STUDIES OF THE FLOCK ORGANIZATION OF THE WHITE-THROATED SPARROW

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SCHJELDERUP-EBBE (1935) performed pioneer and classic investigations on the social order in chickens. He found that in flocks of less than ten individuals the peck-order is usually so arranged that no triangular pecking occurs. This type of social order is based on an almost absolute "peck-right." In flocks of ten individuals or more, although the social order is of the firmly fixed, despotic sort, straight-line pecking is a rarity.

Masure and Allee (1934a) working with the common chicken obtained results similar to those of Schjelderup-Ebbe. However, the same investigators working with the pigeon (1934a) and the Shell Parakeet (1934b) failed to find a flock organization based on an absolute peck-right, but on what Allee calls a "peck-dominance." This type of flock organization involves many return pecks. Shoemaker (1939) reports that the peck-dominance type of flock organization is also characteristic of canaries.

The purpose of the present investigation is to (1) present an improved method for observing the social behavior of wild-caught birds, (2) to determine whether the White-throated Sparrow (*Zonotrichia albicollis*) exhibits the firmly fixed, despotic sort of social order or the peck-dominance type, (3) to learn whether or not there is any correlation between the number of White-throats in a given flock and the number of triangular relationships. The present paper presents studies on correlation of flocks of three, four, five, and six.

IMPROVED METHOD FOR OBSERVING THE SOCIAL BEHAVIOR OF WILD BIRDS IN CAPTIVITY

The accompanying figure illustrates the improved method for observing the social behavior of wild-caught birds. The observations are carried on within a dark room. The investigator is seated behind an observation screen which is furnished with a transparent mirror, B. Thus, the investigator has a clear vision of the birds, whereas the birds are unable to detect the presence of the investigator. Illumination is furnished by an electric light, A. Any light rays reflecting directly on the transparent mirror decreases its visibility. The cardboard shade, C prevents reflection on the transparent mirror.

By keeping the flock in complete darkness except when observations are made(feedings are made during observations), all or most of the contacts may be recorded. The fact that the birds are relatively inactive and not feeding, drinking, and bathing between observations provides greater activity and more frequent contacts during observation periods.

The English Sparrow (*Passer domesticus*), the White-crowned Sparrow (*Zonotrichia leucophrys*), and the White-throated Sparrow were used to test the efficiency of the foregoing method.

Observations with all three species were made with and without the use of the transparent mirror. Although man may gain the confidence

Figure 1. Dark observation room. A. Nickle-plated reflector with 150-watt bulb. B. Transparent mirror. C. Cardboard shade to prevent reflection on transparent mirror.

of English Sparrows in the open field, in captivity they seem to remain intractable. The senior author has been in the presence of the same individuals daily for as long as six months without observing any change in their attitude toward him. The birds seldom feed or bathe during periods of observation. They would retreat to a far corner of the large observation cage and peck viciously for what appeared to be a perch right. He has seen a female draw blood from the eye of a male, an injury which resulted in the permanent loss of sight. This retreating and then pecking might be referred to as a "retreat peck." Under these conditions (a method similar to that used by Schjelderup-Ebbe and Allee) the birds behaved as though they were under a psychological strain. At least for English Sparrows, such a method did not represent ideal experimental conditions in our laboratory.

Using the same flock of English Sparrows, observations were then conducted with the use of the transparent mirror. The birds had been kept in individual cages where they were unable to see one another for three weeks prior to the observations. Schjelderup-Ebbe (1935) states: "Separation of a little over a week may be enough to make the birds quite uncertain, hesitation characterizing their attitude toward each other (the first objective indication of the weakening of recognition). After a separation of a fortnight or three weeks birds usually show no signs of recognition of other birds of the same species." Repeated observations on the same flock of birds after a period of 11 to 17 days separation gave no evidence of forgetfulness, since the same social order was immediately re-established without preliminary "jousting" for rank such as occurred during first contacts. Observations were made every day during the feeding period for the duration of the experiment. After the observer had been sitting quietly for about five minutes behind the observation screen the birds began to move freely about the cage, hopping, flying, chirping, feeding, and bathing. There seemed to be a total absence of any psychological strain. The conditions seemed to be ideal for experimental purposes.

