

The Influence of the Breeding Method on the Behaviour of Adult African Grey Parrots (*Psittacus Erithacus*)

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1. Introduction

African grey parrots (*Psittacus erithacus*) are very commonly kept as companion animals all over the world. Hand-rearing has been increasingly carried out over the last 25 years. Nowadays, thanks to innovative ready-to-use feeding formulas, previous experience in that field gathered by numerous breeders and high technology equipment (Voren and Jordan, 1992; Wagner, 1999; Reinschmidt, 2000; Low, 1987) hand-rearing is much easier to accomplish. However, the exact consequences of the different hand-rearing methods have never been studied and still remain unknown. It is still not clear how long the sensitive stage, during which the birds are imprinted on one specific species, lasts. Still, the development of the chicks' normal behaviour seems to go beyond their nesting period and to involve many components that have to be learned by interaction with parrots and observation of other individuals in the flock. For instance, the importance of the sibling relationship was demonstrated by Wanker (1996) in the case of spectacled parrotlets.

behaviour of male and female cockatiels (Myers et al., 1988) and impaired the ability of isolated lovebirds to socialize with conspecifics (Preiss and Franck, 1974).

Hand-reared parrots choose a specific human being as a partner. This triggers frustration to the birds, as their human bonds cannot fully satisfy their social requirements and often do not understand or do not react compatibly to the birds' body language. Thus, hand-reared grey parrots may develop frustration-related or attention-seeking behavioural disorders, like aggressiveness, feather picking, stereotypies or abnormal sexual behaviours. Contrary to parent-reared parrots, which often also bond to one person, hand-reared parrots are imprinted on humans and seem to be socially more dependent on them. Therefore, we expect them to be prone to develop such frustration-related disorders.

To the authors' knowledge, the few previous studies about hand-rearing in parrots all consider the effects of hand-rearing on the birds' sexual and social behaviour with conspecifics. Siermann (2000) demonstrated that hand-reared macaws, African grey parrots and cockatoos have significantly more problems breeding and bonding with conspecifics than birds that have not been hand-reared. Further study showed that hand-rearing had differential effects on the sexual



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There are many alternatives to hand-rearing. Under certain circumstances, foster parents can be used to rear chicks. Further, if the parents do not feed their offspring sufficiently, supplementary feeds can be given. This method usually has the added advantage of producing chicks which are tame. Finally, neonatal handling is a method which allows the breeders to supply tame birds. Handled orange-winged Amazon chicks were proved to be tamer by all measures of tameness than the birds belonging to the control group (Colette et al., 2000). The predisposition of filial imprinting to occur at one particular developmental stage could not be stated (Aengus and Millam, 1999). But even if this were the case, Aengus and Millam doubt this sensitive phase exists before approximately the 14th day of life because eyes and ears are not open until then.

Although grey parrots' adaptation ability is rather good, it is limited in terms of time and they often develop behavioural problems in captivity. The trauma endured by African grey parrots that were captured in the wild must be considerable and may have long-lasting consequences on the behaviour of the birds, like the development of phobic behaviours. In spite of the impressive intelligence of African grey parrots, which has been estimated to be comparable to that of a 5-year-old child, most parrots possess the emotional development of a 2–3-year-old child (Pepperberg, cited by Davis, 1991).

So far, very few studies have been carried out on the behaviour of African grey parrots in the wild. Hypotheses about normal behaviour of that wild animal species are mainly based on the observation of other psittacine birds, such as cockatoos, Amazon parrots or macaws. Grey parrots are gregarious birds, forming large communal roosts of up to 10,000 individuals

(Juniper and Parr, 1998). Observation of wild subjects seems to be very difficult, as grey parrots are extremely shy, usually perch hidden in the branches of mangroves and fly above the tree canopy (Lepperhoff, 2003).

