# EFFECTS OF FORAGING ENRICHMENT ON THE BEHAVIOUR OF PARROTS

**L E Coulton[1], N K Waran[1] and R J Young[2†]**

[1] Institute of Ecology and Resource Management, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh EH9 3JG, UK

[2] Animal Department, Edinburgh Zoo, Murrayfield, Edinburgh EH12 6TS, UK

[†] Contact for correspondence and requests for reprints

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**Abstract** *Animal Welfare 1997, 6:* 357-363

*The purpose of this study was to enrich parrot enclosures by creating foraging opportunities appropriate for the species and to investigate the possible preference for a variable versus a constant food supply. The foraging device comprised of a length of wood (2x0.08x0.08m) with 50 holes (0.02m diameter x 0.02m depth) drilled into one face. Food was placed in the holes of the foraging device in one of two distributions: 'constant', one food item in every hole (total = 50 food items) or 'variable', 5 food items in 10 of the holes (total = 50 food items). The holes were then covered with starch paper. During the enrichment period the parrots spent significantly more time allopreening than in the baseline or post-enrichment periods. The results also provide some evidence of contrafreeloading in parrots, but no preference for a variable over a constant food source. The study shows that providing extra foraging opportunities for parrots is a useful form of enrichment.*

**Keywords:** *animal welfare, contrafreeloading, environmental enrichment, foraging, parrots*

## Introduction

Seventy-seven of the world's 330 parrot species are at risk from extinction (Birchall 1990). Captive breeding has therefore become critical to many species' survival. It has been suggested that keeping captive birds in as 'natural' enclosures as possible will facilitate captive breeding (Carlstead & Shepherdson 1994). A more natural environment is advantageous to an endangered species because it enables the zoo visitor to make the link between the animal and its habitat and possibly encourages the conservation of that habitat (Hancocks 1980).

Despite the urgency for captive breeding of parrots in captivity and the obvious need for optimizing housing conditions, there is still a bias in enrichment studies towards primates and carnivores (see Shepherdson 1991) even though various forms of abnormal behaviour have been observed in captive parrots (Birchall 1990). Poole (1992) has argued that non-mammalian species suffer less than mammal species in sub-optimal conditions. However, others disagree with this view as, for example, similarities exist between the complex social behaviour of primates and parrots (Birchall 1990).

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Environmental enrichment often involves the addition of environmental features that increase the complexity of a captive animal environment, resulting in beneficial effects on behaviour and other aspects of biological functioning (Newberry 1995). Zoo-housed parrots often have a restricted space allowance and limited opportunities for social interaction. Environmental enrichment may address these welfare problems by helping to preserve natural behavioural repertoires (Hayes 1990).

In its natural environment, a bird is surrounded by a multitude of unpredictable stimuli to which it is adapted to respond (Van Rooijen 1991) and therefore it is able to exert control over certain environmental stimuli. However, within a cage often there is little unpredictability. Furthermore, there is a discrepancy between the control of stimuli and the animal being able to make the appropriate behavioural response (Chamove & Anderson 1989). Certain stimuli are presented to the animal which motivates it to perform a particular behavioural response but, often due to the constraints of the captive environment, the animal is unable to perform the behavioural response it is motivated to do. Thus, the animal has little control over any aspects of its environment, a situation to which it is not well adapted (see Hughes & Duncan 1988). In those aspects of captive life where there is unpredictability, such as visitor presence, the birds have little control and it has been suggested that this is stressful to animals (Joffe *et al* 1973; Chamove & Anderson 1989). Hughes and Duncan (1988) have suggested that an animal working for food in the presence of identical free food (contrafreeloading) is exerting control over an aspect of its environment. Furthermore, studies by Herrnstein (1964) and Inglis and Ferguson (1986) have shown that non-food-deprived animals prefer variable to constant reinforcement, such as food.

The aims of this experiment were to enrich the environment of captive parrots by increasing the foraging opportunities, and to compare the parrots' preference for a variable or a constant food supply.

## Materials and methods

### *Subjects*

The subjects were housed as single-species groups, which comprised two male and two female red-front macaws (*Ara rubrogenys*), a male-female pair of thick-billed parrots (*Rhynchopsitta pachyrhyncha*), a male-female pair of green-winged macaws (*Ara chloroptera*) and a male-female pair of yellow-backed chattering lorys (*Lotius garrulus*). The birds were aged between 9 and 61 months.

### *Housing and maintenance*

All birds were housed at Edinburgh Zoo in enclosures with indoor (approximate size 2x2x2m) and outdoor areas (approximate size 3x3x3m), both of which were on view to visitors. Wire mesh or glass separated the birds from the visitors, and neighbouring birds were separated by wire mesh. Food was available from dishes in the indoor enclosures. The birds were fed between 0930 and 1000h every day. The diet included fruit, vegetables, nuts, seeds, bread and eggs.

### *Enrichment device*

The enrichment device was designed to encourage foraging activity. Two arrangements of the same device were offered so that the birds had the choice of a constant or variable food source.



