

Positive Reinforcement Animal Training in Primate Laboratories

Over the past 20 years, there has been a revolution in how we care for primates living in laboratories, and positive reinforcement training methods have been a major part of this change. Positive reinforcement training (PRT) is a refinement in animal handling methods that can improve animal husbandry, veterinary care, animal welfare, and the value of animals as research subjects.

How Does Positive Reinforcement Work?

When positive reinforcement methods are used, animals are taught to voluntarily cooperate with procedures rather than relying on coercion to get their participation. This type of training is sometimes mistaken as just teaching animals "tricks," for the fun of it. Instead, this approach teaches them to cooperate with a variety of procedures that are a routine part of life for laboratory primates. PRT involves using basic operant conditioning techniques. The animal is presented with a stimulus (such as a verbal cue, "open"), shows the desired behavior (here, opening his mouth), and is reinforced or rewarded (by being given a grape, for example). This process increases the chance that the animal will open his mouth again, when the word "open" is spoken in the future. With an entirely positive reinforcement approach, if the animal chooses not to participate, he is not coerced into participating and there is no

negative consequence. In this way, the animal can exercise choice and has increased control over what is happening in his environment. Both choice and control are believed to be important ways of promoting the welfare of captive animals.

What Behaviors Can be Trained?

Laboratory primates have been trained to perform a wide variety of behaviors. Through PRT, they have been taught to move when asked into transfer boxes, from one enclosure to another, and into areas for research testing. This type of trained behavior can improve the ease and efficiency of husbandry and of conducting research with primates.

Primates have been trained to allow careful examination of parts of their bodies such as opening their mouths or positioning hands, feet, chest, back, etc. for visual inspection; positioning ears for examination or for using a tympanic thermometer; using a stethoscope to listen to the heart or lungs; and presenting the perineum area for parasite testing. Some primates have cooperated with having their wounds closely examined and treated with topical medications, and some have cooperated with x-ray procedures. All of these behaviors facilitate veterinary care of the animals.

Training primates to calmly tolerate restraint (such as sitting in a "primate chair") can increase the ease of conducting research studies with primates, and may improve

the quality or quantity of data being collected from that subject. Many different biological samples can be collected from cooperating primates, used either for their veterinary care or for research studies. Primates have been trained to voluntarily provide urine samples, fecal samples, and nasal samples. Males have been trained for semen collection and females for vaginal sample collection (see Figure 1).

Laboratory primates have been trained to voluntarily cooperate with receiving intramuscular and subcutaneous injections for anesthesia, antibiotics, vaccinations or research compounds. Blood samples are frequently needed for research studies, and primates can be trained to cooperate with conscious blood withdrawal (see Figure 2). In one case, a chimpanzee cooperated with an astounding seven blood sample collections over a 24-hour period, including waking him up to get a sample at 2:00 AM (Lambeth, personal communication)! PRT can reduce aggression and competition within pairs or groups of primates, and decrease fear or abnormal behavior in some cases. Clearly, primates can be taught a huge range of very useful behaviors.

Can You Prove It?

As PRT has become more prevalent, a growing number of objective assessments of training have been published. These scientific studies are important in ensuring



Figure 1. Rhesus monkey voluntarily presenting for collection of a vaginal sample by swabbing. She was trained through positive reinforcement techniques.



Figure 2. Rhesus monkey cooperating with a blood withdrawal procedure. One trainer is holding her leg steady for the other, who is drawing the blood sample.

that we are relying on more than just subjective impressions of how training is working, and that we have more quantified and controlled measurements of the capacities and limitations of PRT approaches. Some of this work has evaluated practical aspects of training, such as how long it takes to weigh a trained marmoset in her home cage (15 seconds is the answer) (McKinley et al, 2003), or how long it takes to teach a rhesus monkey to cooperate with a voluntary blood draw using a

“blood sleeve” apparatus (an average of 257 minutes) (Coleman et al, 2008).

Other evaluations have focused on the broader influence that training can have on behavior. PRT can reduce aggression within chimpanzee groups when they are fed (Bloomsmith, et al., 1994), and can reduce macaque aggression toward humans (Minier et al., 2011). Fearful rhesus monkeys have learned to be less fearful by

the application of desensitization training techniques (Clay et al, 2009). Training can reduce abnormal behavior during the period of time the trainer is working with the primates (Bloomsmith et al., 1997; Morgan et al., 1993). Training behaviors that are incompatible with stereotyped behavior may also be an effective therapy (Bourgeois and Brent, 2005). In some cases, behavior improved even outside

continued on page 18

of times the trainer is working with the animals (Bourgeois and Brent, 2005; Coleman and Maier, 2010; Pomerantz and Terkel, 2009), but not in all cases where this was tested (Baker et al., 2009; Bloomsmith et al., 1997).

