

Research Brief

# Positive Reinforcement Training Facilitates the Voluntary Participation of Scarlet Macaws (*Ara macao*) With Husbandry and Medical Procedures

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**Abstract:** Scarlet macaws (*Ara macao*) kept under human care are excellent candidates for positive reinforcement training programs because they possess advanced cognitive abilities, have complex social interactions, long life expectancies, and a correspondingly high need for interaction and stimulation. The benefits of positive reinforcement training in mammals have been well documented; however, studies in birds are lacking. Two scarlet macaws housed at Alturas Wildlife Sanctuary (Puntarenas, Costa Rica) were trained in 10-minute sessions once daily, 4–6 times a week, for 4 months. The goal was to demonstrate how positive reinforcement training can improve the well-being of captive psittacine birds, while improving their husbandry and medical care through voluntary cooperation during procedures. The following 6 training behaviors were selected: following a target, entering a carrier, staying in the carrier, stepping onto a scale, stepping onto a towel, and drinking from a syringe. One parrot learned all 6 behaviors, while the other learned 4 of the 6 behaviors during the study period. All the behaviors mastered during the initial training period were successfully transferred to other individuals, so the birds would reliably perform them for the husbandry and veterinary staff. By the end of the study period, both macaws had also decreased aggressive behaviors toward caretakers. This demonstrates that positive reinforcement training is an effective and practical tool for teaching captive macaws to perform husbandry and medical behaviors, thereby voluntarily participating in procedures while improving their general welfare and management.

**Key words:** positive reinforcement training, veterinary procedures, animal welfare, avian, parrot, scarlet macaw, *Ara macao*

## INTRODUCTION

Positive reinforcement training (PRT) techniques are standard operant conditioning methods in which animals are presented with a stimulus, perform a target behavior, and subsequently receive a reward.<sup>1</sup> Training animals through PRT promotes their voluntary participation in practices that they would otherwise perceive as negative, such as veterinary procedures or transportation.<sup>2</sup> Positive reinforcement training has been shown to increase the well-being of animals under human care, providing them with positive social interactions and reducing stress, stereotypical behaviors, and aggressiveness toward caretakers and conspecifics. This has been widely demonstrated

in nonhuman primates and other mammals across various environments and situations.<sup>3–5</sup>

The latest science and best practices must inform modern animal care; however, many species, particularly nonmammalian taxa, have not received sufficient attention in the literature surrounding PRT.<sup>6</sup> In particular, studies on PRT to improve birds' welfare and management in zoos or sanctuaries are not readily available; however, the few studies performed reveal encouraging results. For example, research on the marabou stork (*Leptoptilos crumenifer*) at the Edinburgh Zoo demonstrated that the use of PRT in the husbandry process was an effective tool for reducing aggression and stress during movement and health checks.<sup>7</sup>

Psittacine birds have a long history of training for entertainment and are excellent candidates for PRT programs to improve welfare because they have advanced cognitive abilities and complex social interactions, long developmental periods, long life

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expectancies, and correspondingly high needs for interaction and stimulation.<sup>8,9</sup> Considering this, PRT can play crucial roles in improving the well-being of psittacine birds held in zoos and sanctuaries. It is well known that parrots are prone to developing aggressive and self-destructive behaviors, such as feather-damaging behaviors, biting, screaming, and stereotypic behaviors, when in captivity.<sup>10–12</sup> Moreover, manual restraint and handling for veterinary or husbandry procedures have been shown to induce a significant stress response in parrots.<sup>13–15</sup> Positive reinforcement training programs can be an enriching source of stimulation for the animals, teaching them to voluntarily participate in health checks and other husbandry procedures. This approach fosters positive human-animal relationships, making procedures shorter, easier, and less stressful for both birds and caretakers. A study on laboratory adult macaws of different species has already demonstrated how PRT can promote cooperation in research procedures, greatly reducing the stress associated with capture and restraint and thereby improving animal welfare.<sup>16</sup>

This research brief aimed to demonstrate how PRT can also be a valuable tool outside of the laboratory environment. It focused on improving the management of 2 scarlet macaws (*Ara macao*) held at Alturas Wildlife Sanctuary (AWS; Puntarenas, Costa Rica), teaching them to cooperate in husbandry and medical procedures, while improving their general well-being and reducing negative behaviors.

