

THE BEHAVIOR DEVELOPMENT OF GROUP-RAISED AND
ISOLATION-RAISED FEMALE DOMESTIC FOWL

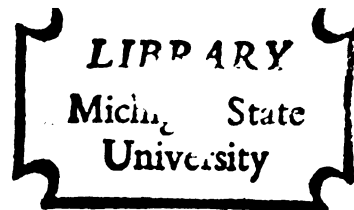
Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

ARDITH HARTFORD

1967

3545514



ABSTRACT

THE BEHAVIOR DEVELOPMENT OF GROUP-RAISED AND ISOLATION-RAISED FEMALE DOMESTIC FOWL

by Ardith Hartford

Stage 1 of this study consisted of the observation and description of the behavioral development of group-raised (I) and isolation-raised (II and III) female domestic fowl from the day of hatching until day 40 post-hatch. Stage 2 involved the observation and description of social-aggressive behaviors after the isolation-raised chicks were assembled into their respective groups (ages 43 through 112 days). The subjects were DeKalb Hybrid (White Leghorn) pullets. Group I contained 10 pullets raised together. Isolation Group II contained 6 pullets; isolation Group III contained 10 pullets.

Two conditions of visual isolation were used during Stage 1 to determine possible differential effects on the behavior of the isolates as a function of the amount of stimulation from the experimenter. In one of these conditions (II), chicks were visually isolated only from other chicks. In the other condition (III), chicks were visually isolated from both other chicks and the experimenter.

Behavioral development during Stage 1 was similar for the three groups except for social-aggressive behaviors.

The early components of aggressive behaviors appeared later and occurred infrequently in the isolate chicks as compared with the normal chicks.

Both Group II and III birds displayed intense fear responses when assembled at the start of Stage 2. Within a week after assembly, the behavior of Group II chicks was equivalent to that of the chicks raised together (I). The early components of aggressive behaviors occurred and were integrated into the vigorous mature aggressive displays. The behavior of Group III chicks was consistently different from the behavior of Groups I and II throughout Stage 2 in respect to fear (escape) reactions and aggressive behaviors. Group III birds showed frequent and intense scattering behavior to mild stimuli which did not elicit this behavior in the other groups of chicks. Early components of aggressive behaviors rarely occurred in Group III after assembly and, thus, were not available for integration into later aggressive behaviors. As a result, the aggressive behavior of Group III birds lacked the vigor of the mature aggressive displays of chicks in Groups I and II.

Each group of chicks did, however, form a peck order, indicating that neither condition of isolation inhibited the formation of a social organization. These results with female domestic fowl extend the generality of findings with male domestic fowl.

**THE BEHAVIOR DEVELOPMENT OF GROUP-RAISED AND
ISOLATION-RAISED FEMALE DOMESTIC FOWL**

By

Ardith Hartford

A THESIS

**Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of**

MASTER OF ARTS

Department of Psychology

1967

Harley C. Ratner

ACKNOWLEDGMENTS

The author wishes to thank Dr. Stanley C. Ratner, the chairman of her committee, for his understanding and guidance. The sharing of his knowledge and enthusiastic interest in animal behavior was especially appreciated by the author.

The author's parents provided considerable and varied assistance without which this manuscript might never have been completed.

Finally, the author dedicates this thesis to Mark who originally led her to an awareness of the fascination of animal behavior.

TABLE OF CONTENTS

	Page
INTRODUCTION.	1
METHOD.	7
STAGE 1	8
Subjects.	8
Apparatus	9
Procedure	11
Measurement	12
Results.	16
Behavior of Group I	16
Behavior of Group II.	22
Behavior of Group III	23
Discussion	25
STAGE 2	28
Subjects.	28
Apparatus	29
Procedure	29
Measurement	31
Results.	34
Behavior of Group I	34
Behavior of Group II.	37
Behavior of Group III	38
Peck Orders	40
Discussion	44
REFERENCES.	47
APPENDICES.	49

LIST OF TABLES

TABLE		Page
1.	Day of Behavior Onset and the Percentage of Subjects Showing the Behavior during Stage 1.....	17
2.	Day of Behavior Onset and the Percentage of Subjects Showing the Behavior during Stage 2.....	35
3.	Proposed Peck Orders.....	41

LIST OF FIGURES

FIGURE		Page
1.	Isolation Cages Used during Stage 1 with Front Wall Removed.....	10
2.	Group I Cage Used during Stage 2 with New Sides Added to Increase the Height of the Cage.....	30

LIST OF APPENDICES

APPENDIX		Page
1.	Day of Behavior Onset during Stage 1 for Individual Subjects in	
	Group I.....	50
	Group II.....	52
	Group III.....	54
2.	Day of Behavior Onset during Stage 2 for Individual Subjects in	
	Group I.....	56
	Group II.....	57
	Group III.....	58

INTRODUCTION

The first stage of the comparative analysis of behavior, as proposed by Ratner and Denny (1964), is the identification and characterization of behavior through observation and description. Description of behavior may be the most important phase of behavioral study as the information gained in this manner often shapes further experimental work (Marler & Hamilton, 1966). Scott (1956) emphasized that the analysis of social organization and behavior of animals requires descriptive study not only of social behavior of mature groups but, also, of the development of social behavior and organization.

An extensive literature exists on the social behavior and organization of adult domestic fowl as evidenced by the reviews of Wood-Gush (1955) and Guhl (1953). However, few studies have described the development of social behavior from hatching to maturity. Those studies reported are briefly described below.

Guhl (1958), from a series of observations of both heterosexual and unisexual groups of chicks, described a developmental sequence of behavior patterns leading to adult social behavior. The sequence was escape (fear) reactions, frolicking, sparring, aggressive pecking, avoidance, and fighting. The behaviors tended to appear in this order but considerable variability was noted in ages of onset of these behaviors. Female chicks showed less frequent aggressive pecking than the males. The

peck orders of female groups were formed later than for male groups.

In a report dealing primarily with the aggressive and courtship behavior of the male Burmese Red Junglefowl, Kruijt (1964) gave detailed descriptions of the developing male behavior patterns. He suggested that there were no clear-cut qualitative differences between the two sexes in aggressive behaviors. However, he stated that fighting was less frequent, less vigorous, and of shorter duration in females compared to males.

The behavioral development of male White Cobb chicks was observed and described by Ratner (1965) with emphasis on aggressive behaviors. He confirmed Guhl's observations of frolicking, sparring, aggressive pecking, and fighting but with some differences in ages of occurrence. In addition, he described frolicking with an object, food dominate and food submit, and the juvenile fight. The developmental patterns of chicks before mature organization were classified into synthesized behavior patterns and differentiated behavior patterns. Synthesized behaviors are those, such as frolicking with an object, which first occur alone and then are integrated into more elaborate behaviors. Differentiated patterns are those which do not change in form but are elicited by more specific stimuli as development proceeds.

