The Grey Matter: Prevention and reduction of abnormal behavior in companion grey parrots (*Psittacus erithacus*)

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Title: The Grey Matter: Prevention and reduction of abnormal behavior in companion grey parrots (*Psittacus erithacus*)

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Abstract

Grey parrots (*Psittacus erithacus*) are popular companion birds, particularly noted for their ability to mimic human speech, their intelligence and longevity. They are also prone to developing abnormal behaviors such as feather damaging behavior (FDB). This review explores the current available knowledge on grey parrots kept as companion birds with respect to behavioral problems and their management. The potential causes for the development of abnormal behaviors in this species are explored. Recommendations are made for future research and advice is provided on the synthesis and application of available...
research to owners, breeders and clinicians of grey parrots so that their well-being is
maximized in captivity.

**Keywords:** Grey Parrot, Abnormal Behavior, Feather Damaging Behavior, Environmental enrichment.

**Introduction**

Captivity may deny parrots the opportunity to fully engage in behaviors observed in the wild. This is particularly the case for individuals kept as companion animals in households where constraints are placed on social interaction, flight, foraging and maintenance behaviors such as bathing and preening (Kennedy and Draper, 1990, van Hoek and Ten Cate, 1998, Engebretson, 2006; Gaskins and Hungerford, 2014). The impinging of normal behavior patterns may lead to the development of abnormal behaviors. Abnormal behaviors are believed to be common in psittacines, although estimates of their prevalence vary, with 10% (Grindlinger, 1991), 15.8% (McDonald Kinkaid et al., 2013) and 17.5% (Costa et al., 2016) of parrots being stated as presenting with feather-damaging behaviors (FDB). The presentation of FDB varies though by species and genus.

Abnormal behaviors that may be observed in grey parrots include feather damaging behaviors, reproductive behaviors directed towards owners (regurgitation/ mating attempts), aggression, and excessive vocalizations (Schmid, 2004). Stereotypic behavior may also be observed. Stereotypies are defined as unvarying, repetitive, and functionless behaviors (Garner et al., 2003) and are commonly noted in captive animals. Stereotypies such as abnormal repetitive behavior (ARB) (e.g. weaving, pacing) are observed in other parrot species (Meehan and Mench, 2006) but rarely documented in grey parrots.
The grey parrot has been selected for review due to its popularity as a companion bird in Europe, the United States and the Middle-East (Birdlife International, 2016) and because it is frequently presented at veterinary clinics due to being prone to developing abnormal behaviors (Seibert, 2006).

Collating and assessing available species-specific research may aid in developing a proactive response to preventing abnormal behavior in grey parrots kept as companion birds. During this review we will introduce the abnormal behaviors seen in grey parrots and then consider the wild ecology of grey parrots. Understanding the ecology of a species gives clinicians and caretakers the insight to provide optimal care (within the constraints of captivity) for their charges (Kirkwood and Hubrecht, 2001), and helps us understand why parrots may be particularly susceptible to developing abnormal behaviors in captivity. We will then review other factors that impact upon susceptibility to abnormal behaviors in grey parrots and consider aspects of husbandry and management may affect the development and maintenance of abnormal behaviors in grey parrots. We highlight how this research can be applied by clinicians, breeders and owners and other caregivers to reduce or prevent abnormal behaviors in companion grey parrots.

Abnormal behaviors seen in grey parrots

A range of behaviors may be observed in captive grey parrots that can be classified as being abnormal or viewed as behavioral problems. In this context we define abnormal behaviors as behaviors which differ in frequency and form from those observed in wild populations (Wiepkema, 1985). Causation may vary between and within abnormal behaviors, however Yenkosky et al. (2010) argue that parrots presented with behavioral ‘problems’ are showing the manifestations of post-traumatic stress disorder (PTSD). The diagnostic criteria for PTSD in humans includes the exposure to actual or threatened death or serious injury, either by directly experiencing or witnessing the traumatic event (American Psychiatric Association,
Yenkosky et al. (2010) maintain that removal for hand-rearing, extraction from the wild or living in a socially-and emotionally-deprived environment are all traumatic experiences for parrots to contend with. ‘From the perspective of traumatology, there are no avian “behavior problems,” only birds suffering psychological distress that lack adequate developmental and/or environmental resources to self-heal and/or coping skills that would permit at least some degree of adjustment to the alien, abnormal, dysfunctional environment’ (Yenkovsky et al., 2010, p. 17 – 27). Environmental conditions and the provision of enrichment devices may be key contributors in improving behavioural health or reducing abnormal behaviours in parrots kept as companion birds and treatment therapies can be considered in four sequential steps: establishing a secure environment; enabling greater control and empowerment of the individual; enabling control of social relationships and desensitization therapy assistance (Yenosky et al., 2010).

