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ARTICLE

Effects of environmental enrichment in a captive pair of Golden Parakeet (*Guaruba guarouba*, Psittacidae) with abnormal behaviors

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ABSTRACT: Abnormal behaviors (e.g., feather plucking and pacing) are commonly observed in captive animals. Environmental enrichment techniques have been used to improve animal welfare by promoting the reduction of such behaviors and stimulating the display of typical behaviors. The present study examined the effects of environmental enrichment techniques in a captive pair of the endangered Golden Parakeet (*Guaruba guarouba*, Psittacidae), which presented feather-plucking behavior. Different objects of environmental enrichment were presented to birds between February and July 2008. Behavioral analyses were performed by comparing pre enrichment, enrichment introduction and after enrichment phases. At each phase, a total of 42 hours of behavioral data were collected through the scan method with instantaneous recording at sampling intervals of 30 seconds. The results showed that the behavioral diversity of the parakeets increased (e.g. "social behavior" 14.00 ± 3.01, df = 2, N = 21, p = 0.19; "locomotion" 25.52 ± 3.14, df = 2, N = 21, p = 0.01) whereas feather plucking ("individual abnormal behavior") decreased with the use of enrichment (0.10 ± 0.07, df = 2, N = 21, p = 0.78). However, abnormal behavior was again observed after removing enrichment objects. Although environmental enrichment did not eliminate completely the display of abnormal behaviors, the introduction of objects had a positive effect on increasing behavioral diversity of the animals and, consequently, improving animal welfare.

KEY-WORDS: Animal behavior, animal welfare, captivity, feather plucking, psittacine.

INTRODUCTION

The life of animals in captivity has many differences when compared to animals that live in a natural environment. Captive animals are protected from competitive interactions, receive adequate food, have sexual partners chosen, do not need to escape from predators and are not affected by environmental changes (Young 2003). Thus, captivity becomes an unattractive and predictable environment for animals, as they must deal daily with the lack of challenges that might affect their welfare, which may result in abnormal behaviors such as self-injury (Dixon *et al.* 2008). The animal has needs to express its normal behavior but due to the inappropriate environment it tries to reduce its frustration through the repetition of behaviors with no apparent function, called stereotyped behaviors (Meehan *et al.* 2003, Meehan *et al.* 2004, Latham & Mason 2007). Numerous studies on captive animals showed that captivity can result in behavioral problems (Bashaw *et al.* 2001, Bachmann *et al.* 2003, Garner *et al.* 2004, Torrey & Widowski 2006, Clubb & Vickery 2006, Harlander-Matauschek *et al.* 2007, Dixon *et al.* 2008) such as feather plucking. This kind of intensified preening can result from chronic stress associated with excessive self-comforting or physical health disorders (Garner *et al.* 2003) and a sterile and predictable environment (van Zeeland *et al.* 2009).

Environmental enrichment is a process that creates a complex and interactive environment, allowing the captive animal to display natural behaviors while promoting new challenges and offering opportunity for choice and control of its environment (Swaisgood & Shepherdson 2005). Environmental enrichment techniques are used to solve and even prevent the appearance of behavioral disorders (Baer 1998, Meehan *et al.* 2004, Garner *et al.* 2006) by reducing the stress caused by captivity and

improving physical, mental and social welfare of animals (Young 2003).

The Golden Parakeet, *Guaruba guarouba*, is an endemic parrot from Brazil, which inhabits upland forests and it is found between northern Rondônia and Mato Grosso, Amazonas, Pará, and western Maranhão (Belmonte & Silveira 2005, Laranjeiras & Cohn-Haft 2009). Measuring about 34 cm, it has yellow-golden plumage with green flight feathers (Sick 1997). The species is considered vulnerable and is a common target for illegal trade (IUCN 2014). According to the Golden Parakeet Management Plan (RIOZOO 1998) proposed by IBAMA - Instituto Brasileiro do Meio Ambiente e Recursos Renováveis, captive individuals can present certain infectious and parasitic diseases, nutritional and behavioral problems. One of the most common abnormal behaviors in captive parrots is feather plucking (Garner *et al.* 2006, Lumeij & Hommers 2008, Jayson *et al.* 2014), which may be a result of social isolation, poor diet, diseases, infections or lack of stimuli in the environment (Young 2003, Rubinstein & Lightfoot 2012).