Another question of interest concerning the development of social behavior and of later mature behavior, is

the effect of early raising conditions. Guhl (1958) also considered this in the previously described paper. He raised chicks in partial isolation from other chicks, that is, the isolated chicks could see each other but could not contact each other. Guhl's primary purpose was to determine if this partial isolation would influence the age at which these chicks formed peck orders when grouped. A small number of isolated males were assembled at the time when an equivalent, raised-together group had formed a peck order. The isolation raised male chicks formed a peck order within two days after assembly. Two groups of pullets were also raised in partial isolation until comparable groups had formed peck orders. The isolation raised pullets formed peck orders within eight hours after assembly. The conclusion drawn by Guhl was that the early experience of such behaviors as frolicking, pecking, and fighting was not essential to rapid formation of social organization. Observations were not conducted on the behavior of the chicks while they were isolated. Therefore, as noted by Ratner (1965), the possibility exists that Guhl's isolates did perform at least some of the behaviors such as frolicking. Also, the partial isolation conditions of this study may have still provided considerable social stimulation to the birds during development.

To determine the effects of isolation on the

development of behavior and on later mature behavior, Ratner (1965) observed a group of White Leghorn cockerals raised together and an equal number of White Leghorn cockerals raised in complete visual isolation from other chickens. The isolate chicks were observed during isolation. Of primary interest is the occurrence of frolic, frolic with an object, sparring, and juvenile fighting behaviors while these chicks were isolated, although the ages of occurrence were somewhat retarded for the isolated chicks as compared with the normals. When the chicks were assembled at age 70 days, aggressive interactions began almost immediately. The aggressive behaviors were somewhat less organized (pecking backs, wings, etc.) than the group-raised birds and the birds were more agitated than the normal animals. However, within a few days after assembly these birds resembled normal birds in behavior and a peck order was formed.

Kruijt (1962) raised male Burmese Red Junglefowl in what might best be described as partial isolation. These chicks could not see fellow isolated chicks but were able to see free-roaming birds. He was particularly interested in the effect of long periods of isolation (9 to 16 months) on courtship behaviors but noted the appearance of abnormal aggressive and escape behaviors while these birds were in isolation. Most of the chicks showed extreme escape behavior during the early

months of isolation, such as running through the cage, "screaming", and ducking in the corners. The eliciting stimuli, although not specifically identified, were probably, as noted by Kruijt, relatively mild, for example, a small bird flying over the cage. Later, these isolated males were observed to direct aggressive responses to their own tails and, also, to humans. These isolated males were never grouped together to determine if social organization with normal aggressive-submissive behaviors would be shown.

Fisher and Hale (1957) visually isolated males for 8 months after hatching and found that, on assembly, fighting behavior was shown within 30 minutes. However, they do not indicate if any aggressive behavior components were performed by these birds while they were isolated.

This brief review of isolation studies indicates that the expression of aggressive behaviors is not inhibited on assembly by previous partial or complete visual isolation from other chicks. However, in all cases, the chicks were exposed to considerable stimulation from the human observers and activity in the experimental rooms.

It is of interest to note that the majority of the studies of the ontogeny of social behavior of domestic fowl has dealt with males. Possible differences between the sexes in social development have been

neglected except for mention of some differences in ages of behavior onset and frequency. None, however, suggested that the developmental patterns of social aggressive behaviors differed between the sexes.

Therefore, the purposes of the present study were (1) the observation and description of the behavioral development of group-raised and isolated female chicks (Stage 1) and (2) the effects of early raising conditions on later aggressive behaviors after grouping (Stage 2). In addition, two conditions of isolation were employed to determine if there would be differential effects on the behavior of the isolates as a function of the amount of stimulation from the experimenter.

METHOD

General Organization

During Stage 1 DeKalb Hybrid pullets were raised under three conditions: Group I subjects were raised together from the day of hatch; Group II subjects were raised in visual isolation from other chicks until day 43 post-hatch; Group III subjects were raised in visual isolation from both other chicks and the room surroundings including the experimenter until day 44 post-hatch. Each bird in each group was observed individually during the course of Stage 1. Then Group II and Group III were assembled and Stage 2 of the experiment was begun. During Stage 2 observations were made primarily of social behaviors. Stage 2 was continued until the birds were 112 days of age.

The procedure, results, and discussion of Stage 1 will be treated first. Then the procedure, etc., of Stage 2 will be considered.

STAGE 1

SUBJECTS

The subjects were 31 DeKalb Hybird (White Leghorn) pullets obtained from a commercial hatchery on the day of hatch. The chicks were put together in a large box and transported to the experimental room. Each was immediately assigned at random to one of the three groups. Ten subjects were placed in Group II and in Group III; eleven subjects were placed in Group I.

Each subject in the group-raised condition (I) was marked with a solution of food dye in alcohol as a means of identification. These subjects were re-marked when necessary (approximately $2\frac{1}{2}$ week intervals). Subjects in the isolation-raised conditions (II and III) were not marked until Stage 2. Chicks in Groups II and III were not handled until Stage 2.

The chicks were maintained on Michigan State University chick starter for the first 26 days post-hatch and then were maintained on Michigan State University pullet grower for the remainder of the experiment. Food and water were available at all times during Stage 1.

Four of the original subjects were eliminated during Stage 1. One chick in Group I was removed on day 30 post-hatch due to incorrect sexing. The other three chicks were eliminated from Group II. One died on day 10 post-hatch; one developed an intestinal virus and pigment

defect on approximately day 25 post-hatch which retarded her physical development; one was incorrectly sexed.

APPARATUS

All subjects were housed and observed during the experiment within the same windowless but well-ventilated room ($7\frac{1}{2}$ ft. x 12 ft.). Room temperature ranged from 86 degrees F. to 69 degrees F. during Stage 1. The temperature was gradually decreased as the birds matured.

Group I subjects were housed together in a 3 ft. x 3 ft. x 1 ft. cage with three walls of light-colored wood and one wall and the floor of $\frac{1}{2}$ in. hardware cloth. A fine net was used to cover the cage top to prevent animals from jumping out during observations. A cardboard cover was placed over the top when the animals were not being observed. A gravity flow water dispenser was placed near the center of one wall; feeders were attached to another wall.

Group II subjects were housed in individual 1 ft. x 1 ft. x 1 ft. cages of white celotex with $\frac{1}{2}$ in. hardware cloth flooring (see Figure 1, page 10). A fine net also was used to cover the tops of these cages. Removable celotex tops were placed on the cages when the birds were not under observation. Plastic containers were used as food and water dispensers. Food and water were added from outside the cages without disturbing the subjects. The cages were built in groups of four so that each cage



**Figure 1: Isolation cages used during Stage 1
with front wall removed.**

shared a wall with two other cages.

Group III subjects were housed in individual cages identical to those of Group II except for fixed tops with 3/4 in. viewing holes cut in the middle of the tops.

Heat in all of the cages was maintained by use of incandescent light bulbs which also provided continuous light. No attempt was made to keep the illumination level constant for all groups but there was a moderate light level in all cages. The lights were used primarily to control temperature. An attempt was made to maintain equal temperatures in the cages. The temperature of the cages was adjusted by raising or lowering the bulbs in the cages, by changing the wattage of the bulbs (40-15 watts), and by varying the room temperature. The temperature in both the group and isolate cages was maintained between 98 degrees F. and 92 degrees F. for the first week then gradually lowered to approximately 77 degrees F. at the end of Stage 1.

During the first week post-hatch the floors of all cages were covered with paper and food was scattered on the floors.