Feather damaging behavior (FDB) in grey parrots

Feather damaging behavior in psittacines is frequently described as an abnormal repetitive behavior/abnormal behavior (van Zeeland et al., 2009; Jayson et al., 2014; Cussen and Mench, 2015) instead of a stereotypic behavior because repeated fixed-action motor patterns are absent. Some authors, however, classify FDB as stereotypic (Owen and Lane, 2006), and some definitions of stereotypic behavior support the use of this term (Mason, 2006).

Gaskins and Hungerford (2014) note that grey parrots are likely to engage in FDB, with grey parrots being eight times more likely to show FDB than other parrot species (except cockatoos, which were thirteen times more likely to evidence FDB). Of 42 birds showing FDB in this study, nearly a quarter of birds were grey parrots, the highest percentage of single-species in the study. Though age of onset of FDB ranges across species, Gaskins and Hungerford (2014) found that grey parrots may initiate FDB when still under 1 year old, with 7/8 birds in their study initiating the problem at this age. This result prompted the
authors to recommend exploration of early behavioral history, and its relevance for behavioral therapy.

Jayson et al. (2014) explored the predisposing factors of FDB in grey parrots kept in the United Kingdom. In a single bird per questionnaire study, 39.4% (N=137) of questionnaires identified individual birds demonstrating FDB. In this study the significant predictive factors for FDB in grey parrots were length of ownership and sleep lasting greater than 12 hours each day. Age was not associated with the likelihood of FDB, but the authors hypothesize that birds maintained in a static environment may adapt poorly if changes subsequently occur. If the environment is sub-optimal, prolonged exposure may lead to the development of FDB. Seibert (2006) states that optimal environments permit birds to engage in species-specific behaviors while Cussen and Mench (2015) use this term to indicate an enriched environment. Lack of sleep has been proposed as a factor in FDB onset (Kennedy and Draper, 1990), but Jayson et al. (2014) found that sleep for greater than 12 hours each day increased the likelihood of FDB developing by seven times.

The isolation of being in a darkened environment for an extended period may lead to boredom, where an animal adapts to its environment in an abnormal way indicative of understimulation, so that the animal may maintain a sense of selfhood (Wemelsfelder, 1984). Covering the cage with a sheet, or placing the bird in a darkened room, removes visual, and possibly, vocal contact with the owner or other birds, which may result in a sense of loneliness. FDB may start as a way to cope with these negative affective states associated with isolation (van Zeeland et al, 2009b).

Rosenthal et al. (2004) removed feathers from parrots (including grey parrots) showing FDB and from control birds with no FDB to determine the extent to which inflammatory changes were present in the skin, feather follicles or pulp of FDB birds. Only one FDB bird showed inflammatory skin cells. One feather pulp sample from a FDB bird grew bacteria, as did one feather pulp sample from a control bird. These results lead to the conclusion that that
dermatitis and folliculitis are unlikely primary causes for FDB, and should not be assumed unless confirmed through further diagnostic techniques (Rosenthal et al., 2004).

Garner et al. (2008) found that biopsies from grey parrots frequently showed traumatic skin lesions, possibly as a result of FDB. Samples taken from grey parrots showing skin or feather disorders indicated that of 77 skin biopsies, 74% were labeled as traumatic skin disease. In this same study 26% (N=77) of grey parrots showed inflammatory skin disease. These results suggest that biopsies are necessary to identify lesions that may be associated with feather picking in grey parrots (Garner et al., 2008).

FDB is considered a multifactorial disorder, and that any underlying inflammation, pruritus, irritation, discomfort or pain may be an inciting factor in the development of FDB (van Zeeland and Schoemaker, 2014a). Comprehensive reviews on FDB in parrots that include medical causes of FDB and diagnostic techniques, can be found in van Zeeland and Schoemaker (2014a, 2014b).