In the current study, the occurrence of behavioural disorders in adult African grey parrots with different rearing histories was evaluated. Their behaviour was compared and our hypotheses that hand-reared parrots tend to develop more often frustrated-related behavioural disorders were tested. The hand-raised parrots were also categorized according to the hand-rearing method in order to evaluate the impact of the different handrearing methods on their behaviour. However, this research work was conducted on African grey parrots belonging to private owners, so the care, housing and social contact of the parrots could not be controlled and were not randomized among rearing methods. Thus, our study was the first to evaluate the role of rearing history in the behaviour of African grey parrots and to assess both the possible influence of the breeding methods and the association of different hand-rearing methods with the parrots' behaviour once adult.

2. Animals and Methods

2.1. Subjects

African grey parrots belonging to both subspecies (*Psittacus erithacus erithacus* and *P. erithacus timneh*) were accepted. Only one species of psittacine birds was selected so as to avoid being confronted with different behavioural patterns of phylogenetically remote parrots, which would have considerably complicated the evaluation of the results. African grey parrots were chosen for their tendency to develop behavioural problems in captivity.



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The African grey parrots had to satisfy certain conditions in order to participate in the study. First, they had to be at least 3 years old. An age limit was set in order to select birds that had a fully formed character and the behaviour of an adult bird except with respect to sexual behavioural patterns because sexual maturity usually takes place between the 3rd and the 5th years of life (Lantermann, 2000). Furthermore, their origins had to be known by the owners or breeders. For the hand-reared parrots, it was essential to find their breeders. Finally, the birds had to be kept as pets and not exclusively for breeding purposes.

The study involved 103 grey parrots, most of them having been found through an avian vet. The parrots were divided into the following main groups: 64 parrots had been handreared, 13 birds had been naturally raised by their parents and 26 parrots had been caught in the wild (equivalent to imported in the current text). Both sexes were almost equally represented with 34 females and 36 males. The sex of 33 parrots was unknown. The ages of the birds were very heterogeneous and ranged from 3 to 73 years. Seven birds were 3 years old, 34 were between 4 and 7 years old, 33 between 8 and 15, 21 ranged from 15 to 35 years old, and 8 grey parrots were over 35 years old at the time of the visit. Only 30.9% of the African grey parrots were kept with one or several other grey parrots at that time.

The 64 hand-reared parrots were divided into different groups according to the handrearing method used. However, certain information could not be obtained for some of the subjects, so the number of birds included in specific analyses varied.

Removal from the nest: 22 parrots developed from eggs that had been artificially incubated or had been kept with their parents briefly (less than 2 weeks) and had been removed from the nest before their eyes had opened; 13 parrots that had been kept 4 weeks with their parents; 12 parrots had been removed from the nest after 6 weeks; 13 parrots had stayed at least 8 weeks with their parents. For certain analyses, the hand-reared birds were divided into two groups: "less than 5 weeks" (35 subjects) and "more than 5 weeks" (25 birds) in the nest.

Feeding method: 22 parrots had been fed with spoons or pipettes. Twenty had been fed using syringes. Sixteen subjects had been given food with tubes directly into their crops and two birds had been fed using different implements during the nesting period.

Frequency of human contact during hand-rearing: the no contact category comprised 14 chicks that had been reared in a room which was not inhabited. The breeders had come in only to feed the birds and had had a minimal contact with them. Twenty-two birds belonged to the intensive breeder group, which means that they had stayed in an inhabited room of the house with more contact (including auditive and sight contact) with the breeders. This group also included the parrots that had been hand-raised in the owners' homes with similar contact with them. Twenty-three chicks were put in the category intensive owner, as they had been hand-raised at the owners' during most of the hand-rearing period. Those birds had been kept in an inhabited room, with sustained contact and very close relationships with the owners.

