PECKING OF LAUGHING GULL CHICKS AT MODELS OF THE PARENTAL HEAD

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DOWNY chicks of the Laughing Gull (*Larus atricilla*) peck at a parent's bill and receive semidigested food held therein (Bent, 1921: 158), but they rarely peck when a parent is not present. This paper reports some field experiments that evaluate the importance of the shape and some other visual characteristics of the parental head as stimuli eliciting and directing the chick's pecking. The method utilized, that of counting chicks' pecks to colored, cardboard models, was patterned after that used by Tinbergen and Perdeck (1950) in their experiments on the Herring Gull (*L. argentatus*), and the results are compared with their findings and those of Weidmann (1959) on the European Black-headed Gull (*L. ridibundus*).

METHOD

During June 1959 my wife and I presented three series of five models each to chicks taken from their nests in the Laughing Gull colony on Green Island, located on the south side of Oregon Inlet, Dare County, North Carolina. Models were made of flat cardboard, colored with watercolor paints (Figures 1–3). Each chick was presented with one series of models only, and then returned to its nest. Ages of chicks varied from newly hatched (down wet with egg tooth present) to prefledged (flight feathers beginning to grow). The order of presentation of models was randomized (with a table of randomly selected digits) to compensate for habituation, or waning of responsiveness, with successive models (see Tinbergen and Perdeck, 1950). Each model was held and moved slightly in front of the chick for one minute, during which time the number of pecks at the model was recorded. It became apparent after running 10 presentations of models that some chicks were "unresponsive," that is, seemed to show no pecking at or even interest in the models. This unresponsiveness may be due to at least two causes: (1) recent feeding by parents in the wild, which reduces pecking, as demonstrated by Weidmann (1959) in the Black-headed Gull; and (2) sleeping. After discovering this unresponsiveness of some chicks, I did not complete experiments on seven subsequent chicks that failed completely to respond to any of the first three models presented, and I discarded data of two chicks that had previously been recorded (neither of which had pecked at the first three models presented and had pecked less than four times at the remaining two models combined).

Results are arranged in Tables 1–3 with the mean number of pecks

The Auk, **79:** 89–98. January, 1962

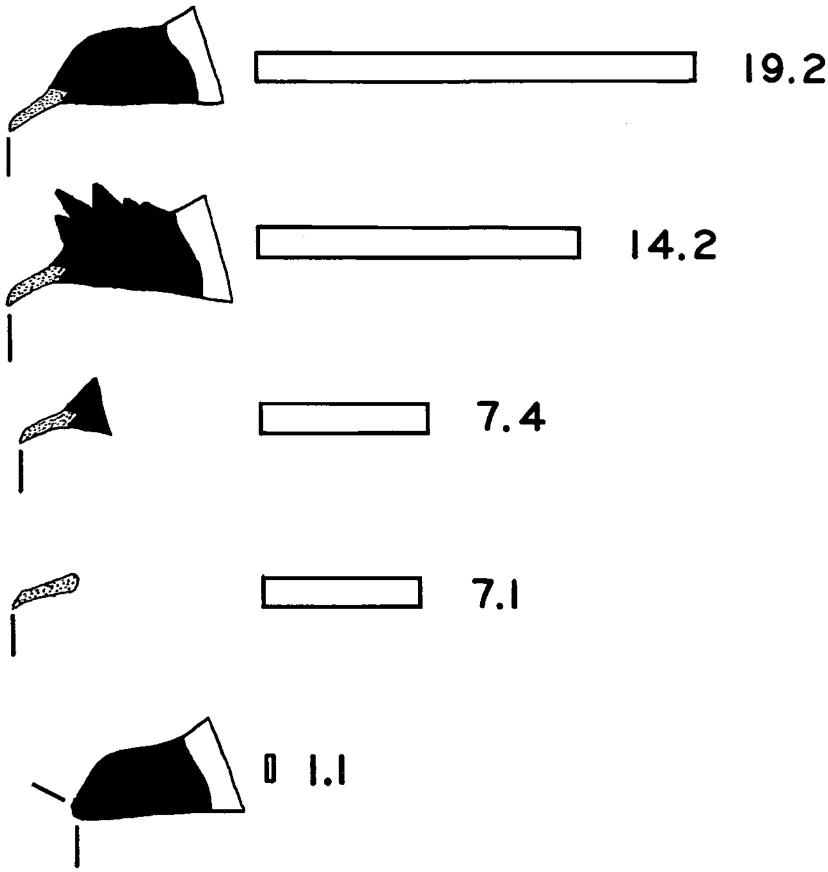

Figure 1. Sketches of models used in the first series (from the top): standard, cock's head, bill and part head, bill only, head only. Horizontal bars show the mean number of pecks per minute received by each model (for transformed means and complete data see Table 1). Arrows indicate the parts of the models at which chicks most often pecked. Sketches in this and following figures were drawn from photographs of actual models used.

