Training Nonhuman Primates to Cooperate During Handling Procedures: A Review

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SUMMARY

There is ample published evidence (46 reports) that nonhuman primates do not need to be forcefully restrained during common handling procedures. Twenty-six reports provide detailed information of how primates can be trained to voluntarily cooperate - rather than resist - during blood collection, injection, topical drug application, blood pressure measurement, urine collection, and capture. Such training techniques minimize distress reactions, thereby safeguarding the subjects' welfare and increasing the validity of research data collected.

INTRODUCTION

Traditionally, nonhuman primates are being regarded as unpredictable and vicious animals, posing a serious danger of zoonoses transmission through bites and scratches to all those who handle them. Hence, it is a commonly endorsed and recommended practice to apply forced restraint when handling primates not only during complex procedures such as blood pressure measurement and blood collection, but also during simple procedures such as drug injection and capture.[1-14] Bites and scratches, however, are frequent despite the rigorous precautions.[15-17]

Involuntary restraint is accompanied by numerous changes from normative behavioural and physiological reactions. Such deviations include: alarm vocalization, fear vocalization, defensive threatening, defensive aggression, acute diarrhoe, struggling, respiratory rate increase, heart rate increase, catecholamine increase, cortisol increase, prolactin increase, luteinizing hormone decrease, testosterone decrease, metabolic acidosis, immune suppression, leukocytosis, enzymatic shifts, drowsiness, and exhibition of neurotic behaviours.[18,19] Individuals respond differently to restraint, thereby introducing additional nonexperimental variables into the research data.[20] This problem has traditionally been dealt with by using more experimental animals in order to improve statistical significance. Training techniques that reduce or eliminate such sources of variability have, therefore, the potential of reducing the number of animals required in a given protocol. [21-29]

The Primate Research Institute of Kyoto University stipulates that unnecessary physical restraint should be avoided.[30] The International Primatological Society also underscores that restraint procedures should be used only when less stressful alternatives are not feasable.[31] Prentice et al make it a principal rule that physical restraint should be used only after alternatives have been considered and found to be inadequate.[32] Training the animals to cooperate - rather than resist - during handling procedures is an *adequate alternative* which:

- reduces or eliminates data-confounding stress responses thereby enhancing the quality of data collection,[16,19,33-44]
- decreases the risk of injury,[16,45-51]
- reduces the amount of time and the number of personnel required to perform a procedure,[38,40,48,52-55]
- provides mental stimulation not only for the animal subject but also for the care personnel,[42,46,49,50,54-61]

- and fosters a human-animal relationship that is based on trust rather than fear.[48,62]

For the present review of the literature, *training* nonhuman primates to cooperate during procedures is defined as: *teaching* the subject to *voluntarily* respond to a key situation in predetermined fashion and *accept* the handling procedure. This definition implies that the subject is not coerced but is *free to resist* the handling. All publications included in this review provide background information not only of the species but also of the gender and age of the subjects.

CASUAL OBSERVATIONS

Some authors allude to training protocols without outlining the actual technique. Often, this hint is given to point out that research data were collected from subjects who were not exposed to data-contaminating distress.

Smith & Ansevin studied adult rhesus macaques (*Macaca mulatta*) of both sexes who were trained to allow reproducible blood pressure measurements.[63] Bernstein et al examined reliable plasma concentrations of testosterone in group-housed adult male rhesus who were trained to present a leg for blood collection in a transport box.[64] Herndon et al and Billiard et al worked with individually-housed adult male and adult female rhesus who extended a leg out of a transport box to facilitate blood collection for obtaining baseline levels of various hormones.[65,66] Rosenblum & Coulston assessed the normal range of haematology values of juvenile and adult female rhesus macaques who were trained to present an arm through a small cage opening for blood collection.[67] Wall et al conducted a haematological study with singly caged adult female vervet monkeys (*Cercopithecus aethiops*) who were trained to offer a limb for "unstressed" blood sampling.[68] Hein et al studied normal endocrine profiles of adult female longtailed macaques (*Macaca fascicularis*) who were trained to extend their arms through the bars of their cages for blood drawing.[69]

Laule et al trained adult male chimpanzees (*Pan troglodytes*) for venipunture in the home cage.[70,71] McGinnis & Kraemer and April published photographs of an adolescent male and a juvenile female chimpanzee who were trained to accept blood collection in the home cage and on a treatment table, respectively.[72,42] Reinhardt published photos of an adult female rhesus macaque who had learned to freely present a leg for ketamine injection.[73]

