Routledge
Taylor & Francis Group

Journal of Applied Animal Welfare Science

ISSN: 1088-8705 (Print) 1532-7604 (Online) Journal homepage: www.tandfonline.com/journals/haaw20

Positive Reinforcement Training for a Trunk Wash in Nepal's Working Elephants: Demonstrating Alternatives to Traditional Elephant Training Techniques

Ariel Fagen, Narayan Acharya & Gretchen E. Kaufman

To cite this article: Ariel Fagen, Narayan Acharya & Gretchen E. Kaufman (2014) Positive Reinforcement Training for a Trunk Wash in Nepal's Working Elephants: Demonstrating Alternatives to Traditional Elephant Training Techniques, Journal of Applied Animal Welfare Science, 17:2, 83-97, DOI: 10.1080/10888705.2014.856258

To link to this article: https://doi.org/10.1080/10888705.2014.856258

JOURNAL OF APPLIED ANIMAL WELFARE SCIENCE, *17*:83–97, 2014

ISSN: 1088-8705 print/1532-7604 online
DOI: 10.1080/10888705.2014.856258

Routledge
Taylor & Francis Group

ARTICLES

Positive Reinforcement Training for a Trunk Wash in Nepal's Working Elephants: Demonstrating Alternatives to Traditional Elephant Training Techniques

Ariel Fagen,[1] Narayan Acharya,[2] and Gretchen E. Kaufman[1]
[1]*Cummings School of Veterinary Medicine, Tufts University*
[2]*Institute of Agriculture and Animal Science, Tribhuvan University, Chitwan, Nepal*

Many trainers of animals in the zoo now rely on positive reinforcement training to teach animals to voluntarily participate in husbandry and veterinary procedures in an effort to improve behavioral reliability, captive management, and welfare. However, captive elephant handlers in Nepal still rely heavily on punishment- and aversion-based methods. The aim of this project was to determine the effectiveness of secondary positive reinforcement (SPR) in training free-contact elephants in Nepal to voluntarily participate in a trunk wash for the purpose of tuberculosis testing. Five female elephants, 4 juveniles and 1 adult, were enrolled in the project. Data were collected in the form of minutes of training, number of offers made for each training task, and success rate for each task in performance tests. Four out of 5 elephants, all juveniles, successfully learned the trunk wash in 35 sessions or fewer, with each session lasting a mean duration of 12 min. The elephants' performance improved from a mean success rate of 39.0% to 89.3% during the course of the training. This study proves that it is feasible to efficiently train juvenile, free-contact, traditionally trained elephants in Nepal to voluntarily and reliably participate in a trunk wash using only SPR techniques.

Keywords: *positive reinforcement, training, elephant, clicker training, operant conditioning, trunk wash*

Traditional elephant training methods rely on punishment, negative reinforcement (the removal of a negative stimulus to reward a wanted behavior, also known as aversion training), and positive reinforcement (Locke, 2006). Punishment and aversion techniques rely on an aversive

Ariel Fagen is now at Wheat Ridge Animal Hospital, Wheat Ridge, CO. Gretchen E. Kaufman is now at Washington State University, Pullman.

Correspondence should be sent to Ariel Fagen, Wheat Ridge Animal Hospital, 3695 Kipling St., Wheat Ridge, CO 80033. Email: arielfagen@gmail.com

stimulus, such as pain or fear of pain, to elicit avoidance behaviors (Laule, 2003). For example, in the traditional methods employed in some areas of Southeast Asia, elephants are trained using the pain inflicted by the sharp end of a whittled bamboo stick, known as the *kocha* in Nepal, as a motivator to perform behaviors, such as turning right when the point is pressed into the back of the left ear (Locke, 2006).

In Nepal, captive elephant management relies on traditional training methods with unlimited contact between handlers and trainers (Locke, 2006), a management system known as free contact (Laule & Whittaker, 2000b). Concerns for nonhuman animal welfare and keeper safety have prompted many zoos to try a different approach (Desmond & Laule, 1994a; Laule & Whittaker, 2000a). They have switched to a management system known as protected contact, which improves keeper safety by maintaining a barrier between the handler and elephants and that relies solely on positive reinforcement or reward-based training (Desmond & Laule, 1994a, 1994b, n.d.; Laule & Whittaker, 2000a).

One form of positive reinforcement used in protected contact utilizes a distinctive sound marker, which acts as a secondary reinforcer or conditioned reinforcer (American Veterinary Medical Association, 2008; Desmond & Laule, 1991; Laule & Whittaker, 2000b) and is consistently followed by a primary positive reinforcer, often food. This method of training is called secondary positive reinforcement (SPR) training (Pryor, 1999). Once the animal is conditioned to the marker–reward relationship, the marker can more precisely indicate the moment the animal performs the expected behavior better than food treats alone by minimizing the delay in reinforcement due to the retrieval and presentation of treats. Thus, the association between the specific body movement and the reward is stronger and communication is more consistent. Once the behavior becomes reliable, the marker can be phased out and the food treats can be provided at appropriate intervals to maintain the behavior (Pryor, 1999).

With positive reinforcement, a handler can elicit requested behavior in a reliable, voluntary fashion that is motivated by the prospect of something pleasant and not by fear (Laule, 2003). The benefits of this approach include increased creativity, choice, control, and problem solving on the animal's part, safer conditions for the handlers, and generally improved psychological well being of the elephants (Desmond & Laule, n.d.). Positive reinforcement is also of particular use in training animals to accept veterinary procedures, which can include an element of pain or discomfort (e.g., a needle prick). Willingness to participate voluntarily in a veterinary procedure allows for easier, less stressful sample collection and a reduced need for anesthesia or sedation; thus, there is the potential for more regular monitoring and precise care (Desmond & Laule, 1994b).

