternal. These descriptions share a common thread of fear, discomfort, uncertainty, and apprehension. In the previously cited gorilla introduction carried out by Desmond and Laule\textsuperscript{42} the use of cooperative feeding and desensitization techniques with both the females and the silverback helped achieve a peaceful outcome, showing that desensitization can, in fact, successfully reduce the potential for aggressive behavior by addressing social stimuli which might otherwise produce fear.

**ENHANCED ENVIRONMENTAL ENRICHMENT PROGRAMS**

Environmental enrichment has been defined as “an animal husbandry principle that seeks to enhance the quality of captive animal care by identifying and providing the environmental stimuli necessary for optimal psychological and physiological well-being.”\textsuperscript{51} Enrichment can be divided into various categories including physical environment, choice gradients, manipulatable objects, feeding, sensory stimuli, social environment, occupational enrichment, and human interaction. Training can have an impact on each of these categories. Animals can be trained to use the entire physical environment and choice gradients, such as vertical spaces, when, for example, they do not fully utilize the enclosure. Manipulatable objects can be changed multiple times per day, providing improved enrichment opportunity and novelty, if animals are trained to quickly and reliably move between enclosures or on and off exhibit. Feeding enrichment, such as novel foods, can also be given throughout the day when animals readily move between areas. The use of complex feeding devices offers animals the opportunity to work at acquiring and processing their food; such devices greatly increase the amount of time spent in appetitive behaviors. Occupational enrichment offers animals the chance to “work for a living.” Training is enriching and challenges animals to think. Since participation is voluntary, training is believed to be fun for animals.

**SUMMARY**

To date, the use of positive reinforcement training techniques with nonhuman primates has a fairly lengthy history and an impressive list of documented benefits. In fact, it is difficult to conceive of a convincing argument against the use of such training to achieve voluntary cooperation in husbandry and veterinary procedures, to enhance socialization and decrease aggression in these highly social animals, to reduce fear and anxiety associated with many aspects of captivity, and to enhance
environmental enrichment programs. Because PRT is an affective tool that offers very real options for addressing the adverse consequences of captivity, every facility caring for nonhuman primates should integrate training strategies into its management systems and teach training techniques to its staff.

REFERENCES

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