per minute indicated for each model in each series. Because of the heterogeneous variances, a square root (actually $\sqrt{n+1}$) transformation (Snedecor, 1956, 315–316) on the entire data was made prior to statistical analysis. Standard two-way analysis of variance calculation was carried out, and the transformed means of each column were calculated and compared by the method of smallest significant difference (*ibid.*, 294–295). The smallest difference that is significant at the 5 per cent level is included along with the transformed means at the bottom of each table so

TABLE 1
RESPONSIVENESS TO HEAD SHAPES
(See Figure 1)

Chick	*Model:*	*Standard*	*Cock's head*	*Bill and part head*	*Bill only*	*Head only*
1		14	17	0	0	0
2		16	26	2	17	0
3		18	0	3	2	3
4		45	39	35	15	6
5		28	29	6	14	0
6		7	0	5	3	0
7		15	8	1	1	1
8		14	16	9	11	0
9		30	6	6	8	1
10		5	1	7	0	0
Mean pecks/minute		19.2	14.2	7.4*	7.1*	1.1*
Transformed mean		4.32	3.44	2.59	2.57	1.35

* Significantly less than standard model.
5% difference between transformed means: 1.26.

that significance of the difference between any two models may be judged. Columns in the tables are arranged in descending order of means from left to right, and asterisks indicate means that differ significantly from the most effective model of the series.

Each series of models contained a diagrammatic model of the Laughing Gull head in profile, hereafter referred to as the "standard" model (Figures 1–3). Each other model in the series was like the standard except for a single characteristic. By comparing responses to the standard and to the other model, the relative importance of the altered characteristic is suggested.

RESPONSIVENESS TO MODELS

Presence and shape of the head. The first series of models tested the importance of the presence and shape of the head (Figure 1). The standard model, a bill without a head, a bill with part of the head present, and a head without the bill were used. In addition, a "cock's head," patterned after the model of Tinbergen and Perdeck (1950), was included to test the effectiveness of a complete, but irregularly shaped, head.

Table 1 shows that the standard model was the most effective in the series (significantly better than all but the cock's head). The normal head without a bill was nearly ineffective as an eliciting stimulus, and just misses being significantly different from the bills with no head and just a portion of head. The cock's head is neither significantly below the standard nor above the bill with a portion of head.

Shape of the bill and bill tip. Since the bill appeared to be the primary

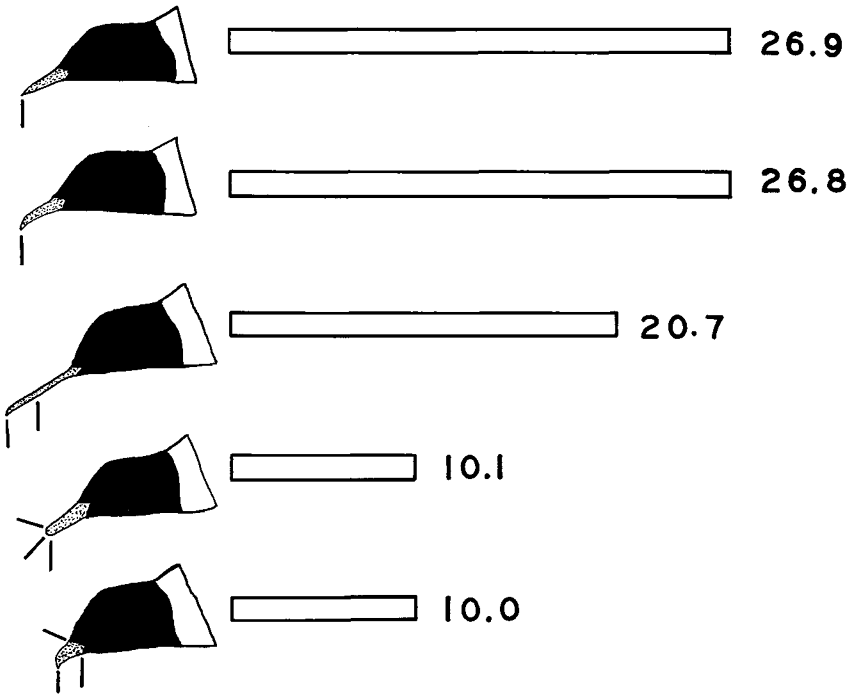

Figure 2. Models used in the second series (from the top): pointed, standard, long-and-thin, rounded, short. Legend as in Figure 1.