## MATERIALS AND METHODS

Two nonreleasable adult scarlet macaws (*Ara macao*) held at the AWS were the subjects for this study. Their exact age and sex were unknown. Both birds were kept as pets from a young age, then confiscated, and moved to a sanctuary where they bonded with one another. They were subsequently moved to AWS in 2020. Since their arrival at AWS, they have exhibited aggressive behaviors toward caretakers and displayed excessive vocalization. Veterinary staff reported difficulties in restraining the birds for examinations, both due to the impracticality of capturing them in their large enclosure and the distress caused by capture, resulting in increased heart and respiratory rates. Both individuals would call loudly when placed in carriers and moved to the clinic, gnaw the carriers' bars, and try to bite the veterinarians during handling. The macaws also showed aggressiveness toward caretakers and visitors, screaming when anyone approached the enclosure and attempting to nip staff members through the enclosure bars. It was considered unsafe to enter the enclosure when the macaws

were out of the crate because they would chase and attack. A particular aversion of the parrots toward male individuals was observed.

Both birds were housed in an outside enclosure (6.0 × 4.9 × 3.0 m) that was connected to a smaller crate (1.3 × 1.1 × 0.8 m) with a sliding door. The birds had been previously trained to move into the crate, allowing the caretakers to safely enter the enclosure for cleaning and feeding procedures. The animals were fed twice a day with fresh fruit, vegetables, and chickpeas (270 g). Peanuts were occasionally provided as enrichment. Pecutrin powder (Bayer, Leverkusen, Germany), a vitamin and mineral supplement, was provided as a supplement (0.1 g added to diet) 5 days per week.

No formal initial behavioral assessment was conducted before starting the training program. A non-professional trainer, who was part of the sanctuary internship program, attempted to teach the macaws to follow a target (metal stick with an orange plastic ball attached to the top) in their enclosure. A clicker attached to the stick was also used and peanuts were provided as food treat (reinforcement). This allowed for the identification of differences in the 2 animals' baseline behaviors that turned out to be significant for the PRT program setup. One of the individuals (W) appeared to be less fearful than the other (S). Macaw W was not afraid of the target and quickly learned to follow it, whereas S showed behavioral signs of fear of the target and/or the human holding the target and could not learn to follow the target. The individual W was also reported to display more aggressive behaviors than S. It lunged at S when S was being offered a treat, screaming loudly, and trying to bite S during some training sessions. Considering that macaws housed in pairs had been reported to interfere with the training of their cage mate in a previous study involving laboratory individuals,<sup>16</sup> the small crate in the AWS macaw enclosure was used during this study to separate them and train them one at a time.

Six desired behaviors were identified together with the veterinary team and taught in the following progression: (1) follow a target; (2) enter in a carrier; (3) stay in the carrier; (4) step onto a scale; (5) step onto a towel; and (6) drink from a syringe. Each of the behaviors and steps to reach them was defined before training (Table 1).

The training progression consisted of the following 4 phases: habituation, initial, maintenance, and transfer (Table 1). During the habituation phase, new objects were presented to the animals and left in the enclosure for a specified period to allow the birds to

**Table 1.** Six behaviors for a positive reinforcement training program for 2 scarlet macaws (*Ara macao*; individuals S, W) in the sequence in which they were trained. The steps taken to reach these behaviors (habituation, initial, maintenance, and transfer) are described. Any approximations and modifications made to the training progression are reported.