This study aimed to evaluate the effects of environmental enrichment techniques in a pair of *Guaruba guarouba*, which exhibited abnormal behavior of feather plucking, in order to decrease or eliminate this behavior and consequently improve their welfare.

METHODS

This study was conducted from February to July 2008, with a pair of *Guaruba guarouba* kept in an enclosure outside the public view, at Fundação Zoo-Botânica de Belo Horizonte – FZB-BH, Minas Gerais, Brazil. The two individuals arrived at FZB-BH in September 2007, from a conservationist breeding facility in the state of Maranhão, Brazil, already showing feather plucking behavior. The enclosure measured 3.82 m long, 2.94 m wide and 1.91 m high with cemented walls and floor, front and roof of wire mesh and 1/3 covered with asbestos tile. There were also two perches and some strings for locomotion within the enclosure.

The birds' diet was balanced and included fruits, vegetables (such as apple, banana, papaya, carrots, peppers and others) and free access to water. Individuals received food twice a day, at 08h30min and 13h30min, but no food was available after 15h30min. According to veterinarians of FZB-BH, the pair had good physical health without any disease or infection.

An ethogram was created to include behavioral data displayed by parrots (Table 1) after observing animals through the *ad libitum* sampling method (Martin & Bateson 2007), for 10 hours, during a week.

As the birds had a high degree of feather plucking, we

TABLE 1. Ethogram of behaviors performed by a pair of Golden Parakeet (*Guaruba guarouba*) at the Fundação Zoo-Botânica de Belo Horizonte, Brazil.

Behavior	Descriptions
Resting	Bird remains in resting position, alone or side by side with its partner.
Social behavior	Bird cleaning feathers of the other. Bird offering his head to the other or feeds the partner with its beak.
Vigilance	Bird is alert, guiding his head in sideways movements directing towards sounds or stimulus.
Exploring	Bird walking in over stimulus object. Bird trying to catch something like twigs, objects and other environmental stimuli without eating.
Pecking	Bird gnawed repeatedly, chewing the ID ring itself or components of the environment as the canvas enclosure, rope, perch, walls or feeder.
Manipulating and feeding	Bird holding some object, food, branch, etc. Bird watching and/or eating the object.
Locomotion	Bird moving by any form of locomotion from one place to another (walking or flying).
Vocalization	Bird performing any type of vocalization.
Preening	Bird cleaning and arranging its feathers using the beak. Bird passing beak alternately and repeatedly against the substrate. Scratching the beak or other body parts with its feet.
Individual Abnormal Behavior	Bird showing excessive feather preening (tearing off).
Mutual Abnormal Behavior	Bird showing excessive partner's feather preening (tearing off).
Not Visible	Bird is not visible to the observer.
Others	Other behaviors not described in the ethogram.

chose to use an environmental enrichment methodology developed in FZB-BH. The methodology consists in presenting several different stimuli over 4 consecutive days, in consecutive weeks, resulting in a rapid increase in behavioral diversity, and the possible solution for displaying abnormal behaviors of self-mutilation such as feather plucking (C. Cipreste *pers. comm.*).

We collected behavioral data using the scan method with instantaneous recording at sampling intervals of 30 seconds. Data collection were carried out from Monday to Friday, only once a day, in alternating times between 07h30min and 16h00min, so they could cover all periods of the individuals' activity. The study was divided into three phases: pre enrichment (before the presentation of environmental enrichment), enrichment introduction (during the introduction of enrichment items), and after enrichment (after the removal of environmental stimuli from the enclosure). According to methodology developed in FZB-BH and previously applied to other species (C. Cipreste *pers. comm.*), the study was conducted over 21 consecutive weeks without interval between the three phases.

