Literature Featherpecking - What is injurious and feather pecking?

Blokhuis, H. J. (1986). "Feather-pecking in poultry: Its relation with ground-pecking." Applied Animal Behaviour Science **16**(1): 63-67.

It was shown that the motivation for non-aggressive pecking at conspecifics varies along with ground-pecking motivation. This supported the view of a common regulating mechanism. It was concluded that feather-pecking is to be considered as redirected ground-pecking, and hence that the latter is an important parameter in experiments comparing the risk of different environmental factors concerning the development of feather-pecking.

Blokhuis, H. J. (1989). The development and causation of feather pecking in the domestic fowl. [S.l.], Blokhuis.

Uitgaande van de hypothese dat verenpikken in de leghennenhouderij beschouwd kan worden als een vorm van omgericht bodempikken, is divers gedragsonderzoek verricht op strooisel- of roostervloeren, of een combinatie van beide. Ook werd het effect van snavelkappen op het bodem- en verenpikken bestudeerd. Thesis: http://edepot.wur.nl/202211.

Brunberg, E., et al. (2011). "Feather pecking behavior in laying hens: Hypothalamic gene expression in birds performing and receiving pecks." Poultry Science **90**(6): 1145-1152.

Feather pecking (FP) is a welfare and economic problem in the egg production sector. Beak trimming, the current method used to reduce FP, is also criticized. The present study used gene expression to explore the biological mechanisms underlying this behavior, which could lead to a greater understanding of the cause and a tool to mitigate the problem. White Leghorn hens performing and receiving FP, as well as neutral control birds, were identified on a commercial farm. Hypothalamic RNA from 11 peckers, 10 victims, and 10 controls was hybridized onto GeneChip Chicken Genome Arrays (Affymetrix Inc., Santa Clara, CA) to compare gene expression profiles in the different groups. Eleven transcripts corresponding to 10 genes differed significantly between the 3 groups (adjusted $P < 0.05$). Eight of these transcripts differed in the peckers compared with the controls, 1 was upregulated in the victims compared with the controls, and 6 differed significantly in the peckers compared with the victims. Additionally, 5 transcripts showed a trend (adjusted $P < 0.1$) to differ in the pecker-victim comparison. Some of the products of the differently expressed genes are involved in disorders, such as intestinal inflammation and insulin resistance, which fit well with the previously proposed hypothesis that FP is an abnormal foraging behavior. Other findings may also support the proposal that FP is linked to immune mechanisms and may serve as an animal model for obsessive compulsive disorder in humans. In conclusion, this study provides a gene list that may be useful in further research on the mechanisms behind FP.

Cheng, H. W. and W. M. Muir (2007). "Mechanisms of aggression and production in chickens: genetic variations in the functions of serotonin, catecholamine, and corticosterone." Worlds Poultry Science Journal **63**(2): 233-254.

The neuroendocrine systems, such as dopamine (DA) and serotonin (5- HT) as well as corticosterone (CORT), are involved in regulating behavioural patterns and reproduction in humans and other mammals. Similar functions of neuroendocrine system may present in laying hens. To test the hypothesis, two divergent chicken lines were used in the study. Each line has distinct levels of aggressiveness and productivity at a group setting and exhibits differen susceptibility to various environmental stressors. We found that, at 21 wks of age, LGPS (Low Group Productivity and Survivability) birds had significantly higher blood concentrations of DA and epinephrine than the KGB birds (Kind Gentle Birds, also previously termed HGPS, birds with a High Group Productivity and Survivability) ($P< 0.01$, respectively). The blood concentration of norepinephrine was not significantly different between the lines but the ratio of epinephrine to norepinephrine was higher in LGPS birds ($P< 0.01$). The blood concentration of 5- HT was also significantly higher in LGPS birds compared to KGB birds ($P< 0.01$). In contrast, KGB birds tended to have a higher level of blood CORT ($P= 0.1$). The results suggest that genetic selection for productivity and survivability with domestic behaviours alters the birds' neuroendocrine homeostasis. The selection-associated plasticity of the neuroendocrine system in controlling animal aggression and productivity were discussed in the article.