Behavior	Habituation	Initial training	Maintenance and transfer training	Approximations for training	Modifications
Follow a target	Target presented to the animal at an initial distance of 1 m, then moved to 50 cm after 10 s and next to the animals' beak after 20 s.	Touch plastic ball with beak.	Touch plastic ball with beak.	Move toward target held by trainer, touch target held by trainer, follow and touch target held by trainer.	The verbal signal "come" was used to ask to perform the behavior. No initial training needed for W, who had mastered the behavior before the beginning of the study.
Enter carrier	Carrier positioned in the enclosure in the location where training was expected to occur, and left there for the entire study period, food scattered inside.	Enter the carrier with at least 2/3 of the body.	Enter the carrier with the whole body.	Move toward carrier following target, touch target at carrier door, touch target at carrier end.	The verbal signal "come" was used to ask to perform the behavior. The behavior was always accompanied by following the target into the carrier.
Stay in carrier	Carrier left in the enclosure for the entire study period, food scattered inside.	Stay in the carrier with door open for up to 10 s.	Allow trainer to close the door and stay inside for 1–5 min without showing aggressiveness.	Touch target at carrier end twice, wait for reward without exiting.	The verbal signal "stay" was used to ask to perform the behavior. S was trained with open door only.
Step on scale	Scale left in the enclosure during 3 training sessions, while training other behaviors.	Step on scale with both feet.	Stay on scale enough time to allow the trainer to properly read the weight.	Move toward scale following target, touch target at scale edge, and touch target at scale center.	The verbal signal "come" was used to ask to perform the behavior. The 2 individuals could be trained together for this behavior during maintenance phase, moving them up and down the 2 sides of the scale alternately.
Step on towel	Towel left in the enclosure in the location where training was expected to occur for 1 d before the initial phase started.	Step on towel with both feet.	Stay on a towel with both feet for at least 10 s.	Move toward towel following target, touch target at towel edge, touch target at towel center.	The verbal signal "come" was used to ask to perform the behavior. No habituation needed for W. This was the last behavior that was taught to S.
Drink from syringe	Syringe presented to the animal at an initial distance of 1 m, then moved to 50 cm after 10 s and next to the animals' beak after 20 s. Both birds allowed the trainer to touch their beak with the syringe after 3 d of habituation.	Accept up to 1 mL of papaya and pineapple smoothie from a 3-mL syringe.	Accept 3 volumes of papaya and pineapple smoothie from a 3-mL syringe.	Touch syringe with beak, hold syringe with beak for 5 s, accept some drops, 0.3 mL, 0.5 mL, 1 mL of papaya and pineapple smoothie.	The verbal signal "syringe" was used to ask to perform the behavior. Trainer worked with both animals simultaneously from outside the enclosure, separating them using the crate.

become familiar with the objects. This phase was shortened if the birds showed no fear toward the new objects. Initial training then began by using PRT to shape and increase the frequency of the desired behaviors. The percentage success for each training session was calculated by dividing the number of successful behaviors displayed by the animal by the number of attempts performed by the trainer. A behavior was considered reliable when the success rate was  $\geq 90\%$ . This decision was based on the experience gained by AWS staff in training other animals residing in the sanctuary. Once the birds mastered a behavior, the maintenance phase began. During the maintenance phase, the behavior was requested 3 times a week, then 1 time a week. If the performance began to regress, additional maintenance training sessions were conducted as needed. Only 1 trainer with basic training experience was involved during these phases. In the transfer phase, the primary trainer was shadowed by another trainer (either an intern or a staff member) during 1 training session for each bird. Then, the primary trainer shadowed the secondary trainer to help shape their training skills as they worked with the birds. The transfer phase continued until the birds reached reliability for all behaviors mastered in the initial phases with the primary trainer. Twelve secondary trainers participated in the transfer phase, none of whom had prior experience with PRT.

Modifications to the behaviors, training progression, and phases were necessary during the study, as expected with any training plan, and are reported in Table 1. For maintaining the “staying in the carrier” behavior, 2 distinct modalities were used to train the macaws. Individual W was reinforced for staying in the carrier without biting the bars or screaming when the door was closed at 10- to 15-second intervals during the first maintenance session, for a total time of 1 minute in the carrier. During the following sessions, the intervals of time before reinforcement were gradually lengthened, as was the total time in the kennel, until W was able to stay in the carrier without exhibiting negative behaviors for 5 minutes, receiving a food reward only once, when the door was reopened. Training S was attempted similarly, but when the carrier door was closed for the first time, it started hyperventilating, biting the bars very hard, and pacing. Even if it was let out after a few seconds, S refused to participate in the following training session 2 days later, avoiding the trainer. To avoid excessive stress that could negatively impact learning, training was performed with the carrier door opened.

Individuals were trained in 10-minute sessions once daily, before regular feeding, 4–6 days per week

for 4 months, from February to May 2024. During a single training session, the birds were required to perform a behavior they had already mastered (the first part of the training session) and a behavior in its initial phase (the second part of the training session). This was timesaving for the trainers and stimulating for the animals, which showed increased interest in attempting new behaviors after being rewarded during the first part of the session. A bridging stimulus was used to mark the desired behavior (clicker), and peanuts were provided as a food reinforcer. Peanuts (not part of their regular diet) were selected as the reinforcer because they were a reward for which the macaws were willing to work.