First phase data were collected on Mondays for 120 minutes. Second phase data were collected from Monday to Thursday with duration of 30 minutes per day. Third phase data were collected on Fridays for 120 minutes. The birds did not receive environmental enrichment from Friday to Sunday. This study resulted in 42 hours of data collection in each phase, totaling 126 hours of behavioral data.

Some environmental enrichment items used were: tree branches with leaves; cinnamon pendants; pendants of rawhide chew bone with edible aniline; branches with fruit kebabs; coconut bowls with dry grass and fig; zucchini filled with fruit pieces; ice blocks with fruit juice and/or gelatin and fruit pieces; pineapple leaves with/without fruit pieces; hollowed wooden wheel filled with mashed banana and honey; baskets of twisted popsicle sticks dyed with edible aniline with mashed fruits, honey or vanilla essence, hanging cardboard boxes with dry grass and one of the following: fruit, clove, walnuts, hazelnuts or Brazil nuts. Other fruits used in enrichments depended on the availability of the FZB-BH kitchen and fruiting period. Usually, they were not part of the diet of birds (such as persimmon, strawberry, kiwi, grape and others) but were used to improve the attraction degree for the enrichment items.

Enrichment was done as follows: from Monday to Thursday several tree branches with leaves, accompanied by some of the other items mentioned above were inserted in the enclosure. The sequence of use of each item was random, but no item was repeated during the week. All items were chosen to stimulate foraging behavior and locomotion besides providing positive social interactions as, most of the time, the parrots remained inactive and frequently the social interactions resulted in feather plucking.

Due to the non-normality of the data generated by the behavioral samplings (tested with the Anderson-Darling test; Zar 1999), we compared the occurrence of behaviors through means among the three phases of the study using the Friedman Test, with a *post-hoc* Tukey Test (Zar 1999). For each phase, the mean of a given behavior was calculated as the total number of records obtained with that type of behavior by the total number of records obtained for all types of behavior. Standard errors were also estimated among the three phases of the study. All analyzes were performed by the Minitab v.12 and BioEstat v.3 programs, at significance level of 95 %.

RESULTS

All behavioral data collected in 126 hours of study and statistical significance of all behavioral categories during the three phase of study are shown in Table 2. The most frequent behaviors displayed during the pre-enrichment phase were (mean ± standard error of the number of records): "resting" (345.40 ± 12.10), "manipulating and feeding" (43.62 ± 7.20) and "vigilance" (26.76 ± 3.74). The less frequent behaviors displayed at the same phase were: "exploring" (0.00 ± 0.00), "individual abnormal behavior" (0.29 ± 0.14) and "mutual abnormal behavior" (1.29 ± 1.05). In the second phase, during the introduction of environmental enrichment, the most frequent behaviors displayed were: "resting" (252.50 ± 20.60), "exploring" (60.70 ± 11.40) and "manipulating and feeding" (54.14 ± 7.05). The less frequent behaviors displayed at this phase were: "individual abnormal behavior" (0.10 ± 0.07), "others" (0.24 ± 0.14) and "mutual abnormal behavior" (0.29 ± 0.21). Finally, after the enrichment phase the most frequent behaviors were: "resting" (326.20 ± 12.20), "manipulating and feeding" (38.95 ± 6.91) and "locomotion" (26.24 ± 2.45). The less frequent behaviors were: "exploring" (0.00 ± 0.00), "individual abnormal behavior" (0.14 ± 0.08) and "mutual abnormal behavior" (0.33 ± 0.25).

