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DO ADULT GULLS RECOGNIZE THEIR OWN YOUNG: AN EXPERIMENTAL TEST

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ABSTRACT.—Adult gulls are reported to recognize their own chicks by the time they are 5 or 6 days old (Tinbergen 1953). We experimentally tested this hypothesis by allowing single chicks to live on their own territory for between 3 and 25 days before being switched to another territory. To prevent straying by the chicks, a chicken-wire fence, 30.5 cm high and enclosing 1 m^2, was placed around each nest at time of hatching. Twenty-two of 25 adult gulls accepted and offered food to chicks after experimental manipulation. Older chicks showed various degrees of "concern" during the first hour after being switched but they accepted food. Subsequently we rotated 10 chicks between 10 territories once each day for 30 days and then placed them on natural, control territories. These chicks begged for food, were fed and accepted in 8 of 10 trials. We conclude that Glaucous-winged Gulls do not recognize their own chicks individually.

In his now classic book, The Herring Gull's World (1953), Tinbergen reported that Herring Gull parents (*Larus argentatus*) recognized their young at five days of age and older. His primary evidence was that until this age, chicks could be exchanged between nests without adult rejection. After this time, chicks wandering naturally or placed experimentally in the vicinity of another nest were chased out of the territory or attacked and often killed.

The importance of individual recognition of chicks by parents is particularly germane to the sociobiological concept of inclusive fitness. To achieve maximal fitness for its own genes in the next generation, a parent gull not only must care for its own chicks efficiently, but must refrain from contributing to the survival of competing gene carriers at the expense of its own reproductive output (Miller and Emlen 1975). In closely-packed, territorial, gull colonies, theory indicates that natural selection should favor restriction of parental care to the "right" offspring, or mechanisms that maintain maximal parental attention to specific, healthy young (Hailman 1967).

Beer (1970a, 1979) performed several experiments showing that Laughing Gull chicks (*Larus atricilla*) could distinguish between the voices of their parents and other adults by as early as the first day of life. He further showed that by the end of the first week, they responded exclusively to the calls of their parents by approaching and calling but were silent, remained crouched or moved away during playback of calls of other adults. Miller and Emlen (1975) demonstrated that adult Ring-billed Gulls (*Larus delawarensis*) accepted any chick placed in or around their nest for the first five days after the chicks hatch, but rejected all intruders after day seven.

Holley (1981, 1984) reported naturally occurring adoptions of Herring Gull chicks between the ages of 6 and 35 days. From samples of three colonies studied in Great Britain, the rate of natural adoption was determined to be 13.4% (16 chicks of 119 nesting pairs). Several recorded adoptions were even between members of different but closely-related, sympatric species (Herring and Lesser Blackbacked gulls, *L. argentatus* and *L. fuscus*) breeding in the same colony. Of greater behavioral interest was the result of experimentally transferring 8 chicks to nests containing young of the same age. Four chicks were placed in territories from which they could easily escape; all were rejected by the resident adults. Another four were transferred to territories from which escape was not possible (due either to being on a cliff edge or within a small, fenced enclosure); all were accepted. Holley explains these results by noting that the chicks that could do so, tried to escape, a behavior resident chicks would not normally show. Thus they distinguished themselves as strangers. Those that could not escape showed only "appeasement behavior" (Holley 1984), with which the resident adults were familiar, and thus were not attacked.

The purpose of our study was (1) to experimentally confirm the age of parental recognition of individual chicks in Glaucous-winged Gulls (*Larus glaucescens*), reported to be about 5 days by Vermeer (1963); (2) to determine the effect of disrupting filial imprinting (by rotating chicks between different nests) upon the subsequent development of parent-young recognition; and (3) to determine if the behavior of chicks that had been rotated between several nests would allow them to be adopted more easily than natural, control chicks.

METHODS AND MATERIALS

Our experiments were conducted during the months of July 1983, 1984, 1985 on Protection Island, Jefferson County, Washington. This gull colony was composed of approximately 10,000 Glaucous-winged Gulls breeding on an area of about 25 ha.