The same general results were obtained with the White-crowned and the White-throated Sparrows. However, these two species do not show as high a degree of apparent nervousness in the presence of an observer as do the English Sparrows. Although the improved method is evidently an excellent one for observing wild birds in captivity, apparently it is not necessary for observing tame birds, as chickens, canaries, and Shell Parakeets. The use of the screen in the study of any wild-caught bird should be considered good technique for it reduces to a minimum the possible errors in making observations.

Flock Organization of the White-throated Sparrow

All of the following observations were made with the use of the improved method. Studies of flocks of three and four birds were made by the senior author and studies of flocks of five and six birds by both authors. Some of the observations were made by both investigators concurrently, using two screens. Each investigator served as a check on the other. All such observations showed a marked agreement. Some observations were made in which two separate recordings were made simultaneously, one in which all pecks were recorded and one in which only strong and aggressive pecks were recorded. In these studies there was perfect agreement in social order patterns.

Some difficulty was experienced in determination of sex prior to autopsy. While in most cases plumage differences were sufficiently great to make sex determination relatively accurate, there were some intergrading individuals whose sex could be determined only by autopsy. In most of the experiments the birds were not killed until four to six

weeks after termination of the experiments. During this post-observation period the birds were watched daily for any irregularity and to see if there was any correlation between the occurrence of death during this time and position in the social order. No correlation was noted.

In flocks of three and four birds, colored celluloid bands were used for identification purposes. In flocks of five and six birds, oil paints were used. The crown and neck were painted.

The total number of pecks recorded in the following experiments were 1966. The total number of actual minutes of observation were 3345.

The birds were trapped in Park Ridge, Illinois, and then transported to Chicago where the observations were made. Series B, Experiment 1, conducted during the spring of 1939, contained fall migrants carried over from the autumn of 1938. In all of the other experiments, the birds were trapped and studied in the fall.

Series A, Experiment 1

This study included a flock of three birds. Bk was a single-testes bird (L.V. Domm and J. P. Wessel, 1940), Bl was a male, and W was a female.

During the first observation period of two hours, a total of 37 pecks were delivered. Bk pecked Bl seven times and Bl returned two pecks. Beginning on the second day and for the duration of the experiment there were no return pecks. Table 1 does not include the 37 pecks observed during the first observation period, October 11, 1938. The table includes recordings from October 12 to October 20, 1938 inclusive.

TABLE 1

Series A, Experiment 1

Bk	pecked	Bl – 58,	W – 65	
Bl	pecked		W – 22,	Bk – 0
W	pecked	Bl – 0,		Bk – 0

Series A, Experiment 2

The birds of Experiment 1 were separated from October 20 to November 1, 1938, a period of eleven days. They were then brought together in the large observation cage. There were no return pecks on the first day or any following day of the entire observation period. The observations lasted from November 1 to November 10 inclusive.

TABLE 2

Series A, Experiment 2

Bk	pecked	Bl – 63,	W – 24	
Bl	pecked		W – 49,	Bk – 0
W	pecked	Bl – 0,		Bk – 0

Series B, Experiment 3

This study included a flock of four birds. Y and B were males, G and R females. During the first observation period of two hours there was a total of 43 pecks. Y pecked B eight times and B returned three pecks. This occurred on April 3, 1939. Between April 4 and April 7, there were no return pecks. Table 3 does not include pecks delivered on April 3.

TABLE 3

Series B, Experiment 3

Y pecked	B-34,	G-20,	R-32		
B pecked		G-21,	R-29,	Y-0	
G pecked	B- 0,		R-19,	Y-0	
R pecked	B- 0,	G- 0,		Y-0	

Series B, Experiment 4

The birds of Experiment 3 were separated from April 7 to April 24, 1939, a period of seventeen days. There were no return pecks on the first day, April 24, nor any subsequent day. Observations were made from April 24 to April 28 inclusive.

TABLE 4

Series B, Experiment 4

Y pecked	B-33,	G-44,	R-43	
B pecked		G-57,	R-33,	Y-0
G pecked	B- 0,		R-24,	Y-0
R pecked	B- 0,	G- 0,		Y-0

Series C, Experiment 5

This study included a flock of five birds. V, Br, and Bl were males, Y and Bk were females. During the first observation period of one and one-half hours there was a total of 92 pecks. Y pecked Br two times and Br returned one peck. V pecked Br eleven times and Br returned one peck. This occurred on November 26, 1940. Between November 27 and December 2 inclusive there were no return pecks. Table 5 does not include pecks delivered on November 26.