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The foraging device was composed of a length of wood (2x0.08x0.08m) with 50 holes (0.02m diameter x 0.02m depth) drilled into one face. Food was placed in the holes in one of two distributions: 'constant', one food item (either one sunflower seed, three saffra seeds or one bean) in every hole (total = 50 food items), or 'variable', 5 food items in 10 of the holes (total = 50 food items).

The holes were covered with starch paper which remained attached to the wood when previously dipped in water (dried within 30 minutes). The devices were balanced as perches at appropriate positions within the enclosures.

*Experimental protocol*

The study was divided into four sequential periods: baseline - observations made of parrot behaviour before enrichment (33 hours); training - no observations made, birds allowed several days to learn how to use the device; enrichment - birds observed when given the foraging devices (37 hours); post-enrichment - observations made when conditions were returned to those during their baseline period (32 hours).

*Data recording*

The categories of behavioural data collected are shown in Table 1. The data were collected by scanning all birds simultaneously using instantaneous time sampling with a 3-minute interval, for 1-hour observation periods. Normally, 3 to 4 hours of observations were made across each day of each observation period.

**Table 1 Ethogram of recorded parrot behaviours.**

| Behaviour | Description |
|---|---|
| *Cage* | Moving or sitting on wire mesh of cage wall or ceiling |
| *Branch* | Moving or sitting on branch or bush |
| *Rope* | Moving or sitting on rope |
| *Floor* | Moving or sitting on floor |
| *Metal bar* | Moving or sitting on outdoor metal bar |
| *Nesting box* | In or on nesting box |
| *Food bowl* | Sitting at food bowl |
| *Drinking bowl* | Sitting at drinking bowl |
| *Pool* | In outdoor water bath |
| *Eating* | Eating |
| *Drinking* | Drinking |
| *Bark stripping* | Stripping bark from branch or nest box with its beak |
| *Sitting alert* | Sitting still but apparently alert with eyes open |
| *Sitting not alert* | Sitting still and apparently not alert with eyes closed |
| *Climbing* | Climbing either up wire mesh or branch |
| *High* | Out of immediate eye level view of visitors |
| *Preening* | Preening self |
| *Allopreening* | Preening another individual |
| *Social interaction* | Social interaction between subjects |
| *Flying* | Flying |
| *Constant* | On and foraging from device with equal seed distribution |
| *Variable* | On and foraging from device with unequal seed distribution |



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*Statistical analysis*

The mean number of scans of each behaviour per hour was calculated for every bird. Significant differences between the three observation periods were identified using the Kruskal-Wallis one-way non-parametric analysis of variance test. Overall significant differences detected by the Kruskal-Wallis test were then analysed post-hoc using the Mann-Whitney $U$ test to determine which specific periods differed significantly. The total time spent using the two types of foraging devices was statistically compared using the Mann-Whitney $U$ test.

## Results

The thick-billed parrots, green-winged macaws and yellow-backed chattering lorys all emptied the enrichment devices within 24 hours. However, the red-fronted macaws rarely used the enrichment devices. Birds extracted food items from the enrichment device by stripping away the starch paper with their beak.

*Behaviour*

A significant difference was found between the observation periods in the number of scans in which the birds were on the rope ($H = 10.34$, $df = 2$, $P < 0.01$). Post-hoc analysis indicated that birds spent more time on the rope during baseline ($W = 138.5$, $P < 0.05$; see Table 2) and post-enrichment periods ($W = 66$, $P < 0.01$; see Table 2) compared to the enrichment period.

**Table 2** **Mean (±SEM) number of behavioural observations for all birds per hour by treatment period.**

| Behaviour | Treatment period | | |
|---|---|---|---|
| | Baseline | Enrichment | Post-enrichment |
| *Cage* | 3.49 ± 0.43 | 3.24 ± 0.68 | 4.07 ± 0.56 |
| *Branch* | 5.67 ± 0.82 | 5.02 ± 0.90 | 6.39 ± 0.96 |
| *Rope** | 2.83 ± 0.55 | 0.62 ± 0.07 | 2.26 ± 0.33 |
| *Floor* | 0.23 ± 0.11 | 0.22 ± 0.15 | 0.17 ± 0.11 |
| *Metal bar** | 2.68 ± 0.50 | 6.70 ± 0.84 | 4.08 ± 0.71 |
| *Nesting box* | 0.80 ± 0.41 | 2.11 ± 1.41 | 1.34 ± 0.89 |
| *Food bowl** | 4.52 ± 0.42 | 3.75 ± 0.38 | 3.96 ± 0.37 |
| *Drinking bowl* | 0.04 ± 0.03 | 0.20 ± 0.10 | 0.20 ± 0.12 |
| *Eating* | 4.73 ± 0.40 | 5.70 ± 0.85 | 4.31 ± 0.34 |
| *Drinking* | 0.04 ± 0.03 | 0.20 ± 0.10 | 0.21 ± 0.12 |
| *Chewing bark* | 0.86 ± 0.39 | 0.79 ± 0.26 | 0.69 ± 0.24 |
| *Sitting alert* | 6.52 ± 1.21 | 9.48 ± 1.59 | 7.64 ± 0.92 |
| *Sitting not alert* | 0.08 ± 0.03 | 0.15 ± 0.07 | 0.57 ± 0.27 |
| *Climbing** | 0.14 ± 0.04 | 0.31 ± 0.05 | 0.94 ± 0.21 |
| *High* | 0.60 ± 0.37 | 0.13 ± 0.05 | 0.80 ± 0.52 |
| *Preening* | 1.44 ± 0.16 | 1.95 ± 0.41 | 2.17 ± 0.33 |
| *Allopreening** | 0.15 ± 0.05 | 0.44 ± 0.09 | 0.35 ± 0.09 |
| *Species interaction* | 0.56 ± 0.24 | 0.54 ± 0.19 | 0.78 ± 0.22 |
| *Flying* | 0.17 ± 0.05 | 0.14 ± 0.06 | 0.18 ± 0.09 |
| *Constant* | - | 0.65 ± 0.29 | - |
| *Variable* | - | 0.88 ±0.32 | - |

