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Individual attributes as predictors of social status in small groups of laying hens

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ABSTRACT

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Physical characters (weight, feather colour, comb size and comb colour) were investigated as predictors of social status (dominance, aggression and social interactiveness) in four groups of laying hens. In one group there was a significant positive correlation between comb colour and dominance. In a second group there were significant positive correlations comb size and aggression and comb size and interactiveness. In a third group there was a significant positive correlation between body weight and interactiveness. No significant correlations between any measured physical characters and social status were found in the fourth group. The lack of correlational evidence across all groups suggests that social status is not determined by simple morphological characteristics but that the mechanisms involved are more complex.

INTRODUCTION

Since Schjelderup-Ebbe (1922, 1923) first described peck-orders in chickens, a great deal of research has been devoted to explaining underlying causation (see e.g. Chase (1974) and references therein; Jackson, 1988). Explanations have been numerous but inconclusive.

Early explanations of social order in laying hens suggested an individual's rank may be predicted based on characteristics thought to determine dominance (e.g. size, age and sex) and this predicted rank is correlated with the actual rank of the individual in the hierarchy (Jackson, 1988). These explanations have been called correlational models by Chase (1974) and individual attributes models by Jackson and Winnegrad (1987).

Extensive criticisms of correlational models (e.g. Gartlan, 1968; Landau, 1968; Rowell, 1974; Wade, 1978) have recently been challenged. Jackson and

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Winnegrad (1987) maintained that the individual attributes of group members may still account for observed degrees of linearity in most cases and analysed the data of Clutton-Brock et al. (1976) (ponies) and Espmark (1964) (reindeer), finding correlations between weight and dominance. There is also considerable evidence from past literature that a variety of individual characteristics such as body weight, comb size and age are correlated with social status in laying hens (Collias, 1943).

The objective of this study was to seek evidence for the individual attributes model by examining whether physical properties of individual laying hens within a small social group correlated with measures of social status.

ANIMALS, MATERIALS AND METHODS

Four groups of six 18-week-old Ross Brown laying hens were obtained from a commercial breeder. Details of subjects and home pen treatment can be found in Bradshaw (1992).

Procedure for recording data

The procedure for recording data is described in Bradshaw (1992). Data were recorded every day (for three 20 min periods during each day) from Day 1 (the first day of the birds' introduction) to Day 21. All instances of head pecks, threats and body pecks were treated as 'instantaneous' and quietly dictated into a tape recorder by the observer as sequences of behavioural acts (identity of actor, type of behaviour, identity of recipient). Data relating to physical characters of the birds were also recorded during the same period (see section on physical characters below).

Physical characters

Data on the following physical characters were recorded: (i) Feather colour, comb size, comb colour—these were recorded as 'relative' indices (i.e. relative to each other). Birds in both groups were scanned every 3 days (after the last data collection period of the day) and an index of 1–6 was determined with the bird with the darkest brown feather colour/largest comb/darkest red comb assigned the rank of 1, and the bird with the lightest brown feather colour/smallest comb/lightest pink comb assigned the rank 6. (ii) Weight records—animals were individually weighed every 3 days using a Salter Top Line 265 Scales fitted with a 54 cm × 42 cm Perspex sheet. Birds were weighed after the last data collection period of the day; precautions were taken to cause minimal disruption to the social group. Weights were converted to a rank order for the purposes of the present analysis: the heaviest bird was assigned the rank of 1; the lightest bird was assigned the rank of 6.

Calculation of social status

The procedures employed are described in Bradshaw (1992). Three ranked measures of social status (dominance, aggression and social interactiveness) were calculated based on the frequency of head pecks, threats and body pecks.

Analysis

The relationship between social status at Week 3 and ranked physical properties of the social group was examined by calculation of Spearman rank correlation coefficients. Because of the presence of triangularities in the dominance relationships of three of the groups, the construction of a linear rank order would have been arbitrary. No correlation coefficients between dominance and the ranked physical attributes were therefore calculated for these groups. Measures of 'aggression' and 'interactiveness' were calculated for all groups and therefore correlation coefficients were calculated between these rank orders of social status and non-behavioural data.