Bunyak et al took advantage of the characteristic hindquarter-presentation and coached group-housed adult stumptailed macaques (*Macaca arctoides*) to allow vaginal swabbing.[35] Desmond et al shaped in similar way the behaviour of drills (*Papio leucophaeus*) to facilitate artificial insemination.[74] Laule et aland Stone et al trained adult single- and group-housed female chimpanzees to urinate into a pan that slides under the wire front, or climb onto the chain link and urinate into a small cup inserted beneath them.[70,75]

Paciulli conditioned a solitary adult male gorilla (*Gorilla gorilla gorilla*) to open his mouth and stick out his tongue when a flashlight and a tongue depressor were held in front of him, and to allow the veterinarian to listen to his heart beats with a stethoscope.[56]

Elvidge et al trained adult female rhesus macaques to jump from their cages into a restraint box for subsequent blood collection.[33] Smith and Klaiber-Schuh & Welker coached group-housed stumptailed and longtailed macaques of both sexes and all ages to voluntarily enter a transport box one-by-one.[76,77] Walkeret al mention that group-housed adult female rhesus quickly learn to box and usually require very little coaxing.[78] Stone et al trained female and male chimpanzees of all ages to move as a group on a verbal cue to the indoor portion of their enclosure.[79]

DETAILED OBSERVATIONS

Numerous authors furnish explicit information of the protocols used to train nonhuman primates to cooperate during procedures.

Injection and blood collection

Levison et al developed a shaping technique by which an adult male baboon (*Papio cynocephalus*) learned to offer his arm through a porthole and accept intramuscular injection in his home cage.[80]

- The training started by holding a slice of fruit in front of the hole and giving it to the baboon when he extended his arm through the opening.
- Then, the fruit was given only when the arm was fully extended,
- and later, held quietly for a number of seconds.
- Next, the subject was required to maintain this posture while the trainer touched his arm. The male received fruit after each satisfactory extension. This reward was withheld if the arm was bent or withdrawn in response to tactile stimulation.
- During subsequent sessions, the trainer held the baboon's wrist with one hand and touched the biceps with the other hand, then with the syringe, and with the needle which was finally inserted into the muscle.
- Injection was reliably obtained after approximately nine one-hour training sessions distributed over a three-week period.

Walker et al trained 22 adult group-housed female rhesus macaques for blood collection in a restraint apparatus.[78] Individuals were confined to the front, allowing the experimenter to reach inside and grasp a leg. Once the leg was held firmly, the restraint was released and venipuncture was carried out. The animals quickly learned to extend their legs and accept the handling. Phillippi-Falkenstein and Clarke trained five adult females and one adult male of a rhesus breeding troop for the same purpose[81].

- Two technicians, carrying a net and plastic sticks "guided" the animals into a chute, and prompted them to enter from there the sample cage one at a time. Once trapped, the subject was rewarded with preferred food.
- Gentle movement of the squeeze back encouraged the monkey to come to the front of the cage. Another food reward was offered, and the squeeze mechanism released. After 3-5 minutes of acclimatization, the animal was discharged back into the corral.
- During the subsequent eight daily sessions, individuals were again transferred to the sample cage. The trainer reached through a porthole for the monkey's leg which she carefully pulled out of the cage thereby exposing the saphenous vein.
- The squeeze back was pushed into its normal position and the monkey's leg continuously held and gently pinched for 3-5 minutes.
- By day 9, the male stopped resisting, and three of the five females spontaneously presented their legs and remained unruffled when blood samples were collected.

Dettmer et al trained eight adult female capuchin monkeys (*Cebus apella*) for venipuncture in a squeeze apparatus equipped with a padded hole through which the monkey's leg could be obtained. 44 If the animal did not willingly offer a leg within the first minute, the squeeze mechanism was applied until the individual tolerated her leg to be exteriorized and a blood sample taken. The squeeze back was then returned to its normal position, and a food reward offered. After 19 training sessions distributed over a 6.5 week-period, none of the eight capuchins presented a leg, but four of them were scored as behaviourally and physiologically habituated to the handling procedure.

Vertein & Reinhardt taught eight pair-housed adult female rhesus macaques to accept blood sampling in their home cages.[82] Normally, the animals were venipunctured in traditional fashion, which implied manual restraint on a table or mechanical restraint in a squeeze apparatus.