PROCEDURE

Observations of the chicks' behavior were conducted daily for the first 14 days after hatching then on alternate days until day 40. Each bird was observed individually for 5 minutes per observation session.

Subjects were observed in an order which alternated among the three groups. For example, on session 1, Bird 376 of Group II was observed, then Bird 364 of Group III, then Bird 357 of Group I, etc., until all birds in all groups had been observed. On the next session the order was changed.

The room was well-illuminated by a ceiling light fixture. At the start of each observation session, the tops were removed from the cages of Groups I and II. The tops were replaced after all birds had been observed. The experimenter was within 1 ft. of the cage when observing Groups I and II. Group III subjects were observed through the viewing holes cut in the tops of their cages.

Behaviors were recorded in the order of occurrence with 30-sec. time intervals noted on the recording sheet. Specific responses, listed below, were recorded and an attempt to identify the eliciting stimulus for a particular behavior was made when possible. However, at times the birds did not display the listed behaviors and then the behavior shown was noted and briefly described on the recording sheet.

MEASUREMENT

Occurrences of the following behaviors were noted on the daily protocol sheets:

Rest: in a squat position with the legs tucked under the

body. Underside of the body rests on the floor; eyes are closed. In young chicks the head rests on the breast or floor; when older, the head is turned over one shoulder and the bill is tucked into the wing.

Huddle: two or more birds standing or squatting close together while resting or preening.

Eat: pecking at food grains.

Grain Scratch: legs move backward, one at a time, rapidly with the toes scratching food grains, the floor, dirt, etc.

Drink: pecking at water. In young chicks the head is then raised up and back and swallowing movements occur; this is less obvious in older birds.

Bill Wipe: alternately wipes sides of bill over the floor.

Head Shake: head moves rapidly from side to side several times.

Head Scratch: head and neck are quickly scratched with the toes of a raised leg.

Preen: soft pecking, nibbling, pulling, and combing of the body and feathers (Kruijt, 1964).

Mutual Preen: soft pecking of another bird's body and feathers.

Stretch: both wings stretch up and back over the back; the leg and wing of the same side raise up and backward.

Stretch Tail: standing with legs, neck, and head stretched upward.

Walk: legs moved forward alternately.

Run: fast walking.

Jump: slight crouch, springs off ground with both feet, and travels vertically. Wings may flap.

Leap: springs off ground a small distance and travels horizontally.

Frolic: running with wings raised or flapping (Guhl, 1958; Ratner, 1965).

Frolic with Object: frolic while carrying some object (dirt, feather, paper, etc.) in the beak (Ratner, 1965).

Run with Object: same as frolic with object but wings are not raised or flapping. Appears to be equivalent to frolic with object.

Rapid Approach: a short run toward another bird stopping short of contact (Farris, 1964).

Spar: run and jump toward another bird or object in the cage (Guhl, 1958; Ratner, 1965).

Aggressive Peck: a hard peck on the head of another bird (Guhl, 1958; Ratner, 1965).

Threat: aggressive peck movements toward another bird but no peck is delivered (Guhl, 1958; Ratner, 1965).

Juvenile Fight: two birds spar with feet thrust forward toward the other bird. May result in physical contact but no pecks are delivered (Ratner, 1965).

Fight with Pecks: a vigorous juvenile fight during which pecks are delivered (Ratner, 1965).

Startle: a sudden jerk of the head or body.

Alert Posture: standing motionless with the neck and

head stretched upward. Head may be oriented toward the source of stimulation (Farris, 1964).

Scatter (escape running): running away from a source of stimulation. (Or, the birds may run in all directions.) Sometimes involves jumping. (Guhl, 1958; Kruijt, 1964)

Generalized Pecking: pecking at loose grain, dirt, paper, walls, light bulbs, etc. (Ratner, 1965).

Competitive Pecking: two or more birds peck at the same spot or same object. Never peck each other. (Farris, 1964)

RESULTS

Table 1 (page 17) presents the day of onset of each behavior for each of the three groups and the percentage of birds in each group showing each behavior during Stage 1 (the first 40 days after hatching). The day of behavior onset was defined as the age at which the first bird was observed to perform the behavior in each group. The percentage of birds showing the behavior was calculated from the number of birds in the group that were observed to have performed the behavior at sometime during Stage 1.

By definition some of the behaviors could not occur in the isolated animals (huddle, mutual preen, rapid approach, aggressive pecking, threat, juvenile fight, fight with pecks, and competitive pecking). All of these behaviors required two birds. Sparring was not excluded from the isolates' behavior as some of the isolates were observed to make sparring movements toward objects in the cage or the cage walls.

BEHAVIOR OF GROUP I

Behavioral development during Stage 1 for the group-raised chicks was characterized by an increasing competence in behavior performance and the addition of new response components along with the integration of behavioral components. Some response durations changed and, although identification of eliciting stimuli was

Table 1: Day of behavior onset and the percentage of subjects showing the behavior during Stage 1.

Behavior Class	Day of Onset			Percentage		
	Group			Group		
	I	II	III	I	II	III
Rest	1	1	1	100	100	100
Huddle	1	x	x	100	x	x
Eat	1	1	1	100	100	100
Grain Scratch	2	4	4	100	100	100
Drink	1	1	1	100	100	100
Bill Wipe	1	2	3	100	86	90
Head Shake	1	2	1	100	100	100
Head Scratch	1	1	2	100	100	90
Preen	1	2	1	100	100	100
Mutual Preen	8	x	x	100	x	x
Stretch	2	3	1	100	100	100
Stretch Tail	4	2	3	80	100	100
Walk	1	1	1	100	100	100
Run	1	2	2	100	100	90
Jump	4	2	4	80	100	100
Leap	8	36	39	30	28	10
Frolic	2	7	6	90	43	10
Frolic with object	--	--	--	0	0	0
Run with object	6	--	--	50	0	0

Table 1 continued on next page.

Table 1: Continued

Behavior Class	Day of Onset			Percentage		
	Group			Group		
	I	II	III	I	II	III
Rapid Approach	8	x	x	60	x	x
Spar	9	31	18	100	43	20
Aggressive Peck	23	x	x	40	x	x
Threat	--	x	x	0	x	x
Juvenile Fight	--	x	x	0	x	x
Fight with Pecks	--	x	x	0	x	x
Startle	3	1	1	70	100	90
Alert Posture	4	4	3	100	71	60
Scatter	1	3	3	100	71	60
Generalized Pecking	1	1	1	100	100	100
Competitive Pecking	1	x	x	100	x	x

x Behavior could not occur
for isolates.

-- Behavior not shown.

difficult, some eliciting stimuli appeared to change.

Increasing competence in behavior was illustrated by head scratching. This behavior was observed on day 1; however, all birds fell over on to their sides while head scratching. By day 3 none of the birds fell while head scratching.

New responses developed after day 1. For example, jumping was not seen until day 4; stretching tail was also not observed until day 4.

Grain scratching gradually became a part of eating. Although shown in a primitive form on day 2, it was performed infrequently with eating until approximately day 7 by all birds. The range of eliciting stimuli broadened with increasing age for grain scratching. First, only loose grains elicited the behavior; later, dirt, objects on the floor, and other birds' backs elicited grain scratching movements.

