THE RESPONSE OF CHICKS OF THE FRANKLIN'S GULL TO PARENTAL BILL-COLOR

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THE adult Franklin's Gull (*Larus pipixcan*) in the breeding season has a black head and a bright red bill with a vague dusky spot near the tip. The downy young may be fed by regurgitation of food from the mouth of the parent. The young may peck at the bill of the parent when the latter arrives at the nest and stands next to the young with bill lowered.

The purpose of our study was to see whether the *red color* of the parental bill helped stimulate the feeding responses of the downy young to the parent, as is suggested by their pecking at the bill of the parent. Tinbergen and Perdeck (Behaviour, **3**: 1–39, 1950) have reported experiments with models from which they concluded that the feeding responses of downy Herring Gull chicks are stimulated by sight of the red spot on the lower mandible of the yellow bill of the parent. This work was responsible for the initiation of our own studies.

However, instead of using presentation of hand-held models as did these authors, we have attempted to make our experimental procedure somewhat more objective by not touching the models and by usually not touching the chicks during the course of an experimental test. We also used *simultaneous* presentation of models of heads, each with a differently colored bill, instead of *successive* presentation as was done by Tinbergen and his colleagues.

Method and materials.—Each gull chick to be tested was placed in a cardboard box on one end of which there were two flat models of adult heads of the Franklin's Gull, placed so as to face each other with the bills pointing downward at an angle of about 60° and with the tips of the two bills about ½ inch apart (Figure 1). The bill of one head was red; the bill of the other head was either green or white.

Each bill was attached to a plain black head, devoid of eyes and pasted on a piece of brown paper, which in turn was fastened to a firm cardboard backing.

Each bill actually was a complex affair, consisting in the first place of a hole, cut in the shape of the bill, through the cardboard backing and brown paper on which the black heads of the models were fastened. The purpose of each bill-shaped hole was to enable us to shine a light through from behind, illuminating the bill. An ordinary goose-necked lamp was used for this purpose and was centered behind at an equal distance from each of the two bills.

Behind each bill-hole could be placed a removable panel of a given color. The color was provided by red or green cellophane. The cellophane was backed by white paper to render the transmitted illumination diffuse and translucent rather than merely transparent, as it would have been if the cellophane had been used alone. These colored panels were actually sliding panels that were inserted between the brown paper front and the cardboard backing of the set-up. Since the panels were removable, it was readily possible to switch the relative positions of red and green bills, or of red and white bills, from one test to the next, as a control over possible position effects.

A steady illumination of the bills from behind proved to have relatively weak stimulating value for the gull chicks being tested. This stimulating value was greatly increased by inserting a flasher

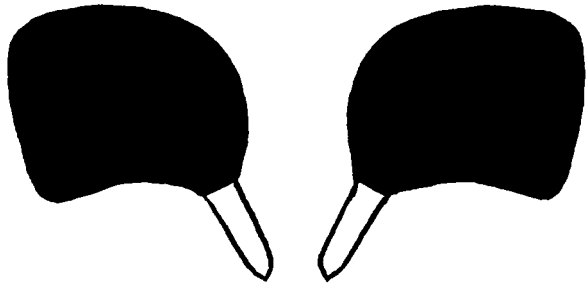

FIGURE 1. Illustration of the crude models of heads of parent gulls used in testing responses of chicks of the Franklin's Gull to bill color.

device into the light socket of the 60-watt bulb used. In this way it was possible to have both bills flash on and off together at a uniform rate of about 85 times per minute. We believe that this flashing device served as a substitute for motion of the bill in a standardized and objective way.

For support of this project we are grateful to the Delta Waterfowl Research Station, where all of this work was done. Eggs were collected from a local breeding colony of the Franklin's Gull and were hatched in an incubator at the station. This procedure assured that the chicks had not become conditioned to the sight of the red bill of the parent bird, prior to testing.

After being hatched, the gull chick to be tested was placed in the test box equidistant from, directly between, and usually about 1 to 2 inches from the models. During the test the chick was kept warm by a lamp a short distance above it and was observed from over the lamp or through a slit-like peephole in the cardboard box.

As a rule the chick was allowed from 1 to 2 minutes to become light adapted before the bills of the models were lighted from behind by the flashing lamp, signalizing the onset of the test. Later on, the procedure was altered slightly and the models were covered with a piece of cloth until after the chick had a chance to become light-adapted; the test was not timed until the chick delivered its first peck.

The number of pecks delivered by the chick on each of the two bills being compared was recorded during a period of standard length. These test periods were 3 minutes long for about the first half of the experiment and then were made one minute in length, in an attempt to maintain the motivation of the chick at a higher level. Different chicks were subjected to varying numbers of three-minute or one-minute tests.