At the beginning of each experiment, 10–25 nests

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TABLE 1
RESULTS OF EXPERIMENT 1 IN WHICH CHICKS WERE RAISED IN AN ENCLOSURE BY ONE SET OF PARENTS FOR A VARIABLE NUMBER OF DAYS AND THEN SWITCHED TO AN ENCLOSURE ON A NEW TERRITORY

Switch	Gull chicks		
	Age on day of switch	Number switched	Number attacked
1	3	5	1
2	6	5	1
3	8	5	0
4	13	5	1
5	15	5	0
Total		25	3

TABLE 2
RESULTS OF EXPERIMENT 2 SHOWING NUMBER OF ATTACKS BY ADULTS ON 6 CHICKS WHICH WERE RAISED BY THE SAME PARENTS (STATIONARY CHICKS AND ADULTS) AND WERE EXCHANGED WITH 6 CHICKS WHICH WERE ROTATED ONE NEST PER DAY (ROTATED CHICKS AND ADULTS) AT SPECIFIED AGES

Age (days)	Attacks per number switched by	
	Stationary adults on rotated chicks	Rotated adults on stationary chicks
5	0/6	0/6
10	0/6	0/6
15	0/6	0/6
21	0/6	0/6
Total	0/24	0/24

containing three eggs were selected within 50 m of our blind. A few days before the first eggs were to hatch, each nest was marked with a numbered stake and surrounded with a chicken-wire fence (2.5 cm mesh) which was 30.5 cm high and enclosed a 1 m^2 area (hereafter called an "enclosure"). Also placed within 25 cm of the nest was a piece of PVC tubing (25 cm long × 10 cm in diameter and enclosed at one end) which served as additional shelter. The evening before each experiment, all eggs were removed and replaced with one pipping egg or freshly hatched chick at each nest.

EXPERIMENT 1 (1983)

In the morning (between 0800–1100 h) on day 3 and at approximately 3-day intervals until day 15, five chicks that had been raised singly by pairs of resident adults were randomly exchanged with one another (25 chicks total). Each chick was put into a new enclosure only once during the experiment. Observations and video records were made continuously for 6 h following each transfer. The occurrence of attacks, feedings, parent calls, and the presence or absence of other parent-young behavior was noted.

EXPERIMENT 2 (1984)

Twelve nests were used. Six, designated experimental, had their chicks rotated among them each day for 30 days. The other nests, designated controls, had their chicks carried around the colony each day for a duration similar to that required to move the experimental chicks (approximately 30 seconds) and then returned to their own enclosures. For the next two hours, note was made of whether the returning adult(s) attacked, fed, and/or called to the chicks or not.

On days 5, 10, 15, and 21 the six experimental chicks were randomly exchanged with the six control chicks and all chicks were left in new enclosures for 4 h. Observations mentioned above were then made. The chicks were then returned to their original nests and enclosures.

EXPERIMENT 3 (1985)

Chicks from ten nests were rotated one nest position each day for 30 days as in Experiment 2. On day 30, each of these chicks was carried in its shelter to a randomly selected natural nest located at least 20 m away with 2–3 resident chicks of approximately the same age (25–30 days). For the next 2 h we observed the interaction of each chick with its new family. Five of the experimental chicks were then returned to their enclosures for the night. The next day these chicks were removed and five randomly chosen, naturally reared chicks selected from the colony were placed in these enclosures and observed for 2 h.

RESULTS

EXPERIMENT 1

During 25 opportunities for acceptance or rejection by territorial adults of chicks transferred at 3–15 days, only 3 times were chicks attacked by adult gulls (Table 1). Interestingly, each attack occurred on a different day (3, 6, and 13). All other chick transfers resulted in parental acceptance (feeding, calling, adult care, etc.).

EXPERIMENT 2

In 48 trials using chicks, aged 5–21 days, which had been rotated daily or had remained with the same adults before being exchanged, no attacks were recorded (Table 2).