Chow, A. and J. A. Hogan (2005). "The development of feather pecking in Burmese red junglefowl: the influence of early experience with exploratory-rich environments." Applied Animal Behaviour Science **93**(3-4): 283-294.

This study examines the development of feather pecking and its relationship to exploration in Burmese red junglefowl (Gallus gallus spadiceus). Ten groups of four chicks each were raised from hatching on wire mesh floors (home pen). Two of the four chicks in each group received experience in exploratory-rich environments four times a week for 5 weeks, and the other two chicks remained in the home pen. Observations conducted in the home pen revealed that chicks deprived of experience in exploratory-rich environments performed significantly more gentle feather pecking, and tended to show more

severe feather pecking than the experienced birds. Experience in the exploratory-rich environments did not affect the frequency of environmental pecking or food pecking. These results suggest that chicks deprived of exploratory-rich environments may come to perceive pen mates as appropriate exploratory stimuli and subsequently direct exploratory behavior toward conspecifics. This tendency to peck pen mates may lead to the development of feather pecking. We suggest that forceful pecks may be reinforcing, and that the more likely pecks are directed to a conspecific, the more likely feather pecking will develop. (c) 2005 Elsevier B.V. All rights reserved.

Dennis, R. L. and H. W. Cheng (2011). "The dopaminergic system and aggression in laying hens." Poultry Science **90**(11): 2440-2448.

The dopaminergic system is involved in the regulation of aggression in many species, especially via dopamine (DA) D1 and D2 receptor pathways. To investigate heritable differences in this regulation, 2 high aggressive strains [Dekalb XL (DXL) and low group egg productivity and survivability (LGPS)] and one low aggressive strain (low group egg productivity and survivability; HGPS) of laying hens were used in the study. The HGPS and LGPS lines were diversely selected using group selection for high and low group production and survivability. The DXL line is a commercial line selected through individual selection based on egg production. Heritable differences in aggressive propensity between the strains have been previously assessed. The birds were pair housed within the same strain and labeled as dominant or subordinate based on behavioral observation. For both experiments 1 and 2, behavioral analysis was performed on all 3 strains whereas neurotransmitter analysis was performed only on the most aggressive (DXL) and least aggressive (HGPS) strains. In experiment 1, the subordinate birds were treated with D1 agonist, D2 agonist; or saline controls (n = 12). In experiment 2, the dominant birds from a separate flock were treated with D1 antagonist, D2 antagonist, or saline controls (n = 12). Treatment-associated changes in aggressive behaviors and central neurotransmitters were measured. Aggression was increased in all strains in response to D1 agonism but increased only in the less aggressive HGPS birds with D2 agonism. Aggression was decreased and hypothalamic serotonin and epinephrine were increased in birds from all strains treated with D2 receptor antagonist. The D1 receptor antagonism elicited different behavioral and neurotransmitter responses based on the aggressive phenotype of the genetic strains. Aggressive strains DXL and LGPS but not the HGPS strain decreased aggressiveness following antagonism of the D1 receptor. The data show evidence for distinct neurotransmitter regulation of aggression in high and low aggressive strains of hens through different receptor systems. These chicken lines could provide new animal models for the biomedical investigation of the genetic basis of aggression.

Dixon, L. M. (2008). "Feather pecking behaviour and associated welfare issues in laying hens." Avian Biology Research **1**(2): 73-87.