Only five behaviors differed significantly among the three phases of study. The behavior "resting" had the highest frequency displayed during the pre-enrichment phase, decreasing significantly during the use of enrichment and increased back again during the third phase (Friedman = 12.67, $p < 0.01$, Table 2). The pair did not exhibit the behavior "exploring" in the pre-enrichment but this behavior was significantly expressed during the enrichment and, after removing the stimuli, this behavior was not displayed anymore (Friedman = 31.50, $p < 0.01$, Table 2). The behavior "locomotion"

was less expressed in the first phase of the study, increased significantly during the use of environmental enrichment and also after its removal (Friedman = 9.02, p < 0.01, Table 2). The behavior "vocalization" was displayed during the stimuli phase, decreasing by almost half after removal of enrichment items, but remained higher when compared to the first phase (Friedman = 7.12, p < 0.01, Table 2). The behavior "preening", decreased on the second phase but increased after the removal of stimulus (Friedman = 8.02, p = 0.02, Table 2).

All other behaviors were not significantly different among the three study phases. However, we observed that "mutual abnormal behavior" and "individual abnormal behavior" decreased over the use of enrichment stimuli and increased slightly after the withdrawal of stimulus (Friedman = 0.17, p = 0.92 / Friedman = 0.50, p = 0.78 respectively, Table 2). The behaviors "manipulating and feeding" and "vigilance" increased during the phase of the stimulus and fell after removal of the items (Friedman = 2.17, p = 0.34 / Friedman = 5.02, p = 0.08, respectively, Table 2). The behavior "pecking" decreased after removal of enrichment items and had a larger drop during the stimuli (Friedman = 3.88, p = 0.14, Table 2). Finally, the behavior "social interaction" increased during the use of environmental enrichment and even more after withdrawal (Friedman = 3.31, p = 0.19, Table 2).

TABLE 2. Mean ± standard error of the number of behavioral records and Friedman Test results for the exhibited behaviors of a pair of Golden Parakeet (*Guaruba guarouba*) during three phases: pre enrichment, enrichment introducing and after enrichment, at FZB-BH, along 21 weeks between February and July 2008 (df = 2, N = 21, α = 0.05).

Behavior	Pre enrichment	Enrichment introducing	After enrichment	Friedman	p
RE	345.40 ± 12.10	252.50 ± 20.60	326.20 ± 12.20	12.67	< 0.01*
SB	10.48 ± 1.97	14.00 ± 3.01	18.43 ± 3.11	3.31	0.19
VI	26.76 ± 3.74	35.67 ±3.95	26.52 ± 2.98	5.02	0.08
EX	0.00 ± 0.00	60.70 ± 11.40	0.00 ± 0.00	31.50	< 0.01*
PE	13.10 ± 2.35	8.05 ± 1.09	11.19 ± 1.82	3.88	0.14
MF	43.62 ± 7.20	54.14 ± 7.05	38.95 ± 6.91	2.17	0.34
LO	17.81 ± 2.05	25.52 ± 3.14	26.24 ± 2.45	9.02	0.01*
VO	3.00 ± 0.77	12.14 ± 2.45	6.38 ± 1.35	12.07	<0.01*
PR	16.67 ± 2.62	16.52 ± 2.30	25.19 ± 2.77	8.02	0.02*
IAB	0.29 ± 0.14	0.10 ± 0.07	0.14 ± 0.08	0.50	0.78
MAB	1.29 ± 1.05	0.29 ± 0.21	0.33 ± 0.25	0.17	0.92
NV	0.10 ± 0.10	0.14 ± 0.14	0.00 ± 0.00	0.07	0.96
OT	1.48 ± 1.38	0.24 ± 0.14	0.38 ± 0.33	0.02	0.99

RE = resting, SB = social behavior, VI = vigilance, EX = exploring, PE = pecking, MF = manipulating and feeding, LO = locomotion, VO = vocalization, PR = preening, IAB = individual abnormal behavior, MAB = mutual abnormal behavior, NV = not visible, OT = others

* = Significant differences, p < 0.05. (The means obtained for each behavior was the number of behavior's records divided by the number of all behavioral records. The standard error was the sample standard deviation divided by the square root of the sample size.)