TABLE 5

Series C, Experiment 5

Y	pecked	V-16,	Br- 4,	Bl-41,	Bk-32	
V	pecked		Br-26,	Bl-18,	Bk- 5,	Y-0
Br	pecked	V- 0,		Bl-46,	Bk-17,	Y-0
Bl	pecked	V- 0,	Br- 0,		Bk- 6,	Y-0
Bk	pecked	V- 0,	Br- 0,	Bl- 0,		Y-0

In this experiment there developed what might be called a territorial triangle. The term territorial is here used in a restricted sense to indicate the fact that when V, Y, and Br approached each other within the cage, V always moved away from Y, Br moved away from V, and Y moved away from Br. Naturally such behavior prevented bodily contact and the delivering of a large number of pecks.

The question arose concerning what effect the introduction of a sixth bird into the flock would have on this territorial triangular relationship. One of three things might occur. First, the territorial-triangle might develop into a peck-triangle; second, the territorial-triangle might be dissolved without any replacement by a peck-triangle; third there might be no change whatever.

Series D, Experiments 6 and 7

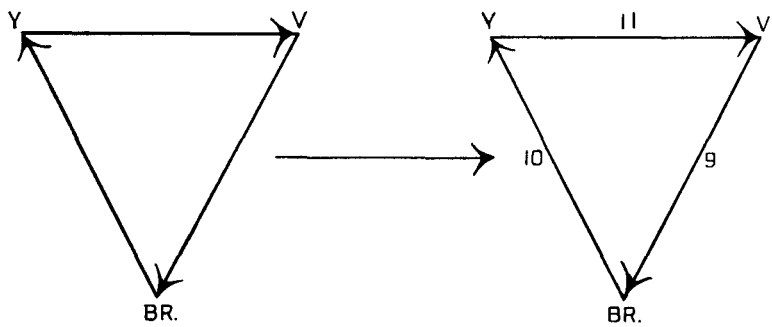
This study includes the five birds of Experiment 5 with the introduction of a sixth bird W, a male. W was introduced during the afternoon of December 2, 1940. During a one hour period 35 pecks were delivered. W first encountered Y. Y pecked W once and W returned pecks viciously on four different occasions during which Y gave way. Almost immediately following the defeat of Y, Br charged Y, delivering an aggressive peck. Y did not return the peck. Y maintained her dominance over V. W pecked Br two times and Br returned one peck. There were return pecks between Y and W, W and Br and one reversal between Y and Br. On subsequent observations of December 3, 4, and 5, there were no return pecks. Table 6 does not include pecks delivered on December 2.

TABLE 6

Series D, Experiment 6

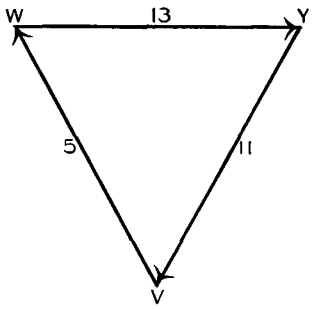
W pecked	V – 0,	Y – 13,	Br – 6,	Bl – 19,	Bk – 6,
V pecked		Y – 0,	Br – 6,	Bl – 4,	Bk – 2, W – 5
Y pecked	V – 11,		Br – 0,	Bl – 25,	Bk – 8, W – 0
Br pecked	V – 0,	Y – 10,		Bl – 16,	Bk – 2, W – 0
Bl pecked	V – 0,	Y – 0,	Br – 0,		Bk – 2, W – 0
Bk pecked	V – 0,	Y – 0,	Br – 0,	Bl – 0,	W – 0

The territorial triangular relationship, present before the introduction of the sixth bird W, has now developed into a peck-triangle.



NO.1. TERRITORIAL-TRIANGLE NO.1 PECK-TRIANGLE

A second triangle is present, having no territorial history, involving Y, V, and W.



NO.2. PECK-TRIANGLE

During the morning of December 5, Br was especially aggressive toward Y. In the afternoon of the same day a revolt took place in which Y became dominant over Br. On subsequent days and until the experiment was brought to a close on December 13, Y remained dominant over Br, and during this time there was no return pecking. Table 7 shows the flock organization after the revolt took place.