component of the eliciting stimulus, a second series of models tested the importance of the shape of the bill (Figure 2). In addition to the standard model, this series included a model with a more pointed bill tip, one with a more rounded bill tip, one with a very short bill, and one with an extremely long-and-thin bill, the last because Tinbergen and Perdeck (1950) showed that such a model of the Herring Gull evoked more responses than the normal model.

The standard and the pointed bill-tip models received significantly higher frequencies of response than did the other models, except for the long-and-thin bill model, which was neither significantly below the first two nor significantly above the last two.

Other visual characteristics. The final series (Figure 3) was designed to suggest other visual characteristics that might be important in eliciting the chicks' pecking. Responses to the standard model were compared with those to a more realistic representation of the Laughing Gull head, which contained an eye and details of the bill. A similar detailed head with simulated food in the bill was included in the series to test the hypothesis

TABLE 2

RESPONSIVENESS TO BILL SHAPES

(See Figure 2)

Chick	*Model:*	*Pointed*	*Standard*	*Long-and-thin*	*Rounded*	*Short*
1		20	42	8	0	1
2		32	19	20	9	13
3		20	5	23	12	0
4		39	24	22	20	6
5		26	35	8	9	14
6		25	22	16	7	6
7		29	22	20	9	26
8		40	35	23	0	8
9		11	37	46	25	16
Mean pecks/minute		26.9	26.8	20.7	10.1*	10.0*
Transformed mean		5.20	5.14	4.42	3.07	2.95

* Significantly less than pointed and standard models.
5% difference between transformed means: 1.42 .

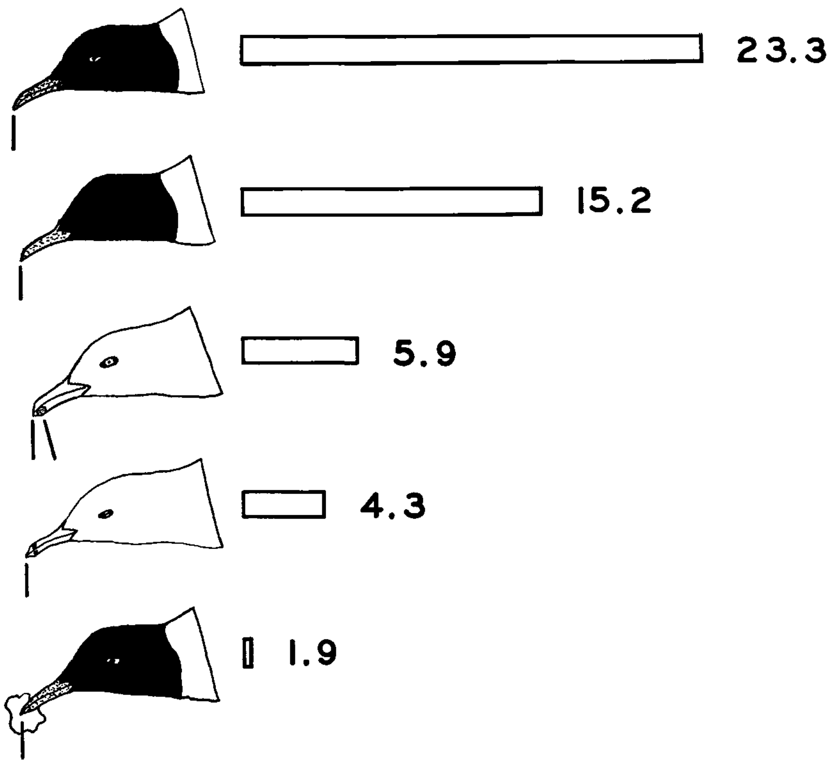

Figure 3. Models used in the third series (from the top): Laughing Gull, standard, Herring Gull, Ring-billed Gull, Laughing Gull with food. Legend as in Figure 1.

that the sight of food increased the chicks' pecking. The series was completed with detailed models of the heads of two other species, the Herring Gull and the Ring-billed Gull (*L. delawarensis*), to test the importance of species-specific characteristics.