DISCUSSION

In pre enrichment phase, birds remained inactive most of the time but a reduction in such inactivity was noticeable after insertion of enrichment items, since the birds began to interact with stimuli, a pattern that has been observed in other captive birds (Azevedo & Faggioli 2001, Meehan & Mench 2002, Andrade & Azevedo 2011). The birds increased movement because of their interaction with enrichment items and kept moving even after removal. This suggests that they might keep seeking for novelties in the enclosure once stimulated.

Some studies have demonstrated that the use of environmental enrichment techniques reduces stereotyped behaviors and increases behavioral repertoire of captive birds (Mason 1995, Meehan *et al.* 2003, Meehan *et al.* 2004, Andrade & Azevedo 2011). In the present study, environmental enrichment increased behavioral diversity of birds, although they continued showing feather plucking behavior. According to Swaisgood & Shepherdson (2005), sometimes environmental enrichment techniques cannot fix completely but just reduce the display of abnormal behaviors, as such behaviors can be persistent, depending on how long they

have been in place or what stimulus was applied (Mason *et al.* 2007).

An increase of the category "preening" was significant after removing the stimulus and birds started plucking feathers again even before the study completion. Feather plucking may be considered an exaggerated kind of preening (Meehan *et al.* 2003). Thus, results suggesting a small increase in abnormal behaviors, both individual and mutual, could have been caused by increased "preening" carried out by birds after removing enrichment from the enclosure. We used an overexposure stimuli technique that might have over-stimulated the "preening" behavior and according to Newberry & Estevez (1997), overstimulation can produce stronger responses than natural stimulation.

Despite a few records of positive social interactions before the introduction of enrichment, most of the interactions shown by the Golden Parakeets resulted in mutual mutilation. However, the number of positive social interactions increased with the introduction of stimulus and after its removal. The use of social enrichments in environments with individuals of the same or different species can result in positive interactions (Bayne 2005). For Sandos (1999), the use of environmental enrichment techniques for captive birds decreases the attacks among individuals, since they spend more time interacting with the enrichment.

It was noticed an increase of alert behaviors during the exposure of the stimuli, whereas this situation was different from the birds routine. One of the objectives of the introduction of environmental enrichment stimuli was to create new challenges and novelties to Golden Parakeets as in the natural environment. Schaap (2002) studied *Sarcophilus harrisii* (Mammalia: Dasyuromorphia: Dasyuridae) with abnormal behavior and noted an improvement in their state of alert after the use of environmental enrichment.

The increase of vocalization was a result of using stimuli suggesting that the pair kept a closer interaction during enrichments. Apparently, vocalizations were used as alert, wakefulness and, sometimes, to request food from the partner. According to Ueno (2007), vocalizations of *Anodorhynchus hyacinthinus* (Psittaciformes: Psittacidae) characterize the emotional state of the bird, ranging from hostility to fearfulness. Nonetheless, further studies about specific vocalizations of Golden Parakeet would be necessary to verify similar findings.

It is important to mention that the enclosure's location in the extra sector within the FZB-BH might have influenced our results. The extra sector (outside the public view) shows no close characteristic to a natural environment and lacks fundamental stimulus for the development of typical behaviors of the *G. guarouba*. Therefore, we cannot eliminate the possibility that the cause of feather plucking is somehow related to the enclosure's location, once individuals have reached the FZB-BH already with this behavioral problem. Other individuals of the same species have been previously maintained in the same enclosure without presenting feather plucking. Dixon *et al.* (2008), studying *Gallus gallus* (Galliformes: Phasianidae), described that a small and sterile enclosure results in the incidence of abnormal behaviors. For Gaskins & Hungerford (2014) sometimes the enclosure size is less important than cage complexity for maintaining the animal welfare.

At the present study we focused on attempting to eliminate abnormal behaviors of a captive pair of parakeets using environmental enrichment techniques that increased their behavior diversity. Even though the abnormal behavior of feather plucking was not eliminated, the increased activity of the animals helped on reducing the display of such behaviors, which characterizes a possible improvement of the pair's welfare. We suggest that these individuals continue to participate in a weekly environmental enrichment program that creates variations on their normal routine and allows them to express more natural and diverse behavior.

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