Table 1
Overview of the points raised in the questionnaire

Address and phone number

Parrot's curriculum vitae

Identification, name, sex, date of birth/acquisition, origin, previous owners, reasons for donation
 Breeding method, hand-rearing method^a: contact with parrots/humans during hand-rearing/weaning, age when removed from nest, feeding method, diet, age of weaning

Social contact

Animals: contact with other pets/parrots (past/present)
 Humans: sex of owner, presence of owners/relatives, availability for parrot, relationship with parrot^b

Acquisition

Reasons for acquisition, behaviour at time of purchase

Training

Training, taming method, owner's reaction to unwanted behaviour

Behaviour

Aggressiveness^c
 Screeches/screams^c
 Feather picking^{c,d}: maximal stage ever reached, stage at time of visit, cyclical changes, method
 Repetitive movements^c
 Phobia^c
 Infantile behaviour, mouth-to-beak feeding^c
 Sexual behaviour: allofeeding, sexual activity with parrots/humans^c
 Mimicry ability

Care and housing

Housing: size/shape of cage, location, highest perch, cage covered at night, perches (number, height), bathing opportunity, toys, mirror, TV/radio on?, flight ability, feather-clipping
 Care: litter, grit, brightness, exposure to the sun, length of daylight, humidity, freedom (frequency, duration), cage moved outside, quality of diet, new branches/changes in the cage

Clinical examination, history

History: previous/current illness(es), medication, operations
 State of health^b: bird's activity, stance on the perch, breathing, nostrils, eyes, bill quality and growth, claws, weight, droppings/urine, quality of plumage

Observation during the interview^{c,b}

- a Questions asked to the breeders of the hand-reared parrots.
 b Own observation during the interview.
 c Frequency, duration, trigger, owner's reaction, onset and description of the behaviour were taken into consideration.
 d Feather picking stages: 1, no feather picking; 2, some feathers missing or gnawed; 3, breast, shoulder, back or tail periodically picked; 4, whole body periodically picked; 5, feather picking and self-mutilation.

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Weaning period: 29 birds were weaned (i.e. could eat on their own) at the breeders' and 30 subjects were sold to the owners before they had gained their independence.

2.2. Visit to the owner, questionnaire

A questionnaire containing mostly closed questions was used (Table 1). Some rather subjective criteria (e.g. aggressiveness) that were used in the statistical analysis were evaluated and objectified using a key combining several factors from the questionnaire (e.g. for the criteria aggressiveness, the occurrence of the following factors were taken into account: flying attacks (at one particular person/at anyone), frequency, circumstances and seriousness of bites, circumstances of attacks (on its own/only when provoked/ impossibility to touch the bird without being attacked).

All visits to the owners' homes were made by the same person and the questions were thus always asked in a very similar way. Most of the parrots could be observed during the whole interview (which lasted approximately 2 h), except for the birds that for one reason or another could not be put into the same room as the interviewer. After the interview, at least 10 min were always taken to examine the animal closely and to try to come into contact with the parrot. The subjects had got used to the intruder's presence by then and had started

acting normally. The observation of the parrot's demeanour during the visit provided supplementary information which helped us to get a better overview of both the owner's approach to the bird and the parrot's character but was not used in the statistical analysis, as the parrot's behaviour and reactions can vary from one day to another as well as in response to the intruder's mood and approach to the bird.

Most of the time, the exact hand-rearing method was unknown at the time of the visit, as the information was obtained afterwards by phoning the breeder. This procedure prevented the interviewer from influencing and biasing the answers by personal views and hindered the development of potential prejudices against some hand-rearing methods. In addition, all the observations that were not totally objective were reconsidered using the data evaluation key once all the parrots had been examined. Thanks to this method, the bias due to our expectations could be reduced to a minimum.

The breeders of all the hand-reared birds (31 people) were phoned after the interview with the owner. For some birds, pet shops had to be contacted to try and find out information about the origins of the birds.

Table 2
Multivariable logistic regression analysis for the factor *begging once adult*

	Regression coefficient (B or beta)	Odds ratio Exp(B)	Lower 95% confidence limit	Upper 95% confidence limit	p-Level	Wald-p
Hand-reared parrots	1.37	3.93	1.31	11.75	0.003	0.01
Leftovers ^a	0.74	2.11	0.81	5.49	0.023	0.13
Mouth-to-beak-feedings	0.66	1.94	0.76	4.97	0.018	0.17

One hundred and three adult African grey parrots were used in this model. The influence of the following confounders: *rearing history*, *diet* and *mouth-to-beak-feedings* on the occurrence of *begging once adult* were analysed. $R^2 = 0.46$. % correctly classified = 68.9. Wald-p: calculated using multivariable logistic regression. p-Level: calculated using univariable logistic regression.

