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Foraging 'enrichment' as treatment for pterotillomania

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Abstract

This study was performed to determine whether foraging 'enrichment' reduces self-directed psychogenic feather picking (pterotillomania) in parrots. A positive correlation between increased foraging time and improvement of feather score was hypothesised.

Eighteen pterotillomanic African grey parrots (*Psittacus erithacus*) were randomly assigned to experimental and control groups in a crossover design for two 1-month-periods. The experimental group received food in pipe feeders, while the controls received food in a bowl in the presence of two empty pipe feeders.

The 10-point plumage scoring system from Meehan was used as an indirect measurement of feather picking behaviour (better plumage results in higher score). Scoring took place before the study; after 4 weeks, just before the crossover; and 4 weeks after the crossover. Foraging time was calculated with a time-lapse recorder.

A pipe feeder significantly increased foraging time and feather score. The logistic model of the influence of foraging time on improvement of feather score was significant (Chi-square 7.1; d.f. = 1; $P = 0.0076$). Each hour extra spent on foraging multiplies the odds of improvement of feather score with a factor 2.9 (95% CI 1.2–7.0).

The results suggest that the redirected foraging hypothesis might be an explanation for pterotillomania in African grey parrots and provide an effective treatment strategy for this common behavioural disorder. The findings may have implications for the treatment of trichotillomania in humans.

Keywords: Psychogenic feather picking; Feather pecking; Impulse control disorder; Animal model; Trichotillomania; Redirected foraging behaviour; African grey parrot

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1. Introduction

Psychogenic feather picking is one of the most challenging behavioural problems of captive parrots. It has been estimated that 10% of captive parrots perform this feather picking behaviour (Grindlinger, 1991). Feather picking generally applies to all mutilation of the feathers by the beak and includes chewing or plucking (Harrison, 1986). Psychogenic feather picking develops or persists in the absence of medical causes, and observational evidence suggests that it may be associated with a number of management factors, such as inadequate diet, social isolation and lack of environmental stimulation (Mertens, 1997). A compelling case has been made by Bordnick et al. (1994), that trichotillomania in humans and feather picking disorder in birds are similar behavioural disorders. Here a new term 'pterotillomania' (PTM) is proposed instead of 'feather picking' to emphasize the similarity with the human condition 'trichotillomania' (TTM). This term enables use of the Greek term for this disease in all languages (trichos = hair; pteron = feather or wing; tillein = to pluck; mania = excessively intense desire). A well-recognised animal model for a human disease has the advantage that animal and human research can be mutually beneficial.

In chickens many studies are in support of the redirected ground peck hypothesis which explains the feather pecking from lack of appropriate foraging material (Huber-Eicher and Wechsler, 1997; Blokhuis, 1986; Aerni et al., 2000). In one study in Amazon parrots it was shown that combined environmental and foraging enrichment improved the feather score over a 1-year-period (Meehan et al., 2003). The experimental set-up in that study, however, did not allow to differentiate between environmental enrichment and foraging enrichment.

The term 'enrichment' needs some explanation. Some have argued that 'providing environmental requirements' should be used in situations were the basic needs of the animal are provided in order to avoid states of suffering, such as pain, discomfort, frustration and fear, and that 'environmental enrichment', should be reserved for environmental manipulations which enhance quality of life even further by leading to states of pleasure (Duncan and Olsson, 2001). However, the term enrichment is used in many studies in animal welfare science to describe a situation which contrasts with the barren environment in the control group. In the present study the term 'enrichment' indicates 'to improve the environment', without implying that the original situation was already satisfactory.

Based on the assumption that psychogenic feather picking in captive parrots, like in laying hens, can be regarded as a form of redirected foraging behaviour, we hypothesised that providing only foraging 'enrichment' devices would reduce psychogenic feather picking in these animals. Since it is known that feathers redevelop in about 3 weeks after plucking we also hypothesised that improvement within 1 month should be possible. This study was performed to test this hypothesis in a prospective crossover experiment.