EXPERIMENT 3

Eight of ten chicks rotated daily for 30 days before being transferred to a natural nest in the colony were accepted into new families. In the two cases in which chicks were rejected, the transferred chick was first harassed by resident chicks and then attacked by the adults.

Three of 5 control chicks (25–30 days of age) placed in enclosures on territories of adults that had been subjected to chick rotation every day for the prior 30 days were also accepted.

OBSERVATIONAL EVIDENCE

Qualitative evidence from our field notes suggested that adult gulls did not behave differently toward young placed in their enclosure compared to their own chicks. For instance, during the first week, adult gulls jumped into the enclosures to

brood and feed experimental and control chicks alike. These adults also "mewed" (Tinbergen 1959) around the outside periphery of the fences for minutes at a time, occasionally regurgitating food in front of the chick. Often the chick attempted to eat the food but, because of the fence, was unable to do so. Other times the adult held the food in its bill and the chick ate. Occasionally, especially when older, the chick ran to the other side of the enclosure at these times and attempted to get out. The resident gulls then alarm-called (*kek* and *keow*; Tinbergen 1959), re-swallowed the deposited food, "mewed" around the fence and offered food again. Inevitably, however, even these chicks would eat. We saw this sequence occur with both experimental and control chicks.

Behavior of control and experimental chicks was consistently very similar. After being switched to new enclosures, chicks hid in the tube shelters until the colony disturbance subsided. Then they backed out. If the chicks were less than a week old or had been rotated daily between other enclosures, they stood with their necks extended in an erect posture and looked around. When older, a few switched chicks tried to escape from what was a new area to them for extended periods of time. The chicks might then explore their new enclosure before begging for food, which when offered by their new parents, was eaten through the mesh holes in the fence. Chicks which had been raised by the same parents for extended periods of time (10 days or more) occasionally cowered in the corners of the new enclosures for a considerable time after being switched. It was our impression that they behaved in a less "confident" way than did the rotated chicks or chicks which were returned to their own territory.

DISCUSSION

There was no consistent evidence that adult Glaucous-winged Gulls differentiated between strange chicks they had not seen before and individual chicks that they had raised for periods of time up to 30 days. In fact, our data strongly suggests that adult gulls do not recognize chicks individually. This finding is similar to Holley's (1984) conclusion that adult Herring Gulls are unable to recognize their own young below the age of 35 days. Beer (1970b) has also reported several instances where adult Laughing Gulls attacked their own young or adopted unrelated chicks.

If adult Glaucous-winged Gulls do not distinguish between their own and other chicks on the basis of visual, morphological cues, why is it that they regularly chase, attack and kill chicks who enter their territory? We presently believe that the best explanation supported by our data is that adult gulls of this species, and probably others, identify their young, biological or foster, primarily by the way they behave. That is to say, as long as a chick's behavior is appropriate for an "offspring," it will be treated as such by the resident adults. Miller and Emlen (1975) referred to this possibility as "comportment discrimination." Beer (1979) hinted at a similar, possible interpretation when he offered that Tinbergen's earlier observations of apparent parental recognition of chicks might, in fact, be due to recognition of parents by chicks, with consequent changes in chick behavior being used by adults to discriminate between their own and unrelated chicks.

Chick Recognition by Adults

The strongest experimental evidence to date suggesting that adult gulls might distinguish their young individually by visual cues is the work of Miller and Emlen (1975) on Ring-bills (*L. delawarensis*). Of 12 chicks whose head plumage and facial features were altered with black ink, over half were attacked or at least not accepted. It may be important to know the extent and similarity of the alterations before drawing further conclusions, for the location or configuration of the markings may have obliterated the "gull chickness" of these chicks. That they were initially rejected but eventually accepted (within a couple of hours) and not killed suggests that they were treated differently than natural chick intruders.

Other chick exchanges by Miller and Emlen demonstrated differential rejection of chicks between the ages of 5 days (1 rejected/14 presented), 7 days (7 rejected/14 presented) and 9 days (10 rejected/14 presented). One cannot rule out the possibility that chick behavior changed during this time period and caused the consequent change in adult behavior.