Feather pecking, the pecking at or removal of feathers from one bird by another, is a problem in the poultry industry. Elimination of damaging feather pecking from flocks is made especially difficult by the numerous factors that appear to influence its prevalence. This review outlines the various contributors to feather pecking organised around Tinbergen's four questions on causation, ontogeny, phylogeny and function. There is growing evidence that feather pecking (especially severe feather pecking) is related to foraging motivation and gut function. However, other factors, such as improper early experiences, strain and individual differences and perseveration of the behaviour help explain its continued occurrence, even if the birds are kept in enriched environments. To date, methods of dealing with feather pecking are inadequate and involve welfare concerns of their own and alternate solutions, such as provision of forages, are not usually successful in abolishing feather pecking behaviour. The problems of excessive pelage/plummage removal or redirected oral/foraging related behaviour are not unique to poultry and seem to occur in other species in which foraging and forage intake is important. Between species comparisons of related behaviour patterns may improve our understanding of feather pecking and help to design effective solutions. In order to solve the problem of feather pecking, the factors discussed in this review need to be accounted for or we risk applying 'band-aid' solutions, which may appear outwardly to be solving the problem. However, the underlying cause(s) may still be present and the animal's welfare may still be compromised.

Dixon, L. M., et al. (2008). "What's in a peck? Using fixed action pattern morphology to identify the motivational basis of abnormal feather-pecking behaviour." Animal Behaviour **76**: 1035-1042.

Like many captive animals, hens, Gallus gallus, used for agricultural production perform abnormal behaviours. They are particularly prone to feather pecking, the severest form of which involves the pecking at and removal of feathers, which can cause bleeding and even stimulate cannibalism. The two main hypothesized explanations for feather pecking concern frustrated motivations to forage or, alternatively, to dust-bathe, leading to redirected behaviour in the form of pecks at plumage. Previous work on pigeons has shown that the detailed morphology of pecks involved in drinking and feeding, or in working for food or water, involves motivationally distinct fixed action patterns. We therefore used methods similar to these fixed action pattern studies to quantify the motor patterns involved in foraging and in dustbathing pecks, for comparison to feather pecking. We videoed 60 chickens pecking at a variety of forages and dustbaths, along with novel objects, water and bird models that could be feather pecked. We recorded the durations of the head fixation before the peck, between the head fixation to beak contact with each stimulus and of the whole peck sequence. We used mixed models to assess whether the motivation underlying a peck affected its morphology and whether severe feather pecks resembled or differed from either dustbath or foraging pecks (or even novel-object pecking or drinking). The motor patterns involved in pecks at forages, dustbaths, novel objects and water all varied significantly; importantly, the motor patterns involved in pecking during dustbathing and

foraging differed (P < 0.0001 for all measures). Severe feather pecks proved similar to foraging pecks (NSD: power > 0.95) but different from all other pecks, including dustbathing (P < 0.0001 for all measures). These results indicate that severe feather pecking derives from frustrated motivations to forage, not to dustbathe. More broadly, they suggest that finely analysing fixed action pattern morphology can help elucidate the motivational bases of puzzling abnormal behaviours in captive animals. (c) 2008 The Association for the Study of Animal Behaviour. Published by Elsevier Ltd. All rights reserved.

Jensen, P., et al. (2005). "Feather pecking in chickens is genetically related to behavioural and developmental traits." Physiology & Behavior **86**(1-2): 52-60.

Feather pecking (FP) is a detrimental behaviour in chickens, which is performed by only some individuals in a flock. FP was studied in 54 red junglefowl (ancestor of domestic chickens), 36 White Leghorn laying hens, and 762 birds from an F-2-intercross between these two lines. From all F-2-birds, growth and feed consumption were measured. Age at sexual maturity and egg production in females, and corticosterone levels in males were also measured. From 333 F-2-birds of both sexes, and 20 parental birds, body composition with respect to bone mineral content, muscle and fat was obtained by post-mortem examinations using Dual X-Ray Absorptiometry (DXA). In femurs of the same birds, the bone density and structure were analysed using DXA and Peripheral Quantitative Computerized Tomography (pQCT), and a biomechanical analysis of bone strength was performed. Furthermore, plumage condition was determined in all birds as a measure of being exposed to feather pecking. Using 105 DNA-markers in all F2-birds, a genome-wide scan for Quantitative Trait Loci (QTL), associated with the behaviour in the F-2-generation was performed. FP was at least as frequent in the red junglefowl as in the White Leghorn strain studied here, and significantly more common among females both in the parental strains and in the F-2-generation. In the F-2-birds, FP was phenotypically linked to early sexual maturation, fast growth, weak bones, and, in males, also high fat accumulation, indicating that feather peckers have a different resource allocation pattern. Behaviourally, F-2 feather peckers were more active in an open field test, in a novel food/novel object test, and in a restraint test, indicating that feather pecking might be genetically linked to a proactive coping strategy. Only one suggestive QTL with a low explanatory value was found on chromosome 3, showing that many genes, each with a small effect, are probably involved in the causation of feather pecking. There were significant effects of sire and dam on the risk of being a victim of feather pecking, and victims grew faster pre- and post-hatching, had lower corticosterone levels and were less active in a restraint test. Hence, a wide array of behavioural and developmental traits were genetically linked to FP. (c) 2005 Elsevier Inc. All rights reserved.