2. Methods

2.1. Birds

The parrots used for this study were 18 feather picking African Grey parrots (*Psittacus erithacus erithacus*), which had been donated to a parrot shelter (Nederlandse Opvang Papegaaien [NOP], Veldhoven, The Netherlands) by there previous owners. The birds showed the typical pattern of feather picking, with well-formed feathers on the head and random areas of feather loss or feather damage in body areas accessible to the birds' beak (Westerhof and Lumeij, 1987. They were divided, at random, in two groups of equal size in a crossover design were they alternated between a treatment group and a control group in two 1-month experimental periods.

2.2. Caging

The parrots were housed individually in cages ($l \times w \times h = 80\ \text{cm} \times 50\ \text{cm} \times 105\ \text{cm}$). Each cage contained two hard wooden perches, a water-bowl and two pipe feeders (see below). The parrots of the control group were fed 60 g per day in a food-bowl and two empty pipe feeders were given. The 'enriched' group received their pellets in the pipe feeders (40 g per device) and had no food-bowl. After 4 weeks the groups were crossed over. To teach the 'enriched' group where to look for food, a little food was placed around the pipe feeders. In a few days they learned the trick. The cages were all placed in the same room and visual barriers were installed between cages. Vocal contact was possible between all parrots in the room. Birds were exposed to natural daylight through a fully transparent ceiling for a period extending from 1 month before to 1 month after the summer solistice at location 51°27′N; 05°29′E (sunrise 5.21 am; sunset 9.59 pm). After 2 weeks of habituation to the new environment, and 2 days of habituation to the empty pipe feeders, the experiment was started. The parrots remained in their own cage during both 1-month experimental periods.

2.3. Extruded pellets

Two weeks before the study started, the parrots were adjusted to a commercial extruded parrot pellet (Bingo® fitvoer, a.a.-vet, Harderwijk, The Netherlands). They had been previously adjusted to another brand of extruded pellet in the parrot shelter. The reason to give the parrots this specific brand was that these pellets were all of the same shape and same size, which enabled the pellets to pass through the holes of the pipe feeders without clogging the system.

2.4. Pipe feeders

Two pipe feeders were used: one on the bottom of the cage (Fig. 1), and one hanging at a height of 12 cm above the bottom (Fig. 2). The parrots had to manipulate the objects, to let the pellets come out through the holes. The parrots had to roll the first pipe feeder and had to swing the second one. The pipe feeders where filled with pellets every morning at 8.30 a.m.

2.5. Daily work

The cages were cleaned every day, before the enrichment devices or food-bowls were refilled. Every day the birds received fresh water. The amount of time the care-taker spent with the cages of the control

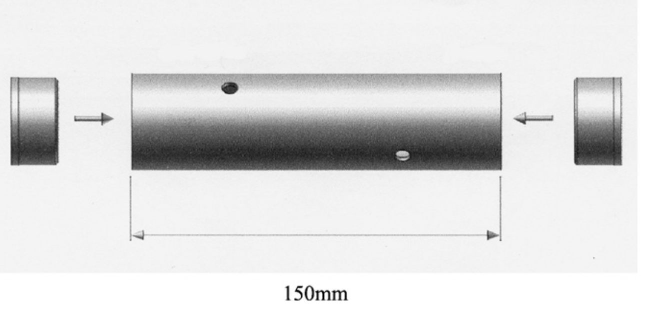

Fig. 1. Pipe feeder #1 (150 mm × 40 mm) used to put on the bottom of the cage. The parrots had to roll this device to have the pellets fall through one of the four holes (diameter 6.5 mm).

