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Animal Welfare 2004, 13: S215-219
ISSN 0962-7286

Feather pecking in poultry: the application of science in a search for practical solutions

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Abstract

Traditional battery cages for laying hens will soon be banned in the EU but the increased risk of feather pecking (FP) hampers the adoption of alternative housing systems. FP can cause injury and lead to cannibalism and the painful death of target birds. Current management practices (beak trimming, low light) have associated problems. In a joint European project we sought alternative solutions. In our study of associated traits, birds from a line showing low (LFP) rather than high feather pecking (HFP) exhibited greater sociality (motivation to be near companions) and a passive 'coping' style. High sociality and passivity were also negatively associated with FP in adults. These findings may guide future breeding programs. Trimming hens' feathers to mimic the results of FP elicited pecking and some cannibalism, even by birds that had previously shown no FP. Social transmission of gentle but not severe FP occurred when LFP and HFP birds were housed together. Gentle pecking could conceivably lead to severe FP. We then examined chickens' pecking preferences to guide environmental enrichment strategies. Bunches of string elicited substantially greater interest than other stimuli, including feathers, and white or yellow string was the most attractive. The birds' manipulation of the string resembled preening. Incorporating silver beads or moving the devices reduced pecking. String sustained lengthy interest, reduced FP in HFP birds, and decreased feather damage in caged layers on a commercial farm. String offers effective, affordable and practicable environmental enrichment. The integrated application of appropriate environmental and genetic strategies is likely to attenuate the expression of FP and its harmful consequences.

Keywords: *animal welfare, behavioural traits, domestic fowl, environmental enrichment, feather pecking, poultry*

Introduction

Feather pecking (FP) occurs when one bird pecks at and pulls out the feathers of another. It is a major welfare problem in laying hens and turkeys because, apart from causing pain (Gentle & Hunter 1990), it can lead to cannibalism and the painful death of target birds (McAdie & Keeling 2000). It also imposes an economic burden because denuded birds lose heat faster and must eat more to maintain body temperature (Leeson & Morrison 1978). In response to a public call for more animal-friendly housing, traditional battery cages for laying hens will be banned in the European Community from 2012. However, FP can be particularly problematic in alternative systems, such as aviaries, percheries and free range, because it is more difficult to control when birds are kept in large flocks (Jones 2001a). Indeed, although the incidence of FP is unpredictable, up to 99% of hens in loose-housing systems in Sweden showed pecking-related damage (Gunnarsson *et al* 1999) and 37.5% of Swiss flocks were affected (Huber-Eicher & Sebo 2001). Current practices for reducing FP include beak trimming (partial amputation of the beak) and/or keeping the birds under dim light, but these can cause chronic pain and the development of eye abnormalities respectively.

Clearly, there is a pressing need for the development of effective and acceptable methods of minimising the expression of this harmful behavioural vice. A recent multi-site, multi-disciplinary project sought practical solutions. There is widespread acceptance that the development of FP reflects multi-factorial processes, that FP varies substantially between and within breeds, and that its expression is sensitive to housing conditions and environmental disturbances (Blokhuis 1986; Jones & Hocking 1999; Huber-Eicher & Sebo 2001). Therefore, in a broad-brush approach we studied genetic and environmental variables. This paper provides an overview of our efforts.

Associated traits

The existence of differences in FP between strains of chickens and between individuals within strains implies a

Table 1 Behavioural and physiological characteristics of hens from two genetic lines that coincidentally show low (LFP) or high (HFP) levels of feather pecking (FP).

Measure	Line comparisons
Gentle feather pecking	HFP > LFP
Severe feather pecking	HFP > LFP
Autopreening	HFP > LFP
Foraging behaviour	LFP > HFP
Ambulation	LFP > HFP
Sociality (social reinstatement)	LFP > HFP
Active 'coping' strategy	HFP > LFP
Catecholamine response	HFP > LFP
Adrenocortical activation	LFP > HFP
Heart rate variability	LFP > HFP
Central dopamine turnover	LFP > HFP
Central serotonin turnover	LFP > HFP

strong genetic component and, hence, a probable sensitivity to selective breeding. Indeed, selection programmes resulting in reduced FP have been established in the laboratory (Muir & Craig 1998; Kjaer *et al* 2001). However, an improved understanding of the relationships between FP and other important behavioural, physiological and production traits is essential before we can recommend specific selection criteria for commercial breeding programmes.