Several studies have explored the efficacy of SPR training in multiple species with varying results (Langbein, Siebert, Neurnberg, & Manteuffel, 2007; Whistance, Sinclair, Arney, & Phillips, 2009; Williams, Friend, Nevill, & Archer, 2004). There is substantial evidence to support the efficacy of positive reinforcement training among nonhuman primates (reviewed in Laule, Bloomsmith, & Schapiro, 2003; Laule & Whittaker, 2007; Schapiro, Bloomsmith, & Laule, 2003) as well as studies to show its success in bongo (*Tragelaphus eurycerus*; Phillips, Grandin, Graffam, Irlbeck, & Cambre, 1998), nyala (*Tragelaphus angasi*; Grandin et al., 1995), and giant pandas (*Ailuropoda melanoleuca*; Bloomsmith et al., 2003) for veterinary and captive management. To date, no studies that the authors are aware of have been published to document and quantify the success of SPR training with elephants.

One situation in which veterinary management of elephants could be greatly enhanced by effective training is for the collection of sputum samples for tuberculosis (TB) testing.

Elephant TB, primarily caused by the bacteria *Mycobacterium tuberculosis*, is a significant health concern in captive populations of elephants, with 11% to 25% of captive populations in India, Nepal, and the United States and 22% of the captive population in Nepal alone estimated to be effected (Elephant Care International, 2011). Clinical signs in elephants range from subclinical disease to weight loss, coughing, dyspnea, anorexia, and nasal discharge (Mikota et al., 2001; U.S. Animal Health Association [USAHA] Elephant Tuberculosis Subcommittee, 2012). Evidence supports the possibility of zoonotic transfer of TB from elephants to people, adding further pressure to adequately control the disease in captive populations (Michalak et al., 1998; Murphree, Warkentin, Dunn, Schaffner, & Jones, 2011). The USAHA Elephant Tuberculosis Subcommittee (2012) recommends annual testing among captive herds. The current gold standard for detecting active infection in elephants is via bacterial culture of a sputum sample obtained using a procedure known as the trunk wash (Mikota et al., 2001).

Researchers who are attempting to monitor and treat TB in captive, working elephants in Nepal (Elephant Care International, 2011) have encountered significant challenges in consistently obtaining quality trunk wash samples for TB testing. The goal of this study was to determine the feasibility of using SPR training to teach free-contact traditionally trained elephants to participate in a trunk wash.

MATERIALS AND METHODS

Animals, Housing, and Care

The elephants used in this study were five females housed at the same elephant stable in Nepal. Four of the five elephant subjects (Numbers 1–4) were 5- to 7-year-old juveniles who were born at the stable. The remaining elephant subject was an adult female, (Number 5), estimated to be in her 50s. Selection of these individual elephants was made by the facility's staff and was based on docility, lack of pregnancy or current calf, and willingness of the elephant's handlers (mahouts) to participate in the study. All elephants had been trained with traditional methods, and none had previous exposure to SPR training, according to staff.

Elephants went into the jungle to graze under the control of their mahouts from 5 a.m. to 7 a.m. and 10:30 a.m. to 4 p.m. each day, and they were leg-chained to posts in open stalls for the remainder of the day and night. Leg chains were normally placed with both front legs chained together or on a single front leg, with a chain approximately 6 ft to 8 ft long (1.8 m to 2.4 m) between them and the post. This setup allowed enough laxity in the chains for the elephant to shuffle in a diameter that was 6 ft to 8 ft around her stake. The elephants' diet consisted mainly of fresh grasses and *dhana* (packets of grain, nutritional supplements, and grasses). The elephants had access to the river for water during their grazing time but were otherwise not offered water outside of the training protocol. These husbandry conditions are the standard practice at the stable and no alterations were made for the purposes of the study.

Training Methodology

The training method used within this study was entirely the SPR technique. The primary reinforcer used was chopped banana, and the secondary reinforcer was a short whistle blow.

Training was conducted during morning and afternoon sessions (7:30 a.m.–10 a.m. and 4 p.m.–7 p.m.) while the elephants were chained in their stalls. Not every elephant was trained during each session due to time constraints and mahout availability, but no elephant went longer than 2 days without a training session. Given the limited freedom permitted by their chains, the elephants could clearly indicate a preference to not participate in training sessions by walking to the other side of their stalls or simply turning away from the trainer. Mahouts were present at all sessions and stood on the periphery for the safety of the trainer, but they were clearly instructed not to speak to or signal the elephants in any way during the sessions to maintain the integrity of the training. The mahouts complied with this request.

Training for the trunk wash using voluntary methods required the elephant to put the end of her trunk in the trainer's hand, allow the trainer to instill saline or sterile water into the trunk, lift the trunk upward so that the fluid ran to the base of the trunk, and hold the fluid there before lowering the tip of the trunk into a collection container and blowing the sample out. All of these behavioral tasks had to occur smoothly in succession so that none of the fluid was lost on the ground and the elephant did not drink the solution.

A more passive method has been well described by the USAHA Elephant Tuberculosis Subcommittee (2012) in which the elephant is trained to allow handlers to restrain the tip of the trunk and move it to the appropriate position. This method is distinguished from the method used here in which the elephants are trained to actively move their trunks on their own in response to a cue.