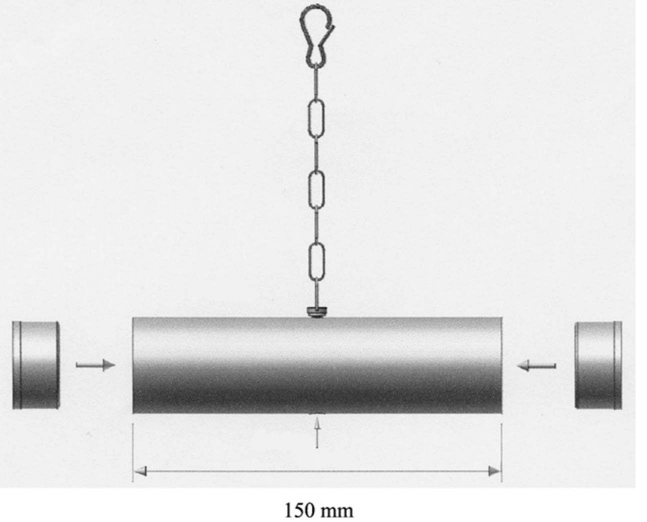

Fig. 2. Pipe feeder #2 (150 mm × 40 mm) suspended from the ceiling. The parrots had to swing this device to have the pellets fall through the single hole in the middle of the underside (small arrow; diameter 6.5 mm).

parrots and the cages of the 'enriched' parrots was equal. The rest of the day, no one had access to the room.

2.6. Tape-recording

To avoid observer effects on behaviour, all observations were performed by camera and video-recorder. Two parrots were filmed simultaneously for 24 h, with a time-lapse recorder. Every second on the videotape equalled nine seconds real time. The camera used was infra-red sensitive, so there was no light additional light needed and the parrots were not disturbed. The camera was repositioned every day, so every day two other parrots were filmed. The parrots were filmed continuously during a 24-h-period. After this the camera was switched to another couple of parrots. Each parrot was filmed for six 24-h-periods of which three during the enriched period and three during the control period. The time spent foraging for each period was calculated as the mean of three 24-h-observations. Foraging time in the enriched group was total time spent with the food enrichment devices or looking for food around the food enrichment devices, while in the control group foraging times equalled time spent looking for food and eating out of the food-bowl.

2.7. Crossover

After 4 weeks a crossover took place. The control group became the 'enriched' group and vice versa. A 1-month experimental period was considered long enough, because it is known that feathers redevelop within 3 weeks after plucking.

2.8. Plumage scoring

The plumage score was used as an indirect measurement of feather picking behaviour. To quantify plumage condition the 10-point scoring system from Meehan et al. (2003) was used (Table 1). This system involves scoring the feather condition on five separate body areas, chest/flank, back, legs, tail and wings. These sub-scores lead to an overall score, by adding them. Similar scoring systems have been used for chickens (Tauson et al., 1984). The scoring took place at three moments: the first time before the study; the

Table 1
Feather scoring system (from Meehan et al., 2003)

(a) Scoring system used for chest/flank, back and legs	
0	All or most feathers removed, down removed and skin exposed, evidence of skin or tissue injury
0.25	All or most feathers removed, down removed and skin exposed, no evidence of skin or tissue injury
0.5	All or most feathers removed, some down removed, patches of skin exposed
0.75	All or most feathers removed, down exposed and intact or feathers removed from more than half of the area, some down removed, patches of skin exposed
1.0	Feathers removed from less than half of the area, some down removed and skin exposed
1.25	Feathers removed from more than half of the area, down exposed and intact
1.5	Feathers removed from less than half of the area, down exposed and intact
1.75	Feathers intact with fraying or breakage
2.0	Feathers intact with little or no fraying or breakage
(b) Scoring system used for wings	
0	All or most primaries, secondaries and coverts removed, down removed, skin exposed, evidence of skin or tissue injury
0.5	All or most primaries, secondaries and coverts removed, down removed, skin exposed, no evidence of injury
1.0	More than half of coverts removed, down exposed and intact or more than half of primaries and secondaries removed, down exposed and intact
1.5	Fewer than half of coverts removed, down exposed and intact or fewer than half of primaries and secondaries removed, down exposed and intact or primaries and secondaries intact with significant breakage and fraying
2.0	Feathers intact with little or no fraying or breakage
(c) Scoring system used for tail	
0	All or most tail feathers removed or broken
1	Some tail feathers removed or broken or significant fraying of tail feathers
2	Feathers intact with little or no fraying or breakage

second time after 4 weeks, just before the crossover; the third time 4 weeks after the crossover. Scoring of the plumage was performed by an independent observer blinded for the treatment.