Table 3 reveals that the detailed and standard models were both significantly better than models of the other two species and surprisingly better than the model with "food." The last, which received very few responses, appeared to frighten the chicks, and they often turned from the model and attempted to hide in a near corner of the containing box.

PARTS OF MODELS PECKED

The particular place(s) on the models at which the chicks pecked were observed during the experiments. In models with normally shaped bills, pecking was usually directed at the tip of the bill. Thus only when the bill shape varied (Figure 2) were other regions pecked. An exception to this rule was the Herring Gull model (Figure 3); here pecking was directed to both the bill tip and the red spot on the lower mandible.

The second series (Figure 2) showed some interesting variations in the direction of pecking. In both the standard and pointed-bill models, pecking was at the point of the bill, but in the rounded-bill model, pecking was indiscriminately aimed in the area of the end of the bill. The short bill evidently caused confusion: pecks were delivered at the tip, at the edges of the bill where it meets the head, and even occasionally at the "corner" of red in the most proximal end of the bill. Finally, two areas of the long-and-thin bill were repeatedly pecked: (1) the tip of the bill itself, and (2) about halfway between the bill tip and the head.

TABLE 3
RESPONSIVENESS TO OTHER VISUAL CHARACTERISTICS
(See Figure 3)

Chick	*Model:*	*Laughing Gull*	*Standard*	*Herring Gull*	*Ring-billed Gull*	*With food*
1		16	11	4	2	5
2		48	19	1	0	1
3		17	6	8	2	3
4		42	18	29	7	2
5		15	12	2	19	3
6		15	9	6	2	0
7		1	18	0	0	0
8		25	17	3	0	1
9		31	27	0	7	2
Mean pecks/minute		23.3	15.2	5.9*	4.3*	1.9*
Transformed mean		4.67	3.93	2.29	2.04	1.67

* Significantly less than Laughing Gull and standard models.
5% difference between transformed means: 1.47 .

DISCUSSION

From these preliminary experiments, it appears that the parental bill, and not the food itself, is the most important visual stimulus eliciting the chick's pecking. The long, narrow proportions and the pointed tip of the bill enhance its value as a stimulus, and the presence of the head improves the stimulus value of the bill.

The importance of some other characteristics remains tenuous. Because sample sizes were relatively small, the random presentations probably did not completely "smooth out" effects due to habituation. Therefore a few differences between models that are close to but not quite significant at the 5 per cent level may be considered briefly. For instance, in Table 1 the head lacking a bill received so few responses that it is probably less effective than the bill lacking a head (difference between transformed means: 1.22; 5 per cent significant difference: 1.26), demonstrating the relatively greater importance of the bill. However, the importance of the whole of the stimulus is suggested by the fact that the sum of responses to the head and bill separately is less than the total response to the two components together (standard model). Another characteristic from Table 1 of unproved importance is the normal shape of the head, since the cock's head is neither significantly below the standard nor above the bill with some head portion; it is possible, then, that the shape of the head does have some effect upon the frequency of response.

In a similar manner, Table 2 shows that the long-and-thin bill is not significantly different from either the standard or the round-bill models. The surprising effectiveness of the long-and-thin bill may be due, as suggested by Tinbergen and Perdeck (1950), to its resemblance to the frontal aspect of the parental bill. Since the adult gull's bill is compressed laterally, a chick viewing the parent's bill while standing under the parent between the latter's legs would see a long and thin aspect, in contrast to the thicker profile. Such a suggestion is particularly interesting because it may account for the effectiveness of the pointed bill-tip model in the second series. Perhaps chicks respond to a slightly hooked bill (standard model) as they would to the parental bill seen in profile, and respond equally as often to the thin, tapering point (pointed-bill model) as they would to the frontal aspect of the parental bill.

The species–specific differences found in the last experiment may depend on the color and pattern of the bill (and perhaps of the head), since the shapes of the Herring and Ring-billed gull models were identical with the Laughing Gull model. Actually, another series of models with varying colors of head and bill was presented to seven chicks, but no significant differences between models were uncovered, presumably due at least partly to the small sample size. Since bill color is an important component of the eliciting stimulus in other gull species (Tinbergen and Perdeck, 1950; Collias and Collias, 1957; Weidmann and Weidmann, 1958; Weidmann, 1959), further work on the influence of this component is being planned for evaluation under more controlled conditions.

Characteristics of the parental head that direct the response seem to be similar to those that elicit it. Pecks delivered to all three "corners" of the short-bill model suggest that chicks peck normally at the bill point itself. Pecks delivered to the long-and-thin bill halfway down its length suggest that chicks tend to peck a certain distance from the head along the bill. This assumption is further substantiated by pecks at the end of the rounded bill, which was normal in length but had no pointed tip.