Training began by teaching the elephants the bridge between the primary and secondary reinforcer, which was achieved by repeatedly pairing the whistle blow with a follow-up banana reward. The elephants were then trained in basic tasks using a few elementary training tools: capture, lure, and shaping.

The capture technique is a useful starting place for a behavior that an animal spontaneously does without training or that is similar to a spontaneous behavior (e.g., sitting in a dog). This method works by the trainer simply waiting for the animal to perform this natural behavior and then "capturing" it by marking and rewarding it repeatedly (Alexander, Friend, & Haug, 2011).

For those behaviors that are not natural behaviors for an animal, one can use the lure technique. In the lure technique, the animal is initially drawn into a wanted body position by strategic placement of a reward. This body position is rewarded and is used as the starting point from which to work on the desired behavior (Alexander et al., 2011).

After starting the training process with either the capture or lure techniques, the training continues often via the use of shaping. Shaping relies on natural variation in the quality of the behaviors offered during repetition and works by rewarding only the behaviors offered that are closer to the eventual goal. This rewarding of the "best" behaviors offered incrementally brings the average response closer to the desired goal (Alexander et al., 2011; Pryor, 1999).

Using these training tools, elephants were trained to do each of the following basic behavioral tasks separately (see Table 1):

(1) Trunk here: The elephant gently places the end of her trunk in the trainer's outstretched hand in preparation to allow the instillation of saline or water into her trunk. Elephants were initially trained for this task using a lure method, with a banana placed on the outstretched palm of the trainer for the elephant to retrieve. The lure was removed after

TABLE 1
Descriptions of Trained Behaviors

Behavior	*Description*
Trunk Here	The distal end of the trunk is placed gently on top of the outstretched palm of the trainer, with the ventral aspect of the trunk in contact with the trainer's palm.
Trunk Up	The distal end of the trunk is held upward either in a loose curl with the dorsal aspect of the tip of the trunk in close contact with the elephant's own forehead or is held diagonally up and outward with a completely straight trunk. The exact height or angle of the trunk is not measured.
Bucket	The distal end of the trunk is gently placed inside a bucket.
Blow	The elephant gives a strong, sharp exhale through the trunk.
Steady	The elephant holds the trunk still with the trunk held in the position previously requested (trunk here, trunk down, or trunk out). The elephant can move his or her feet, ears, head, tail, and body slightly as long as the trunk remains still in the previous position requested.
Syringe	The elephant holds the trunk still in the trunk-here position to have the distal end of a catheter tip syringe placed inside the nostril of the trunk and up to 60 mL of saline or water instilled into the trunk.
Blow into Bucket	The elephant places the distal end of the trunk in the bucket and gives a strong, sharp exhale through the trunk.
Trunk Down	The trunk is held in a relaxed position with the trunk hanging loose toward the ground.
Trunk Out	The trunk is held stretched straight outward, approximately parallel to the ground.
Targeting	The elephant moves such that the center of the forehead makes contact with the end of a targeting stick placed at the height of the forehead.

a few repetitions, and the behavior was shaped such that the elephant was only rewarded when the ventral aspect of the tip of the trunk was gently placed on the outstretched palm of the trainer.

(2) Trunk up: The elephant lifts her trunk upward to allow the saline or water to run down to the base of her trunk. This position was also used as a replacement behavior for those elephants who attempted to drink the solution after blowing it into the bucket for collection. Elephants were trained for this task using lure and shaping techniques. For those juveniles who were short enough, the trainer initially lured the trunk-up position by bringing banana pieces a few inches above the forehead for the elephants to retrieve with their trunks. For the adult and those juveniles who were too tall for this method, the lure was used with the trainer's arm fully extended above her own head and with the treats in her hand. The position of the trunk was then shaped for increasing height.

(3) Bucket: The elephant places the distal end of her trunk in a bucket in preparation to blow. Elephants were initially trained for this behavior with a lure where banana pieces were placed in the bottom of the bucket. The lure was removed after a few repetitions, and the behavior was marked and rewarded.

(4) Blow: The elephant gives a strong exhale through her trunk to blow out the solution for sample collection. Elephants were trained for this behavior by capturing the natural exhale associated with breathing and shaping it for more force.

(5) Steady: The elephant holds the position she has just been previously asked to do. Elephants were trained for this behavior after they had learned certain positions in which to apply this hold cue. Shaping was used to increase the length of time a position

was held. The steady behavior was reinforced by repetitive marking of the hold with the primary reinforcer delivered upon completion of the hold. There was no associated hand cue for the steady task; instead, the hand cue for the position was simply maintained for the extent of time in which the steady task was requested. Relaxation of the trainer out of the hand cue position indicated the elephant could relax out of the hold as well and defined completion of the steady behavior.

Only after the elephant performed the individual behavioral task did the trainer pair a verbal cue with the behavior. Verbal cues were monosyllabic, distinctive words created to mean nothing in either English or Nepali, so as to avoid any misconception on the mahouts' part that the elephants could potentially comprehend the meaning of the verbal cues, a noted occurrence in this community by anthropologist Pierre Locke (2006, pp. 281–282).

Three other tasks—targeting, trunk down, and trunk out—were introduced to some or all of the elephants but were quickly abandoned or deemphasized, as they were not needed for performance of a trunk wash in this population. These three tasks were not included as basic behavioral tasks for the remainder of the study, but the time devoted to this training is reflected in some of the data analysis.