TABLE 7

SERIES D, EXPERIMENT 7

W pecked	V – 0,	Y – 36,	Br – 30,	Bl – 83,	Bk – 46				
V pecked		Y – 0,	Br – 20,	Bl – 38,	Bk – 13,	W – 24			
Y pecked	V – 71,		Br – 115,	Bl – 71,	Bk – 32,	W – 0			
Br pecked	V – 0,	Y – 0,		Bl – 16,	Bk – 16,	W – 0			
Bl pecked	V – 0,	Y – 0,	Br – 0,		Bk – 14,	W – 0			
Bk pecked	V – 0,	Y – 0,	Br – 0,	Bl – 0,		W – 0			

Triangle No. 1 no longer exists but Triangle No. 2 persists. The triangle can be considered a fairly fixed characteristic of this flock of six birds.

SERIES D, EXPERIMENT 8

Three days after experiment 7 was brought to a close Br died. The other five birds used previously in Experiment 7 were brought together in the large observation cage to see whether the single stable triangle (No. 2) would persist in this reduced flock of five birds. Table 8 includes all pecks delivered from December 16 to December 19, 1940. During this time there were no return pecks.

TABLE 8

SERIES D, EXPERIMENT 8

W	pecked	V – 0,	Y – 12,	Bl – 37,	Bk – 7	
V	pecked		Y – 0,	Bl – 2,	Bk – 0,	W – 9
Y	pecked	V – 16,		Bl – 7,	Bk – 8,	W – 0
Bl	pecked	V – 0,	Y – 0,		Bk – 1,	W – 0
Bk	pecked	V – 0,	Y – 0,	Bl – 0,		W – 0

Triangle No. 2 persists in this reduced flock of five birds. The total peck relationship in this triangle as observed in Experiments 6, 7, and 8 are: W pecked Y 61 times; Y pecked V 86 times; V pecked W 38 times.

DISCUSSION

When White-throated Sparrows strange to one another are brought together in a laboratory observation cage they are very nervous and extremely alert. During the first day return pecks generally occur between members that are destined to occupy relatively high positions in the peck order. By the second day each member of the flock seems to recognize its natural position and from then on the flock organization is of the firmly fixed, despotic type originally described by Schjelderup-Ebbe (1935).

In our experiments with flocks of three, four, and five, the flock organization is of the straight-line type. In our flock of six, two triangular relationships appeared. Although the absolute straight-line relationship no longer existed, the flock organization was still based on an absolute peck-right phenomenon.

There appears to be a close relationship between territorial right and peck right. In experiment 5, there was a clear case of a territorial-triangle in which V gave way to Y, Br to V, and Y to Br. However, this triangle was in no sense also a peck-right triangle, for although Y definitely avoided Br, Y when the occasions called for it would successfully attack Br demonstrating a strong peck-right over Br. When, however, a sixth bird W was added to the flock (Experiment 6) Y challenged W and lost. During the conflict Br seemed to observe Y's movements and after the defeat challenged Y. Again Y lost. This development of a territorial-triangle into a peck-triangle seemed not to have much permanency as three days later a revolt took place in which Y regained her dominance over Br. Y not only regained her peck dominance over Br but now for the first time achieved also a territorial dominance.

In White-throats there seems to be no relation between sex and position in the social order. In Series A the alpha position was occupied by a single testes bird, in Series B by a male, in Series C by a female, in Series D, Experiment 6 it was shared by two males, and in Series D, Experiments 7 and 8 it was shared by two males and one female. However, in all the experiments the low bird was a female. The most aggressive bird in all of the experiments was Y, a female.

In general there is a correlation between position in the social order and time of feeding and bathing. The alpha birds generally feed first. In none of the experiments did the low birds bathe at any time during the observations.

Summary

1. An observation screen with a transparent mirror provides a situation in which the psychological factors are conducive to satisfactory experimental conditions. This is especially true when studying English Sparrows. The use of the screen in the study of wild birds in captivity is good technique for it reduces to a minimum the possible errors in making observations.

2. Keeping birds in total darkness between periods of observation and providing food only during observations (generally two hours per day) make possible the recording of a majority of the contacts and gives greater quantitative returns during observation periods.

3. The social order among White-throated Sparrows is of the firmly fixed, despotic sort originally described by Schjelderup-Ebbe. In our flocks of three, four, and five the straight-line type was shown to exist. In our flock of six two triangles developed. Peck triangle No. 2, having no territorial history, persisted after the reduction of the flock to five members.

4. In White-throated Sparrows there seems to be no correlation between sex and position in the social order.

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