Results recorded were (1) subject; (2) date; (3) time; (4) weather; (5) temperature; (6) trainer; (7) behavior; (8) time spent on a behavior; (9) number of attempts to achieve a successful behavior; (10) successes; (11) level of interest; and (12) observations. The level of interest was assigned with a score from 0–3 as follows: 0 = the macaw did not approach the target or presented object (carrier, scale, towel, or syringe), showing no interest in participating in the training; 1 = the macaw showed minimal interest in approaching the target or presented object without touching it; 2 = the macaw touched the target or interacted with the presented object less than half of the times requested by the trainer; 3 = the macaw showed full involvement in the training, and touched the target or interacted with the presented object more than half of the times requested by the trainer.

## RESULTS

Over 17 weeks, in 62 days of training, W reliably learned all 6 behaviors, while S mastered 4 of 6 behaviors. Macaw S learned to stay in the carrier only when the door opened and was unable to learn to step onto the towel.

No habituation to the towel was needed for W, who was able to step on it from the very first trial with a 100% success rate in all training sessions for this behavior. Individual S generally displayed more avoidance behaviors when presented with new objects, requiring more time for habituation. Allowing S to have longer habituation phases turned out to be an effective strategy, especially to teach it to enter the carrier. Thus, a kennel was introduced in the enclosure the day before starting to train W to enter it. The new kennel was avoided by S as soon as it was positioned, walking, and perching far away from it. Even if W did not hesitate to approach it from the very first training trial, the carrier was left inside the enclosure from that point on. In this way, S became familiar with it during its target training period; it was

**Table 2.** Total number of initial, maintenance, and training sessions for positive reinforcement training behaviors for 2 macaws (*Ara macao*; individuals S, W) required to master each behavior for each macaw.

Individual	N of initial sessions		N of maintenance sessions		N of transfer sessions	
	S	W	S	W	S	W
Behavior						
Target	22	—	4	—	2	—
Enter carrier	2	6	4	4	5	3
Stay in carrier	2 <sup>a</sup>	2	5 <sup>a</sup>	11	4 <sup>a</sup>	6
Step on scale	7	3	4	4	2	2
Step on towel	Not achieved	1	Not achieved	4	Not achieved	1
Drink from syringe	8	9	4	4	1	1

<sup>a</sup> S was trained to stay in the carrier only with the door opened.

also asked to follow the target near the carrier area, allowing the trainer to work on 2 different phases at once (“follow target” initial or maintenance and “enter carrier” habituation). Initially, S would not approach the target if the trainer placed it near the carrier area; however, after 4 days from when the kennel was introduced, the bird was fully habituated to its presence and would follow the target next to it. In this way, S was then able to master the behavior “enter carrier” in only 2 initial training sessions.

The highest number of initial training sessions (22) was invested in teaching S to follow the target. It also required considerably more initial training sessions compared with W to learn to step on the scale (Table 2). Without considering target training, drinking from the syringe was determined to be the most complex task to master for both birds, taking the greatest amount of initial training sessions; however, it was also the easiest to transfer (Table 2).

Maintenance training for most of the behaviors for both birds only lasted 4 sessions, which was the expected minimum for this phase. Both individuals were able to maintain a  $\geq 90\%$  success rate when asked to perform a behavior they had previously mastered during initial training. Staying in the carrier was the only exception, as the maintenance training for this behavior was conducted in a different manner compared with the others and in 2 distinct modalities for the 2 macaws. After 11 sessions, W was able to stay in the carrier without exhibiting negative behaviors for 5 minutes, receiving a food reward only once, upon the door being opened again. Individual S was able to remain in the carrier with the door open for 5 minutes without exhibiting stress-related behaviors after only 5 sessions.

Even if all transfer phases were eventually completed with all trainers, both macaws showed stress-related behaviors (ie, biting the target too hard, screaming loudly), including occasional aggression

toward male trainers. The level of interest of S was reported to be lower during the first month of training (mean value 1.9/3.0) compared with W (mean value 2.5/3.0). This issue was solved by training W first and allowing S to observe from a distance. By doing so, S was reported to be more motivated to participate in the training procedure, raising its mean level of interest to 2.6/3.0 for the following months. Individual W also increased its mean level of interest score to 2.9/3.0 for the same period.