Aggression

Welle and Luescher (2006) define aggression as the biting or lunging at another parrot or human. It is important to note that under this definition aggressive interactions have an element of biting, but not all biting has an element of aggression. Kennedy and Draper (1990) state that parrots have three distinct periods of development (juvenile, adolescence and adult) and biting may occur in any of them, aggression may also be presented in adolescence and adulthood. Juvenile parrots exhibit a ‘teething’ stage and may have little control over bite pressure. As young parrots reach adolescence some authors believe that they may try to assert their “dominance” over human owners through aggressive reactions or threats or that they try to establish territory around their cage (Welle and Luescher, 2006). However Friedman et al. (2006) warn against using “dominance” terminology due to its ambiguity in psittacine studies, as there is limited research on social hierarchies in parrots.
and state that “This lack of scientific consensus of what dominance is should call into question its usefulness for understanding and managing companion parrot behavior…” (Friedman et al., 2006). Biting may also occur once adulthood, and therefore sexual maturity, is attained as aggression may be directed at perceived competitors (Kennedy and Draper, 1990).

Schmid (2004) noted that aggression was observed in grey parrots which had formed a bond with a human and, conversely, that parrots which had no bonded partner were also particularly aggressive to people. Aggression was also particularly noted in birds between 4-7 years old. Grey parrots may also develop a fear of people, regardless of previous familiarity. Welle and Luescher (2006) suggested that poor socialization when young, inappropriate wing clipping resulting in injury and pain, or emotional instability due to hand-rearing all potentially influence the onset of fear biting. Grey parrots may also show territorial aggression (Gaskins and Bergman, 2010), where their cage or favored area is defended (Welle and Luescher, 2006).

Wild ecology of grey parrots

Despite its popularity as a companion animal, information on the ecology of wild grey parrots is lacking in comparison to other parrot species. Researchers of this species advocate further studies on its ecology, behavior and conservation (Amuno et al., 2007; Tamungang et al., 2013; Tamungang et al., 2016).

The available literature on the wild ecology of grey parrots suggests that providing appropriate care in captivity will be challenging. Wild grey parrots exhibit a high degree of sociability, with roosting sites including up to 10,000 individuals (Juniper and Parr, 1998). Strong monogamous pair bonds are reported (de Grahl, 1987; Aydinonat et al., 2014) and individuals display contact-calling between trees when foraging (Chapman et al., 1993). Sustained flight is required to travel between seasonal feeding and roosting locations.
Tamungang et al. (2016) observe that populations fluctuate depending on season and habitat; grey parrots will move away from drier range areas during the dry season (Birdlife, 2016). Nesting sites are located in tree cavities (Juste, 1996) which affects light and humidity for eggs and nestlings. These environmental factors may be potentially important considerations in the artificial rearing of young birds (Wilson and Luescher, 2006). Rainfall and ambient humidity varies seasonally through the species range (Tamungang et al., 2016). Kennedy and Draper (1990) and Schmid (2004) suggest that humidity and bathing may be a predisposing factor in FDB in captive birds if bathing opportunities are not provided or are infrequent. Peron et al. (2011) state that the maintenance of stable monogamous pairs over multiple breeding seasons, biparental care, affiliative behaviors and mobbing of potential predators all support that this species has the cognitive abilities to function in complex social situations and to demonstrate cooperative behaviors.

Susceptibility to abnormal behaviors: species traits, cognition, and personality

Comparative studies on general characteristics between species within the order psittaciformes are limited, however the literature suggests that there are trends in personality seen amongst genera. Members of *Amazona* are considered “extrovert” and voluble (Silva, 1991) with males becoming aggressive during breeding times (van Sant, 2006). Though the general personality traits of grey parrots have not been confirmed through empirical research, Rosskopf and Woerpel (1991) suggest that grey parrots are susceptible to FDB due to their ‘high strung’ and intelligent nature, and Wilson (2000) describes them as a “highly sensitive species”. Silva (1991) advises that this species is shy and therefore best avoided by aggressive individuals or those with large families, while Wilson & Luescher (2006) suggest that grey parrots are more likely to present phobic behaviours than many other species.
Variation in personality not only occurs between parrot species and may also be important in
the occurrence of FDB within individual grey parrots. van Zeeland et al. (2013a) explored the
effect of coping styles on the presence (n=11) or absence (n=11) of FDB in grey parrots. In
general, coping styles may be categorized into ‘proactive’/‘bold’ or ‘reactive’/‘shy’ styles, in
which bold individuals exhibit higher levels of aggression, superficial but fast exploration of
the environment and tend to have fixed behaviors which are rarely swayed by external
stimuli (Koolhaas et al., 1999; Korte et al., 2005). Shy individuals tend to ‘freeze’, are less
aggressive, demonstrate more thorough but cautious exploratory behavior and adapt more
readily to external stimuli or the situation in which it is presented (Koolhaas et al., 1999;
Korte et al., 2005). In humans and other species, individuals displaying bold coping
mechanisms have an increased propensity for stress-related behavioral or health issues
(Korte et al., 2005). van Zealand et al. (2013a) exposed grey parrots to a range of tests to
measure coping styles; birds with FDB demonstrated behaviors characterized to a bold
coping style. Significant differences were observed between birds with and without FDB in a
novel object test. Parrots with FDB had an active response in either approaching or avoiding
the object, whereas birds without FDB either froze or had a passive response to the object.
In an Open Field Test there were also significant differences in response. Birds with FDB
were more active and had shorter latency times prior to exploration, with greater area
covered and longer time spent in exploration, compared to birds without FDB. Knowledge of
personality characteristics such as ‘boldness’ could be used as a tool in management of
abnormal behaviors by identifying which individuals are more at risk of developing FDB, and
identifying the role of personality traits in the etiology of FDBs in grey parrots.