Once the elephant was skilled in the five basic behavioral tasks, the trainer progressed to creating strings of behaviors via behavioral chaining. Behavioral chaining enables separately trained behaviors to be performed in succession in response to cues. One theory behind behavioral chaining is that once a behavior is learned to be strongly associated with the primary reinforcer, the behavior itself becomes a reinforcer for the behavior that precedes it (McGreevy & Boakes, 2007, pp. 58–59). Completing the first behavior in the sequence essentially earns the animal the right to perform the second behavior correctly and earn a reward.

First, the elephant was taught to blow consistently and exclusively into the bucket (blow into bucket) by pairing bucket and blow in immediate succession. The elephant was rewarded for blows made in contact with the bucket, and then the behavior was shaped for blows centered inside the bucket only. Following this, the elephant was taught to string the other behaviors together in small sequences to ensure smooth transitions. The separate behaviors were paired in different combinations at first and then were practiced in multiple behavior sequences that comprised various sections of the full trunk-wash behavior chain. During the sequences, the trainer continued to mark the behaviors at the appropriate times and then followed up with the primary reinforcer at the end of the sequence. Once the elephant could comfortably do the varying sequences, the trainer strung together all the behaviors: trunk here with a short steady, trunk up with a longer steady, and then bucket and blow.

After this repertoire became reliable, the syringe and sample fluid were introduced using desensitization and counterconditioning methods. In this training, a new, potentially negative experience was introduced incrementally and paired with a reward to make the experience less aversive to the elephant (Laule et al., 2003). The trainer introduced the syringe in the trunk-here position, which was always followed by the complete chain of trunk-wash behaviors. The elephant was rewarded for remaining in the trunk-here position as the syringe was presented and then brought gradually closer to the trunk tip until contact was made. Slowly, touching the outside of the trunk tip with the syringe was transitioned to touching the inside of the nostril and to gradually inserting the syringe tip into the nostril. Finally, increasing amounts of fluid were introduced into the trunk via the syringe, starting with just a drop and building up in

small increments (ranging from 1–15 mL) to reach a tolerance to the full 60 mL of fluid used for sample collection.

All elephants were started on 0.9% saline as the sample medium. They were then transitioned to plain water for training purposes. Once this step in the training process was reached, each elephant was offered water to drink at the beginning of each training session to reduce the likelihood that the elephant would drink the solution and interfere with successful completion of the tasks. One elephant had a preference for the saline over the water and would continue to drink the saline after rejecting the offered drinking water. She was transitioned over immediately to using water instead of saline as the sample medium, and her success rate improved dramatically with this approach.

Given the individuality of each elephant and different rates of learning, there was no prescribed amount of time spent at each stage in the training process. Progression through the training was dictated by the success of the individual elephant, and training plans were tailored to the individuals' needs at the discretion of the trainer (the first author) to optimize learning.

Data Collection

Session times. An assistant timed each training session to the minute, starting from when the first cue was offered and ending after the elephant's response to the last cue offered. If a session could not be, or was not, accurately timed due to lack of personnel, missing data points were substituted with the mean minutes per session of that individual elephant.

Number of offers. In each session, an assistant tallied the total number of times the elephant was given a cue for a certain behavior, and this was recorded as the number of offers for each behavior. During desensitization and the beginning of learning a new task, offers were counted even when no specific response was expected from the elephant and the verbal cue had not yet been paired.

Performance tests. Starting after Session 10, a test was administered to each elephant approximately every five sessions (after Sessions 10, 15, 20, etc.), which allowed for some flexibility. Tests were not administered until after Session 10 because the authors anticipated that a few sessions would be needed for the elephants to understand the training methodology before they could start learning the basic behavioral tasks. At each test session, elephants were tested on all the previous behaviors they had been taught, with a passing score taken to be 80% or higher for each task (i.e., 8 or more correct out of 10 offers). If an elephant had not been taught a behavior yet, it was not tested and the elephant received a default score of 0% in the records. Whether a behavioral response during the test qualified as passing was described as being "of sufficient quality to function in a trunk wash" and was subjectively determined by the trainer.

If an elephant had an 80% success rate or greater on a sequence of tasks (e.g., the trunk-here behavior into the trunk-up behavior into bucket), this was considered a "pass" for the sequence as well as for each individual behavior within the sequence. The sequence was then given a score equivalent to the elephant's success rate in the test (80%–100%). Each individual behavior within that sequence was then given a separate default passing score of 90% as the median passing score possible between 80% and 100%. If an elephant received a default pass

on any individual task, then it was not tested individually. If an elephant failed to pass on a sequence of behaviors, each task or shorter sequences were retested to determine the point of failure.

The steady and trunk-down behaviors were the only behaviors that were continually tested separately. The trunk-down behavior, where the elephant relaxes her trunk in the down position, was not part of the sequence necessary for the full trunk wash and was introduced only as a control method, so it was necessary to test it separately. The steady behavior was tested by requesting a hold in three positions: trunk up, trunk down, and trunk here. Because passing the steady test required achievement in the trunk-down position, and the trunk wash only utilized the steady behavior in the trunk-here and trunk-up positions, it could not be included as a default pass in the tested sequences and was tested as a separate task. Training was considered complete and concluded when an elephant had a passing rate of 80% or greater on the full trunk wash, regardless of the passing rate for the trunk-down and steady behaviors.

