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Effect of broody hens on behaviour of chicks

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ABSTRACT

The objective of the present study was to examine the details of dynamic changes of behaviour of brooded and non-brooded chicks at an early age, the effects of broody hens on the behavioural development and fearfulness of chicks and the correlation between maternal care and fearfulness of chicks, as seen in mice. Five groups of five chicks each were reared by a broody hen, and five groups of five chicks each were provided with a red heating lamp for 28 days. The behaviour of all chicks was recorded using scan sampling at 5-min intervals for 6 h per day at 1, 5, 9, 13, 17, 21 and 25 days of age. Two behavioural tests for evaluating fearfulness and familiarity with humans were conducted at 27 and 28 days of age, and the duration of freezing and latency to the first vocalisation and first step, as well as the number of vocalisations and steps during 10 min, were recorded. The data were analysed using repeated-measures analysis of variance (ANOVA) or Student's *t*-test. Although the brooded chicks spent 60% of their time resting under broody hens at 1 day of age, the proportion then decreased sharply during the first 2 weeks, stabilised around 10% from 13 days of age and, finally, was reduced to almost zero at 25 days of age. The brooded chicks spent more time on active behaviour ($P < 0.05$), dust-bathing ($P < 0.01$) and floor pecking ($P < 0.01$), but less time on gentle feather pecking ($P < 0.01$) than non-brooded chicks. In both behavioural tests, the total duration of freezing was shorter in brooded chicks ($P < 0.001$) and the total number of vocalisations ($P < 0.001$) and steps taken ($P < 0.001$) were higher in brooded chicks. No correlation between resting under broody hens and fearfulness was found. In conclusion, the behavioural development of chicks was promoted and fearfulness was decreased markedly by the presence of a broody hen.

1. Introduction

Animal welfare has progressed rapidly from a concept to laws or guidelines around the world. In the European Union (EU), conventional cages will be banned from 2012, and furnished cages or non-cage systems such as aviaries and free-range system have been developed. Thus, the transition from the unenriched cage to housing systems with environmental enrichment has commenced. Therefore, a variety of studies on these housing systems have been conducted, and detailed laws about animal housing exist (Tauson, 2005). However, because laying hens are introduced into such housing systems at around 120 days of age, just before the start of egg laying, the experiments are performed using hens that have essentially reached maturity. Further, unlike mammals, chicks can be reared without parents, and, therefore, providing maternal care is

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not necessary for commercial practice, and, even in the EU, few laws on rearing conditions exist. However, there are an increasing number of studies on the effects of maternal care on behavioural development of chicks, and these studies consistently report that maternal care has positive effects (Kent, 1987; Nicol and Pope, 1996; Perré et al., 2002; Riber et al., 2007b; Roden and Wechsler, 1998; Rodenburg et al., 2009; for a review, see Rodenburg et al., 2008). For example, Perré et al. (2002) found that chicks raised by a hen had higher social motivation compared with chicks housed without a hen, and Roden and Wechsler (1998) also showed that brooded chicks were less fearful than non-brooded chicks. However, the details on dynamic changes of behaviour of brooded and non-brooded chicks during early age have not been reported.

Studies on environmental enrichment similar to those regarding laying hens have been also conducted on mammals, especially rodents. The number of neurons and glial cells in the brains of mice housed in enriched cages after maturity was increased, and neurogenesis was also more active, resulting in progress in the abilities to learn and memorise (Kempermann et al., 1997). In addition to the studies of environmental enrichment after maturity in mice, the early environment of rodent pups has been well studied, and it has been confirmed that maternal behaviour plays a key role in behavioural development among all other factors. For example, a correlation between the maternal behaviour pups received and character after maturity was reported, in which the pups reared by mothers that groomed and licked them more frequently showed lower fearfulness and higher learning ability as they matured (Liu et al., 2000).

