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Individual Recognition between Siblings of the Young Black-tailed Gull (*Larus crassirostris*)

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ABSTRACT: We had 18 eggs artificially hatched in a mass breeding place of black-tailed gulls and examined the individual recognition between young siblings in a laboratory environment. The results of the experiment showed that the young gulls selectively responded to their siblings and non-siblings at an early stage after hatching. It was shown that they began to recognize the begging call among the voice signals of siblings and non-siblings 15-16 days after hatching, and the chirirah call 11-12 days after hatching. Also, more significant results were shown with the chirirah call than with the begging call. In an experiment of visual recognition between siblings and non-siblings, the young black-tailed gulls approached their siblings significantly 9-10 days after hatching. The recognition between young siblings in a mass breeding place provides an important evolutionary indicator in terms of their social behaviors.

Key words: Begging call, Black-tailed gull, Individual recognition, Sibling, Social behavior

INTRODUCTION

The recognition of relatives is an important starting point for the evolution of animals with social behavior (Hamilton 1964, Tivers 1971), and has been a point of interest in the research of animal behavioral science over the last 20 years. The recognition of relatives based on individual recognition can be divided into recognition between adults and their young (Tinbergen 1953, Hutchision *et al.* 1968, Penny 1968, Tschantz 1968, Beer 1969, 1970, 1979, Evans 1970a, b, Stevenson *et al.* 1970, Burger 1974, Busse and Busse 1977, Shugart 1977), and recognition between siblings.

Birds generally recognize individuals by applying their visual or auditory senses, or sometimes both (Burger *et al* 1988). However, it is known that the basic recognition of birds in mass breeding places depends on the auditory sense rather than the visual sense (Stevenson *et al.* 1970). It is reported that they have various voice signals and transmit a variety of information by using each sound effectively (Smith 1977, Witt 1977).

In his book 'Herring Gull' s World', Tinbergen(1953) reports for the first time that herring gulls show mutual recognition between adults and the young. After that, research on the recognition of relatives has continued. The research on the recognition between adults and the young has been conducted in a variety of ways in the meantime. Evans (1973, 1975) claims that the young of the Herring Gull (*Larus argentatus*) and the Ring-billed Gull (*Larus delawarensis*) can distinguish their parents' mew call from the call of other parents. Beer (1970, 1979) reports, from his experiments, that the young of the Laughing Gull (*Larus atricilla*) selectively respond to their parents' voices at an early stage after their hatching. However, research on the recognition of relatives has mainly focused on the young and their parents, whereas research on the recognition between siblings is relatively rare (Review in Evans 1980, Beecher 1988, Halpin 1991).

The ability to distinguish siblings from non-siblings is a critical factor in deciding whether animals with social behavior scatter or not (Palestis and Burger 1999). By conducting experiments on young Ring-billed Gulls 4-6 days after their hatching, Evans (1970a) proved that the young approached their siblings more significantly more often than non-siblings. In addition, he observed the young Black-billed Gulls (*Larus bulleri*) in a very active period move together with their siblings during their parents' absence, and explained that the siblings recognize each other (Evans 1980). Palestis *et al.* (1999) reports that the young Common Terns breeding in nests on flatland have a high probability of hovering over the neighboring regions, and so the most active individuals that are up to 12 days-old begin to recognize their siblings. According to the experiments, the 12 day-old young could not find their nests when there were no young gulls in the nest, when their siblings were removed temporarily, when their siblings were moved to neighboring nests, or when other siblings were moved to their nests. However, when their siblings were in the nest, the nest was found at a higher rate.

At the mass breeding places of black-tailed gulls in Korea, the

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distance between nests is approximately 1.1m, and, on average, there are 13 nests for 10 m^2 (Gwon 1998), a very high density of nests. In addition, the young black-tailed gulls can move around to neighboring nests 3 days after their hatching (Roh 1993), so there is a high probability that they are mixed with other young gulls in the neighboring nests when their parents are absent. Accordingly, there is a need for research on the recognition between siblings, as well as between the young and their parents. Young Black-tailed gulls respond to adult gulls with two types of voice signals (Chung 2000). They produce begging calls when they want food and they use this to tell parent gulls to bring food (begging call, Evans 1988). The second is chirirah call, young gulls' answer to mew calls. The exact function of this has not been found yet. It is assumed that the signals are used to let their locations be known or used for recognizing signals between siblings or parent-young gulls (Park and Park 1997, Park and Chung 2002).

Attempting to find out whether the young black-tailed gulls can recognize their siblings or not, this study examined selective responses of each individual when the voices of siblings and non-siblings were played back. Then, the study observed the behavior of each individual towards visual stimulus of siblings and non-siblings. Lastly, it examined the competitive behavior between siblings and between non-siblings.