There has been a wealth of research into the cognitive abilities of grey parrots. Grey parrots
not only demonstrate some ability to comprehend human-given cues such as gaze direction
and pointing (Giret et al., 2009) but also possess the ability to learn to use English speech in
a meaningful way for interspecies communication (e.g. Pepperberg, 2002a, 2002b).
Grey parrots can demonstrate both cooperative (Péron, et al., 2011) and insightful problem solving (Pepperberg, 2004). This species has also been demonstrated to display inferential reasoning (Mikolasch et al., 2011; Schloegl et al., 2012; Pepperberg, 2013), advanced numerical competence (Pepperberg, 1994; Pepperberg and Gordon, 2005; Pepperberg, 2006a, 2006b; Al Aîn et al., 2009; Pepperberg 2012) and comprehension of object permanence (Pepperberg and Kozak, 1986; Pepperberg et al., 1997).

While the cognitive abilities of grey parrots differs between individuals (e.g., Mikolasch, 2011; Pepperberg, 2004; Pepperberg, 2007), the high-end cognition demonstrated by grey parrots should be considered in the husbandry of this species and as a potential contributing factor for behavioral concerns.

Husbandry and management: effects on abnormal behaviors

Influence of rearing-method

It is important to note that the majority of parrot species can still be classed as “non-domesticated”, having similar thresholds and behaviors to wild counterparts (Kalmar et al., 2007). Due to the lifespan of some parrots, veterinary clinicians may still be treating wild-caught birds (the USA banned the import of CITES listed wild birds in 1992, the UK in 2007) or birds that are only one or two generations removed from their wild counterparts. Such birds will display wild-type behaviors since no selection has been applied or had time to act to change behavior. Parrots are bred and hand-reared in large quantities each year to satisfy the demand for pet birds (Schmid, 2004; Schmid et al., 2005; Fox, 2006). It is considered that hand-raised grey parrots make for better companion birds (Rosskopf and Woerpel, 1991), being tamer, more confident and easier to handle. More recent research suggests that parent-reared young are less likely to develop behavioral problems (Schmid, 2004). Studies on orange-winged amazon parrots (Amazonica amazonica) show that if young are handled in the natal nest as they develop, they can show comparable levels of tameness to
hand-reared individuals (Aengus and Millam, 1999). Slight variation was seen in tameness dependent on the age that handling started, suggesting that there may be a sensitive period, where handling of chicks has a greater effect on future behavior. Wild caught birds are unlikely to seek human attention and nervousness persists in captivity (Silva, 1991).

Schmid et al. (2006) investigated effects of rearing methods on later behavior in grey parrots, studying wild-caught, parent-raised and hand-reared birds. Aggression and person-preference were highest for hand-reared birds while wild-caught individuals developed more phobic behaviors as pets, demonstrated greater feather-plucking and had poorer overall health. It also appears that greater time spent in the natal nest with the parents benefits the chicks as these birds are less likely to develop stereotypies than chicks which are removed at <5 weeks. Feeding chicks with tubes instead of spoons or syringes also resulted in increased aggression and overall poorer health as adults. Schmid et al. (2006) summarize that once adulthood is reached hand-reared grey parrots demonstrate more problem behaviors than those naturally reared.

Aydinonat et al. (2014) suggest that though parent-reared birds are less likely to mal-imprint on humans, they are equally affected by the effects of solitary housing. Social development continues once chicks fledge the nest and interact with other birds and isolation from conspecifics is likely to result in negative changes to behavior and physiology. Regardless of rearing method the importance of appropriate imprinting and early social interactions of grey parrots must not be underestimated (Schmid, 2004).