Among the studies of maternal behaviour using mice, a series of studies of an early weaning model, weaning 1 week before normal, is also interesting. The mice weaned early exhibited higher fearfulness and higher stress responses, and had lower glucocorticoid receptor expression in the hippocampus, which codes for stress-coping functions (Kikusui et al., 2004, 2006). In later studies, the glucocorticoid receptor gene was confirmed to be methylated, which would indicate that the level of glucocorticoid secretion in later life was determined by the early environment (Kikusui et al., unpublished data). More interestingly, an experiment that compared ethologically the effect of weaning on pups with that of enrichment devices after they matured confirmed that the fearfulness of mice weaned early remained lower regardless of the availability of enrichment devices after maturity, which may suggest that the effect of the early environment surpassed that of the later (Iwata et al., 2007). If this result can be applied to laying hens, it indicates the inadequacy of improving chicken welfare by modifying housing systems only after the birds have matured.

There are also studies of laying hens that examined the effects of providing substrates, such as wood shavings, for litter exploring and/or dust-bathing during rearing on behaviour, especially feather pecking, after the hens have matured (Johnsen et al., 1998; Nicol et al., 2001; Nørgaard-Nielsen et al., 1993). These studies consistently indicated that feather pecking in adulthood was reduced by providing substrates during rearing. Johnsen et al. (1998) concluded that the rearing conditions during the first 4 weeks of life have major influences on the subsequent development of feather pecking in laying hens, and Nicol et al. (2001) reported that exposure to substrate for even 10 days after hatching had the effect of decreasing feather pecking during laying periods. Therefore, as in, it has been shown in laying hens that early environment has durable effects on behaviour in adulthood. However, it remains unknown whether the effect of the early environment on laying hens surpasses that of the later. Although our final goal is to clarify this question, here we indicate the details of dynamic changes of behaviour of brooded and non-brooded chicks during early age, show the effects of broody hens on the behavioural development and fearfulness of chicks, and also report the correlation between maternal care and the fearfulness of chicks, as has been shown in mice (Liu et al., 2000).

2. Materials and methods

2.1. Animals and experimental design

A total of 50 female chicks (White Leghorn, light Julia, a Japanese commercial hybrid) were used. The sex of this hybrid is judged by the feathers. The chicks were randomly assigned to one of two treatment groups: five pens with five chicks each were reared by a broody hen and five pens with five chicks each were provided with a red heating lamp for farm animals (300 W; NK-RH12C, Navec Co., Ltd., Japan). The former were defined as brooded chicks and the latter as non-brooded chicks. The heating lamp was located next to the wall side of the pen, 40 cm above the ground, because the broody hens brooded at the same location.

Silky hens remain strongly broody (Kansaku, unpublished data), and therefore, they were used as the broody hens. Silky hens that had been managed commercially in conventional cages for 1 year were introduced singly to the pens described below. Broodiness was observed in early summer. The broodiness of each individual was confirmed using a time-lapse recorder (20 frames per second; AG-6740, Panasonic, Japan), and only individuals who spent most of their time incubating eggs were selected as broody hens. After broodiness was confirmed, the eggs under the broody hens were replaced with fake wooden eggs to prevent cracked eggs. At the same time, a total of 150 fertilised eggs were incubated in an incubator for 21 days at 37 °C and 60% humidity. The fake eggs under the broody hens were replaced with the incubated fertilised eggs (three eggs per broody hen; all eggs were not introduced because some eggs were un-incubated by the broody hens decreasing the hatch rate) at 18 days of incubation (3 days before hatching) and/or because broody hens sometimes kill chicks that have not hatched under them (Kansaku, unpublished data). At 21 days after the fertilised eggs were introduced into the incubator (at hatching), the chicks were confirmed to have actually hatched under the broody hens; all chicks hatched under the broody hens and all eggs were removed. At the same time, female chicks hatched in the incubator were introduced to broody hens to set five female chicks per broody hen per pen after the sex was identified by the feather type and leg rings were attached for individual