Generalized pecking behavior changed in response duration and frequency. Also, the eliciting stimuli for the behavior became more narrow. During the first three days after hatching, especially day 1, the birds frequently pecked once or twice at almost any object. (However, the light bulbs, the glass water bottle, and the eyes of other birds were primary eliciting stimuli.) After the first week, the frequency of generalized pecking declined but the duration increased along with

a narrowing of the range of eliciting stimuli. Rather than frequent pecks spread over a five minute observation period, a bird would repeatedly peck, for example, a rough spot on the wall for 30 seconds and then show no other generalized pecking during the observation period. Rough spots, dirt, and recently filled, glass water bottles were most frequently pecked by older birds. Eyes were no longer pecked after the first 3 days.

Integration of response components was involved in sparring. Birds ran on day 1 and jumped on day 4 but the two responses were not performed together in sparring until day 9.

Preening behavior illustrates several of the characteristics of the birds' development. It was simple during the first several days (soft pecks) and directed mainly at the breast and top side of the wings. Gradually more areas of the body were preened: the legs, the back, the underside of the wings, the rear, the tail, and the oil glands. As feathers grew, preening became more elaborate (nibbling, pulling, combing the feathers with the beak) and increased in duration.

The influence of the presence of other chicks on behavior was evident. From the first day, all chicks rested in a huddle with other chicks. It was extremely rare to observe an animal resting alone. The presence of one bird drinking often appeared to stimulate other chicks to approach and to drink. Generalized pecking

by one bird very frequently led to competitive pecking; one or several other birds approached and pecked the same spot in turn. Often it appeared that a running or frolicking bird elicited running or frolicking by others. Several occurrences of running with an object involved most of the animals running fastly about the cage with possession of the object changing frequently among the birds.

Some behavior sequences appeared to develop. Preening was shown regularly before and after resting by all of the birds. Stretching of the wings and legs often occurred after a long period of eating or resting. The birds appeared to have developed a regular rest-activity cycle. Frequent, short rest periods were mixed with somewhat longer activity periods.

Although not specifically observed, much of a bird's behavior during active periods (besides maintenance behaviors) was best described by Scott's (1958) term, investigatory behavior. Birds spent much time walking about slowly while orienting their heads in various directions. This might be described as sensory investigation of the environment.

Aggressive behaviors were low in frequency during Stage 1 and appeared to be incomplete. Often several birds would spar at the same time but the behavior was not directed at another bird. The behaviors were ineffective; that is, no clear dominant or submissive

behaviors were seen. For example, an aggressive (hard) peck might result in the receiving bird simply shaking or scratching her head and then continuing with eating. Unilateral pushing was not obvious; it appeared that birds simply pushed any bird and the push sometimes displaced another bird. The displaced bird was any bird in the group rather than a specific bird being regularly displaced.

Escape behavior changed with age in Group I birds. Scattering was seen on day 1 and the group's behavior was well-organized. Usually, all birds ran away from the fear-producing stimulus into the most distant corner of the cage where they huddled together briefly. Scattering became less frequent with age. Older group-raised birds startled or alerted at stimuli previously eliciting scatter. A change occurred in the birds' responses to the experimenter. When food and water were added during the first two weeks, birds usually ran to the far wall; later, birds often approached to the arm of the experimenter.

BEHAVIOR OF GROUP II

The behavior of the isolated birds of Group II was much like that of the group-raised birds except, of course, for social behaviors. Some of the exceptions are considered below.

Stretching tall and jumping were observed on day 2

in this group compared to day 4 for Group I. Jumping was more frequent in Group II than in Group I. The impression given by the birds' behavior was that these chicks were often orienting upward toward the open tops of their cages.

Leaping and frolicking occurred later and only two animals showed leaping behavior while three showed frolicking. Running was somewhat less frequent for these animals; however, they showed a frequent walking about the cage which might best be described as pacing back and forth.

Generalized pecking developed in much the same way as in Group I birds except that several of the Group II isolates spent much time repeatedly pecking and nibbling at the light bulb and socket.

Scattering developed later in these birds than the startle. Scattering was infrequent; when a bird did "scatter", she generally ran into a distant corner away from the stimulus. A startle followed by the alert posture was often observed to occur as a result of noises from adjoining cages (such as another bird jumping).

Again, the behavior of these birds, while they were active, appeared to be of an investigatory nature.

BEHAVIOR OF GROUP III

The behavioral development of these birds was much like that of Group I. These birds resembled Group II animals with respect to generalized pecking and escape

behavior.

Much of the behavior of these chicks (aside from maintenance behaviors) might be described as standing quietly interspersed with slow walking and some pacing back and forth.

Until the third week, these animals appeared to orient upward less frequently than Group II isolates. During week three jumping upward toward the viewing hole appeared and became frequent. Birds often attempted to peck at the edge of the hole. Also, birds often stood under the hole with their heads directed upward as if looking at the hole.

Sparring was identified only 3 times, once on day 18, twice on day 39. It involved a short run and a slight jump with the bird's head oriented to the wall rather than upwards.

DISCUSSION

Many of the non-social or maintenance behaviors were present on day 1 post-hatch; all of the non-social behaviors were exhibited in all three groups by the end of the first week. The development of these behaviors was mainly related to structural maturation. For instance, the growth of feathers influenced the body areas preened and the form and duration of preening. The non-social behaviors did not appear to have been differentially affected by the raising conditions. This is in agreement with the observations of quail development (Farris, 1964) and of male chicken development (Ratner, 1965).

It should be noted here that in comparing the results of both stages of the present study with other work in the area, the day of behavior onset may not be the most appropriate measure to consider. Several studies have indicated considerable variability in the ages of behavior onset not only among different breeds but also among different strains of the same breed (Holabird, 1955; Guhl, 1958). Also, with reference in particular to the non-social behaviors, the possibility exists that different definitions or criteria of behavior were used in the various experiments. Preening, among other behaviors, suggested this point. Farris (1964) with quail and Kruijt (1964) with semi-domestic fowl both reported preening behavior on the day of hatching in

agreement with the present study. However, Ratner (1965) reported the first occurrence of preening behavior on day 12. Early preening behavior was simple body pecking which gradually became more complex with age and the growth of feathers. Possibly this more complex behavior was used as the definition of preening in the Ratner (1965) study. As a consequence, the sequence of behavior development was emphasized in comparing the results of the present study with others.

In general, social behaviors developed later than non-social behaviors for both the grouped and isolated birds. The aggressive behaviors of both isolate groups were retarded compared to the group-raised birds. Some behaviors were not shown during Stage 1 by the isolated chicks (for example, run with object) and many of the individuals in these groups (II and III) showed no aggressive behavior components. This may have been a result of inadequate stimulation and/or the size of the isolation cages. These observations were in agreement with those of Farris (1964) and Ratner (1965). However, a greater number of isolated male chicks performed aggressive behaviors while isolated in the Ratner study than did female isolates in the present study.

The aggressive behaviors of the group-raised birds (I) were not fully integrated into adult displays at the end of Stage 1. However, the sequence of development was similar to those observed by Guhl (1958) and Ratner

(1965). Frolicking, running with an object, leaping and rapid approach, sparring, and aggressive pecking developed in that order. Leaping and rapid approach were not specifically mentioned in the development of male aggressive behavior. These two components were observed in the female chicks, and, as discussed in Stage 2, appeared to be part of the adult aggressive behavior.