^a Food for human consumption given to the birds on a daily basis.

2.3. Definitions of behavioural disorders

2.3.1. Stereotypic movements

Stereotypies are abnormal repetitive, unvarying and functionless behavioural patterns that are often performed by captive and domesticated animals housed in barren environments (Garner et al., 2003).

2.3.2. Nervous repetitive habits

In this study, some parrots had abnormal gestures that could not be considered to be stereotypic (such as nodding, scratching or shaking their heads, shaking their feet in the air in front of them and gnawing their claws). They looked like displacement activities, were performed excessively frequently and were usually carried out in specific situations, in which the birds obviously felt oppressed or nervous. Those movements might have been a very early stage of development of stereotypic behaviour and may become stereotypic over a certain period of time.

2.3.3. Phobic behaviour

This is a fear subject to generalization which is out of proportion and out of context. It is a long-lasting fear (with a long recovery) which interferes with the animal's normal functions and which does not require the presence of the original trigger. In

addition, it is not graded and usually increases in old age (Heath, 2004, personal communication). Triggers are very heterogeneous. The parrots considered in the study often developed phobia towards other animals (dogs, cats, birds of prey, crows), different objects, particular persons or earth tremors.

2.4. Statistical analysis

Multivariable logistic regression was used (NCSS 2001) to discern the effects of certain factors and to distinguish the influences of confounders (such as care and housing) from those of other important criteria (such as breeding method). The confounders for the most important criteria are illustrated in Tables 2–4 and 6. The data were also analysed using Chisquare statistics or two-tailed Fisher's Exact Test. The Fisher's Exact Test was used when the expected value (number of birds) in at least one row was smaller than 5. The care, housing and social contact of the subjects were not standardized. Not all confounding factors (e.g. age of the birds, number of previous owners, social contact with other parrots, size of the cage, wingclipping and approach to the bird) are discussed in order to avoid cluttering the text, but all of them were taken into account when conducting each of the reported analyses.

Table 3
Multivariable logistic regression analysis for the factor *phobic behavior*

	Regression coefficient (B or beta)	Odds ratio Exp(B)	Lower 95% confidence limit	Upper 95% confidence limit	p-Level	Wald-p
Wild-caught parrots	1.07	2.90	0.94	8.97	0.004	0.06
“Small cage” (max. 80 cm x 100 m x 120 cm)	0.63	1.87	0.60	5.75	0.017	0.27
Mouth-to-beak-feedings	0.51	1.66	0.50	5.46	0.010	0.4

One hundred adult African grey parrots were used in this model. The influence of the following confounders: *rearing history*, *cage size* and *height of perches* on the occurrence of *phobic behaviours* were analysed. $R^2 = 0.29$. % correctly classified = 65.00. Wald-p: calculated using multivariable logistic regression. p-Level: calculated using univariable logistic regression.

3. Results

3.1. Distribution of behavioural disorders

First, the incidence of the distinctive behavioural features of the 103 parrots is introduced, without considering the influence of the breeding method on the subjects. As far as their aggressiveness is concerned, 13 birds had already attacked people by flying at them. Altogether, 12 African greys were considered to be very aggressive. Only four of the parrots were real screechers and screamed almost continuously or for several hours every day. The vocal behaviour of eight other parrots was a real problem for the owners, though these birds could not be considered to be true screechers. But as the birds in both groups were problematic in the owners' eyes, they were all categorized in the "screecher" group.

Fifty-two parrots had already picked or still picked their feathers. Of these, 31 parrots still picked their feathers at the time of the visit to the owners; 9 birds occasionally (rarely or only in particular situations) picked their feathers; the status of 4 birds was unclear, as their owners explained the state of their plumage by the birds' bad health or had never noticed any feather picking, though the parrots' plumage clearly appeared abnormal. The seven remaining birds had stopped picking their feathers by the time of the visit.