Kjaer, J. B. (2011). "Neonate pecking preferences and feather pecking in domestic chickens: investigating the 'changed template' hypothesis." Archiv Fur Geflugelkunde **75**(4): 273-278.

Domestic chickens from lines selected for low (LFP) or high (HFP) levels of feather pecking (FP) were reared in 14 bird groups and pecking to various forms presented on a computer screen was recorded at 2 weeks of age. HFP chickens delivered significantly more pecks (combined for all forms: circle, ellipse, rod, rods in feather like pattern and feather in colours: red, yellow, green) than LPF chickens, whereas no significant effects were found for form, colour, hatch or interactions. Total FP (sum of gentle and severe FP) was significantly higher in HFP chickens and decreased significantly with increasing age from 6 over 9 to 21 days. According to the 'changed template'-hypothesis, pecking preferences of HFP chickens would differ to those of LFP chickens but data could not support this hypothesis. Rather, the HFP chickens pecked at any form and colour with a much higher intensity than the LFP chickens lending support to the hyperactivity model of feather pecking in that genetic selection for a higher level of FP is paralleled by a higher level of arousal leading to increased pecking to animate (FP) as well as inanimate (i.e. forms on a screen) stimuli.

Kjaer, J. B., et al. "Perseveration in a guessing task by laying hens selected for high or low levels of feather pecking does not support classification of feather pecking as a stereotypy." Applied Animal Behaviour Science(0).

Abstract Feather pecking is a behaviour by which birds damage or destroy the feathers of themselves (self-pecking) or other birds (allo feather pecking), in some cases even plucking out feathers and eating these. The self-pecking is rarely seen in domestic laying hens but is not uncommon in parrots. Feather pecking in laying hens has been described as being stereotypic, i.e. a repetitive invariant motor pattern without an obvious function, and indeed the amount of self-pecking in parrots was found to correlate positively with the amount of recurrent perseveration (RP), the tendency to repeat responses inappropriately, which in humans and other animals was found to correlate with stereotypic behaviour. In the present experiment we set out to investigate the correlation between allo feather pecking and RP in laying hens. We used birds (N = 92) from the 10th and 11th generation (G10 and G11) of lines selectively bred for high feather pecking (HFP) and low feather pecking (LFP), and from an unselected control line (CON) with intermediate levels of feather pecking. We hypothesised that levels of RP would be higher, and the time taken (standardised latency) to repeat a response lower, in HFP compared to LFP hens, with CON hens in between. Using a two-choice guessing task, we found that lines differed significantly in their levels of RP, with HFP unexpectedly showing lower levels of RP than CON and LFP. Latency to make a repeat did not differ between lines. Latency to make a switch differed between lines with a shorter latency in HFP compared to LFP (in G10), or CON (in G11). Latency to peck for repeats versus latency to peck for switches did not differ between lines. Total time to complete the test was significantly shorter in HFP compared to CON and LFP. Thus, our hypotheses were not supported by the data. In contrast, selection for feather pecking seems to induce the

opposite effects than would be expected from stereotyping animals: pecking was less sequenced and reaction to make a switch and to complete the test was lower in HFP. This supports the hyperactivity-model of feather pecking, suggesting that feather pecking is related to a higher general activity, possibly due to changes in the dopaminergic system.