- The first five sessions included alternately offering both partners of each pair favoured food for two minutes, and leaving them alone for five minutes while the back wall was pulled and the floor area reduced by approximately 75%. The animals were not immobilized in this situation but had room to walk back and forth and turn freely around. The back wall was pushed into its normal position thereafter and the two females rewarded again with food.
- This routine was repeated during sessions six and seven, when the trainer also groomed each animal's leg during the two-minute periods of food offering.
- Succeeding sessions 8-23 entailed grasping the leg,
- pulling the leg gently but firmly to the door while stroking the subject's calves,
- holding the leg outside the door for 20 seconds,
- and finally puncturing the saphenous vein. One female persistently turned the extended limb thereby exposing her groin area; the femoral vein was, therefore, punctured in this subject. Each session was concluded with a food reward which was always enthusiastically taken from the trainer's hand.
- During session 24, blood collection was accomplished in all eight animals. Three of them, including the one who had the femoral vein punctured, actively presented a leg on this occasion. The other five were less cooperative but also showed no signs of fear or resistance to having a leg pulled through the cage door and a blood sample taken.

Reinhardt adapted this technique for ten pair- and five single-housed adult male rhesus who were accustomed to being forcibly venipunctured in a squeeze apparatus.[48] Each cage was equipped with a sliding Plexiglas panel fitting over the cage door. The panel had a smooth-edged slot that allowed a male to comfortably exteriorize a leg, yet was small enough to prevent him from protruding his head out of the cage.

- Training sessions started by slowly pulling the back wall. This was followed by unfastening of the door while sliding the Plexiglas panel over the opening.
- During the initial sessions, the subject's freedom of movement was considerably restricted, and the animal had to get into an upright position to turn around. Reaching a hand through the aperture of the panel, the trainer calmly groomed the back of the subject, carefully lifted and firmly but gently pulled one of his legs toward and through the cage opening. This was accompanied by saphenous venipuncture after a few sessions.
- On average, a cumulative total of 24 minutes was required to overcome the males' resistance to this manipulation. Paired males tended to stop resisting quicker than single males.
- During subsequent sessions, the back wall was pulled only about 60% so that the subject could comfortably move around and had the option of refusing to be touched.

- On average, an additional 16 minutes of training were required until the males cooperated, i.e., freely presented a leg behind, in, or through the slot of the panel and displayed no resistance during blood collection (Figure 1).

Once trained, all indivuduals cooperated not only with the trainer but also with the attending care personnel. It took 1-2 minutes from entering an animal room to the completion of one blood sample collection. Serum cortisol concentrations did not show the significant increase which typically accompanies the conventional procedure in the squeeze apparatus.[83]

FIGURE 1. Adult male rhesus macaque trained to cooperate during blood collection. (From: International Zoo News 39 (1992); with permission of the Editor)

The 15 males were trained with gentle firmness and strict consistency:

1. They were never punished, but patience was applied to help them learn what was requested of them. This made the interaction with the trainer *predictable* and *non-threatening*, giving the animals no reason to show aggressive reactions.
2. While working with a male, the trainer constantly talked to him reassuringly, using phrases such as "What a good boy! You are really nice, aren't you?"
3. The duration of training sessions was determined by the monkeys not by the handler, and under no circumstances were sessions terminated before the subject's leg was pulled out of the cage for one minute, or for the time period required for a successful venipuncture.
4. When this was accomplished, the subject was released and the back wall pushed into its normal position.
5. The males never hesitated to take food rewards from the trainer's hand at the completion of each session.

Reinhardt tested this training protocol in six pair-housed juvenile female rhesus macaques.[84] The partners of only one pair voluntarily extended a leg through the cage opening for venipuncture after a cumulative total of 46 and 47 minutes, respectively. The training of the other four kids was discontinued after 60-120 minutes when it was acknowledged that they had difficulties overcoming their fear and hence stubbornly refused to cooperate. Reinhardt & Cowley were more successful when applying the scheme in six pair-housed adult female stumptailed macaques.[85] On average, 16 minutes of training were invested until subjects tolerated in-home cage venipuncture. An additional 18 minutes were then spent to ensure active cooperation and acceptance of the handling. Endocrine analysis confirmed the impression that the animals were not distressed during blood collection: There was no rise in serum cortisol concentration.