Twenty-eight birds had developed stereotypic movements that were either observed during the visit or had previously been witnessed numerous times by the owners. Nervous repetitive habits (displacement activities) are usually triggered by a situation that the bird perceives as being very stressful and are quite normal reactions in those circumstances. Most parrots develop to a certain

extent such nervous habits when they face a difficult situation (Lantermann, 1999). However, 18 grey parrots in this study showed one or several nervous habits excessively often (usually many times during the visit). Twenty-six grey parrots had developed phobia concerning a specific object, person, animal or situation. Phobic behaviours seldom seemed to give any cause of concern to the owners.

Thirty-one parrots begged for food. Twenty-one of their owners reacted to that infantile behaviour by feeding the bird, thereby reinforcing it. Twenty-nine parrots considered their owners as their sexual partners and were sexually active with them, by mounting on their hands or shoes. Fourteen birds had chosen another parrot as a partner, 10 birds presumably led a normal sexual life with another parrot, though the owners had never clearly observed copulation, and 22 subjects did not show any sexual behavioural patterns, although they were kept in couples.

3.2. The influence of the breeding methods on the birds' behaviour

The hand-reared birds were significantly more aggressive towards humans (OR = 7.88) and subsequently attacked people by flying at them more often than the parrots that had not been hand-reared (Table 5).

It is interesting to note that the hand-reared parrots were significantly more selective towards humans. They allowed only one specific person to scratch or stroke them ($p = 0.008$, $\chi^2 = 9.72$). They also begged for food significantly more than the parent-bred and imported birds (Table 2).

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Table 4**Multivariable logistic regression analysis for the factor *feather-picking method: chewing***

	Regression coefficient (B or beta)	Odds ratio Exp(B)	Lower 95% confidence limit	Upper 95% confidence limit	p-Level	Wald-p
Hand-reared parrots	1.64	5.16	0.90	29.56	0.007	0.07
No toys/only one toy in the cage	1.39	4.02	0.75	21.50	0.048	0.1
Not able to fly	1.56	4.75	0.43	52.60	0.006	0.2

Thirty-nine adult African grey parrots were considered in this model. Only the grey parrots that picked their feathers and whose feather-picking method was known (chewing/plucking) were taken into account. The influence of the following confounders: *rearing history*, *number of toys in cage* and *ability to fly* on the occurrence of *feather chewing* were analysed. $R^2 = 0.74$. % correctly classified = 76.9. Wald-p: calculated using multivariable logistic regression. p-Level: calculated using univariable logistic regression.

The wild-caught parrots developed phobic behaviours significantly more often than the birds that had not been imported (Table 3).

In addition to phobia, the wild-caught birds had already picked their feathers significantly more often than the parrots that had not been imported (OR = 2.59). 42.2% of the hand-reared parrots had already picked their feathers (including the birds that had stopped feather picking), compared with 53.8% of the parent-bred birds and 65.4% of the wild-caught parrots. The percentage of parent-bred birds that picked their feathers was between that of hand-reared and imported parrots. As only a small number of parent-bred parrots were studied, no conclusions could be drawn concerning their tendency to have such problems. The methods the parrots use to pick their feathers differed: the hand-reared grey parrots chewed their feathers more than plucked them, whereas the not hand-reared birds usually plucked their feathers (Table 4).

As far as preening was concerned, we noted that all the parrots whose plumage was under- or overpreened had been hand-reared ($p = 0.005$, $\chi^2 = 7.38$). 33.3% of the handreared birds (taking into account only the parrots doing no feather picking) had a dishevelled or ruffled appearance.

At the time of the visit to the owners', the parent-reared and hand-reared birds were in significantly

better health condition than the imported ones ($p = 0.006$, $\chi^2 = 7.51$; Table 5). The table also shows that the parent-bred grey parrots were in the best state of health. As regarding the different diseases of the birds according to their breeding method, there is a disparity concerning the clinical evidence of respiratory problems found during the observation of the parrots. 57.7% of the imported parrots had already had respiratory problems, compared with 30.8% of the parent-bred birds and only 12.5% of the handreared parrots.