2.9. Statistical analysis

(1) Based on a 2×2 contingency table the relative risk (RR), or more appropriately in this context the "Benefit Ratio", was calculated: $\text{RR} = [a/(a+b)]/[c/(c+d)]$. The absolute risk reduction (ARR), or more appropriate here the absolute benefit increase (ABI), obtained by providing the pipe feeders was calculated by subtracting the control event rate (CER) from the experimental event rate (EER) $[\text{ARR} = \text{ABI} = a/(a+b) - c/(c+d)]$. The number needed to treat (NNT) was calculated from 1/ARR (Cockroft and Holmes, 2004). For RR, ARR and NNT the 95% confidence intervals (CI) were calculated. The 95% CI of RR was defined as $e^{-1.96.\text{se}(\ln(\text{RR}))}\cdot\text{RR}$, $e^{1.96.\text{se}(\ln(\text{RR}))}\cdot\text{RR}$, were $\text{se}(\ln(\text{RR})) = \sqrt{[1/b - 1/(a+b) + 1/d - 1/(c+d)]}$. The 95% CI of ARR was defined as $\text{ARR} \pm 1.96\cdot\text{se}[\text{ARR}]$, were $\text{se}[\text{ARR}] = \sqrt{[ab/(a+b)^3 + cd/(c+d)^3]}$. For these calculations all individuals during the 'enriched' periods were compared with all individuals in the control periods. The presence or absence of improvement was tabulated against the presence or absence of pipe feeders.
(2) Feather scores at the beginning and end of each 1-month-period within each group were compared with a two-tailed paired Student's *t*-test.
(3) Differences between foraging times with and without food enrichment devices were tested for significance by Student's two-tailed *t*-test for paired (group 2) and unpaired (group 1) observations.
(4) A logistic regression model was used to evaluate the influence of time spent on food gathering on improvement of feather score. The dependent variable which measures whether improvement in feather score was seen is yes. Yes is equal to 1, when improvement is seen, and 0 otherwise.

Table 2
Effects of 1 month pipe feeding on feather scores in 18 African grey parrots[a]

	Improvement		
	Yes	No	
Pipe feeding			
Yes	14(a)	4(b)	EER = $a/(a + b)$ = 14/18
No	4(c)	12(d)	CER = $c/(c + d)$ = 4/16

[a] A 2 × 2 contingency table depicting improvement/no improvement during a 1 month pipe feeding period and a control period in 18 feather picking parrots divided at random in a crossover design. Two subjects were removed after the first experimental period and did not enter the control group in the second period because of illness of undetermined cause.

For all calculations significance was assumed at $P < 0.05$.

3. Results

At the end of the first 1-month-experimental period two parrots from group 1 were removed from the experiment because of illness of undetermined cause. These animals therefore did not participate in the second period of group 1.

(1) During the 1-month-period of pipe feeding the feather score was not changed in three out of 18 parrots. Fourteen out of 18 parrots improved their feather score (i.e. improvement 78%; 95% CI 52–93%). One out of 18 parrots had a decrease in feather score (i.e. decrease 6%; 95% CI 1–27%).

During the 1-month-control-period the feather score was not changed in three out of 16 parrots. Nine out of 16 parrots had a decrease of feather score (i.e. decrease 56%; 95% CI 30–80%). Four out of 16 parrots improved their feather score (i.e. increase 25%; 95% CI 7–52%) (Table 2).

Table 3
Feather scores at the beginning and end of the pipe feeding period and the control periods in parrots from group 1[a]

Parrot #	Pipe feeding period			Control period		
	Feather score 1	Δ feather score 1 → 2	Feather score 2	Feather score 2	Δ feather score 2 → 3	Feather score 3
1	3.25	−0.25	3.0	3.0	−1.75	1.25
2	2.75	+1.25	4.0	4.0	−1.0	3.0
3	4.75	+0.25	5.0	5.0	−0.25	4.75
4	3.75	+1.0	4.75	4.75	+1.0	5.75
5	6.25	+0.75	7.0	7.0	−0.25	6.75
6	5.75	0	5.75	5.75	0	5.75
7	5.0	+0.75	5.75	5.75	−0.75	5.0
8	3.25	+1.75	5.0	Removed from experiment		
9	7.5	0	7.5	Removed from experiment		
Mean ± S.D.	4.69 ± 1.60	0.61 ± 0.67[b]	5.31 ± 1.40	5.04 ± 1.30	−0.430 ± 0.86[c]	4.61 ± 1.89