Laule et al trained an infant female chimpanzee for venipuncture.[71] Initially, *Allie* was taught to sit on a tabletop and allow her arm to be manipulated and held by the trainer. Next, she was desensitized to having her arm touched by, first, the trainer's finger, then a cotton swab, and then a syringe without a needle, with a blunt needle, and finally with a sharp needle. Throughout the process, *Allie* was rewarded with favoured food for being relaxed and tolerating each stimulus for increasingly longer periods of time. The first blood draw occurred during the 18th training session, with a total of 275 minutes invested prior to that. *Allie* showed no fear during this and subsequent blood draws but sat quietly, watched the entire procedure, and eagerly consumed the food rewards.

Priest shaped the behaviour of an adult diabetic male drill in such a way that the animal would accept his daily insulin injection and periodic blood collection.[19]

- For the first assignment, the male was immobilized by using the squeeze back of the cage; the subsequent insulin injection was consistently parred with a food reward.
- The need for the squeeze back gradually diminished until the animal predictably accepted the injection without being restrained.
- For the second assignment, the monkey had to learn to reach on command into a stainless steel sleeve, which was attached to the front of the cage, grasp with his extended arm a rod positioned at the end of the tube, and remain in this position until a clicker was sounded; this signal was immediately followed by the offering of a food reward.
- The male complied within a few days, but it took several further weeks until he took the food reward without swiping at the trainer.
- Through an ellipse cut in the sleeve, the trainer then gradually desensitized the drill to being groomed and touched at the venipuncture site, while continuously grasping the rod at the end of the tube. Cooperation earned a food reward and a "good back scratch".
- After five weeks of the training, the unrestrained monkey placidly allowed blood sampling.

Blood pressure measurement

Turkkan et al taught ten singly caged adult male baboons to extend an arm on command onto a shelf attached to the outside of the cage, and accept repeated cuff inflations for blood pressure measurements.[53] The trainee was rewarded with favoured food for the following actions in progression:

- Extending an arm onto the shelf,
- touching the vertical post at the end of the shelf,
- grasping the post and holding it for increased durations,
- allowing the extended arm to be touched, and stroked with the blood pressure cuff,
- allowing the cuff to be placed, fastened and unfastened around the arm.
- With the cuff in place, allowing the stethoscope to touch the arm,
- allowing the inflation and gradual deflation of the cuff during blood pressure measurement.

An episode of uncooperativeness was never 'rewarded' by ending a particular training session, but the food reward was withheld and the training resumed after a few minutes. Individual baboons cooperated during the procedure after 1-5 months of training.

Topical drug administration

Reinhardt & Cowley trained 17 adult male and three adult female stumptailed macaques for weekly test-drug application on their foreheads.[54] Traditionally, the animals were removed from their cages and treated in a squeeze apparatus. They were pair-housed in double cages equipped with Plexiglas plates sliding over the cage door openings. Each plate had a face-shaped hole fitting an adult monkey's head and two smaller circular holes fitting his/her forearms. The three holes were smooth-edged and arranged in such a way that a monkey could secure and eat peanuts offered, but not grab or bite the technician who, using a brush, would apply the medication on the animal's forehead. All 20 stumptails learned within 1-14 training sessions, each lasting 1-5 minutes, to present their heads and remain still during the treatment while taking peanuts from the technician's hand (Figure 2). They cooperated not only with the trainer but also with other care personnel.

FIGURE 2. Adult male stumpt-tailed macaque trained to cooperate during topical drug application. (From: Laboratory Primate Newsletter 29 (1990); with permission of the Editor)

Segerson & Laule trained a solitary female gorilla to allow topical treatment of a wound.[86]

- Initially the trainer desensitized *Hope* to being touched with a stick.
- She was then conditioned to present her injured leg when requested and held it in place for several seconds. A clicker was used to signal a correct response to a verbal command, with a food reward immediately following.
- Thereafter, desensitization to having the leg touched was undertaken.
- First, a cotton swab was used to touch the wound, which *Hope* accepted right away. Then the cotton swab was moistened with water and lightly rubbed on the wound. She tolerated this after several trials.
- Second, an empty squirt bottle was introduced and puffs of air blown on the wound. After three days, *Hope* was comfortable with this operation, and the bottle was filled with water.
- It took nine further days until she allowed water being squirted on the wound.
- A month later, *Hope* willingly cooperated and remained still when an antiseptic was applied on the wound.

Urine collection

Sunde & Sievert conditioned adult female gorillas to urinate when asked.[87] Each female was first isolated from her companions and given one liter of juice. While standing on the ceiling-grating of the cage, the trainer beseeched the gorilla to urinate. Compliance was rewarded with verbal praise and favoured food. Training involved one-hour sessions each morning. Adults required one month, juveniles about four months until they micturated reliably on command.