3.3. Hand-reared birds: age at which the chicks were removed from the nest

The parrots that had been kept less than 5 weeks with their parents developed significantly more stereotypies (37%) than those that had stayed for a longer period in the nest (8%) (Table 6).

Further, the parrots that had stayed no more than 2 weeks in the nest or whose eggs had been artificially incubated were significantly less sexually active than the birds that had been kept for more than 2 weeks with their parents ($p = 0.027$, $\chi^2 = 4.87$). Only 36.4% of the "0–2 weeks" category had shown any sexual activity, as against 69.2, 58.3 and 69.2% of the "4 weeks", "6 weeks" and "at least 8 weeks in the nest" groups. In addition, if we look at the percentages of the birds who might display normal sexual behaviour with other parrots

Table 5
State of health and flying attacks of the parrots according to their breeding methods

	Breeding Method		
	Hand-reared (%)	Parent-bred (%)	Wild-caught (%)
State of health			
Good health	82.8	92.3	40.0
Satisfactory ^a	12.5	7.7	48.8
III ^b	4.7	0.0	12.0
Flying attacks	17.2	7.7	3.8

^a The parrots belonging to the group “satisfactory” had obvious symptoms at the time of the visit to the owners’ (such as respiratory distress) although they were not being treated and had not been to the vet for their problems.

^b The birds in the category “III” had a diagnosed disease and were under medication at the time of the visit.

(i.e. those which are kept with conspecifics), we can see that fewer birds in the “0–2 weeks” group were able to display normal sexual behaviour with another parrot.

3.4. Hand-reared birds: the influence of the feeding method on the birds’ behaviour

The parrots that had been tube-fed became significantly more aggressive towards humans as adults than the birds that had been fed with spoons or syringes (OR = 5.09, $R^2 = 0.77$). 37.5% of the tube-fed parrots began attacking people by flying at them once adult. Only 13.6% of the birds that had been fed using pipettes or spoons and 10% of the parrots that had been fed using syringes showed that behaviour.

Moreover, at the time of the visit, the health of the parrots that had been tube-fed was significantly worse than that of birds that had been fed using other implements ($p = 0.027$, $\chi^2 = 5.82$).

3.5. Hand-reared birds: the influence of contact with human beings during rearing on the birds’ behaviour

Contact with humans during hand-rearing primarily affected the parrots’ abilities to have a normal sexual life with another parrot. 87.5% of the parrots that had been raised with a minimal contact with human beings (i.e. with breeders who had come into contact with the chicks only to feed them) displayed normal sexual behaviour with other

parrots and only 41.7% of the parrots that had been hand-raised at the owners’ (OR = 4.20, $R^2 = 0.74$) displayed such behaviour. Only the parrots that were kept with another psittacine bird were considered in this analysis. The trend is quite clear, though the result is not significant ($p = 0.060$, $\chi^2 = 4.21$), probably because of the small number of birds.

3.6. Hand-reared birds: the influence of the weaning period on the birds’ behaviour

The parrots that had been weaned at the breeders’ picked their feathers at the time of the visit significantly more than parrots that had been sold before weaning ($p = 0.024$, $\chi^2 = 5.07$). In spite of that, the parrots sold before weaning had plumage in a much worse state when they picked their feathers. Whereas the parrots that had been sold before weaning under- or overpreened their plumage, which led to a similar percentage of birds in both groups that had their plumage in good condition ($p = 0.011$, $\chi^2 = 9.01$).

4. Discussion

First, the influence of the breeding methods on the birds’ behaviour will be discussed. The observation of the birds’ aggressiveness confirms the statements made by many authors regarding the increased aggressiveness of hand-reared parrots (Low, 2001; Lantermann, 1998; Munkes and Munkes, 2002). Increased aggressiveness in parrots typically involves dominance, protective and territorial aggressions (Juppien, 1996). Handreared

birds have lost their natural respect for humans, and therefore rarely bite out of fear as wild-caught and parent-bred birds do (Low, 2001). As a result, they tend to bite to show their dominance or their control over the owner or to defend the owner against “intruders”, such as guests or the owner’s family. The parrot also bites when the owner does not respect its individual distance, which is an essential aspect of the bird’s social behaviour. In addition, imprinting on human beings and the lack of socialization at an early stage in the bird’s development enable parrots to create an especially strong bond with humans, and therefore to become more selective towards them. Subsequently, they choose human partners and consider themselves as being part of a human flock.