Our comparisons of two genetic lines of laying hens that are coincidentally predisposed to show low (LFP) or high (HFP) levels of FP yielded useful insights (Table 1). For example, a longitudinal study confirmed that HFP birds showed more of both gentle and severe FP than did LFP hens (Blokhuis *et al* 2001) and that autopreening, another feather-directed behaviour, was more pronounced in HFP birds. Conversely, HFP birds showed less foraging and ambulation than LFP birds (Blokhuis *et al* 2001). Despite a proposed positive link between FP and fearfulness (Hughes & Duncan 1972), earlier studies have indicated that this relationship is extremely labile and that increased fear is more likely to be an effect of FP than a cause (Jones *et al* 1995). Chicks of the LFP line showed much stronger social reinstatement behaviour (running, jumping and peeping) than HFP ones when tested individually in a novel environment (Jones *et al* 1995), thus indicating line divergence in underlying sociality (motivation to be near companions). This trait was subsequently compared at various ages in the two lines by placing individual birds in a start box at the opposite end of a runway to a goal box containing three other birds. The LFP birds consistently reached the goal box sooner than HFP ones (Blokhuis *et al* 2001). Since social affiliation in runway tests is positively related to sociality in gallinaceous birds (Vallortigara & Zanforlin 1990; Jones & Mills 1999), this finding further supports the notion that underlying sociality is greater in chickens of the low than the high feather pecking line (Blokhuis *et al* 2001).

Line differences in the birds' so-called 'coping' responses to specific challenges were also apparent. Thus, whereas LFP birds generally reacted in a way that resembled passive coping (low levels of struggling and vocalisation, high plasma corticosterone levels) when briefly exposed to manual or mechanical restraint, the responses of HFP birds (pronounced struggling, loud vocalisation, high plasma catecholamine concentrations) more closely resembled those of active copers (Korte *et al* 1997; Blokhuis *et al* 2001). HFP hens also showed lower heart rate variability (less parasympathetic activity) during brief manual restraint as well as a lower turnover of brain dopamine and serotonin (Korte *et al* 1999; van Hierden *et al* 2002). In view of the latter finding it was suggested that HFP chicks might be more predisposed to develop a stereotypy, such as gentle FP (van Hierden *et al* 2002). It has been suggested that gentle FP might be a stereotypy because it is usually performed in long bouts and because its motor patterns closely resemble drug-induced stereotypic pecking (Kjaer & Vestergaard 1999).

Animals that adopt active coping strategies are thought to be more likely to show rigid, routine-like forms of behaviour and to be more vulnerable to the development of behavioural abnormalities (Koolhaas *et al* 1999). Collectively, our findings suggested that birds with an active coping style and low sociality might be more likely to become feather peckers. This suggestion is supported by our observation that a passive coping style and high sociality were both negatively correlated with the occurrence of FP in the experimental lines at 24 and 30 weeks of age (Blokhuis *et al* 2001). Results such as these may guide the choice of selection criteria in future breeding programs intended to eradicate feather pecking and cannibalism. We also consider that the apparent relationship between FP and sociality is particularly pertinent to breeding programs that are based on group selection rather than on birds housed in individual cages (Muir & Craig 1998; Muir 2003).

Social factors

The presence of just one bird that shows feather pecking might cause the behaviour to spread throughout the flock. Social transmission of FP could happen in various ways: a) damage to a bird's feathers might elicit pecking from others because stimulus contrast can be attractive (stimulus enhancement); b) since stress is an influential and non-specific variable in the development of FP, increased nervousness caused by the presence of feather pecking birds might lead other birds to develop this behavioural vice; and/or c) chickens might learn to feather peck by imitating others.

The first question to be addressed focused on whether a hen with damaged feathers would attract pecking from other birds. To answer this, the Swedish team damaged the plumage of selected hens either by pulling feathers the wrong way through their fingers so that barbs on the vane were broken, trimming small patches of feathers until the white downy plumage became visible through the brown, or cutting the feathers to reveal a small patch of skin. These manipulations were performed on the birds' backs, tails or breasts, and the birds were then replaced in the flock. The birds bearing damaged feathers received three times as

https://doi.org/10.1017/S0962728600014627 Published online by Cambridge University Press

many severe feather pecks as the non-manipulated hens and the incidence of gentle pecking was also increased (McAdie & Keeling 2000). Clearly, damage to the plumage encouraged feather pecking; it even elicited cannibalism in some cases. Thus, the attractiveness of damaged feathers is one likely mechanism for the spread of FP within a flock.