Bond developed a technique for an adult group-housed female gorilla to obtain urine samples *without* having to shift the donor out of her home pen.[88]

- A cement urinal-perch was installed in the enclosure. In the beginning, the trainer stood behind the urinal, and gesturing toward the "potty" encouraged the gorilla to sit on it. Cooperation was reinforced by praising the animal, who would ultimately sit on the potty on demand.
- In order to increase the female's awareness of urination, the trainer then used the key phrase "Good girl, you made pee-pee!" whenever she was seen urinating.
- Once *Mandara* positioned herself on the urinal reliably, the trainer started requesting urine samples by using the key phrase "Okay, *Mandara*, time to pee!". Urination into the potty earned a high preference food reward.

Mandara has been producing daily samples on demand for several years. She is so committed that, occasionally, she would go and get a drink of water when asked for a sample at a time when her bladder was empty.

Laule et al used a similar technique for a female infant chimpanzee.[71]

- Preliminary training consisted of inserting a urine collection wand through the wire mesh and waiting until *Allie* urinated at any location. Micturation was consistently rewarded with praise and a favoured drink offered in a squirt bottle.
- At the same time, *Allie* was induced to sit on a perch while grasping the cage front. This was achieved by giving her small sips of the drink every 30-60 seconds as long as she remained in this position.
- Once *Allie* learned to maintain position, the reward was gradually diminished to one small squirt of drink upon initial positioning, followed by a large sip when she urinated.
- Next, *Allie* was desensitized to the wand. While maintaining correct position on her perch, she was rewarded for allowing the tip of the instrument to be positioned beneath her, and for not grabbing it. The two cage-mates were also rewarded for not touching the wand.
- The first successful urine collection occurred in session four after a cumulative total of 42 minutes of training.

After this incidence, *Allie* cooperated during urine collection not only with trainer but also with other members of the animal care staff.

Kelley & Bramblett took advantage of the spontaneous inclination of male vervet monkeys to urinate on an intruder, and trained eight adult males of a breeding group to cooperate during urine sample collection.[52]

- At first, two peanuts were given to any male who happened to sit on the horizontal perch in the presence of the trainer. After several sessions, individuals promptly positioned themselves on the perch.
- The reward criterion of two peanuts was then successively changed to urinating from the perch,
- urinating in close proximity to the trainer, and

- finally urinating in a plastic beaker.
- A sample that went into the beaker without touching the perch earned four peanuts.

Six of the eight males reliably produced clean urine samples after a two-month period of training. Cumulative training time per individual was 6.75 hours.

Anzenberger & Gossweiler trained members of marmoset (*Callithrix jacchus*) families to enter single compartments of a specially designed apparatus and urinate within a few minutes for sample collection.[89]

- The main goal of the first week of training was to familiarize the monkeys with the apparatus as an extension of their home cage and as a source of favoured food.
- During the second and third week, the marmosets were trapped individually in the compartments after leaving their sleeping quarters. Animals who showed any signs of discomfort when being locked in a compartment were immediately released, and trained again the next morning.
- At the beginning of the third week, none of the monkeys showed signs of panicking when confined in the cubicles, but would void their morning urine soon after starting to eat the food reward.

By the end of the third week, it was not unusual to collect urine samples from an entire family consisting of 4-16 individuals.

Capture

Clarke et al conditioned juvenile single-caged female macaques to cooperate during capture.[90] Subjects were given one minute to enter a transport box. If a female refused to leave the home cage, she was forced to do so using the squeeze back. Once caught in the box, the monkey was rewarded with raisins, and released after 30 seconds back into the home cage. The average number of trials required to promptly enter the transport box was 11 for seven rhesus macaques, 15 for longtailed macaques, and 28 for seven bonnet macaques (*M. radiata*).

Heath taught seven single-housed adolescent longtailed macaque females to enter a transport box.[91] During the first two weeks, the subjects were caught by hand - using the squeeze back to bring the animals to the front of the cage - and placed into the box where they received a food reward. Thereafter, it was decided to hold the box up to the cage to see if the monkeys would freely enter. After seven days using this method, five of the seven females went into the box without hesitation. The other two continued to need prompting with the squeeze back to do what was requested of them.