Again, the hand-reared parrots displayed infantile behaviour more often because human beings acted as foster parents on whom the hand-reared birds became imprinted. Kaleta (2003) also attributed begging to be a consequence of imprinting on humans, and suggested that this made it very difficult to correct. Hand-reared birds may carry on begging once adult because weaning following hand-rearing differs from the natural weaning process and because some important social interactions, which enable parrots to gain their independence, are lacking.


Preening is a behavioural pattern that is partly learned by observing other parrots doing so. Unfortunately, under- and overpreening cannot clearly be differentiated from one another, although their aetiologies are most probably divergent. Underpreening may be the consequence of little contact with other parrots during hand-rearing whereas overpreening could have the same cause or could be the beginning of feather chewing, which is often encountered in hand-raised parrots.

As parent-bred and imported birds have contact with other parrots at the beginning of their lives and tend to pluck their feathers rather than chew them, they usually either preen normally or pluck their feathers, which gives them a distinctive appearance.

The fact that wild-caught parrots develop phobic behaviours particularly often is probably a consequence of the traumatic nature of their capture and importation. Two methods are used to capture adult grey parrots: nets on the ground and lime-twigs. Both methods take advantage of the fact that grey parrots ground forage in forest clearings and can damage the birds severely (May, 2002). Cameroon is one of the biggest exporters of African grey parrots today. Its annual quota of exportation is 12,000 African grey parrots, but each year more than 15,000 are exported (Ngenyi, 2002). According to Luft (1994), the mortality rate during quarantine in the countries of import varies between 10 and 100%. Some of the wild-caught parrots in the study reacted to objects that were directly connected with their capture, such as wooden boxes, sticks, carpets or spindly objects (string or even spaghetti). Other fears did not seem to have been directly triggered by importation (such as fears of soft toys, dogs, balloons or specific persons), though the trauma endured during

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importation, adaptation and taming probably set off the inclination to develop phobias. In a similar way, the bad health of the imported parrots could be due to the antibiotic treatment prescribed during quarantine and to the stress of importation. However, we also observed that the African greys whose owners never changed the configuration of items in their cages developed phobia towards one specific object more than the birds whose owners regularly put new objects in their cages. Similarly, in a study conducted at the University of California, Fox and Millam (2004) suggested that the development of neophobia (fear response to novel objects) in orange-winged Amazon parrots was not related to parental care, but perhaps to the level of novelty that the chicks experienced during early life.

Feather picking and mutilation are most commonly seen in cockatoos, African grey parrots and macaws. According to Wedel (1999), feather picking has never been observed in the wild and very often begins at the time when birds reach sexual maturity. It can be caused by many different factors (Gabrisch and Zwart, 2001; Gylstorff and Grimm, 1998), some of which are yet to be discovered. It is therefore very difficult to ascertain the reason why the wild-caught birds considered in the study picked their feathers more often than the hand-reared parrots. Again, the capture, the handling and housing prior to importation, the importation itself, the adaptation to a totally new environment, the forced bond with human beings and their rather poor health are most probably responsible for feather picking in the case of many imported grey parrots. Many confounders, such as housing, occupation, social interactions or health of the birds, that were all considerably worse for wild-

caught parrots than for hand-reared ones, did not have a direct influence on feather picking. Even a potential influence of age (the wild-caught parrots were significantly older than the captivebred birds) could be ruled out.

The parent-reared birds were generally in very good health. However, it was very difficult to come to any conclusions about that group of parrots because of the small number of birds available for study. Nevertheless, the parent-reared parrots seemed to have well-balanced behaviour and seemed less likely to develop problematic behaviour. Like wild-caught parrots, when they picked their feathers, they usually plucked them and they seldom bit, but when they did, the owners interpreted it as a fear response. Nonetheless, they did not tend to develop phobias like wild-caught parrots.