A second experiment investigated whether LFP birds showed more FP if they were housed from 1 day to 32 weeks of age in either cages or pens with HFP chicks. Not unexpectedly, significantly less feather pecking and feather damage was observed among birds housed in pens than in cages. The fact that severe FP did not spread from HFP to LFP birds (McAdie & Keeling 2002) suggests that the development of this harmful behaviour is not dependent on observational learning or on the elicitation of fear and stress by the presence of birds that show FP. On the other hand, there was some evidence for the social transmission of gentle FP among older hens housed in cages (medians of 23.5 and 49.3 pecks per hour in LFP and mixed-line groups respectively). Traditionally, this behaviour has not been regarded as damaging or as a welfare problem but the above results sound two cautionary notes. First, the very high levels of gentle pecking observed in this study (McAdie & Keeling 2002) may themselves be abnormal; indeed, repeated pecking at the same spot on another bird resembled stereotyped behaviour and thereby supported a previous observation (Kjaer & Vestergaard 1999). Furthermore, the high frequency of gentle feather pecks could ultimately lead to feather damage. Second, high levels of gentle pecking could increase the risk that severe FP develops opportunistically (Blokhuis *et al* 2001). For example, severe FP may develop indirectly simply because the birds are devoting high proportions of their time budgets to pecking at others. Indeed, it has been proposed that severe FP develops from gentle FP because its first expression has been shown to be embedded in bouts of gentle pecking (Riedstra & Groothuis 2001). On the other hand, laying hens may show up to 3000 gentle pecks per bird per hour (LJ Keeling 2000, personal communication). Such high levels of gentle FP may themselves ruffle or damage the other birds' feathers, which can, in turn, directly elicit the expression of severe FP (McAdie & Keeling 2000). Thus, the apparent spread of gentle FP is a cause for concern.

Environmental enrichment

Numerous objects have been used in attempts to enrich a chicken's environment, including flowers, toys, baubles, balls, bells, stones, silver paper, and specifically designed devices as well as commercially available ones (eg Sherwin 1993; Reed *et al* 1993; Gao *et al* 1994). Their use is intended to reduce the occurrence of potentially harmful behaviours, such as fear and feather pecking. However, some stimuli actually increase social pecking while many others are ignored (Jones 2001a). These 'failures' probably reflect the fact that the stimuli were chosen according to human preconceptions rather than a critical consideration of the chickens' preferences and predispositions. Clearly, the design of enrichment devices required more critical thought. Our immediate objectives were to systematically establish chickens' specific pecking preferences, to thereby identify practicable enrichment devices that would reliably sustain their interest, and to rigorously test their effectiveness. Our approach involved a series of experiments.

When pairs of chicks from two commercial breeds were simultaneously presented with selected pecking stimuli in their home cages, either continuously or for varying periods of time over five consecutive days, they always pecked much sooner and more often at string (bunches of white polypropylene twine) than at beads, chains, feathers or baubles; a preference which became stronger over time (Jones & Carmichael 1999; Jones *et al* 2000). The chicks may have been attracted to string because it resembled some inherently supernormal stimulus, such as straw, twigs or worms. However, they manipulated it differently from the other stimuli. As well as pecking and pulling at it, they drew the string through their beaks and teased the strands apart; actions that resembled preening (Jones 2001a). Thus, pecking at string may provide the most positive feedback.

Chickens have tetrachromatic vision so colour is likely to be an important attribute of any enrichment device. Although colour preferences have notoriously varied according to the type of stimulus and the experimental context, we established that chicks and adult hens consistently paid more attention to white or yellow strings than to green, blue, red or orange ones (Jones & Carmichael 1988; Jones *et al* 2000). These findings support suggestions (see Jones *et al* 2000) that chickens find blue objects aversive and that red often serves as a warning signal causing alarm and avoidance. Furthermore, although visual complexity is thought to be generally attractive and to encourage animals to interact with their environment (Chamove 1989), simple white or yellow strings were consistently pecked sooner and more often than combinations of white and yellow or of each of the five colours identified above (Jones *et al* 2000).

Complexity is generally thought to encourage animals to interact with their environment (see Jones 2001a). Therefore, since chickens are strongly attracted to small spherical and/or shiny objects (Rogers 1995), we assessed the effects of incorporating silver beads in the string devices. Contrary to that expected, the chicks pecked more at plain string than at beaded devices. This might imply a preference for simple rather than complex devices, but it is probably more likely that the beads interfered with the chicks' ability to tease the strands of string apart, and thereby rendered this device less attractive.

For many species, moving objects are thought to be more effective in stimulating play than stationary ones (Newberry 1995). However, chicks consistently pecked less at bunches of string that were moved occasionally (by other chicks or by the experimenter) than they did at stationary devices (Jones 2001b), perhaps because unpredictable movement caused slight alarm and avoidance (Jones 1996).