Wilson and Luescher (2006) highlight the importance of light levels for neonatal parrots. Wild grey parrots nest in tree cavities (de Grahl, 1987) and nesting cavities of parrots are generally small and deep (Silva, 1991) so limited light enters the nesting cavity. Breeders of grey parrots state that nest boxes are most accepted if placed in darkened sections of the cage/aviary (Silva, 1991; Jordan and Pattison, 1999). If reared under high levels of light, phobias are more likely to develop, particularly for species which are considered highly strung, such as grey parrots (Wilson and Luescher, 2006). Phobias may be presented as
hyper-reactivity to sounds, to direct eye contact or to human proximity within the parrot’s comfort-zone around the cage, eliciting a strong escape flight response from the perceived threat (Wilson and Luescher, 2006).

Housing and Environment

Brinker and Friedman (1999) recommend that cage placement for grey parrots should be dependent on the personality of the individual. Cages should be placed against a wall to ensure that the bird is able to see people approaching the cage, and ideally there should be high visibility of family activities so the bird can participate or withdraw from activities as it feels fit (Brinker and Friedman, 1999). Placement of cages in front of windows may cause startle responses and damage (Kalmar et al., 2007). Birds need to be provided with the opportunity to engage with enrichment items as limited environmental stimulation is proposed as a cause for aggression (Schmid, 2004) and suggested in the etiology of FDB (Owen and Lane, 2006; Lumeij, and Hommers, 2008).

Bathing is one activity that parrots may initially dislike (Brinker and Friedman, 1999), but is important for overall feather health. Schmid (2004) notes that captive grey parrots kept in areas of high humidity (>60%) exhibited less FDB than those housed in areas of lower humidity. Offering bathing opportunities such as shallow water bowls or misting with a spray-bottle may raise ambient humidity and encourage preening behaviors (Kennedy and Draper, 1990). Spraying may also help with plumage regrowth following illness. Briscoe et al. (2008) report that after spraying a body region previously infected with methicillin-resistant Staphylococcus aureus (MRSA) in a grey parrot exhibiting FDB, the bird showed less interest in chewing re-growing feathers once sprayed.

Social contact can also affect the development and maintenance of abnormal behaviors. van Zeeland et al. (2013b) noted that after placing grey parrots in individual cages with visual barriers between cages, one parrot developed mild FDB. This behavior ceased once a visual
barrier was removed to enable contact with a neighboring bird (van Zeeland et al., 2013b), suggesting that some FDB may be due to changes in environment or social contact. Social isolation can also negatively affect grey parrots at a cellular level since chronic stress is associated with cellular senescence (Aydinonat et al., 2014). Comparison of telomere length, the caps of eukaryotic chromosomes which control the stability of the chromosome and dictate cellular senescence (Aydinonat et al., 2014), can be used to assess welfare in management systems (Bateson, 2016). Aydinonat et al. (2014) explored the difference in telomere length between pair-housed (n=26) and solitary-housed (n=19) grey parrots. Results indicate that solitary-housed birds have significantly shorter telomeres than pair-housed birds. Telomeres shorten with age, however the reduced length was observed in birds of the same age from the two housing conditions. Shortened telomere lengths are associated with age-related diseases in humans, negatively impact longevity in other species and are indicative of chronic stress (Aydinonat et al., 2014). The findings from this study suggest that solitary-housed birds aged nine years old had comparable relative telomere length to pair-housed birds aged 32 years old.

Gaskins and Hungerford (2014) state that, of the non-medical causes for FDB, birds taken in as rescue animals and birds which were uncaged for greater than 8 hours a day had higher odds of showing FDB. The authors suggest that rehoming may cause separation-type anxiety as seen in dogs, however it is not known whether the birds were showing FDB prior to rehoming. It’s also unclear whether uncaged bird were uncaged as part of the management strategy to reduce FDB.

One factor which appeared to decrease the risk of FDB by nearly 90% was having a minimum of 4 hours per day human-bird contact, with these authors suggesting that potential owners who were unable to commit to this minimum contact time reconsider owning grey parrots and opt for other species as a companion bird. Grey parrots were grouped with other species and genera for this analysis, so it is unclear whether these factors are indicative of this species.
Feeding

Wild parrots may forage for 4-8 hours each day (Magrath and Lill, 1985; Snyder et al., 1987), with flight to, and between, feeding sites and the manipulation of food to extract edible components contributing to the feeding time-budget. Food provisioned in bowls reduces total feed time to generally < 60 minutes (van Zeeland, 2013b). Even with food freely available grey parrots will still work to earn food (van Zeeland et al., 2009a), known as contrafreeloading (Inglis et al., 1997), suggesting that foraging satisfies a behavioral need.