Lastly, the influence of the hand-rearing methods on the birds' behaviour will be discussed. The fact that the parrots which had been removed very early from the nest (prior to the 5th week) developed stereotypic movements significantly more than the birds that had stayed longer in the nest before having been removed for hand-rearing, confirms what Philbin (1998) brought to light about other animal species, such as monkeys and rats which suffer from maternal deprivation. Furthermore, Philbin (1998) suggests that intrinsic factors, such as rearing history, breed or genotype and also individual disposition determine whether or not an animal will develop stereotypic behaviour. Analogous to Philbin, Kaleta (2003) indicates that stereotypic behaviour in caged parrots is often induced by handrearing, and is therefore very difficult to reduce.

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In addition, the fact that the chicks which had been removed from the nest before their eyes had opened had more difficulty leading a normal sexual life with other parrots and tended to be sexually inactive in general is probably the consequence of a very strong bond with human beings. Those results suggest that the parrots' development, during their first 2 weeks of life, is essential for the maturation of normal sexual behaviour and is very important for their later sexual activity. That implies that the chicks which had stayed at the most 2 weeks with their parents were particularly imprinted on humans, even if they had been kept with other chicks during the hand-rearing period.

The parrots that had been fed using tubes, which is most probably uncomfortable for the chicks, reacted to it by developing aggressiveness towards humans. This feeding implement is the most unnatural one for the birds, as it does not allow chicks to swallow the food. The findings suggest that tube-feeding generates strain and distress to the chicks and should be used for medical treatment only. There might be several reasons for the bad health of the chicks that had been fed using an invasive method. First of all, their bad health could be explained by the discomfort induced by the method which that group of handreared parrots undergoes and which presumably causes stress, and thus affects the chicks' immune systems. In addition, tubes are also very difficult to use hygienically, as they are very difficult to clean (Reinschmidt, 2000).

The main effects of the frequency and intensity of the contact with people during the hand-rearing period were related to the later bond with humans.

The parrots that had had minimal contact with people during hand-rearing were able to have a normal sexual life with other parrots more easily choosing birds rather than people as partners.

The fact that the parrots which had been weaned at the breeders' tended to pick their feathers more could be due to the unfavourable conditions (more animals around, possibly stressful handling and potential contact with pathogenic germs) at the breeders'. On the other hand, the worse stage of feather picking and the over- or underpreening of the birds that had been sold before weaning demonstrate that selling the chicks before their independence to owners who have no experience in hand-rearing may have negative consequences on their behaviour.

5. Conclusion

Our results confirm that the breeding method had an obvious influence on the behaviour and on the incidence of behavioural disorders of grey parrots. They suggest that future research on specific aspects of hand-rearing needs to be carried out, as a better understanding of the consequences of the different hand-rearing methods would be of great benefit to the parrots' welfare.

Hand-reared parrots tend to become more problematic for their owners than parent-bred and wild-caught birds. Most of the problems of hand-reared parrots can be explained by imprinting on human beings. Nevertheless, some methods used to hand-raise chicks have fewer consequences on the birds' adult behaviour, such as spoon-, syringe- or pipettefeeding, a long stay in the nest with



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the parents and less social contact with humans during hand-rearing, and therefore should be used more often. In addition, the chicks should always be kept with other parrots during hand-rearing, if possible with birds belonging to the same species. Once they have fledged, it is crucial to keep the young parrots with conspecifics in aviaries for a few weeks, so that they can learn species-specific behavioural patterns.

Parent-reared parrots are usually well-balanced birds which have learnt all the specific behavioural patterns of their species. In addition, this rearing-method allows the parents to rear their chicks naturally, which is certainly a considerable benefit for their welfare. On a long-term basis, parent-rearing also prevents the breeding pairs from losing their ability to rear their chicks naturally, which could potentially be a dramatic consequence of systematically hand-rearing chicks.

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