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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

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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 vs. 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.

1. Introduction

Feather pecking is a behaviour by which hens damage or destroy the feathers of other birds (allo pecking), in some cases even plucking out feathers and eating these. In severe cases feather pecking can be associated with cannibalism, where hens eat the blood and tissue of other birds. When birds peck their own feathers, it is by some referred to as feather picking, a behaviour that strongly resembles feather pecking (Meehan et al., 2003). Such self-pecking is rare in domestic laying hens, whereas in parrots, self-pecking seems to be the more common form (Levine, 1984). A wide range of factors affecting feather pecking have been reported in laying hens, including aspects of housing and rearing conditions, as well as feeding (Sharma et al., 1999). Genetic selection may also play a role and laying hen lines differing in the level of feather pecking have been developed (Kjaer et al., 2001). Despite extensive studies, the biological mechanisms behind feather pecking are not yet understood. Hypotheses trying to explain the development of feather pecking includes redirected foraging (Hoffmeyer, 1969; Blokhuis, 1986), redirected dustpecks in relation to dustbathing (Vestergaard and Lisborg, 1993), redirected social grooming (Riedstra and Groothuis, 2002) or stemming from neurological changes also inducing behavioural hyperactivity (Kjaer, 2009).

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Feather pecking has been described as, under certain circumstances, having a repeated, stereotyped form (in laying hens: Keeling, 1994; McAdie and Keeling, 2002; Newberry, 2004; Rodenburg et al., 2004; in parrots: Jenkins, 2001; van Zeeland et al., 2009) and it has been classified as a stereotypy in laying hens (Kjaer and Vestergaard, 1999). Stereotypies are part of a complex of abnormal repetitive behaviours which also include perseverative behaviours (Ridley, 1994). Perseveration can be further grouped in three categories, namely, (i) stuck-in-set perseveration being 'the inappropriate maintenance of a current category or framework', (ii) recurrent perseveration being 'the unintentional repetition of a previous response to a subsequent stimulus' and finally (iii) continuous perseveration as 'the inappropriate prolongation or repetition of a behaviour without interruption' (Sandson and Albert, 1984).

Perseveration can be investigated more in detail using psychological tests, one example being the two choice guessing task. In this test, human patients with diagnosed schizophrenia showed more patterned responses, being a sign of more recurrent perseveration (stereotypy), than healthy controls (Frith and Done, 1983). They defined a response pattern in these patients as stereotypic when: 'the response sequences are stereotyped if only a very restriced set of the possible subsequences are produced'. Also rodents (Garner and Mason, 2002) and parrots (Garner et al., 2003) with a high level of stereotypy showed more patterned responses within the stereotyped behaviour compared to those with lower levels of stereotypy, and time taken to repeat a choice, but not to make a switch, differed between groups.

Whether the same is true for laying hens selected for high levels of feather pecking is not known, so in the present experiment we set out to investigate this. We used laying hens from lines selectively bred for high (HFP) and low (LFP) levels of allo feather pecking, respectively, as well as an intermediary control line (CON), and hypothesised that the level of recurrent perseveration (RP) would be higher in HFP compared to LFP hens, with CON hens in between. Furthermore, we expected the time taken to repeat a response to be lower in HFP than LFP hens, with CON hens being intermediary. The speed of switched responses should be unrelated to stereotypy and therefore should not differ between lines.

2. Methods

2.1. Subjects

The experiment was performed in accordance with the Institutional protocols of the FLI and German regulations on Animal Welfare.

2.1.1. Developing divergent feather pecking lines

Lines differing in the level of feather pecking were developed by genetic selection. A detailed description of the selection procedure is given in Kjaer et al. (2001). In brief, the founder line was a White Leghorn line formed from several commercial lines. Since 1970 this line was bred randomly with an effective population size of approximately 130 birds and served as the control (CON) line. In each generation, chickens were sexed at hatch and females were reared separate from males but mixed with respect to lines in floor pens littered with wood shavings. At 18 weeks of age, pullets were transferred to four-bird battery cages, in which they were separated by line. At 26–34 weeks of age, while CON line birds stayed in the cages, females of the HFP and LFP lines were transferred to smaller floor pens for the recording of feather pecking behaviour. The birds were housed in groups of 20, 10 birds from each selection line. After a few days of settling, a 3-h video tape recording of each group during an undisturbed afternoon period was made. From the tapes it was possible to record all feather pecking on an individual basis. Based on the feather pecking recorded during this 3-h observation, breeding values were calculated using an animal model, thereby including information from relatives. Breeding values of males were calculated on basis of feather pecking of the female relatives. Birds with the highest breeding values were selected in the high feather pecking line (HFP) and birds with the lowest breeding values were selected in the low feather pecking line (LFP) in each generation.

2.1.2. Present experiment

In the first trial of the experiment, laying hens of the 10th generation (G10) were used (HFP, $N = 23$, LFP, $N = 22$, and CON, $N = 19$). The second trial was a repetition of the first. Hens from the 11th generation (G11) were used (HFP, $N = 11$, LFP, $N = 8$, and CON, $N = 9$). All birds were around 1 year old when tested. No specific observation of feather pecking behaviour was done in the experimental subjects, but observations made in a following generation showed a level of feather pecking twice as high in the HFP compared to the LFP birds (Kjaer, 2011).

2.2. Test boxes and training

Two custom made test-boxes (Fig. 1) with the dimensions 46 cm × 58 cm × 66 cm (width, depth, height) were used. At one end of a box was a TFT video monitor model DT-121-A from Distronic (Distronic, D-65239 Hochheim/Main, Germany). The display was a SVGA 600 × 800 pixel model LB121S03-TD01 from Phillips (Phillips Deutschland GmbH, D-20001 Hamburg, Germany) with the size 19 cm high, 25 cm wide and 31 cm diagonal. Around the

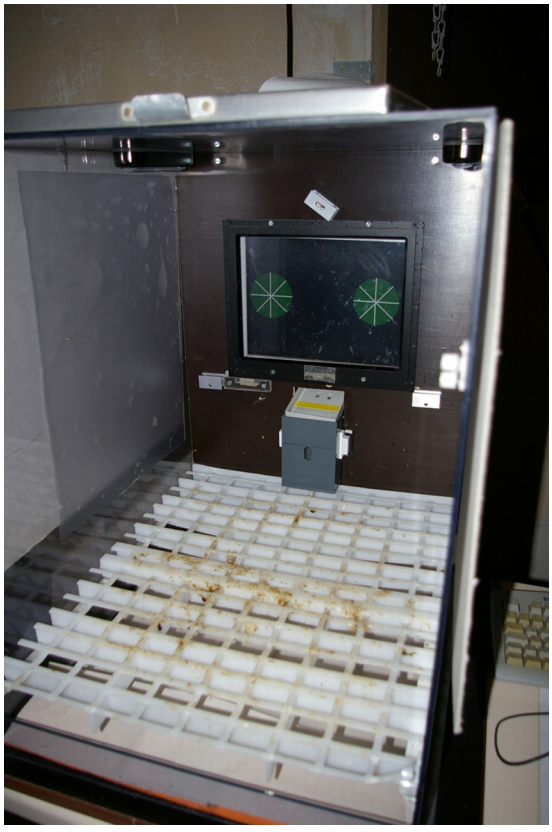

Fig. 1. Test box. The plexi-glass board in front of the screen is not shown. The feed trough is below the screen. The black frame surrounding the screen emits and receives infrared beams and records all interferences (pecks). The two identical pictures of a green circle (diameter 6 cm) with white spokes can be seen on the screen. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)