Statistical Analysis

Data were analyzed using basic descriptive techniques, including calculation of means and standard error. The relative difficulty, or average number of offers made for a behavioral task before achieving a passing score on a performance test, was calculated by accounting for all isolated behavioral offers for the associated task as well as every time the task was offered in combination with other tasks. The exception to this was the steady task, which was integrated in many combination tasks in varying sequences and was not recorded outside of isolated offers. Successful repetitions of a task after the time of receiving a passing score were not included in the analysis. A one-way analysis of variance was used to determine any significant difference between the individual tasks in the number of offers required before successfully passing a test.

RESULTS

The four juvenile elephants all successfully learned the trunk wash in the time available for the study, while the adult elephant, Elephant 5, did not (Figure 1, Table 2). Elephant 2 passed her

TABLE 2
Duration and Number of Training Sessions Needed for Success

	# of Sessions	*Mean Duration of Sessions*
Elephant 1	30	12.42
Elephant 2	25	10.29
Elephant 3	35	13.27
Elephant 4	35	11.11

Note. Mean duration of training sessions is in minutes, and number of sessions indicates the number of sessions needed to pass the full trunk-wash test. Elephant 5 is not included because she did not pass a trunk-wash test.

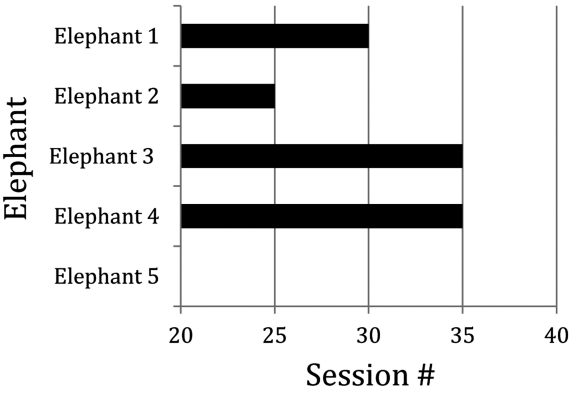

FIGURE 1 Number of sessions needed before each elephant passed her test for the full trunk wash. Elephant 5 never passed a trunk-wash test.

final test after only 25 training sessions of a mean duration of 10.29 min, Elephant 1 passed her test after 30 training sessions with a mean duration of 12.42 min, and Elephants 3 and 4 passed their tests after 35 training sessions with mean durations of 13.27 min and 11.11 min, respectively. Elephant 5 was never tested on the trunk wash, as she did not learn all the necessary components.

All elephants passed all tests for the individual tasks prior to, or during, their final testing session, with a few exceptions. Elephant 5 never passed her blow into bucket, desensitization to syringe, and steady tests. Elephants 2 and 4 also never passed their steady tests, despite being able to pass their full trunk-wash tests. The ability to pass an individual behavioral test was dependent both on the relative difficulty of the task as well as when the task was first introduced in the training process.

The relative difficulty of a specific task was reflected by the number of offers necessary prior to first receiving a passing score on the associated performance task—that is, how much practice was needed before a task was considered reliable (Figure 2, Table 3). A one-way analysis of variance showed a significant difference ($p = .017$) in relative difficulty for each of these tasks. The trunk-here task ($M = 295$, $SE = \pm 62$ offers) required more offers than both the bucket ($M = 61 \pm 16$ offers) and blow-into-bucket tasks ($M = 54 \pm 25$ offers). Steady task data are not included in Figure 2 because obtaining a count of the task's use within combination tasks was too difficult procedurally to measure, and thus, it was not obtained.

Total training time is the sum in minutes of all training given to each elephant. Total training time ranged from 257 min for Elephant 2 to 451 min for Elephant 4 (Figure 3). The mean total training time was 378 min among all elephants and 367 min among those elephants who successfully passed the trunk-wash test (Elephants 1–4). Each training session lasted a mean duration of 12 min for all elephants.

The gradual improvement in performance of the elephants during the course of the training period is represented by the mean percent correct in all the tasks for all the elephants for each test (Figure 4). The elephants' performance improved from a mean success rate of 39.0% after 10 sessions of training to 89.3% after 35 sessions of training. The mean percent correct

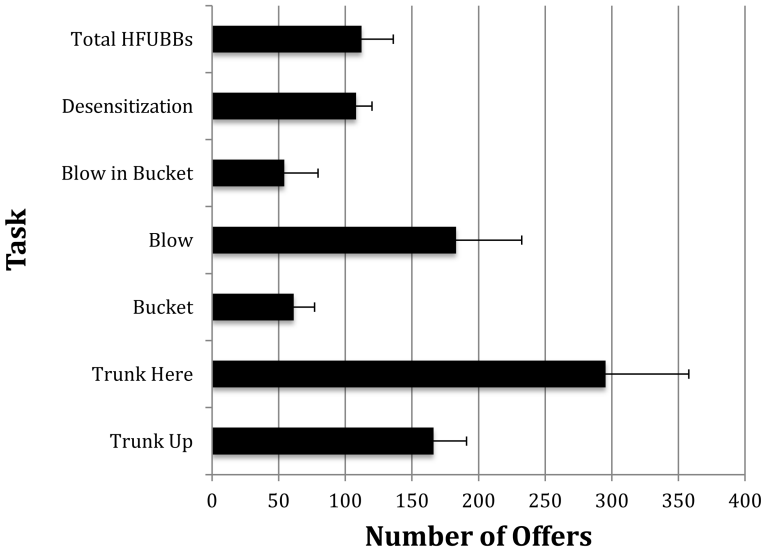

FIGURE 2 The average sum of all offers made for each of the basic behavioral tasks required to pass a performance test (in isolation or in combination), indicating relative difficulty in learning the task. Total HFUBBs represents the total offers made for the trunk-wash sequence (here, fluid, up, bucket, and blow) with the varying amounts of fluid used. The error bars represent the standard error.