[a] The first 1-month-period is the pipe feeding period, the second 1-month-period is the control period. During the pipe feeding period a significant improvement was seen, while changes during the control period were not significant.
[b] Student's two-tailed t-test, $P = 0.024$.
[c] Student's two-tailed t-test, $P = 0.23$.

Table 4
Feather scores at the beginning and end of the pipe feeding period and the control period in parrots from group 2[a]

Parrot #	Control period			Pipe feeding period		
	Feather score 1	Δ feather score 1 → 2	Feather score 2	Feather score 2	Δ feather score 2 → 3	Feather score 3
10	6.0	−0.25	5.75	5.75	+0.75	6.5
11	6.0	−2.0	4.0	4.0	+0.75	4.75
12	4.75	+1.0	5.75	5.75	+1.5	7.25
13	1.5	+0.25	1.75	1.75	+1.25	3.0
14	7.25	−0.5	6.75	6.75	+1.0	7.75
15	2.75	+2.0	4.75	4.75	+0.5	5.25
16	3.0	0	3.0	3.0	0	3.0
17	3.0	+1.5	4.5	4.5	+1.0	5.5
18	6.0	0	6.0	6.0	+0.75	6.75
$X \pm$ S.D.	4.47 ± 1.97	0.22 ± 1.1[b]	4.70 ± 1.59	4.70 ± 1.59	0.83 ± 0.43[c]	5.53 ± 1.73

[a] The first 1-month-period was the control period, the second 1-month-period the pipe feeding period. During the pipe feeding period a significant improvement was seen, while changes in the control period were not significant.
[b] Student's two-tailed t-test, $P = 0.565$.
[c] Student's two-tailed t-test, $P = 0.0004$.

(2) In both groups the feather score improved significantly during pipe feeding, while the control period did not show significant changes (Tables 3 and 4). The relative risk of improvement when parrots are given 1 month pipe feeding was 0.78/0.25 = 3.12 (95% CI 1.3–7.7).
The absolute risk reduction was: ARR = 0.78–0.25 = 0.53 (95% CI 0.25–0.81). The number needed to treat (NNT = 1/ARR) was 1/0.53 = 1.9 (95% CI 1.2–4).
(3) An increase in foraging time leads to improvement of feather score. Foraging times with and without a pipe feeders were significantly different between both groups (Tables 5 and 6).
(4) The logistic model looking at the influence of foraging time on improvement of feather score was significant according to the model Chi-square statistic (Chi-square 7.1; d.f. = 1; $P = 0.0076$). The odds ratio for the time coefficient (time unit 1 min) is 1.0179 (95% CI 1.0029–1.0331). The overall % correct predictions of the model was 71%. According to this model each minute spent on foraging increases the odds of improvement of feather score with

Table 5
Foraging time with and without pipe feeding in parrots from group 1

Parrot #	Foraging time (min/24 h)	
	With pipe feeding	Without pipe feeding
1	143	58
2	146	72
3	147	67
4	244	213
5	122	54
6	206	144
7	125	51
8	263	Removed
9	110	Removed
$X \pm$ S.D.	167 ± 56[a]	94 ± 61

[a] Pipe feeding caused a significant increase in foraging time (Students two-tailed unpaired t-test, $P = 0.0252$).

Table 6
Foraging time with and without pipe feeding in parrots from group 2

Parrot #	Foraging time (min/24 h)	
	Without pipe feeding	With pipe feeding
10	79	86
11	81	127
12	233	212
13	158	215
14	53	111
15	96	141
16	120	167
17	50	137
18	180	181
$X \pm$ S.D.	116 ± 62	153 ± 44[a]

[a] Pipe feeding caused a significant increase in foraging time (Student's two-tailed paired t-test, $P = 0.0120$).