COMPARISONS WITH OTHER SPECIES

At least two other species have been investigated with regard to stimuli that elicit pecking: the Herring Gull was studied by Tinbergen and Perdeck (1950), whose investigations are also related in detail in Tinbergen (1953, Chapter 22); and the Black-headed Gull was recently studied by U. and R. Weidmann (Weidmann and Weidmann, 1958; Tinbergen, 1958, Chapter 13; Weidmann, 1959). Neither the shape nor presence of the head has any effect upon pecking in the chicks of these two species. This is in contrast to the Laughing Gull, in which the presence (and possibly the normal shape) of the head increases the effectiveness of a normally shaped bill. In general, a long-and-thin bill is more effective than a bill of other abnormal proportions in both Herring and Black-headed gulls. Such a bill receives more responses than normal bills by Herring Gull chicks, but the same or fewer responses from chicks of the Laughing and Black-headed gulls. The shape of the bill tip is not important in the Herring Gull, but may be in the Black-headed Gull where a pointed tip received more responses than a rounded tip (U. Weidmann, pers. comm.).

The presence of simulated food on the bill increased the number of pecks from Black-headed Gull chicks, but not from Laughing Gull chicks. Weidmann (pers. comm.) used "food" that was the same color (red) as the bill, whereas the Laughing Gull "food" was white (Figure 3). Tinbergen and Perdeck (*op. cit.*) presented a model with a small bump on the mandible, which was chosen over the plain bill by Herring Gull chicks. Perhaps the size and color of the projecting "food" are important.

In addition to stimuli that elicit the response, Tinbergen and Perdeck (*op. cit.*) found that the red spot on the bill and the actual bill tip direct the pecking of the Herring Gull chick. Interestingly, Herring Gull chicks also peck at the corner of the bill where it meets the head, emphasizing the importance of a point in directing the response.

The specific differences suggested above are tentative because different techniques and subjects of different ages were used in studying the three species. Increasingly objective techniques, like that of Collias and Collias (1957), will facilitate better comparisons. Weidmann (1959) suggests comparing newly hatched chicks before the first feeding, in order to equate experiences of the individuals. It is my feeling that a truly comparative study should include the full ontogenetic developmental sequences in each species.

ACKNOWLEDGMENTS

Mr. Verd Watson, Park Naturalist of the Hatteras National Seashore Recreation Area, and Mrs. Floy Burford were helpful in locating the Green Island colony. Mr. Charles Noble, Manager of Pea Island National Wildlife Refuge, helpfully allowed us to carry out the study at the colony. The manuscript benefited greatly from critical readings of an early draft by Dr. Peter H. Klopfer and Dr. Uli Weidmann, to whom I am much indebted. Advice on statistical methods was kindly offered by Dr. David L. Wallace.

SUMMARY

Chicks of the Laughing Gull (*Larus atricilla*) peck at the bill of the parent and thereby find regurgitated food held between the mandibles. Certain visual characteristics of the parental head were tested to determine their value as stimuli eliciting pecking by comparing the frequencies of pecking by chicks to various models (Figures 1–3). Table 1 shows that a head with no bill is the poorest stimulus, that a bill with no head and a bill with some head evoke a modicum of pecking, and that a normal but diagrammatic Laughing Gull head is the best stimulus; a bill with an irregularly shaped head is possibly less effective than the standard diagrammatic model. Table 2 shows that a rounded bill tip and a short bill are less effective than the standard model and one with a pointed bill tip, and a model with a very long-and-thin bill is intermediate. Table 3 indicates that detailed models of two other gull species are significantly poorer stimuli than the diagrammatic model, as was a detailed Laughing Gull head with simulated food in the bill. However, a detailed head without food was as effective, perhaps more so, than the diagrammatic model.

Chicks pecked at the bill tips in all normally shaped models, but pecked indiscriminately around the end of the rounded bill-tip model. Pecks to the short bill were delivered to the tip, but also to the "corners" of red

where the bill meets the head (Figure 3). Pecks to the long-and-thin bill were directed to its tip and to a region about halfway down its length.

The stimuli that elicit and direct the pecking of the chicks of Laughing Gulls appear to differ somewhat from those to which chicks of other species of gulls react; however, the differences are not necessarily due to specific differences in the morphology of the adult heads. It is suggested that the best comparative study would involve comparisons of the ontogenetic development of pecking behavior.

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