PRT has been shown to reduce physiological measures of stress, and thereby improve animal welfare. Evidence includes reductions in cortisol levels, stress-related abortions, physical resistance to handling, and acute diarrhea (Moseley and Davis, 1989; Reinhardt et al., 1990; Vertein and Reinhardt, 1989). Trained chimpanzees who presented for injections of an anesthetic had significantly reduced physiological measures of stress when compared to those who were anesthetized via chemical darts (Lambeth et al., 2006). Cynomolgus macaques involved in daily PRT sessions showed decreased cortisol measures, as well as diminished hematological and cardiovascular measures of stress when compared to those not exposed to PRT (Koban et al., 2005). This growing body of scientific literature should be carefully reviewed by those who are trying to discern the value of PRT for their own primate management programs. Based on this literature, and on the increasing practice of PRT, clearly PRT is now established as a feasible means of managing and caring for primates. It can be done and it does work. However, there are real obstacles to the broad implementation of PRT.

So Why Isn't Everybody Using PRT, All the Time?

We are beginning to recognize the power that PRT has to improve the welfare of laboratory primates. There is now added incentive to develop PRT programs, as the recent edition of the *Guide for the Care and*

Use of Laboratory Animals (National Research Council, 2011) includes many recommendations to incorporate positive training methods into husbandry and research procedures. Despite this, animal training is not yet widely incorporated into primate care and management programs in U.S. primate laboratories. We should ask, what is keeping this from happening?

Surely there are many reasons, but I believe one of the fundamental reasons is the complexity of developing a comprehensive PRT program. PRT itself is deceptively easy. You reward the animals after they do what you want, and they will do it again. It's that simple. One might assume that all that needs to be done is to hire a trainer, and your program would be complete. But to fully incorporate PRT into our primate management programs, many, many things have to change. Change is needed among all staff members working in animal care, veterinary care, behavioral management and research who work directly with the primates. Staff members need to learn training techniques, become competent trainers, be patient and consistent when working with the animals, and refrain from using more traditional techniques with which they are very familiar, and which might work more quickly, but rely on coercion or physical restraint. Change is needed in the way animals are moved for cleaning their enclosures, the way animals are accessed for biological sample collection, and the way they are fed (using PRT to reduce fighting over food, for example, or feeding preferred foods during training sessions rather than in feeding enrichment devices). Facilities may need to be modified to allow access to animals

to facilitate training, and equipment may need to be designed, built or purchased (e.g., for collection of blood samples or tunnels for transferring animals). New positions may need to be funded and budgets expanded for training supplies and equipment. Operating systems need to allow people additional time for training, encourage people to communicate about training, and allow people to work together at certain times. New documentation needs to be put in place, with access by people from multiple working groups. Research projects and the grants that fund them may need to alter timelines and budgets to allow the use of PRT. And...IACUC members need to know enough about how PRT can be used in research protocols, so that they can require it when appropriate.

So, while the foundational concept of PRT is uncomplicated, implementing a fully-functioning training program is certainly not easy. This type of change will require time, skill, resources, and concerted efforts from several levels of an organization to be successful. There are two recent publications that describe some of these steps in developing programs and that detail models that might be useful to emulate (Perlman, et al; 2012; Prescott et al, 2005).

Ten Things You Can Do to Get Started

Because of the complexities mentioned above, it can be overwhelming to begin a PRT program. To start, I suggest you begin with some of these practical steps. Whether you are an animal caregiver, a veterinarian, an IACUC member, or a researcher studying primates, there are things you can do which will be small steps toward a fully-fledged PRT program.

1) Read the two articles noted above (Perlman, et al; 2012; Prescott et al, 2005) about the organization and implementation of PRT programs.

2) Send a staff member to a workshop or conference to develop training skills. Support that person in implementing changes.

3) Begin training some of your primates using PRT for some behaviors, even if you can't train all of your primates for everything that would be useful. For example, perhaps you don't think you can initially train them for voluntary blood collection, but maybe you can train them to be less afraid of the restraint process used in that procedure.

4) Make time in staff members' schedules to do some training, and check up on how it is going. One person's accomplishments can be an important example of how PRT might work at your facility.

5) Document the training that is begun, so you can later answer questions about how long the training required, and what was accomplished.

6) If you have trained primates for research procedures, present your findings to your colleagues. It is especially important that investigators present this information to other scientists working in their own field.

7) Include a plan for PRT in your next grant proposal and as research studies are being designed. Include a description of training techniques used in your next publication.

8) Determine whether your IACUC is reviewing protocols from a training perspective, and, if not, determine a way for that to begin.

9) Assess the current state of primate training at your facility, and map out a plan to expand the program.

(10) Reward someone who has taken the initiative to begin training to improve animal welfare. PRT works on people too!

Conclusion

I believe the value of PRT has been firmly established. A huge variety of behaviors can be trained, and the training can have beneficial effects on animals' welfare, veterinary care, husbandry, and research projects conducted with primates. The next challenge is to figure out how PRT can be used in a more widespread and effective manner. As the laboratory primate community, we need to embrace this challenge and make rapid progress on this very important refinement in caring for primates.

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