The activity of foraging for food material (the appetitive stage) as well as its consumption (consummatory stage) has been shown to release opioids in other species, which are associated with pleasurable feelings (Berridge, 1996). Changes in presentation of food has been shown to improve the overall feather quality score in grey parrots with FDB. Lumeji and Hommers (2008) replaced feeding bowls with feeding pipes where pelleted food had to be manipulated from a small hole in a feeding tube. This strategy significantly increased foraging time and feather quality improved significantly over the course of one month. The authors propose that FDB in grey parrots may be mediated with appropriate devices which prolong foraging and feeding behaviors.

van Zeeland et al. (2013b) explored a range of foraging enrichment devices (puzzle-feeders, increased food size particles, multiple feeding-stations and feed mixed with inedible items) to determine which type increased foraging time in grey parrots (n=12). Prior to enrichment provision the caged birds spent on average 47± 18 minutes each day feeding from a food bowl. The most successful of the devices increased this time 2.5 fold up to 123 minutes. Foraging enrichment which enables parrots to tear and shred material (cardboard in this case) are one of the preferred types of devices, as this is a natural foraging behavior observed in wild grey parrots (May, 2001). Puzzle feeders and feeders with apertures with holes only slightly larger than the pellets also increased time in accessing the food items (van Zeeland et al., 2013b) Mixing food with non-edible items (marbles) increased search
time, and also provided additional play items, with the parrots manipulating the marbles with beak and feet. Time spent consuming food was also increased by the provision of a nutritionally balanced, berry-sized mix of compressed peanuts, seed, corn and pellets. This option resulted in increased foraging times of >100 minutes each day.

Wing Clipping

Jayson et al. (2014) did not identify a relationship between wing-clipping and FDB in grey parrots, and Gaskins and Hungerford (2014) state that the likelihood of FDB being seen in grey parrots with clipped wings are similar to flighted birds. However Schimd et al. (2006) found that wing-clipped grey parrots were five times more likely to show FDB than flighted birds. Gaskins and Hungerford (2014) suggest that the effect of wing-clipping on FDB may depend on several other factors including housing and rearing method. The variation in the results support this notion, as all three studies focus on parrots kept in a diversity of home environments and reared by different methods.

Owner Contact

Educating owners on their pet’s needs, so that they can meet the bird’s requirements may address some of the behavioral issues that captive birds encounter. Grey parrots may consider their owner a ‘conspecific pair-mate’ and form close bonds (Colbert-White et al., 2011). Hand-reared grey parrots have a tendency towards selective preference over human care-givers, and may attack other people out of perceived ‘jealousy’ (Schmid, 2004). Owner-parrot interactions also need considering in the role of undesired reproductive and feather damaging behaviors. Van Sant (2006) suggests that the physical contact between owner and parrot, petting the tail and back for example, increases the likelihood of pair bonding, and with it associated reproductive problems. In parrots, allopreening between breeding pairs or preferred associates is often directed to areas which the recipient cannot reach, such as the head, and serves to strengthen the bond between individuals (Seibert and Sung,
Therefore pet owners may unconsciously be encouraging sexual responses, which in turn may spur undesired behaviors such as rubbing of the cloaca or vent on the owner (masturbation) and regurgitation of food.

Owners may also influence aggressive responses in their parrots. Schimd (2004) found that owners who had an inappropriate reaction to unwanted behaviors (e.g., shouting at the bird, throwing objects at the bird) or approached the parrots in an inappropriate manner, such as ignoring signs of discomfort, resulted in birds exhibiting higher levels of aggression.

Yenkosky et al. (2010) suggest that drawing the attention of owners to the similarity between human Post-Traumatic Stress Disorder and observed behavioral problems in companion parrots should be a priority for those who work in the avian healthcare industry, so that owner are aware of potential causes of ‘behavioral problems’. By providing owners with appropriate information and guidance the well-being of captive parrots can only be improved.

**Application of research to prevent and reduce abnormal behaviors in grey parrots**

From this review it can be said that there are no definitive solutions to preventing abnormal behaviors, however there are results from studies which can be applied or considered which may mediate the risks of them developing. The information can be used to provide guidance to breeders, owners and clinicians on how best to reduce or prevent behavioral problems in grey parrots.