Usually a chick was not touched by the observer during the course of a test. Occasionally a chick wandered away from the models and had to be replaced next to the models.

Results.—The first table shows the results when all of the data gathered are considered. It will be seen that 17 *individually tested*

TABLE 1

INCUBATOR-HATCHED CHICKS OF THE FRANKLIN'S GULL PECK MORE OFTEN AT A RED BILL THAN AT A GREEN OR WHITE BILL*

Comparison	*Number of chicks*	*Number of pecks*	*Probability of chance difference*
Red: green	17	3150 to 633	0.001
Red: white	18	1076 to 143	0.011

* Total time of tests per chick 6 to 18 minutes.

chicks of the Franklin's Gull, when given a simultaneous choice between models of two heads, one with a red and one with a green bill, pecked the red bill over 3000 times and the green bill only 633 times. Under similar conditions, 18 other chicks pecked the red bill over 1000 times and a white bill only 143 times. This preference of the chicks for a red bill, i.e., one of the normal color of the parental bill, was statistically significant when tested by Student's method of paired comparisons.

These chicks ranged in age from 4 hours to 4½ days when tested. If a chick was too young it was likely to go to sleep during the test; if too old, our impression was that the chick was not much attracted to flat models.

For the purpose of a more uniform comparison, the data were reclassified, and we included only the data for the first six minutes that each chick was tested. Under these conditions most of the chicks were 7 to 20 hours old when tested; only 3 of the 35 chicks tested were more than a day old.

The second table shows that 17 chicks, each individually tested for a total of 6 minutes, pecked the red bill over 2000 times and a green bill, simultaneously presented, fewer than 500 times. Under

TABLE 2

INCUBATOR-HATCHED CHICKS OF THE FRANKLIN'S GULL PECK MORE OFTEN AT A RED BILL THAN AT A GREEN OR WHITE BILL*

Comparison	*Number of chicks*	*Number of pecks*	*Probability of chance difference*
Red: green	17	2105 to 492	0.0004
Red: white	18	895 to 60	0.0006

* Each chick was tested for a total of 6 minutes.

TABLE 3

EXAMPLE OF THE RESULTS OF SUCCESSIVE THREE-MINUTE TESTS ON TWO INDIVIDUAL CHICKS. (FRANKLIN'S GULL)

	"Yellow-head"		*"Green-head"*	
	Red	*Green*	*Red*	*White*
	85	2	92	0
	49	1	41	11
	204	7	12	9
	114	1	34	0
	86	22	38	0
	37	12		
Totals	575	45	216	20

similar conditions, 18 other chicks pecked the red bill almost 900 times and a white bill, simultaneously presented, only 60 times. This preference of the gull chicks for a red bill, when each chick was tested for a total time of exactly six minutes, was statistically significant.

The third table shows the records of two individual chicks, and is intended as an example of the consistency with which many chicks will peck the red bill in preference to a green or white bill during the course of successive tests. Sometimes a chick would be seen to pause in its attacks on the red bill, turn toward and apparently inspect the green or white bill, and then turn back and resume its pecking of the red bill.

The question arises as to whether the chicks were actually responding to color as such or merely to differences in relative intensity of the three colors tested. Measurements with a phototronic foot-candle meter indicated that the white bill transmitted roughly about twice as much light as did the red bill, which in turn transmitted about twice as much light as did the green bill. It follows that the apparent preference of the chicks for red could not have been due to a consistent preference for a greater or lesser intensity of light in the red bill, as compared with the green or white bill.

It seemed possible, however, that the chicks might merely prefer light of a medium intensity. But the usual variation in the distance of the rear lamp from the test panel was about 3 inches, and even this small variation resulted in about a 100 per cent variation in the amount of light transmitted by either the red, green, or white bill. The consistent preference of the gull chicks for the red bill, despite almost 100 per cent variation in the absolute intensity of light transmitted by the differently colored bills, is evidence for color preference as against selection of a certain absolute intensity of light in the red bill.

Summary and conclusions.—A new technique is described for the objective testing of the reactions of young birds to color stimuli involving the simultaneous presentation of flashing colored lights. This technique was applied to incubator-hatched chicks of the Franklin's Gull (*Larus pipixcan*). Individual chicks were exposed to two flat cardboard models of the head of the adult gull, each head having a differently colored bill. Summarizing all of the tests, we observed that the chicks pecked at a red bill (the parental bill color) 7 times as often as they pecked at a white bill and 5 times as often as they pecked at a green bill. The differences were statistically significant.

We concluded that the red color of the bill of the adult breeding Franklin's Gull is, at least in part, an adaptation to stimulate and direct the initial feeding responses of the downy young.

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