Genetic Variation in Social Aggressiveness and Competition Effects Between Sire Families in Small Flocks of Chickens[1,2,3]

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EVIDENCE has been accumulated by Guhl, Craig and Mueller (1960) and by Komai, Craig and Wearden (1959) indicating that social aggressiveness within strains of chickens is heritable.

Significant associations between social rank and production traits have been reported by Guhl (1953) and Tindell and Craig (1959) within strains, while social "competition effects" between strains were also reported by the latter authors.

The current investigation was set up to yield information on the hypothesis advanced by Tindell and Craig (1959) that competition effects might also be present between families within strains. In addition, variation in social aggressiveness was analyzed to furnish further evidence as to the heritable nature of this characteristic.

Pullets were obtained from eight sire families of the Cornell randombred control population of White Leghorns (see King, Carson and Doolittle, 1959) to conduct the study. All chicks were hatched, wingbanded and dubbed February 12, 1958. They were raised in battery brooders until four weeks of age, then transferred to a brooder house. From eight weeks of age until housing at 21 weeks of age the 248 pullets involved in this investigation were reared within a single pen.

All birds were wing-badged, debeaked and housed July 7, 1958. The laying house which contained the pullets during the experimental period, was divided into 31 similar pens (6 ft.×6 ft.). Each pen had one cup-type waterer and 36 lineal inches of feeder space. Aggressiveness and egg production traits were measured in 15 intermingled flocks in which one bird represented each of the eight sire families in each flock, *i.e.*, 8 birds per flock, with 15 replications. Only laying performance was measured in 16 unmixed sire-family flocks, *i.e.*, 8 birds of the same sire family per flock with two replications for each sire family. Intermingled and unmixed flocks were assigned to pens at random. Pullets within sire families were assigned to the two kinds of flocks by a stratified random scheme, except that full-sibs were not placed in the same unmixed flock, *i.e.*, sire-family flocks consisted entirely of paternal half-sibs.

Each of the 15 intermingled flocks was observed for at least one and one half hours per week for the first month after housing. Social interactions involving fights, pecks, threats and avoidances were all used in estimating the social order of each flock. The relative aggressiveness of each of the 8 sire families was estimated within each of the 15 mixed flocks by converting the percentage of birds dominated by any given individual to an

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ordered social rank. The ranking score was a numerical rating from 1–8 in which 8 indicated the most aggressive individual. On the basis of these individual ranks, sire-family means were obtained. Since relative social ranks do not follow a normal distribution, Friedman's non-parametric test, as described by Wilcoxon (1949), was used to test for family differences. Egg production traits measured by means of trapnesting three days per week were: age at first egg, hen-day percentage egg production and hen-housed egg production to 265 days of age.

Coefficients of correlation between ordered social status and the egg production traits were calculated for individuals within mixed flocks. Associations of mean social status of the sire families and inter-sire-family "competition effects" were also estimated by correlation coefficients. Competition effects for each sire family were estimated on the basis of average performance in intermingled flocks minus average performance in unmixed flocks.

The mean social rank for each sire family is given in Table 1. Statistically significant differences between aggressiveness ranks of the sire families were present ($X_r^2 = 14.21$; $P < 0.05$). This implies that genetic variation is present for social aggressiveness within this heterogeneous White Leghorn strain and is in agreement with results obtained by Guhl, Craig and Mueller (1960) and Komai, Craig and Wearden (1959).

TABLE 1.—*Mean social ranks of the eight sire families*

Sire family	Mean social rank
904	5.8
901	5.6
902	4.9
903	4.6
912	4.1
916	4.1
915	3.7
907	3.3

A significant negative correlation was present between social status within mixed flocks and sexual maturity ($r = -0.24$). Although no correlation was found with rate of lay, social status tended to be correlated with hen-housed egg production ($r = 0.17$, $P < 0.10$). Since rate of lay was not correlated with social rank and there was essentially no mortality, the latter correlation appears primarily due to the effect of sexual maturity. Comparisons of correlations between aggressiveness and egg production traits from this

TABLE 2.—*Correlations of social rank and egg production traits within flocks of different sizes*

Trait	Flock size					
	8[1]		24[2]		96[3]	
	df	r	df	r	df	r
Sexual maturity	101	−.24*	116	−.38**	94	−.29**
Hen-day percentage Egg production (from first egg)	101	.03	116	.14	84	.05
Hen-housed Egg production	101	.17(*)	121	.34**	94	.27**

[1] Current investigation, July 10–December 20, 1958.
[2] Tindell and Craig (1959), September 4–December 31, 1956, pure strain flocks only.
[3] Guhl (1953), from housing to 265 days of age for hen-day percentage and hen-housed egg production calculated from data supplied by Guhl.
** $P < .01$.
* $P < .05$.
(*) $P < .10$.

and two other studies in which flock size differed (see Table 2) suggest a possible tendency for the within-flock competition effects to be of less importance in very small flocks as compared with larger ones. If this is so, any lack of competition effects between families in small flocks may reflect poorly on what would happen in larger flocks.

Correlation coefficients of −0.28, −0.03 and 0.17 were found between sire-family social rank and competition effects on sexual maturity, hen-day and hen-housed egg production, respectively. Although the associations of aggressiveness level with age at sexual maturity and hen-housed production were in the directions expected, *i.e.* submissive families were later maturing and laid fewer eggs when in competition with more aggressive families, the correlations were of small magnitude and statistically nonsignificant. This would indicate that selection for performance on a sire-family basis is not likely to be influenced much by inter-family social competition within strains. Whether this conclusion is valid only within very small flocks, as in the present study, or may be extended to larger flocks is a question of some importance, but the answer is not apparent from the present investigation.

SUMMARY

Significant differences in aggressiveness were found between pullets of eight sire families of one strain indicating that additive genetic variation was present.

Within-flock correlations of small magnitude were found to exist when social rank was correlated with sexual maturity and hen-housed egg production.

Competition effects between sire families within small flocks were small and nonsignificant.

REFERENCES

Guhl, A. M., 1953. The social behavior of the domestic fowl. Kansas Agr. Expt. Sta. Techn. Bul. 73: 1–48.

Guhl, A. M., J. V. Craig and C. D. Mueller, 1960. Selective breeding for aggressiveness in chickens. Poultry Sci. 39:970–980.

King, S. C., J. R. Carson and D. P. Doolittle, 1959. The Connecticut and Cornell randombred populations of chickens. World's Poultry Sci. J. 15: 139–159.

Komai, T., J. V. Craig and S. Wearden, 1959. Heritability and repeatability of social aggressiveness in the domestic chicken. Poultry Sci. 38: 356–359.

Tindell, D., and J. V. Craig, 1959. Effects of social competition on laying house performance in the chicken. Poultry Sci. 38: 95–105.

Wilcoxon, F., 1949. Some rapid approximate statistical procedures. Amer. Cyanamid Co., New York City, Pages 7–8.

NEWS AND NOTES

BRITISH POULTRY SCIENCE

In April, 1960, Volume 1, No. 1 of *British Poultry Science* made its debut. This is a new journal sponsored by the Poultry Education Association of Great Britain and published by Oliver and Boyd Ltd., Tweeddale Court, 14 High Street, Edinburgh 1, Scotland. Initially two numbers annually will be published in April and October. The annual subscription is 30 shillings or $5.00 in Canada and the United States, single numbers being 17 shillings and 6 pence or $2.75 in Canada and the United States.

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