STAGE 2

SUBJECTS

The same subjects were used in Stage 2.

Group I subjects were kept together as in Stage 1. The seven remaining isolate chicks of Group II were assembled together on day 43 post-hatch. The ten isolate chicks of Group III were placed together on day 44 post-hatch.

All subjects were marked with a solution of food dye in alcohol for identification at the start of Stage 2. They were re-marked at approximately 3 week intervals until the end of Stage 2.

Food (Michigan State University pullet grower) and water were always available except for 2-4 hour deprivation periods before some of the observation sessions.

One subject was eliminated during Stage 2. One of the chicks from Group II had, during Stage 1, developed curly toes, apparently as a result of an inability to efficiently utilize Riboflavin (Biester & Schwarte, 1959). She appeared to be reasonably healthy at the start of Stage 2 and was assembled with the others. However, she had to be removed on day 51 due to difficulty in walking and bleeding from the toes.

Therefore, Stage 2 was completed with a total of 26 birds. Group I and Group III were each composed of ten chicks while Group II was composed of six chicks.

APPARATUS

The same experimental room was used for Stage 2.

Group I subjects were kept in the same cage as used in Stage 1. Group II subjects were housed in a cage identical with that of Group I and adjoining it. Group III subjects were placed into a cage of the same dimensions (3 ft. x 3 ft. x 1 ft.) as Groups I and II but the cage was made of white celotex. This cage was placed within 1 ft. of the other cages.

The light bulbs were not used in the cages during Stage 2. Heat was provided only by the room heating system. Temperatures ranged from 78 degrees F. to 68 degrees F. during Stage 2. Again, this was gradually reduced to the lower figure as the birds matured.

Constant light was provided by the overhead ceiling fixture. The cages were only partially covered between observations so that the food and water areas were always well-illuminated.

On day 77, the birds were temporarily removed from the cages and cardboard sides were added to increase the height of the cages to 2 ft. (see fig. 2, page 30).

PROCEDURE

On day 43 Group II subjects were removed from the isolation cages, marked, and returned to the isolation cages. Then these birds were transferred one at a time to the new cage with order noted. Total transfer time



Figure 2: Group I cage used during Stage 2 with new sides added to increase the height of the cage.

was 120 seconds. Another observer recorded behaviors shown during transfer and aided in group observations on this day. The group was observed continuously for 3 hours after transfer and for an additional 2 hours spread over the remainder of the day.

On day 44 Group III subjects were assembled in the same manner. Total transfer time for this group was 180 seconds. The group was observed continuously for 3 hours after transfer and for an additional hour during the day.

Observations of the three groups were conducted every 1 to 3 days at various times until day 112. An additional observation was made of Group III on day 122. Each group was observed for 25 to 50 minutes per session. Two to four hour food deprivation periods before observations were begun on day 57 post-hatch. The condition of the room was like that of Stage 1 during observations. The experimenter sat within 1 ft. of the cage being observed.

A different method of observation was used. The birds were observed as a group rather than individually. Particular attention was paid to social behaviors, that is, aggressive responses, mutual preening, etc.

MEASUREMENT

Occurrences of the following behaviors were noted during Stage 2. All may be characterized as social behaviors in that at least two birds are generally

involved.

Mutual Preening: soft pecking, occasionally nibbling, of another bird's body.

Scatter (escape running): running away from a source of stimulation. (Or, the birds may run in all directions.) Sometimes involves jumping. (Guhl, 1958; Kruijt, 1964)

Aggressive-Submissive Behaviors

Rapid Approach: a short run toward another bird stopping short of contact (Farris, 1964).

Leap: springs off the ground a small distance and travels horizontally toward another bird or birds. May or may not result in contact.

Spar: run and jump toward another bird or object in the cage (Guhl, 1958; Ratner, 1965).

Aggressive Peck: a hard peck on the head of another bird (Guhl, 1958; Ratner, 1965). Occasionally, an aggressive peck was directed at the back of an eating animal.

Threat: aggressive peck movements toward another bird but no peck is delivered (Guhl, 1958; Ratner, 1965).

Displace: pushing another bird from her position.

Juvenile Fight: two birds spar with feet thrust forward toward the other bird. May result in physical contact but no pecks are delivered (Ratner, 1965).

Fight with Pecks: a vigorous juvenile fight during which pecks are delivered (Ratner, 1965).

Dominate: being superior over another bird as a result of delivering an aggressive peck, a threat, or displacing,

or by winning a fight.

Submit: being inferior to another bird as a result of receiving an aggressive peck, a threat, being displaced, or by losing a fight. Indicated by moving away from the dominant bird or taking a submissive posture with the body and head lowered.

RESULTS

Table 2 (page 35) presents the day of onset of each behavior noted during Stage 2 for each of the three groups and the percentage of birds in each group showing each behavior during Stage 2. The day of behavior onset was defined as the age at which the first bird was observed to perform the behavior in each groups. If the behavior had occurred during Stage 1, the day of onset during Stage 1 is given. The percentage of birds showing the behavior was calculated from the number of birds in the group that was observed to have performed the behavior at sometime during Stage 2. (All birds that had shown a behavior during Stage 1 also showed the behavior during Stage 2.)

It should be noted that Group II was assembled one day earlier (43 days post-hatch) than Group III (44 days post-hatch); therefore, occurrence on day 43 for Group II is equivalent to occurrence on day 44 for Group III.

BEHAVIOR OF GROUP I

Aggressive-submissive behavior continued to occur infrequently and incompletely early in Stage 2 (days 43-53). However, the early components of aggressive behavior (rapid approach, leaping, and sparring) occurred very frequently. Sparring was especially frequent for the first 10 days then gradually declined and was rare after day 65. These early components of aggressive behavior

Table 2: Day of behavior onset and the percentage of subjects showing the behavior during Stage 2.

Behavior Class	Day of Onset			Percentage		
	Group			Group		
	I	II	III	I	II	III
Rapid Approach	8*	43	47	100	100	70
Leap	4*	36*	39*	100	100	90
Spar	9*	31*	18*	100	100	30
Aggressive Peck	23*	51	47	90	100	100
Threat	43	49	49	100	100	90
Displace	43	51	51	100	83	100
Juvenile Fight	44	84	103	40	50	20
Fight with Pecks	65	--	--	30	0	0
Dominate	43	51	47	100	100	100
Submit	43	51	47	90	100	100
Mutual Preening	8*	43	44	100	100	100

* Day of onset during Stage 1.

-- Behavior not shown.

did not disappear but became integrated into adult aggressive displays. For example, a slight spar-like jump sometimes occurred with the delivery of a threat.

The first observed submissive behavior resulted from one bird displacing another (day 43). Later (day 49), submission resulted from aggressive pecking and threatening. Before day 49, responses of pecked birds were much like those described for Stage 1.

With increasing age the form of the aggressive-submissive behaviors developed into the vigorous mature displays. There was an exception to this. Remote and subtle threats delivered by the dominant animal in this group became highly effective in eliciting avoidance in many of the other chicks.