never reached 100% because as sequences of behavior received a passing score, all individual behaviors within the sequence received a default score of 90%. Thus, by the time the full trunk wash was being passed, the elephants could only receive a score greater than 90% for the full trunk-wash, steady, and trunk-down tasks. It is important to note that as elephants passed their full trunk-wash tests, their training was completed and they were dropped from future calculations. By the Session 35 test, only Elephants 3 and 4 were being trained.

TABLE 3
Relative Difficulty: Average Sum of All Offers Prior to Achieving a Passing Score

Task	*Average # of Offers*	*Standard Error*
Trunk Up	166.20	24.79
Trunk Here	295.40	62.38
Bucket	61.40	15.51
Blow	183.20	49.28
Blow in Bucket	54.25	25.26
Desensitization to Syringe	108.25	11.87
Total HFUBBs	112.25	23.70

Note. Total HFUBBs = total offers made for the trunk-wash sequence (here, fluid, up, bucket, and blow) with the varying amounts of fluid used.

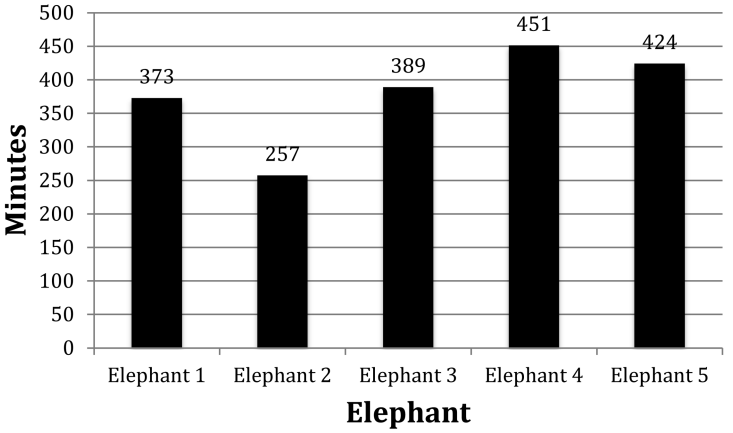

FIGURE 3 Total minutes of training for each elephant during the course of all sessions.

DISCUSSION

The goal of this project was to determine if it is feasible to teach free-contact, traditionally trained elephants to perform a trunk wash using SPR methods. The success rate of four out of five shows that this is feasible. The marked improvement on tests from an approximately 40% success rate to 90% success rate is testament to the effectiveness of this training modality in producing reliable behaviors in this population.

That four elephants reliably performed the trunk wash in 35 sessions or fewer with an overall average session time of 12 min speaks to the efficiency of the training process and utility of SPR training in behavioral management. The results suggest that in less than a month, with one to two short training sessions a day, juvenile elephants can be taught to voluntarily participate

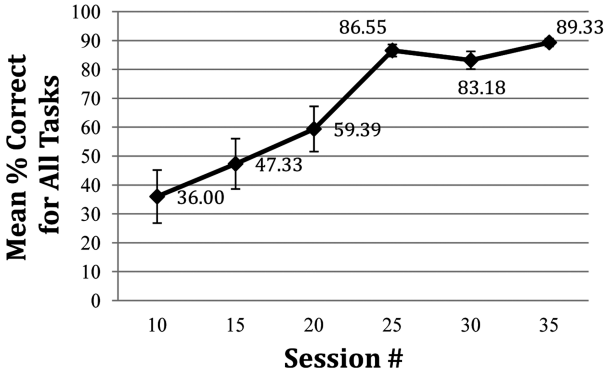

FIGURE 4 Mean percent correct among all the elephants (overall passing rate) for all the tasks during each test. Participant dropout began occurring after Session 25 as participants completed their training. The error bars represent the standard error.

in a trunk wash. The data corresponding to the number of offers needed to pass a test also indicate the relative difficulty of the individual tasks for this set of elephants and may provide some guidance regarding expectations in teaching elephants in similar situations in the future.

Training time is classically understood to be affected by prior and concurrent experiences. Prior experience with SPR would likely have expedited the learning process in this group of elephants. None of these animals showed much fear with regard to taking treats directly from the trainer's hand; thus, transitioning into the trunk-here behavior was relatively simple. Other elephants who exhibit severe trunk-handling phobia may require significant time undergoing trunk desensitization to master certain skills and would benefit from a modified method. Additionally, training time varies according to the trainer experience, strength of the reward, and stress level of the elephant.

There were many concurrent distractions present at the site that may have influenced performance of the elephants including other animals in the neighboring jungle, the presence of large audiences of tourists sometimes approaching to take photographs during the training sessions, and the proximity of the afternoon sessions to their evening meal. Had the conditions been less distracting, the time until completion of training might have been reduced.

Elephant 5's failure to complete the training in the available time might have been due to significant distractions. Most notably, the female in the stall next to Elephant 5 had a 2-month-old calf who wandered into the training sessions on a regular basis, reached into the reward bucket, and interrupted the sessions. The mahouts did their best to keep the baby out of the way, but the efforts to minimize her presence might have been even more distracting to Elephant 5. Additionally, for approximately 1 week toward the end of training, Elephant 5 was noticeably impatient and unfocused, a period coinciding with the presence of a foot abscess.