**Breeders**

The rearing method has perhaps the greatest effect on the future physical and psychological development of the grey parrot, since it is at this stage that the parrots appear to be most susceptible to developing abnormal behaviors. To this end it is recommended that chicks are left as long as possible in the natal nest and are not removed for hand-rearing until over 5
weeks old (Schmid et al., 2006). Once removed, it is suggested that the rearing environment has reduced light levels (Wilson and Luescher, 2006). Chicks should not be sold prior to weaning as they are particularly sensitive to change, and hand-rearing and weaning of chicks can be difficult to achieve safely for the novice owner, due to improper heating or hygiene of feeding equipment (Low, 1991, Anderson, 2014). Breeders should also ensure that chicks have the opportunity to interact safely with other birds prior to sale (Schmid, 2004; Schmid et al., 2006), such as rearing chicks in groups (ideally of the same species) and housing compatible species in weaning cages together (Silva, 1991). Given the needs of grey parrots, and their propensity to develop behavioral problems in particular, breeders should also ensure that potential purchasers are fully versed in the care requirements of parrots.

Owners

It is advised that potential owners who are unable to provide a minimum of 4 hours each day with their bird should not acquire a grey parrot (Gaskins and Hungerford, 2014). That the demands of this species as a companion bird are high is illustrated by the fact that 22% of owners would not have selected a grey parrot as a pet bird if they were aware of the needs of the animal prior to purchase (Schmid, 2004). Ideally parrots should be pair-housed for companionship (Aydinonat et al., 2014) however caution must be used when introducing new individuals to households with established birds, as a strong pair-bond may exist between the original parrot and owner (Welle and Luescher, 2006) resulting in antagonistic reactions towards the newcomer. Environmental enrichment such as toys and foraging devices are encouraged and a regular change of enrichment type or device, approximately weekly, is advised to avoid habituation (van Zeelnd et al., 2013b). Bathing/showering opportunities should be provided frequently (Brinker and Friedman, 1999; Schmid, 2004), and cage placement should be considered for the comfort of the parrot (Brinker and Friedman, 1999; Kalmar et al., 2007).
Clinicians

It is suggested that clinicians review petting and handling strategies with owners (van Sant, 2006) so that parrot sexual behaviors are not inadvertently encouraged. Clinicians should also develop knowledge of enrichment types and how they can be utilized in the prevention and reduction of stereotypic or abnormal behaviors, in order to improve the general welfare of their patients. Table 1 provides literature for consideration that explores positive effects of enrichment on behavior. It is also recommended that skin biopsies are taken from grey parrots showing FDB to identify whether lesions are inflammatory or traumatic in origin, so that the cause may be determined. If the lesions are inflammatory, further investigatory work can be undertaken as to the potential cause and treatment (Garner et al., 2008). However it is important to note that this is not the sole route of diagnosis, and Nett and Tully (2003) recommend specific dermatologic examination to determine presence of mites and to assess for any skin abnormalities such as exudates and crusting. These authors also recommend additional testing in some cases to explore viral, fungal and bacterial impacts. The first step to addressing FDB is a full and competent veterinary evaluation.

Recommendations for future research

Grey parrots continue to be popular pets. To develop our understanding of their needs in captivity we recommend that studies which span genera and species develop in depth profiles at the level of species. We rarely group all rodents together in studies as they do not exhibit homogenous behaviors across all species. Psittaciformes should also be considered with the same respect for their diversity, ecology and behavior. Some studies reviewed in this article further illustrate the difficulty in extracting species-specific data by mixing genera and species in results.
As grey parrots show a high propensity for developing FDB, particularly prior to maturity, greater exploration of the effects of early behavioral development are recommended. Sensitive periods are not well defined in psittacines, unlike domestic cats and dogs, and exploration of critical periods may aid in developing a more appropriate approach to the rearing of grey parrots. Though rearing method has been explored in a few studies, looking further at the environmental conditions of the rearing enclosure (e.g., light level, humidity, diet, temperature, presence or absence of con-specifics) may help our understanding of FDB etiology.

The effect of owner personality and beliefs on domestic canine and feline behavior is frequently explored in the scientific press. Given the longevity of parrots and their individual idiosyncrasies it would be useful to determine how owner personality and behavior affects their well-being over time. Exploring the association between the owner-parrot bond and aggression may aid in managing this behavior problem. Video-recording of parrot activities when they are left alone and subsequent analysis will also help our understanding of daily behavioral patterns, captive time budgets and indicate the presence of stereotypic behaviors which may not be performed in the owner’s presence.