Dominant-submissive relations were primarily settled by either pecking, threatening, or displacing. Fighting behavior (both juvenile and with pecks) was rarely observed. The two recorded fights with pecks were brief encounters and were terminated by one peck by the dominant bird.

Mutual preening and scattering remained much like shown in the latter part of Stage 1. Scattering in these birds was rarely elicited by any stimulus. Approach to the experimenter when food was added increased; several birds attempted to peck the experimenter's hand.

BEHAVIOR OF GROUP II

Day of Assembly

The first behaviors shown on assembly were intense fear responses. When placed into the group cage, each chick popped (sudden jump), then froze in a squat posture. The chicks distributed themselves about the cage rather than in huddles. Contagious popping followed by freezing of all chicks continued for almost the first hour. The stimulus for popping was not detectable. Possibly slight movements of one chick elicited the popping. Toward the end of the first hour, several birds walked slowly and preening began. Birds exhibited generalized pecking while walking about the cage. Within two hours eating and mutual preening had begun. The duration of the freezing responses gradually decreased. The form of the fear responses also changed. Popping and freezing were replaced by startles and very short periods of freezing while standing erect. The contagious characteristic disappeared. That is, different birds were doing different things. Five hours after assembly the birds were calm and showed little fear behavior. No aggressive behavior was noted on this day.

Days 44-112

During the first week together, the birds' behavior differed from that of Group I mainly in respect to fear responses and huddling. Group II showed more scattering; however, the scattering was organized much

like Group I. The birds ran away from the source of stimulation. Huddling was rare during the first days while the birds were resting.

At the end of the first week, the general appearance of the behavior of this group was equivalent to that of Group I. The aggressive-submissive behaviors developed similarly except for some differences in days of onset. Scattering behavior became rare. Occurrences of other behaviors are noted in Table 2.

BEHAVIOR OF GROUP III

Day of Assembly

When placed into the group cage, these birds popped and froze in squat postures much like Group II. However, these behaviors continued for only the first 10 minutes. Then some birds began to walk while others remained frozen. The walking was extremely jerky. At first several birds simply walked into each other or into the water bottle. Within 30 minutes all were walking about slowly and unsteadily. Several birds repeatedly rubbed their heads or bodies along the cage walls. Generalized pecking, especially of the eyes of other birds, was extremely frequent compared to Group II when it was assembled. Preening and mutual preening began about 35 minutes after assembly. Several birds ate briefly within the second hour. Most of the behavior was walking about combined with a great amount of generalized

pecking. Occasionally, the birds scattered or startled. Eight hours after assembly the birds were more relaxed and generalized pecking of the eyes had decreased considerably. These birds also did not rest in huddles. No aggressive behaviors were observed.

Days 45-122

The behavior of Group III differed from that of Groups I and II throughout Stage 2 in respect to both aggressive-submissive behavior and scattering (escape) responses. Although aggressive-submissive behavior patterns developed, they were less vigorous than those of Groups I and II and low intensity stimuli elicited them. Scattering behavior was very frequent (at least once per observation session) and was elicited by stimuli that did not elicit this behavior in the Group I and II birds.

The early components of aggressive behaviors (rapid approach, leaping, and sparring) were rare in this group. Only 3 birds sparred in Group III compared to all of the birds in Groups I and II. When sparring was seen, it often resulted in other birds scattering. However, aggressive-submissive behaviors were complete on day 47 in that the first observed aggressive pecks resulted in submission. However, the aggressive displays lacked the vigor of the mature adult displays shown in Groups I and II. For example, rarely were spar-like jumps integrated with threat behaviors. Birds in Group III sub-

mitted readily.

The scattering behavior of this group differentiated it most obviously from the other groups. Any sudden stimulus, especially movement within or near the cage, resulted in extreme, disorganized scattering. Birds ran and jumped in all directions. Often they bumped into or landed on each other. A fly in the cage resulted in scattering while in Groups I and II the birds did not scatter but often pursued the fly. Slight movements of the observer, ineffective stimuli for Groups I and II, led to wild scattering of these birds. When food was replaced after deprivation periods, 15-20 seconds usually passed before the birds approached the feeder. Group I and II animals approached the feeder immediately.

PECK ORDERS

Guhl (1953) suggested that peck-orders are completed at approximately 10 weeks of age in small groups of pullets. An attempt was made to rank the birds within each of the present groups to verify the existence of peck orders which may be considered the final stage in the development of the social organization of chicken groups.

Table 3 (page 41) presents the proposed peck orders for the three groups. The peck orders were estimated from an examination of all effective aggressive-submissive encounters observed between each pair of birds

Table 3: Proposed peck orders.

Position	Group		
	I	II	III
1	356	375	364
2	354	380	372
3	363	377	368
4	360	381	369
5	361	376	367
6	362	383	366
7	359		370
8	357		373
9	355		365
10	358		371

within each group from day 72 to the end of Stage 2. Day 72 was chosen as a starting point as the peck orders should have been formed at approximately that age. An effective aggressive-submissive encounter was defined as an interaction between two birds in which one of the pair dominated the other as a result of aggressive pecking, threatening, or displacing. Pecks, threats, and displacements were considered equivalent. For each pair, the member who dominated in more encounters was ranked above the other member. All possible pairs were examined in this way for each group. There were 45 pairs in Group I, 15 pairs in Group II, and 45 pairs in Group III. An undecided pair meant that the two birds had not interacted or that they had interacted equally. For undecided pairs, that member who dominated in more other pairs was ranked above the member who dominated fewer birds in other pairings. A linear peck order was assumed for each group.

In general, placement of high ranking and low ranking birds in the peck orders was clear-cut. For example, Bird 356 dominated all other birds in Group I. Bird 371 of Group III was dominated by all other birds in that group. The top or alpha bird of Group III, Bird 364, dominated all but one bird, 372. The encounters between Bird 364 and Bird 372 resulted in no decision---each bird dominated the other equally. However, Bird 372 dominated fewer birds within the group than Bird 364.

Therefore, Bird 364 was placed in the top ranking position.

Placement of birds within the middle range of the peck orders often was based on very few encounters. Some pairs were undecided as the result of no interaction. However, in most cases the rankings did appear to be linear. Group I showed an exception. Bird 354 dominated all birds listed below her in Table 3 except Bird 360. Bird 360 dominated some of the birds below her and was dominated by Bird 363. Therefore, Bird 354 was placed in the second position.

The peck orders did not differ in any conspicuous ways among the three groups; even the percentages of undecided pairs were approximately equal for the three groups. The medians of all aggressive reactions from day 72 to day 112 were 8 per bird for Group I and 11 per bird for Group III, the two extreme groups in terms of raising conditions, and equally sized groups. A Mann-Whitney U-Test between the aggressive reactions of these two groups (I and III) was not significant. However, the forms of the aggressive-submissive responses differed among the three groups as described above.

The protocols for the days of onset of behavior for the top 2 and bottom 2 birds in each peck order were examined to see if any obvious relations existed between rank in the peck orders and behaviors shown before the peck orders developed. Nothing was found that differentiated the top ranking birds from the bottom ranking birds.