Elephant 5 might have also had some vision impairment and trunk weakness, as reported by the mahouts. Elephant 5's age might have also been a factor in her learning style and rate. Finally, because there was a cohort of juveniles in this study, the trainer was better able to learn from failures and successes in one juvenile elephant and apply them to others in the same age group to increase their pace of learning. These modifications were less applicable to Elephant 5 because she was the only adult in the group.

All elephants were given 8 to 16 offers in each performance test to determine their success rate, with one exception. Elephant 1 consistently showed impatience and declining performance with repetition; thus, her final trunk-wash test was preplanned to be only a 5-offer test (still requiring the 80% correct as passing criteria). As Elephant 1 was the youngest of the elephants, perhaps this decline in performance with repetition can be attributed to age or simply personality.

The methodology could have been improved by altering the criteria for passing a behavioral task in the performance tests. The criterion used here was a subjective assessment by the trainer as to whether the behavior was "of high enough quality to be successful in a full trunk wash." Ideally, one would set stricter criteria regarding the time a position is held with exact positioning parameters (e.g., trunk a certain height, in a certain orientation, etc.) and would have a third party available to evaluate or videotape sessions to be available for review and scoring. Additional personnel and equipment were unavailable for this study and may have improved the objectivity and accuracy of data recording.

In particular, the standard for passing the steady task did not accurately reflect the elephants' competencies. Because steady is a cue that is meant to be applied in any body position, the

initial goals were to achieve a steady position in the trunk-up, trunk-here, and trunk-down positions. Thus, general criteria for passing the test were an 80% success rate when asked for a steady three times in the trunk-down position, three times in the trunk-here position, and four times in the trunk-up position (where the strongest steady is needed for a trunk wash). By the end of the training period, many of the elephants had a reliable steady for the trunk-up and trunk-here positions, but none of them had successfully generalized it to the trunk-down position. Thus, few tests showed a success rate of higher than 70% for the steady task.

This failure is likely due to a lack of emphasis on training the steady task in the trunk-down position rather than the elephants' inability to learn it. The trunk-down task was introduced with the intention of being a control method, but in the end, it was not needed, and thus relatively little time was devoted to it. Passing criteria should have only reflected the trunk-up and trunk-here positions, as these tasks were emphasized in the training sessions. The steady task was sufficiently reliable to perform the trunk wash, and this success was not reflected in the steady task testing data.

Aside from the trunk-down task, two other tasks—trunk out and targeting—were initially introduced as control methods but were dropped from the protocol early on. Targeting is where the elephant moves her body so her forehead (or another body part) touches a targeting pole and is used to position the elephant appropriately. Elephant 5 spent some of her first few sessions learning targeting. This was quickly deemed unnecessary for the project goals and was not introduced to any of the other elephants.

Four of the elephants were also introduced to the trunk-out task where the elephant straightens her trunk out ahead of her, intended to help the transition into and out of the trunk-up position without dropping fluid. As training progressed, it became apparent that this task was unnecessary for these elephants (though could be necessary for others), and training was discontinued. Only a minimal amount of effort was devoted to these tasks, with a trunk-out task mean of 28 offers among those to whom it was introduced and a total of 47 target offers for Elephant 5. However, the time devoted to these tasks is included in the total training time results. Had this minimal time not been spent on these tasks, the elephants might have been able to complete their training that much more quickly.

Future studies could explore training for trunk washes using SPR in male elephants, in other age groups, with a larger number of study elephants, or in other locations or settings around the world. Furthermore, studies could expand on its use for training animals in other behaviors necessary for veterinary or general husbandry management. Inclusion of a control group or comparison group of traditionally trained elephants could further emphasize the benefits of SPR training. An interesting follow-up study could assess the welfare impacts of traditional versus SPR training, including their support of veterinary procedures and their effects on the animals' overall stress levels.

CONCLUSION

This study proves that it is feasible to train juvenile, free-contact, traditionally trained elephants in Nepal who have no prior experience with SPR training to voluntarily participate in a trunk wash using only SPR techniques. The elephants respond reliably, and teaching new tasks is an efficient process. SPR could be a great tool for captive management programs around the world

to improve behavioral management, animal health through voluntary veterinary participation, trainer–elephant relations, and animal welfare.

ACKNOWLEDGMENTS

The authors wish to thank Nepal's Department of National Park and Wildlife Conservation, the Institute of Agriculture and Animal Science, the National Trust for Nature Conservation of Nepal, all the staff at the Elephant Breeding Center, Sarah Lim, and Yamini Chalam for providing access to the elephants and aiding the research process. Thank you to Margaret Whittaker, Performing Animal Welfare Society, Dr. Susan Mikota, Otto Fad, Laurie Pond, Helena Telkänranta, and Phyllis Mann for the benefit of their expert knowledge and guidance.

REFERENCES

Alexander, M. B., Friend, T., & Haug, L. (2011). Obedience training effects on search dog performance. *Applied Animal Behaviour Science*, *132*, 152–159.