Both individuals showed lower motivation during rainy days, staying up on a branch and refusing to move and participate in the training session. However, as the training program advanced, improvements were noted. On May 13, 2024, W needed to be checked by the veterinary staff because of a minor problem with its right eye; an overgrown feather was causing excessive lacrimation and redness. Individual W successfully entered a carrier, even in the rain, and remained calm and cooperative while being carried to the clinic. It was anesthetized and hospitalized for 5 days, during which it was administered diclofenac sodium 0.1% ophthalmic drops (0.04 mg OU q24h  $\times$  5 days; 3-A Ofteno, Laboratorios Sophia, Zapopan, Jalisco, MX). The day after W returned to its enclosure, it was asked to enter the carrier during its training session. It performed the behavior correctly without hesitation, allowing the trainer to close the carrier door and remain calmly inside. Neither the hospitalization nor the treatment affected W's response to training after returning to the enclosure.

## DISCUSSION

These results demonstrate that PRT was an effective management tool for these 2 macaws under human care; however, additional work is needed to confirm these findings on a larger scale. Even if individual differences in training progression were reported, both macaws had improved from their baseline by the end of the training

period. They were ready to perform and repeat several husbandry and medical behaviors.

Individual W was successfully transferred to the clinic when requested by the veterinary staff, and no negative behaviors were recorded posthospitalization. This event represents the most important result of these trainings, demonstrating how PRT facilitated medical procedures, as counterconditioning for restraint and hospitalization was a secondary outcome of the training plan. Even if this training program allowed W to be easily moved to the clinic, it was not possible to collect data to verify if PRT had an impact on reducing stress signs, such as increased heart and respiratory rates, during examinations. In the future, the training program could be adjusted to specifically address decreasing both birds' fear of handling. Heart and respiratory rates could be collected before and after the training to assess the effectiveness of PRT in decreasing stress signs associated with physical restraint.

From an animal welfare perspective, the learning process was enriching for the animals, which increased their interest in voluntarily participating in training sessions as the program progressed. Both birds even improved their ability to remain focused during training procedures as the program advanced, and by the end of the study, the trainers were able to work with the macaws around others or inside the enclosure, including during guided tours or cleaning procedures. Moreover, the rates of alarm calling and aggression towards people dramatically decreased in the birds from the beginning of the training. This was not only observed by the trainers but also by the tour guides, who reported that the macaws were calmer when approached by large groups of tourists. These results align with those of a previous study in laboratory macaws, which found that the overall level of stress in the birds caused by human presence was reduced by the application of a PRT program.<sup>16</sup> Keeping a PRT program active for the macaws at AWS could allow the staff to teach the birds further behaviors (ie, open wings and beak for health checks, allow intramuscular injections) while maintaining those they have mastered. This would be of great importance in saving time, facilitating veterinary procedures, and reducing the birds' negative behaviors even further.

The same technique used to habituate S to the presence of the carrier could be used in the future to teach it to step onto the towel, as it did not overcome its fear of it during the training period. Training S to step onto the towel might only require more time and patience to habituate the bird to the towel while shaping the behavior using the target and asking the parrot to follow it close to the towel area. Nevertheless, it is plausible to

think that S might have experienced a traumatic event related to towels before arriving at AWS because parrots remember negative episodes for a long time, even showing clinical signs consistent with those in humans with posttraumatic stress disorder.<sup>17</sup> This might explain the aggressive behaviors performed by the macaws with male trainers. In this case, it might be necessary to design a desensitization or counterconditioning protocol for S. The hesitancy to move toward the towel suggests the presence of a negative reinforcement contingency that drives S's behavior. The association "step on the towel = being restrained" stimulates S to avoid the object and does not allow it to be trained on that specific behavior. Introducing a food stimulus along with the towel could gradually change S's contingency from "step on towel = being restrained," for example, to "towel presence = favorite food available," decreasing the aversive stimulus potency and creating a new positive association between the towel and the food stimulus. Further investigations of S's contingencies and preferred reinforcers could help gain its assent and reach the training objective.

Considering that the trainers involved in the transfer phase had no prior experience in animal training, this work confirms the practicality of PRT as a tool that can be used by individuals with diverse backgrounds. It is of great importance to emphasize that little time was spent teaching the trainers how to correctly use PRT techniques, as they were all able to successfully complete 1 training session independently after 2 shadowing sessions. In a busy facility like AWS, saving time is essential, and PRT has proven to be an excellent compromise for improving animal welfare without requiring an excessive amount of time and effort. This is also important when considering the repeatability of this work because highly trained individuals are not necessarily required to effectively complete a PRT program. The same results had been previously reported for laboratory macaws.<sup>16</sup>

Overall, the results of this study demonstrate the great potential of PRT as a tool to improve the management and well-being of birds in human care. Additional references may be consulted to help build an effective PRT program.<sup>18–23</sup>

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