DISCUSSION

Stage 2 began with the assembling of the two groups of isolates. Both Groups II and III showed extreme fear behavior when assembled but no aggressive behavior. Farris (1964) described similar fear behavior when isolation-reared quail (raised as Group III of the present study) were grouped. Guhl (1958) with various groups of male and female chicks at several ages and Ratner (1965) both reported intense aggressive behavior on assembling isolate birds. However, birds in Guhl's study were only partially isolated from other chicks while Ratner's isolated chicks had been handled by humans during isolation. Also, the isolated males in Ratner's study were older (70 days) when grouped than the pullets in this study.

Fear (escape) behavior declined in Group II animals but did not decline in Group III animals. Farris (1964) also noted that isolate quail of his study continued to show more fear behavior (such as startle and scatter) than birds raised together from hatching. Hinde (1966) indicated that birds reared in restricted environments were more likely to give avoidance responses to strange situations than normally raised birds. The escape behaviors, such as scattering, of Group III subjects were given to minimal stimuli. These chicks appeared to be unable to habituate to stimuli which were ineffective in eliciting escape behaviors in the other two groups.

Group III lacked previous experience during isolation with such things as removal of the cage tops, movement of the experimenter near the cage, etc. Groups I and II had experienced these stimuli during Stage 1.

Groups I and II developed mature aggressive behaviors in a sequence much like that described in studies of cockerals (Guhl, 1958; Ratner, 1965). However, fighting behaviors were rare. Observations by Ratner and Denburg (1959) suggested that young hens were, in general, less aggressive and exhibited fewer fights when compared with older (17 months) hens.

Group III chicks differed from the other two groups in aggressive behavior displays. Early components, such as sparring, were rare which resulted in their aggressive behaviors appearing less vigorous. Absence of sparring, rapid approach, etc., appeared to have prevented the integration of these types of movements in later aggressive behaviors. However, these subjects, as did Group II subjects, completed a peck order. This indicated that even extreme visual isolation does not prevent social organization when the isolates are grouped. Ratner's (1965) and Guhl's (1958) studies verified that isolation does not prevent social organization. However, the present study did indicate that extreme visual isolation may influence the form of the aggressive behaviors displayed when isolates are grouped.

The classification of developmental patterns into synthesized behaviors and differentiated patterns by Ratner (1965) also characterized patterns of behavior displayed by the pullets in the present study. Synthesized behaviors were, for example, sparring, leaping, and rapid approach. That is, these behaviors occurred separately then became integrated into more mature patterns. Differentiated patterns, for example aggressive pecking, were behaviors which maintained their original form but were elicited by more specific stimuli with increasing age. The form of aggressive pecking did not change but this behavior gradually was elicited only by other birds' heads and, perhaps, only by some birds' heads after peck order formation. At earlier ages aggressive pecks were at times delivered to backs or to any bird.

The appearance of Group III after assembly suggested that their behavior lacked some of the synthesized behaviors shown by chicks of the other two groups. If rapid approach, for example, were a low frequency behavior by itself, then it was, perhaps, not available for intergration into later patterns.

REFERENCES

- Biester, H. E. & Schwarte, L. H. (Eds.) Diseases of poultry. Ames, Iowa: Iowa Univer. Press, 1959.
- Farris, H. E. Behavioral development, social organization, and conditioning of courtship behavior in the Japanese quail, Coturnix coturnix Japonica. Unpublished doctoral dissertation, Michigan State Univer., 1964.
- Fisher, A. E. & Hale, E. B. Stimulus determinants of sexual and aggressive behavior in male domestic fowl. Behaviour, 1957, 10, 309-323.
- Guhl, A. M. Social behavior of the domestic fowl. Tech. Bull., 1953, 73, Kansas Agricultural Exp. Station, Manhattan.
- Guhl, A. M. The development of social organization in the domestic chick. Anim. Behav., 1958, 6, 92-111.
- Hinde, R. A. Animal Behaviour, New York: McGraw-Hill, 1966.
- Holabird, C. Social organization in flocks of Light Brahma hens with comparisons to other breeds of the common domestic hens. Physiol. Zool., 1955, 28, 239-255.
- Kruijt, J. P. Imprinting in relation to drive interactions in Burmese Red Junglefowl. Sym. Zool. Soc. Lond., 1962, 8, 219-226.
- Kruijt, J. P. Ontogeny of social behaviour in Burmese Red Junglefowl (Gallus gallus spadiceus) Bonnaterre. Behaviour Suppl. No. 12, 1964.
- Marler, P. & Hamilton, W.J. Mechanisms of animal behavior. New York: John Wiley & Sons, 1966.
- Ratner, S. C. Comparisons between behavior development of normal and isolated domestic fowl. Anim. Behav., 1965, 13, 497-503.
- Ratner, S. C. & Denburg, M. L. The effects of age on the social organization of chickens. Quart. Bull. Mich. Agric. exp. Station, Michigan State Univer., 1959, 41, 544-549.
- Ratner, S. C. & Denny, M. R. Comparative psychology, Homewood, Illinois: The Dorsey Press, 1964.

Scott, J. P. The analysis of social organization in animals. Ecology, 1956, 37, 213-221.

Scott, J. P. Animal Behavior, Chicago: Univer. of Chicago Press, 1958.

Wood-Gush, D. G. M. The behaviour of the domestic chicken: a review of the literature. Brit. J. of Anim. Behav., 1955, 3, 81-110. ✓

APPENDICES

APPENDIX 1

Day of Behavior Onset during Stage 1 for Individual Subjects in Group I

Behavior Class	Bird									
	354	355	356	357	358	359	360	361	362	363
Rest	1	5	1	2	4	1	4	3	2	2
Huddle	1	1	1	1	3	1	1	1	2	2
Eat	2	3	2	4	1	1	1	1	1	1
Grain Scratch	13	4	7	4	2	7	6	7	6	5
Drink	7	6	2	4	1	7	1	2	4	1
Bill Wipe	2	4	3	5	2	7	3	1	3	8
Head Shake	4	3	2	4	11	7	1	1	7	8
Head Scratch	14	1	5	1	9	3	1	13	4	7
Preen	1	1	2	1	1	3	1	1	1	3
Mutual Preen	8	16	39	13	10	32	10	8	14	8
Stretch	2	6	6	5	12	4	12	2	14	8
Stretch Tail	25	23	7	-	-	7	4	13	18	7
Walk	1	1	2	1	1	1	1	1	1	1
Run	6	2	2	1	1	7	2	1	4	5
Jump	7	5	9	-	5	8	9	-	4	9
Leap	-	-	9	-	-	11	-	-	8	-
Frolic	12	10	-	11	5	7	2	14	5	5
Frolic/object	-	-	-	-	-	-	-	-	-	-
Run/object	6	-	-	11	-	11	-	16	-	11
Rapid Approach	12	-	32	11	14	-	20	-	8	-
Spar	33	23	9	18	9	33	12	31	13	9

Continued on next page.

Group I continued.