Newberry, R. C. (2004). Cannibalism. Cambridge, Cabi Publishing.
Cannibalism is a serious welfare problem in laying hens which can cause high mortality. Cannibalistic behaviour is learned by individual birds and can spread to others through social learning. In this chapter, multiple factors influencing the risk of cannibalism are reviewed. These include beak form, light intensity, genetic predisposition, age, sex, timing of sexual maturation, nutrition, food form, availability of attractive foraging materials, learning opportunities, availability of preferred victims, use of perches and nestboxes, and group size. Strategies for controlling cannibalism without resorting to beak trimming are suggested, based on knowledge about factors affecting the motivation and opportunity to perform the behaviour.

Rodenburg, T. B., et al. (2004b). "Feather pecking in laying hens: new insights and directions for research?" Applied Animal Behaviour Science **86**(3/4): 291-298.
The aim of this paper is to present new insights and promising directions for future research on feather pecking in laying hens. Our starting point was a multidisciplinary research program on feather pecking in The Netherlands, in which ethological, physiological, ontogenetic and genetic approaches were combined. The four topics addressed in this paper are: (1) the relation between gentle and severe feather pecking, (2) feather pecking and coping strategy, (3) causation of feather pecking, and (4) the possibility to solve the problem of feather pecking through genetic selection. When the relationship between gentle and severe feather pecking was studied, it was found that both forms of feather pecking are related at the same age. Gentle feather pecking at young age, however, could not be used as a predictor of feather pecking at adult age. Birds from high and low feather pecking lines that showed differences in feather pecking also differed in other behavioural and physiological characteristics. This may reflect line differences in coping strategy. Relating coping strategy with feather pecking may help us to better understand the motivations and characteristics underlying the development of feather pecking. On the causation of feather pecking, there is some evidence that it is redirected ground pecking, deriving either from a foraging or a dustbathing background. However, evidence was found that early feather pecking could also be interpreted as social exploration. Finally, the use of molecular genetics to help solving the problem of feather pecking seems promising. Feather pecking has been shown to be heritable and the first genetic regions (QTL) involved in feather pecking have been identified. To search for a solution for the feather pecking problem it is of importance to identify the mechanisms involved in the development of feather pecking. In this paper, we have combined approaches from different disciplines in order to study feather pecking. The results indicate that combined efforts of multidisciplinary research can be very useful in looking for possible ways to reduce feather pecking in practice.

Rodenburg, T. B., et al. (2013). "The prevention and control of feather pecking in laying hens: identifying the underlying principles." World's poultry science journal **69**(02): 361-374.
Feather pecking (FP) in laying hens remains an important economic and welfare issue. This paper reviews the literature on causes of FP in laying hens. With the ban on conventional cages in the EU from 2012 and the expected future ban on beak trimming in many European countries, addressing this welfare issue has become more pressing than ever. The aim of this review paper is to provide a detailed overview of underlying principles of FP. FP is affected by many different factors and any approach to prevent or reduce FP in commercial flocks should acknowledge that fact and use a multifactorial approach to address this issue. Two forms of FP can be distinguished: gentle FP and severe FP. Severe FP causes the most welfare issues in commercial flocks. Severe FP is clearly related to feeding and foraging behaviour and its development seems to be enhanced in conditions where birds have difficulty in coping with environmental stressors. Stimulating feeding and foraging behaviour by providing high-fibre diets and suitable litter from an early age onwards, and controlling fear and stress levels through genetic selection, reducing maternal stress and improving the stockmanship skills of the farmer, together offer the best prospect for preventing or controlling FP.

Savory, C. J. 1995. Feather pecking and cannibalism. Worlds Poultry Science Journal, 51, 215-219.