MATERIAL AND METHODS

Eggs collecting / method

On May 18, 1999. 21 eggs were collected in Nando (36°40′ 20″ E, 126°03′ 50″ N), located at Gauido-ri, Geunheung-myeon, Seosan-gun, Chungcheongnam-do, which is known as a mass breeding place for black-tailed gulls. When they were collected, 7 nests with 3 eggs each were selected and the eggs of each nest were identified with a oil pen so that the eggs could not be mixed. This allows the same genetic elements to stay together and maintains each blood line in a natural state.

Artificial incubation / a method of breeding

The eggs were artificially hatched in the laboratory. At that time, the temperature of the artificial incubator (Lyon, Model RX2) was maintained at 39±0.5℃, with the moisture 70±5%. Of the 21 eggs, 18 hatched, and colored plastic rings were fixed to their legs to distinguish each hatched individual. They were kept in paper containers, (55×55×60cm) three by three (6 clutches), for breeding, with the eggs from the same nest together. The temperature of the breeding boxes was kept at 37±0.5 ℃ with a radiator plate, and 2 weeks after their hatching they were kept at a normal temperature. Paper containers were put down in each box, replaced everyday. All young gulls were fed with every 2 hours from 09:00 to 21:00pm, and the food was frozen yellow corvina and feed.

Response of chick to a sibling and nonsibling audiotory stimulation

To discover the recognition between siblings, the sounds of each individual were recorded everyday and played back. The sounds of the young were recorded by dividing them into a Begging call and a Chirirah call. A DAT Digital Recorder (PDR 1000) and a condenser microphone (Sennheiser MKH816P48) were used for recording, and the recording was conducted 20± 5cm away from the young gulls. Individual subjects for the experiment were moved to experiment boxes (70×40×40cm) and were allowed to calm down for 3 minutes. After that, by using a Sony cassette recorder TCM-929 and a JBL pro III, the Begging call and Chirirah call of siblings and non-siblings were played back at random every two minutes, and the responses of each individual were observed. This experiment was conducted among 10 age classes (1-2, 3-4, 5-6, 7-8, 9-10, 11-12, 13-14, 15-16, 17-18, 19-20 days after hatching).

Response of chick to a sibling and nonsibling visual stimulation

In an experiment box (70×40×40cm) partitioned in half, an experiment gull was put on one side, and a stimulus gull, either a sibling or non-sibling, was placed on the other. They were then allowed to calm down for 3 minutes. The experiment gull and the stimulus gull were prevented from seeing each other until the partition plate was removed. After the partition plate was removed, the frequency of responses was examined, such as an approach response, an attack response, or a silent response (no response). During the experiment, the colored rings on their legs were removed, but individual markings were made on the soles of their feet to insure proper identification after the experiment.

A statistical analysis

In this experiment, SPSS (version 10.0) was used to process the data. The Wilcoxon test was used to measure the difference in responses to the chirirah call and the begging call, among siblings and non-siblings. We used repeated measures analyses of the Mann-Whitney U test for visual stimulation among siblings and non-siblings.

RESULTS

Responses of each individual towards the voices of siblings and non-siblings

The young black-tailed gulls showed significant responses to the chirirah call of siblings and non-siblings 11-12 days after hatching($N=18$, $z=2.955$, $P<0.003$; Fig. 1, A), and to the begging call 15-16 days after hatching($N=18$, $z=2.587$ $P<0.01$; Fig. 1. B).