The fact that animals soon lose interest in many enrichment stimuli demanded confirmation that the string devices remained attractive for lengthy periods. In a longitudinal

https://doi.org/10.1017/S0962728600014627 Published online by Cambridge University Press

study, small groups of floor-housed chicks were provided with chains, beads and string continuously from 1 day of age. They soon ceased to peck at the first two stimuli but, although interest in string declined gradually, the string was still being pecked after 17 weeks (Jones 2001a). In this context, it may be worthwhile to develop and test an automated system capable of detecting waning of interest in the devices, and then perhaps to move them to a new location or raise them briefly in order to rekindle interest.

The next three studies addressed a critical question: does the provision of string reduce the incidence of injurious feather pecking? First, one adult hen was removed from each of twenty pen-housed groups of five hens, and her rump feathers were trimmed; a procedure previously shown to elicit feather pecking (McAdie & Keeling 2000). Bunches of string were incorporated into the pens of ten of the groups (suspended from a perch) immediately before the trimmed hen was returned, whereas the remaining groups received no string. The absence of severe FP prevented us from testing our hypothesis that string would reduce its occurrence. However, string was pecked significantly sooner and more often than either the trimmed or the untrimmed hens and it was still being pecked after two weeks of continuous exposure (Jones *et al* 2002).

Second, groups of pen-housed chicks from the HFP line known to show high levels of feather pecking (Blokhuis & Beuving 1993) were housed in floor pens containing a substrate of wood shavings and exposed to one of five treatments. These involved placing two bunches of string in the pen continuously from 1, 22 or 52 days of age, for just 4 hours per day from 1 day of age, or not at all (control). String attracted considerable pecking throughout exposure (Blokhuis *et al* 2001; McAdie *et al* in preparation). Severe FP was totally absent and the incidence of gentle FP was strikingly lower in 8-week-old birds that had received access to string from 1 day of age than in controls. Exposure to string from 22 days of age resulted in intermediate levels of FP (Blokhuis *et al* 2001; Jones 2001a; McAdie *et al* in preparation). The presence of string from 1 day of age, either continuously or for 4 hours per day, was equally effective in reducing FP.

Third, in a study on a commercial farm, groups of caged White Leghorn laying hens that had not been beak trimmed were given bunches of string either: a) continuously from 1 day to 30 weeks of age; b) continuously from their transfer from rearing to laying cages at 16 weeks of age; c) for 1 day every 4 weeks from 1 day of age; or d) not at all. Plumage condition was then scored at 35 weeks of age. The birds remained strongly attracted to the bunches of string; in fact, these received so much manipulation that they soon resembled balls of wool. Encouragingly, pecking-related feather damage was substantially reduced among the hens that had access to string (Blokhuis *et al* 2001; Jones 2001a; McAdie *et al* in preparation). This effect was apparent regardless of whether the devices had been provided continuously from 1 day of age, continuously from the birds' transfer from rearing to laying cages at 16 weeks of age, or for just 1 day every 4 weeks from 1 day of age. Such 'plasticity' may reflect the fact that chickens can revise their pecking preferences; for example, FP is lower in hens that receive access to wood shavings in adulthood only than in those that are housed without wood shavings throughout their lives (Nicol *et al* 2001). It is also conceivable that any stimulation might suffice to attenuate FP in the comparatively barren environment of a commercial battery cage regardless of the brevity of stimulation or the age at which it is applied.

Thus, providing chickens from laying strains with stationary bunches of plain white string promoted exploration and foraging, maintained their interest for lengthy periods, and reduced FP and pecking-related feather damage both in the laboratory and on a commercial farm. String has the added advantages of low cost, ready availability and durability.

Conclusions and animal welfare implications

Feather pecking and cannibalism seriously damage poultry welfare. Our study identified influential internal and external variables related to FP. The positive associations between FP and certain characteristics, such as low sociality and an active coping style, may guide the choice of selection criteria for future breeding programs designed to eradicate FP. Damage to feathers elicited FP but evidence for the social transmission of this behaviour through imitation was limited to gentle FP among hens housed in cages. Providing chickens with bunches of string maintained lengthy interest, reduced the incidence of FP, and decreased feather damage on a commercial farm. The integrated application of appropriate breeding programs and suitable environmental enrichment could minimise the expression of FP and its harmful consequences.

Acknowledgements

This work was supported by the Department for Environment, Food and Rural Affairs (DEFRA), UK and the European Commission Agriculture and Fisheries Program (FAIR, Framework IV).

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