American Veterinary Medical Association. (2008). *Welfare implications of elephant training.* Retrieved from https://www.avma.org/KB/Resources/Backgrounders/Pages/Elephant-Training-Backgrounder.aspx

Bloomsmith, M. A., Jones, M. L., Snyder, R. J., Singer, R. A., Gardner, W. A., Liu, S. C., & Maple, T. L. (2003). Positive reinforcement training to elicit voluntary movement of two giant pandas throughout their enclosure. *Zoo Biology, 22*, 323–334.

Desmond, T., & Laule, G. (1991). *Protected-contact elephant training.* Retrieved from http://activeenvironments.org/pdf/PC_Elephant_Training.pdf

Desmond, T., & Laule, G. (1994a). *Converting elephant programs to protected contact.* Retrieved from http://activeenvironments.org/pdf/Convert_elephant_progamPC.pdf

Desmond, T., & Laule, G. (1994b). Use of positive reinforcement training in the management of species for reproduction. *Zoo Biology, 13*, 471–477.

Desmond, T., & Laule, G. (n.d.). *The politics of protected contact.* Retrieved from http://activeenvironments.org/pdf/PC_POLITICS.pdf

Elephant Care International. (2011). *Elephant TB Initiative—Nepal TB Project.* Retrieved from http://www.elephantcare.org/tbnepal.htm

Grandin, T., Rooney, M., Phillips, M., Cambre, R., Irlbeck, N., & Graffam, W. (1995). Conditioning of Nyala (*Tragelaphus angasi*) to blood sampling in a crate with positive reinforcement. *Zoo Biology*, *14*, 261–273.

Langbein, J., Siebert, K., Neurnberg, G., & Manteuffel, G. (2007). The impact of acoustical secondary reinforcement during shape discrimination learning of dwarf goats (*Capra hircus*). *Applied Animal Behaviour Science*, *103*, 35–44.

Laule, G. (2003). Positive reinforcement training and environmental enrichment: Enhancing animal well-being. *Journal of the American Veterinary Medical Association, 223*, 969–973.

Laule, G. E., Bloomsmith, M. A., & Schapiro, S. J. (2003). The use of positive reinforcement training techniques to enhance the care, management, and welfare of primates in the laboratory. *Journal of Applied Animal Welfare Science*, *6*, 163–173.

Laule, G., & Whittaker, M. (2000a). *Protected contact and elephant welfare.* Retrieved from http://www.activeenvironments.org/pdf/PC_Elephant_Welfare.pdf

Laule, G., & Whittaker, M. (2000b, September). *Protected contact—beyond the barrier.* Paper presented at the American Zoo and Aquarium Association Annual Conference, Orlando, FL. Retrieved from http://activeenvironments.org/pdf/PC_Beyond_Barrier.pdf

Laule, G., & Whittaker, M. (2007). Enhancing nonhuman primate care and welfare through the use of positive reinforcement training. *Journal of Applied Animal Welfare Science*, *10*, 31–38.

Locke, P. (2006). *History, practice, identity: An institutional ethnography of elephant handlers in Chitwan, Nepal* (Doctoral dissertation). University of Kent, Canterbury, United Kingdom.

McGreevy, P., & Boakes, R. (2007). *Carrots and sticks: Principles of animal training*. New York, NY: Cambridge University Press.

Michalak, K., Austin, C., Diesel, S., Bacon, M. J., Zimmerman, P., & Maslow, J. N. (1998). *Mycobacterium tuberculosis* infection as a zoonotic disease: Transmission between humans and elephants. *Emerging Infectious Diseases*, *4*, 283–287.

Mikota, S. K., Peddie, L., Peddie, J., Isaza, R., Dunker, F., West, G., . . . Maslow, J. (2001). Epidemiology and diagnosis of *Mycobacterium tuberculosis* in captive Asian elephants (*Elephas maximus*). *Journal of Zoo and Wildlife Medicine*, *32*, 1–16.

Murphree, R., Warkentin, J. V., Dunn, J. R., Schaffner, W., & Jones, T. F. (2011). Elephant-to-human transmission of tuberculosis, 2009. *Emerging Infectious Diseases*, *17*, 366–371.

Phillips, M., Grandin, T., Graffam, W., Irlbeck, N. A., & Cambre, R. C. (1998). Crate conditioning of bongo (*Tragelaphus eurycerus*) for veterinary and husbandry procedures at the Denver Zoological Gardens. *Zoo Biology*, *17*, 25–32.

Pryor, K. (1999). *Don't shoot the dog! The new art of teaching and training* (Revised ed.). New York, NY: Bantam.

Schapiro, S. J., Bloomsmith, M. A., & Laule, G. E. (2003). Positive reinforcement training as a technique to alter nonhuman primate behavior: Quantitative assessments of effectiveness. *Journal of Applied Animal Welfare Science, 6*, 175–187.

U.S. Animal Health Association Elephant Tuberculosis Subcommittee. (2012). *Guidelines for the control of tuberculosis in elephants 2012* (Draft Revision). Retrieved from http://www.usaha.org/Portals/6/Committees/tuberculosis/TB%20Guidelines%202012%20Draft%20revision%2020April2012.pdf

Whistance, L. K., Sinclair, L. A., Arney, D. R., & Phillips, C. J. C. (2009). Trainability of eliminative behavior in dairy heifers using a secondary reinforcer. *Applied Animal Behaviour Science, 117*, 128–136.

Williams, J. L., Friend, T. H., Nevill, C. H., & Archer, G. (2004). The efficacy of a secondary reinforcer (clicker) during acquisition and extinction of an operant task in horses. *Applied Animal Behaviour Science, 88*, 331–341.