Wild ecology and behavior requires further exploration, so that findings can be applied to captive animals. Length of time spent with parents prior to independence, nest cavity characteristics (such as humidity and light penetration), social interactions and hierarchies may all yield applicable information.

We recommend continued exploration of the efficacy of different enrichment devices and sharing laboratory-derived findings with parrot owners. Manufacture and commercialization of appropriate enrichment devices may help improve the welfare of the captive parrot population. Emphasis should be placed on foraging apparatus which, ideally, have an element of shredding and increase foraging time to >60 minutes daily. Technological advances may also yield further enrichment opportunities. For example Peron et al. (2012) showed that grey parrots will use touch-screen computer devices which play either calming
or rhythmic music, depending on which icon they select on the screen. Grey parrots demonstrated individual preferences and interacted with the devices when alone, suggesting that such devices can be used as an enrichment strategy.

In conclusion grey parrots can be considered as a complex, intelligent and social species which appears to be susceptible to developing abnormal behaviors when kept as a companion animal. Abnormal behaviors, and in particular feather-damaging behavior which is commonly noted in grey parrots, can be multifactorial in their etiology and clinicians should consider the influence of environment, management, life history, personality and ecology, as well as the potential medical elements of these behaviors.

Ethical Considerations

Approval for the study was not needed under the ASPA 1986 or the EU Directive 010/63/EU. The study abided by the guidelines of the institutional Research Ethics Committee.

Conflict of interest statement

The authors have no conflicts of interest to declare.

Authorship

The idea for the paper was conceived by Phillip John Greenwell. The article was written by Phillip John Greenwell and Victoria Tamara Montrose.

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Table 1: Enrichment strategies used in captive parrot husbandry

<table>
<thead>
<tr>
<th>Enrichment option (from Bloomsmithe et al., 1991)</th>
<th>Enrichment type</th>
<th>Behavior/ Problem targeted</th>
<th>Species studied</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutritional; occupational</td>
<td>Foraging enrichment: pipe-feeder</td>
<td>Reduce / prevent pterotillomania</td>
<td>Grey parrots</td>
<td>Lumeij &amp; Hommers, 2008</td>
</tr>
<tr>
<td>Nutritional; occupational</td>
<td>Foraging devices (varied)</td>
<td>Increase foraging time</td>
<td>Grey parrots</td>
<td>Van Zeeland et al., 2013b</td>
</tr>
<tr>
<td>Sensory; occupational</td>
<td>Music and touchscreen devices</td>
<td>General behavioral disorders.</td>
<td>Grey parrots</td>
<td>Péron et al., 2012</td>
</tr>
<tr>
<td>Social</td>
<td>Pair housing</td>
<td>Chronic stress indicators (telomere length) suggest that pair-housed birds face less stress.</td>
<td>Grey parrots</td>
<td>Aydınonat et al., 2014</td>
</tr>
<tr>
<td>Social</td>
<td>Pair housing</td>
<td>Prevention of stereotypy development</td>
<td>Orange-winged Amazon</td>
<td>Meehan et al., 2003b.</td>
</tr>
<tr>
<td>Nutritional; occupational</td>
<td>Foraging enrichment (varied)</td>
<td>Reduce locomotor and oral stereotypies</td>
<td>Orange-winged Amazon</td>
<td>Meehan et al., 2004</td>
</tr>
<tr>
<td>Nutritional; occupational; physical</td>
<td>Foraging opportunities and physical complexity of environment</td>
<td>Prevent and reduce psychogenic feather picking</td>
<td>Orange Winged Amazon</td>
<td>Meehan et al., 2003a</td>
</tr>
<tr>
<td>Occupational; social; nutritional; Physical; mixed</td>
<td>Psittacine Enrichment: review of available literature</td>
<td>Multiple</td>
<td>Multiple</td>
<td>Rodríguez-López, 2016</td>
</tr>
<tr>
<td>Nutritional; occupational</td>
<td>Psittacine diets and behavioral enrichment (varied)</td>
<td>General review of enrichment strategies in food provision</td>
<td>Generalised to multiple species</td>
<td>Bauck, 1998</td>
</tr>
</tbody>
</table>
• Grey parrots are prone to developing abnormal behaviors such as feather damaging behavior (FDB).

• Increasing diversity in time budgets and food acquisition appears to help mediate FDB.

• The role of breeders, owners, and clinicians are explored with regards to developing preventative strategies for FDB in grey parrots.