* Indicates behaviours significantly affected by treatments.



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A significant difference was found between the observation periods in the number of scans in which birds were on the metal bar ($H=8.71$, $df=2$, $P<0.05$). Post-hoc analysis indicated that birds spent more time on the bar during enrichment than during baseline conditions ($W=23.0$, $P<0.05$).

There was found to be a significant difference between the observation periods in the number of scans in which the birds were climbing ($H=12.45$, $df=2$, $P<0.01$). Post-hoc analysis indicated significant differences between all pairs of observation periods; baseline less than enrichment ($W=75.0$, $P<0.05$), baseline less than post-enrichment ($W=65.0$, $P<0.01$, and enrichment less than post-enrichment ($W=77.5$, $P<0.05$). Thus, the amount of climbing observed increased over time.

There was found to be a significant difference between observation periods in the number of scans in which birds were allopreening ($H=7.10$, $df=2$, $P<0.05$). Post-hoc analysis showed that allopreening occurred significantly more during enrichment than during baseline periods ($W=70.0$, $P<0.01$).

There was found to be a significant difference between observation periods in the number of scans in which birds were at the food bowl ($H=0.67$, $df=2$, $P<0.05$). Post-hoc analysis indicated that more time was spent at the food bowl during the baseline ($W = 88$, $P < 0.05$) and post-enrichment ($W=47$, $P<0.05$) periods than during the enrichment period.

*Constant versus variable device*

On average, birds spent 3.2 per cent and 4.4 per cent of each hour on the constant and variable foraging devices, respectively. Statistical analysis showed that this level of difference was not significant.

## Discussion

The enrichment devices provided extra foraging opportunities for the birds in a manner appropriate for the species. Casual observations showed that some species and certain individuals were quicker to learn how to use the device than others. We do not know why the red-fronted macaws did not use the foraging device.

During the enrichment period the amount of time spent feeding from the bowl decreased but the recorded level of feeding behaviour remained constant. As the time spent eating other food sources provided by the keepers also remained constant it can be assumed that the birds were compensating for the decrease in feeding from the bowl by spending more time feeding from the enrichment devices.

The changes in the proportions of time spent on the metal bar and rope or in climbing do not appear to be associated with use of the enrichment device. It is more likely that they were associated with changes in other factors, such as weather, that were not investigated or manipulated in this study.

The increase in amount of time spent allopreening during the enrichment period appears to be a consequence of the enrichment device and may be interpreted in two ways: allopreening is a desirable behaviour which the enrichment device has succeeded in augmenting, or allopreening is a fear-reducing behaviour carried out in times of stress, caused by the addition of the novel enrichment devices to the enclosures. As branches and other novel objects are frequently added to the birds' enclosures, the former explanation seems more likely.



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A successful form of environmental enrichment, from the visitors' point of view, would be one that encourages the birds to be in public view for more of the time (Shepherdson *et al* 1993). Although not found to be significant, the birds spent less time high up in their enclosures out of immediate view of the passing visitor during the enrichment period. This is either a direct result of the birds spending time on the enrichment devices or as an indirect positive effect of the environmental enrichment.

Use of the foraging device implied that birds were performing contrafreeloading since identical free food was available in their food bowls. This suggestion is strengthened by the observation that food dishes were never emptied. The results do not indicate a preference for the variable over the constant enrichment device. However, since the time spent on the foraging devices was substantially less than that spent at the food dish, it is possible that the birds were sampling all food supplies available to assess the benefit of switching from one to the other (Krebs & McCleery 1984).

### *Animal welfare implications*

This study shows that it is possible to enrich parrot enclosures relatively simply by increasing foraging opportunities for the parrots. Enrichment is more successful if it is aimed at soliciting species-specific behaviours such as foraging. Foraging and preening take up 90 per cent of a parrot's time in the wild (Birchall 1990), but in captivity most food is provided in a single dish, thus reducing foraging time substantially. By increasing foraging time in captive birds, a time budget more like that of the wild counterpart will be produced. This is advantageous for captive breeding projects, possible future reintroductions and the welfare of the animal.

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