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The relevance of variations in group size and phenotypic appearance on the behaviour and movement patterns of young domestic fowl

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ABSTRACT

Variations in the group size of laying hens might increase the risk of undesired behaviours with important consequences for the birds' health and welfare. However, larger groups housed at constant densities also translate into larger enclosures that may increase space efficiency, therefore improving movement opportunities. The effects of group size (GS), phenotypic appearance (PA) and age on the behaviour and movement trajectories of pullets were analyzed. 1050 Hy-line brown chicks were divided into 45 pens housing 10, 20 or 40 birds at constant density. Simultaneously, different proportions of PA treatments were studied in a full factorial set up (0, 30, 50, 70 or 100% of birds phenotypically modified per group). The PA alteration was achieved by placing a black mark with a non-toxic dye on the back of the birds' head. Birds were observed at 3 age periods during the rearing phase: 5–6 (P1), 10–11 (P2) and 15–16 (P3) weeks of age. The software Chickitizer was used to record behaviour and locations. For the behavioural variables generalized linear mixed models (GLMM) based on a gamma distribution were built, with GS and PA as fixed factors, age as repeated measure and pen as random effect. Some of the variables analyzed presented very low frequencies and non-parametric tests had to be employed. Movement parameters calculated from the recorded positional data were analyzed with normal GLMM models similar to those built for the behavioural variables. The results indicated that birds housed in groups of 10 received more aggression than other GS ($P < 0.05$), whereas locomotion was higher in larger groups ($P < 0.001$). Similarly, birds in GS 40 travelled longer total, net and maximum distances ($P < 0.001$). PA treatments affected the occurrence of aggression given and received ($P < 0.05$) as well as some other behaviours, but the effects could not be easily explained. Activity decreased with age as indicated by the decline in behavioural activity such as foraging, locomotion, social preening and aggression ($P < 0.05$), while standing and resting increased with age ($P < 0.05$). Likewise, total, net, maximum and minimum distances declined with age ($P < 0.05$). In conclusion, birds housed in larger groups received less aggression and levels of locomotion were higher. PA affected some behaviours although the results were difficult to explain. The group sizes tested in the current study do not represent the whole range of pen sizes commercially available. Nonetheless, these results seem to confirm that larger groups, and the larger enclosures associated when maintaining

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constant densities, could be beneficial for the welfare of pullets. However, these effects could be age dependent as trajectories shortened with age which could be explained by the larger size and general decline in activity observed in older birds.

1. Introduction

Group size and its effects on the behaviour of farm animals have been extensively studied in the literature (Nicol et al., 1999; Estevez et al., 2003; Keeling et al., 2003; Schmolke et al., 2004; Leone et al., 2007). For laying hens, large group sizes have been associated with increased mortality, increased fear responses, damage to feathers and skin (Bilcik and Keeling, 1999), reduced egg production and reduced body mass (Keeling et al., 2003). Although initially the negative effects of increasing group size were explained as a consequence of social instability and increased aggression (McBride and Foenander, 1962), later studies conducted with larger group sizes reported low frequency of aggressive interactions (Hughes et al., 1997; Nicol et al., 1999; Estevez et al., 2002) suggesting a high level of dynamism and plasticity in the social behaviour of laying hens (Estevez et al., 2002). Several authors have proposed theoretical models to explain how, when groups of domestic fowl are large, social hierarchies are not established. In this case, hierarchical stratification is no longer an efficient behavioural strategy (Pagel and Dawkins, 1997), whereas being tolerant of group members seems to be a better suited tactic (Estevez et al., 1997). Nonetheless, despite the low aggression factors of different nature might lead to problems in large flocks.

Aggressive interactions in domestic fowl are generally directed towards subordinates (McBride, 1960) and sometimes linked to specific phenotypic appearances (Cloutier and Newberry, 2002). For example, it has been reported that birds which are phenotypically different from their conspecifics, due to a natural or artificial variation in feather colouration, are at a higher risk of being pecked (Estevez et al., 2003; Dennis et al., 2008). In addition to appearance, familiarity has also been found to influence the frequency of aggressive interactions (increased fights in groups of unfamiliar birds, Lindberg and Nicol, 1996), which could be dependent on group size (D'Eath and Keeling, 2003), and their ability to recognize group mates individually or based on badges of status (or traits that may signal their status or fighting ability when individual recognition and pecking orders are not possible, Pagel and Dawkins, 1997). Taking all these considerations into account, social dynamics in the domestic fowl appear to be complex. Group size, phenotypic appearance and familiarity seem to play important roles in determining the social relationships among group members which may translate into important management, production, health and welfare consequences. The repercussions of combining such complex effects may be most relevant in alternative production systems as they offer wider behavioural opportunities and freedom of movements for the birds (Appleby et al., 2002) but also higher risks for potential behavioural problems (Lay et al., 2011).

Domestic fowl are constrained by the spatial limits of their enclosure. Studies in broiler chickens have shown that movement and behaviour are strongly linked to the structural characteristics of their environment, distribution of resources or social factors related to group size (Estevez et al., 1997; Cornetto and Estevez, 2001; Leone et al., 2007; Leone and Estevez, 2008; Mallapur et al., 2009). Optimum space allocation for farmed animals can be considered as the best trade-off between the welfare cost for the animals and the financial benefits for the farming enterprise (Keeling, 1995). Therefore, is feasible to hypothesize that maintaining large group sizes, even in furnished cages at constant densities, would increase space efficiency thus providing the birds with larger total areas to travel. This would consequently increase the opportunities to exercise translating into a welfare benefit for the birds. However, it becomes essential to determine the proper balance between the beneficial effects of increasing total available space and the potential behavioural problems due to increased complexity in the social dynamics.

The objective of this study was to determine the impact of manipulating simultaneously group size and phenotypic appearance on the behaviour and space use of young laying hens as the impact of variation in the phenotypic appearance might be group size dependent. It was hypothesized that larger groups could lead to higher behavioural activity and movements but not necessarily increased aggressive encounters. Birds belonging to the less frequent phenotypes could be involved in more agonistic encounters and these effects could be dependent on the size of the group.

2. Materials and methods

The experiment was approved by the Ethical Committee at Neiker-Tecnalia and the Livestock Services at the Regional Government (Diputación Foral de Alava), complying with the "Real Decreto 1201/2005" that regulates the protection of animals used for experimental and other scientific purposes in Spain. The birds involved in the current experiment were also used for subsequent studies linked with the effects of group size and phenotypic appearance in adult laying hens to maximize the reduction in the number of animals subjected to experimental procedures. When the project was completed (at around 60 weeks of age), the birds were sold and processed at an EU-approved abattoir following commercial practices.

2.1. Experimental facilities

The study took place at the experimental poultry facilities in Neiker-Tecnalia (Vitoria-Gasteiz, Spain). These facilities had two lines of automatic drinkers and feeders as well as a computerized control system for light, ventilation and temperature. The barn was divided into 45 pens built