RESULTS

The results of correlations between ranked social status (dominance, aggression or interactiveness) and ranks of the physical characters of the birds are shown in Table 1.

There was a significant positive correlation between comb colour and dominance in group 3 where dominance relationships were clearly linear ($r_s = 0.82$, $P < 0.05$), i.e. birds with darker combs were more dominant. A strong positive correlation between comb size and both aggression and interactiveness in Group 2 was present (aggression: $r_s = 0.94$, $P < 0.01$; interactiveness:

TABLE 1

Spearman rank correlation coefficients (r_s) between ranked physical characters and ranked measures of dominance, aggression and interactiveness

Character ¹	Dominance				Aggression				Interactiveness			
	1 ²	2	3	4	1	2	3	4	1	2	3	4
Wt	—	—	0.08	—	0.46	0.65	0.14	−0.32	0.98**	0.54	−0.46	−0.32
Fc	—	—	0.08	—	0.54	0.54	0.02	0.2	0.37	0.6	−0.14	0.2
Cs	—	—	0.2	—	−0.08	0.94**	0.42	−0.31	0.08	0.88*	−0.08	−0.31
Cc	—	—	0.82*	—	−0.08	0.6	0.65	−0.31	0.08	0.65	0.08	−0.31

¹Wt, weight of individuals in group; Fc, relative feather colour indices; Cs, comb size indices; Cc, comb colour indices.

²Designated group number.

*Significant at $P < 0.05$; **significant at $P < 0.01$.

$r_s=0.88$, $P<0.05$; the rank order of aggression and interactiveness in Group 2 was not identical) but not in the other three groups. The only other significant correlation was between body weight and interactiveness in Group 1, i.e. heavier birds tended to be more interactive ($r_s=0.98$, $P<0.01$).

Following this analysis the relationship between physical characters within each group was explored (e.g. whether comb colour and comb size within a group were identical). In Group 1 comb size and comb colour indices were identical ($r_s=1$, $P<0.0025$); in Groups 2 and 4 there was a significant correlation between feather colour and comb colour ($r_s=0.94$, $P<0.01$; $r_s=-0.088$, $P<0.025$); in Group 4 there were correlations between weight and comb size ($r_s=0.97$, $P<0.01$) and feather colour and comb size ($r_s=0.82$, $P<0.05$). Thus significant correlations between physical factors within groups were infrequent. Those significant correlations noted were between factors that did not correlate with any measure of social status.

DISCUSSION

The lack of significant correlations between physical characters and measures of social status points away from the notion that social status is in some way determined by, or correlated with, a single or number of obvious 'individual attributes'.

In the case of the calculated linear dominance hierarchy (Group 3) there was a significant correlation between comb colour and dominance supporting the individual attributes model. However, this finding leaves unclear whether colour is a consequence of dominance or determines it. In one group (Group 2) there was a correlation between comb size and aggression and comb size and interactiveness. This finding should be addressed with caution because it was found only in one of the four groups and the age at which the birds were assessed (at point of lay) will be a time of considerable change in both these factors. However, studies on sexual selection have found comb area correlates significantly with dominance (Graves et al., 1985) and that cocks with larger combs tend to rank higher in social dominance hierarchies than do cocks with smaller combs (Allee et al., 1939; Collias, 1944; Guhl and Ortman, 1953; Siegel and Dudley, 1963). There is also evidence that body weight correlates with social rank in cocks (Graves et al., 1985). In the present study heavier birds interacted more, but this correlation was only present in Group 1. There were no significant correlations between dominance and comb size or dominance and body weight (although this could only be tested for Group 3).

The findings of the present study should not be interpreted as clear evidence that social order is not determined by physical characters. One possible explanation for the results may be that social status is determined by factors other than those recorded in the present study. Further study involving a detailed analysis of numerous physical traits employing multiple regression

techniques is clearly essential. In conclusion, while status does not appear to be based in any simple way on the physical characters of individual birds, the 'multiple traits' individual attributes model has yet to be adequately tested.

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