Rather than using a transport box, Nahon fitted permanent collars to [presumably] adult male pigtailed macaques (*M. nemestrina*) and lured the animals with favoured food to freely come to the front of their cages and allow the trainer to hook a pole to the collar.[92] The duration a male spent at the front of his cage was progressively lengthened by offering very small food items which required extra time to be retrieved from the trainer's fingers. Ultimately, the male would stay long enough so that the catching device - which was always in full view of the animal - could be attached and the animal removed from his cage. Anderson & Houghton used the squeeze back instead of enticing food to bring the collar-fitted monkey (adult rhesus macaques of both sexe) to the front of the cage.[93] As soon as the subject was secured by the catch pole, the squeeze back was released. If the animal resisted the pole, it was held in place until it calmed down. The cage door was then opened and a second pole attached to the opposite side of the collar. The first pole was removed and the tethered monkey guided out of the cage. It is not clear if the animals *accepted* this situation or if they simply *tolerated* it because they had not other option.

Reinhardt developed a technique that permits a single person to quietly capture individuals of rhesus breeding groups.[94,95]

- The trainer enters the enclosure and persuades the whole group to move from the large living area to a smaller holding area by clapping his hands and giving vocal commands such as "Let's go! Out of here!" Once they are confined in the holding area, the monkeys receive preferred food from outside through the wire mesh. After 30 minutes, the group is released through a tunnel back into the living area. This routine is repeated daily until the animals promptly move into the holding area when the trainer opens the door of their pen.
- A transport box with open door is attached to the side exit of the tunnel. The animals have continuous free access to the tunnel and to the transport box. Food is distributed at both locations.
- On the next day, the trainer confines the group in the holding area. The tunnel is open but the exits into the living area and transport box are shut. Standing outside, the trainer looks at specific animals while giving vocal commands thereby prompting them to enter the tunnel. Closing the entrance, the trainer traps the monkeys in the tunnel and, with further encouragement incites one of them to enter the transport box. The captured individual is briefly removed from the room and released thereafter into the living area and rewarded with an apple. All other animals are caught and released in the same manner.
- This drill is repeated twice a day until the whole group swiftly enters the tunnel and exits into the transport box one-by-one.

A cumulative total of 9 minutes per individual was invested to successfully train two breeding groups of 28 and 33 animals. It took 19 and 22 minutes, respectively, to capture and release all group-members. Once trained, the two groups cooperated also with the attending personnel during routine capture for weighing, tuberculin testing, veterinary treatment and blood collection.

Luttrell et al tested this technique in a larger breeding troop of 45 rhesus.[96] A cumulative total of 8 training minutes per animal was needed until all group members entered the transport box one-by-one spontaneously or on vocal command. Unlike during the conventional capture method, which involved much excitation caused by shouting, chasing and catching the monkeys with nets, none of the animals showed any of the usual signs of distress, such as acute diarrhoe, rectal prolapse, screaming or defensive aggression.

DISCUSSION

Nonhuman primates can readily be trained to voluntarily cooperate during handling procedures. Twenty-seven reports describing in detail how successful training can be accomplished for blood collection, injection, topical drug application, blood pressure measurement, urine collection and capture have been published.

There is no evidence of one gender being more trainable than the other. Young animals, however, tend to require more training time than adults. The few articles which include behavioural assessments and/or measurements of serum cortisol concentrations confirm the assumption that an animal's distress responses during involuntary handling can, indeed, be avoided if the individual is first trained to cooperate during the procedure.

The information available is not comprehensive, and training protocols have not been published for all species and all handling procedures. However, taking the intelligence of all primates into account, there is good reason to believe that a training technique that has proven to be successful in one particular handling situation in one particular category of primates can be adapted with equal success for a similar category of primates. For example, the blood collection training technique developed for male *Macaca mulatta* is likely to be equally effective and safe when used in adults of the genus *Macaca* in general, but also when used in individuals of other medium-sized primates such as vervet monkeys, capuchin monkeys or female baboons.

In the course of 40 years (1957-1997), 46 cases of nonhuman primates being trained to cooperate during procedures have been reported. The great majority of them (30) were published during the recent 10-year span. This suggests that investigators are becoming more aware of the fact that the traditional forced handling procedures are dissatisfactory and that new ways have to be explored to minimize or eliminate data-biasing distress responses of the research subject during data collection. The 1996-edition of the National Research Council's *Guide for the Care and Use of Laboratory Animals* does not explicitly recommend the training of nonhuman primates but, as a first encouraging step, makes a note of the fact that "many ... nonhuman primates ... can be trained, through use of positve reinfrocement, to present limbs or remain immobile for brief periods."[97] The present know-how of training techniques will have to be further expanded to more systematically reap the benefits not only for the scientific enterprise but also for the animals and for the personnel who care for them.

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