Behavior Class	Bird									
	354	355	356	357	358	359	360	361	362	363
Aggressive Peck	32	25	23	-	-	-	-	-	-	31
Threat	-	-	-	-	-	-	-	-	-	-
Juvenile Fight	-	-	-	-	-	-	-	-	-	-
Fight/Pecks	-	-	-	-	-	-	-	-	-	-
Startle	-	33	18	3	5	-	33	-	31	6
Alert Posture	4	29	7	13	11	18	11	7	33	6
Scatter	4	1	1	4	1	1	9	8	1	7
Generalized Pecking	2	1	1	1	1	3	1	1	1	1
Competitive Pecking	2	6	8	9	1	7	4	6	4	5

- Behavior not shown.

Day of Behavior Onset during Stage 1
for Individual Subjects in Group II

Behavior Class	Bird						
	375	376	377	380	381	382	383
Rest	1	2	2	1	1	1	1
Huddle	x	x	x	x	x	x	x
Eat	20	9	1	2	3	6	7
Grain Scratch	20	9	4	5	12	6	12
Drink	1	5	4	2	7	2	3
Bill Wipe	2	5	10	7	3	-	3
Head Shake	2	5	3	6	2	6	3
Head Scratch	2	4	3	3	1	3	4
Preen	2	6	2	2	2	2	2
Mutual Preen	x	x	x	x	x	x	x
Stretch	3	6	6	10	4	7	7
Stretch Tail	3	3	5	3	3	2	3
Walk	1	1	1	1	1	2	1
Run	18	4	6	3	5	4	2
Jump	3	8	7	2	3	4	3
Leap	-	-	-	39	36	-	-
Frolic	14	-	-	-	7	11	-
Frolic/object	-	-	-	-	-	-	-
Run/object	-	-	-	-	-	-	-
Rapid Approach	x	x	x	x	x	x	x
Spar	-	31	-	22	21	-	-

Continued on next page.

Group II continued.

Behavior Class	Bird						
	375	376	377	380	381	382	383
Aggressive Peck	x	x	x	x	x	x	x
Threat	x	x	x	x	x	x	x
Juvenile Fight	x	x	x	x	x	x	x
Fight/Pecks	x	x	x	x	x	x	x
Startle	11	2	10	1	1	4	1
Alert Posture	-	4	5	8	-	9	8
Scatter	8	9	-	8	3	8	-
Generalized Pecking	2	1	2	2	1	2	2
Competitive Pecking	x	x	x	x	x	x	x

x Behavior could not be shown
by isolates.

- Behavior not shown.

Day of Behavior Onset during Stage 1
for Individual Subjects in Group III

Behavior Class	Bird									
	364	365	366	367	368	369	370	371	372	373
Rest	2	1	1	1	4	2	1	1	1	1
Huddle	x	x	x	x	x	x	x	x	x	x
Eat	2	1	2	4	2	5	4	3	3	9
Grain Scratch	12	12	14	4	14	12	5	6	5	10
Drink	1	1	1	2	1	1	3	2	4	18
Bill Wipe	9	5	39	5	3	3	6	7	6	-
Head Shake	1	9	6	7	2	1	7	3	11	12
Head Scratch	3	2	2	13	2	4	6	3	4	-
Preen	2	4	2	1	1	1	4	1	2	5
Mutual Preen	x	x	x	x	x	x	x	x	x	x
Stretch	6	5	3	2	5	1	4	4	5	5
Stretch Tail	7	9	6	16	29	11	3	33	13	16
Walk	1	1	2	1	1	1	1	1	2	2
Run	3	3	4	18	7	3	4	-	2	6
Jump	13	6	12	13	5	6	12	32	6	4
Leap	-	-	-	-	-	39	-	-	-	-
Frolic	-	-	-	-	6	-	-	-	-	-
Frolic/Object	-	-	-	-	-	-	-	-	-	-
Run/Object	-	-	-	-	-	-	-	-	-	-
Rapid Approach	x	x	x	x	x	x	x	x	x	x
Spar	-	-	-	-	39	18	-	-	-	-

Continued on next page.

Group III continued.

Behavior Class	BIRD									
	364	365	366	367	368	369	370	371	372	373
Aggressive Peck	x	x	x	x	x	x	x	x	x	x
Threat	x	x	x	x	x	x	x	x	x	x
Juvenile Fight	x	x	x	x	x	x	x	x	x	x
Fight/Pecks	x	x	x	x	x	x	x	x	x	x
Startle	-	33	16	5	6	10	13	1	4	5
Alert Posture	7	-	18	3	-	-	32	-	25	11
Scatter	3	4	-	-	27	7	-	3	-	4
Generalized Pecking	1	3	1	1	1	1	3	1	2	4
Competitive Pecking	x	x	x	x	x	x	x	x	x	x

x Behavior could not be shown
by isolates.

- Behavior not shown.

APPENDIX 2

Day of Behavior Onset during Stage 2 for Individual Subjects in Group I

Behavior Class	Bird									
	354	355	356	357	358	359	360	361	362	363
Rapid Approach	12*	47	32*	11*	14*	47	20*	84	8*	49
Leap	7*	5*	9*	43	5*	8*	9*	88	4*	9*
Spar	33*	23*	9*	18*	9*	33*	12*	31*	13*	9*
Aggressive Peck	32*	25*	23*	49	64	74	-	78	43	31*
Threat	48	47	51	43	49	51	44	53	48	43
Displace	97	79	49	52	43	51	64	64	48	56
Juvenile Fight	47	-	44	-	-	-	-	-	105	44
Fight/Pecks	-	-	65	-	-	-	65	-	-	65
Dominate	48	75	53	49	53	74	50	78	72	63
Submit	82	51	-	64	64	53	53	64	48	49
Mutual Preen	8*	16*	39*	13*	10*	32*	10*	8*	14*	8*

* Behavior onset during Stage 1.

- Behavior not shown.

Day of Behavior Onset during Stage 2
for Individual Subjects in Group II

Behavior Class	Bird					
	375	376	377	380	381	383
Rapid Approach	52	43	48	48	57	63
Leap	54	61	61	39*	36*	61
Spar	47	31*	48	32*	31*	48
Aggressive Peck	54	92	57	65	63	51
Threat	57	64	52	49	51	51
Displace	51	61	54	51	55	-
Juvenile Fight	84	88	84	-	-	-
Fight/Pecks	-	-	-	-	-	-
Dominate	54	57	57	51	65	51
Submit	61	52	54	61	51	51
Mutual Preening	43	43	43	43	49	43

* Behavior onset during Stage 1.

- Behavior not shown.

Day of Behavior Onset during Stage 2
for Individual Subjects in Group III

Behavior Class	Bird									
	364	365	366	367	368	369	370	371	372	373
Rapid Approach	-	-	51	-	74	49	49	49	47	51
Leap	95	-	57	48	61	39*	103	79	48	51
Spar	-	-	45	-	39*	18*	-	-	-	-
Aggressive Peck	61	55	51	47	51	65	49	49	47	51
Threat	69	-	49	79	50	57	72	72	51	57
Displace	92	54	57	55	54	69	57	95	51	99
Juvenile Fight	-	-	-	-	103	-	-	-	103	-
Fight/Pecks	-	-	-	-	-	-	-	-	-	-
Dominate	61	55	51	47	57	65	49	57	47	51
Submit	51	57	49	47	47	57	49	55	72	57
Mutual Preening	44	44	44	44	44	44	47	44	44	44

* Behavior onset during Stage 1.

- Behavior not shown.

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 03084 9594