Beer (1979) has shown that adult Laughing Gulls respond to the recorded voices of chicks by orienting toward, calling and approaching the source of the sound. These same adults did not discriminate, however, between the calls of their own and foreign chicks. Beer concluded that it is very unlikely that parent gulls of this species can recognize their chicks individually by voice.

Adult Recognition by Chicks

Currently there is more evidence to support the idea of recognition of parent or territory by chicks than individual recognition of chicks by adults. For instance, Beer (1970a, 1979) and Miller and Emlen (1975) have shown that chicks of Laughing and Ring-billed gulls can differentiate the calls of their parents from other adults by the end of the first week post-hatching. As men-

tioned above, however, parents did not distinguish the calls of their own chicks.

As yet we have not been able to do the quantitative analysis of our chick data necessary to compare differences between the behavior of resident and strange chicks on a natural territory. We believe, however, that our data will support previous work showing that chicks act differently when off, compared to on, home territories. When at home, chicks spend most of their undisturbed time standing with their necks contracted against their bodies (like at rest) or erect and alert. Chicks that are disturbed or off their natural home territory spend much of their time crouched down in cover or running from place to place searching for a place to hide. During exchanges of older chicks in our experiments, we observed these "disturbed" behaviors but not nearly as often as by naturally displaced chicks.

Noseworthy and Lien (1976) have shown that the behavior of chicks not on their territory changes with age. Specifically, the numbers of chicks that return to their nest site after being experimentally moved a standard distance increases during the first week post-hatching until it reaches a maximum at 6 or 7 days. Older chicks do not return as often. If return rate correlates with time of maximal attachment, as they contend it does, then another factor influencing normal chick behavior might be recognition that they were or were not on their natural territory.

To reduce the effect of chick recognition of new territory after being switched, we confined the control and experimental chicks to 1 m^2 of surface area around the nest via fenced enclosures. We also increased topographical homogeneity in the enclosures by removing tall weeds and vegetation. Though there is still a possibility that the chicks recognized that they were not at home, our efforts may have reduced the dissonant cues perceived by both experimental and control chicks and contributed to their acting quite similarly, and naturally, even when switched to new territories and enclosures.

Gull chicks are also known to differentiate their siblings (at least nestmates) from other chicks at a very early age (Noseworthy and Lien 1976). To reduce this potentially confounding variable, we used single chicks raised alone in our experiments. Though we are unaware of any reasons why this might have been inappropriate, it may have affected the development or extent of parent-young attachment.

Another possible explanation of our findings must be considered. It is related to the argument of Graves and Whiten (1980) that adoptions may occur in gull colonies due to the apparent inhibition of adults to attack chicks in close proximity to the nest. As all of our fences enclosed areas around natural nest sites, the consistent acceptance of chicks under our experimental conditions might be thus explained. We have begun work with enclosures placed at different locations in the territory to further evaluate this hypothesis. Also, the mere presence of the fences may have reduced the willingness of adults to attack chicks on their territory. Future experiments using chicks tethered at various locations on the territory will contribute to the answer of this question.

Finally, we do not yet have experimental data from members of biologically related and unrelated families bearing on the question of kin vs. non-kin recognition by gulls. This is an important theoretical extension of our work and is a direction we shall pursue in the future.

SUMMARY

Resident gulls fed and cared for single experimental chicks placed in fenced enclosures surrounding their nests from time of hatching. When chicks were exchanged among nests at ages between 3 and 15 days, 22 of 25 were accepted and cared for within 2 h. Chicks rotated daily between several nests and then placed in control nests, or in enclosures where chicks had been rotated daily, were not attacked by resident adults. Eight of 10 chicks rotated daily between different nests for 30 days were accepted into new families. Even 3 of 5 natural chicks which had been with their biological parents for 25–30 days were accepted by adults which had had their chicks rotated. We conclude that adult gulls do not recognize their chicks individually but treat them as their "own" or "strangers" based upon how they behave. Factors such as recognition of home territory, siblings, and parental voice may influence how chicks act, which in turn determines how they are treated by resident adults.

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