1.8%. That means for each hour spent on foraging the odds of improvement increases with $1.0179^{60} = 2.90$ (95% CI 1.2–7.0).

4. Discussion

The data from this experiment (1) show that feather picking and foraging are inversely related, (2) suggest that pipe feeders are an effective treatment strategy in clinical cases and (3) suggest that the redirected foraging hypothesis might be an explanation for feather picking in parrots.

Parrots in captivity are usually given readily available food that is consumed rapidly, whereas in the wild they would have to spend up to 6 h foraging for it (Snyder et al., 1987).

Although the time-budget for foraging expressed by an animal is usually an expression of a resource density and distribution and tells us nothing about the importance of that behaviour to the species concerned, foraging may well be a behavioural need. If enrichment allows expression of this behavioural need (i.e. motivation) this might improve animal welfare. Three pieces of behavioural evidence in this study suggest improvement of animal welfare by providing pipe feeders. There is (1) reduction of injurious behaviour, (2) promotion of a more natural time-budget for foraging, and (3) promotion of behavioural pattern that is perceived desirable by the scientific community. The final proof that foraging is a behavioural need for which parrots are highly motivated and which is intrinsically rewarding to the animal, might be provided by a further experiment in which the parrots are given both, a food-filled pipe feeder and food which is freely available in a bowl, i.e. contra-freeloading (Inglis and Ferguson, 1986; Inglis et al., 1997). There is already some evidence for contra-freeloading in captive parrots, indicating that they prefer to perform some amount of work for food even when food is readily available for consumption (Coulton et al., 1997).

This investigation has shown a marked improvement of feather score in feather picking African grey parrots after giving them pipe feeders. If with a pipe feeder the foraging time can be lengthened to more than 90 min, small improvements can already be detected. For each hour extra spent on foraging, the odds of improvement increase with 2.9 (95% CI 1.2–7.0). The method can be regarded as therapeutically efficient since the number needed to treat to see improvement within a 1-month-period was 2. The findings are in agreement with earlier findings in poultry material (Huber-Eicher and Wechsler, 1997) and parrots (Meehan et al., 2003).

The feather score improved significantly in 1 month, when the parrots had to obtain their food out of the pipe feeder. The change in feather score during the control period was not significant. For the first group, who had the control period after the pipe feeding period, it might be explained by the fact that the parrots used the empty pipe feeders as a toy. One parrot (parrot 4) even played with the pipe feeder most of the time and at night she slept next to it. For the second group, which had the control period before the pipe feeding period, it might be explained by the fact that all parrots were accustomed to eat pellets from a food-bowl and apart from a change of caging no major changes were made. It was therefore not to be expected that these parrots would show a significant change in feather score during the control period.

Since the improvement in feather quality happened within 4 weeks, a dramatic and nearly immediate decrease in feather picking behaviour must have taken place. Given the fact that feathers take 3 weeks to fully grow and the uncertainty which exist about the time lapse which occurs between the moment of stopping of feather picking and growth of new feathers, the increase due to the use pipe feeders is expected to continue.

The findings from this experimental study in a laboratory setting are a firm basis for further clinical trials using privately owned feather picking pet parrots. In these trials the relative effects of behaviour modification techniques and the previously reported beneficial effects of psychopharmacology interventions need to be investigated (Seibert et al., 2004).

If trichotillomania in humans is indeed analogous to pterotillomania in parrots, and trichotillomania and pterotillomania are redirected behaviours to satisfy a biological need in under-stimulated individuals, then the results of this study suggest that when an appropriate stimulus would be applied to trichotillomanic humans this could reduce this behaviour. Trichotillomanic patients are focussed on an automatic habit with a low level awareness.

The hypothesis which emerges from our observations in parrots is that a scheduled exposure to a functional and rewarding habit that occupies the hands (knitting, rope work, bead work, painting, sculpting, etc.) will significantly reduce trichotillomanic behaviour. This hypothesis needs to be tested in a prospective randomized clinical trial.

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