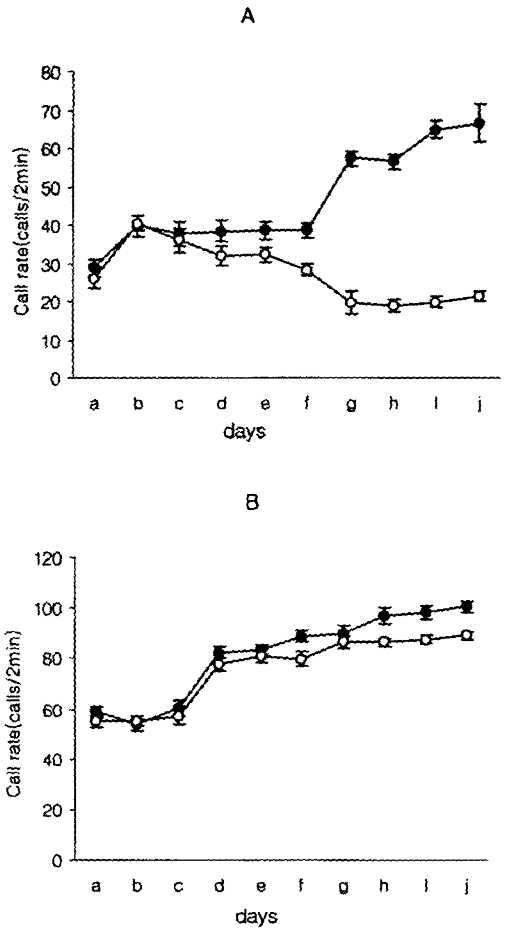

Fig. 1. Mean SE call rate (calls/2min, A:chirirah call, B:begging call) for sibling and non-sibling of call. Age classes a:1-2, b:3-4, c:5-6, d:7-8, e:9-10, f:11-12, g:13-14, h:15-16, i:17-18, j:19-20days (●; response for sibling' s call, ○; response for nonsibling' s call).

Table 1. Responsiveness of sibling versus non-sibling

Age	Approching Sibling	Approching Nonsibling	Attack Sibling	Attack Nonsibling	Silence (%)	Sig
1-2					89	
3-4					65	
5-6					33	
7-8					29	
9-10					14	0.04
11-12					19	0.02
13-14					12	0.01
15-16					8	0.00
17-18					6	0.00
19-20					6	0.00
	50 25	0 25	50 25	0 25	50 (%)	

Responses when seeing siblings and non-siblings

At an early stage after hatching, there was no difference in the approaching response to siblings and non-siblings. However, 9-10 days after hatching, they approached their siblings significantly more often, and showed a significant attack response to non-siblings 9-10 days after hatching (N=18, z=3.388 p<0.04). The silence response occurred at an early stage many times, but decreased as they grew older. It rarely appeared 15 days after hatching (Table 1).

DISCUSSION

It is not widely known that young gulls selectively respond to their siblings, but some studies report that young gulls recognize their siblings and non-siblings (Evans 1970a, Noseworthy and Lien 1976). In experiments on the Black-legged Kittiwake, Noseworthy and Lien (1976) report that the young have little chance to move to other nests due to their nesting habits, and so they begin to recognize their parents about 30 days later than herring gulls which begin to recognize their parents 3-5 days after hatching. According to their report, however, recognition of their siblings was more developed than that of the herring gull. A recent experiment shows that young Common Terns showed different responses to their siblings and non-siblings until they reached a certain age (Palestis and Burger 1999). Our experiment also showed that young black-tailed gulls selectively responded to their siblings and non-siblings. In an experiment on their auditory recognition, each young individual had a significant response to the chirirah call and the begging call of their siblings and non-siblings. However, the young black-tailed gulls responded to the chirirah call more often than the begging call. This may mean that the chirirah call is used as a communication method between their siblings, as well as a recognition method between the young and their parents. The begging behavior of gulls in a natural environment is known as the most honest communication of quantitative expression between the young and their parents to beg for food (Godfray 1991). But it is reported that the chirirah call is the response signal to their parents' mew call in a natural environment, or a voice signal to inform their parents of their location. This provides a very important value to the recognition between the young and their parents (Chung 2000).

It is known that at the early stage of recognition between the young and their parents, the visual recognition of young gulls plays a less important role than the voice signal (Evans 1973, 1975). However, in an experiment on the visual behavior models of Common Terns (*Sterna hirundo*) by Palestis and Burger (1998), it is reported that young Common Terns show an approach response to their siblings, but an attack response to non-siblings. The experiment of this study shows that at early stages of visual response to siblings and non-siblings, there is no recognition of the two groups. But within a certain time, they show significant results. Like the results of the experiment by Palestis and Burger (1999), they approached their siblings and attacked non-siblings. Unlike the recognition between the young and their parents, visual recognition between the young is just as important as auditory recognition. According to Roh (1993), young black-tailed gulls do not leave their nests 1-2 days after hatching, hover around their nests 3-4 days after hatching, and frequently move to their neighboring nests 10-13 days after hatching. Our experiment showed that the silent response frequently occurred at an early stage after hatching, but decreased rapidly 9-10 days after hatching. These results indicate that young black-tailed gulls move actively in the natural environment 9-10 days after hatching. The results of the experiment and these theories imply that young black-tailed gulls begin to form recognition around 10 days after hatching. In this period, their physiological changes increase dramatically. In particular, the weight and the length of the legs increase dramatically 7-8 days after hatching and show moderate increase 23-24 days after hatching (Chung, 2000). According to Chung (2000), the frequency of chirirah calls and begging calls also dramatically increased between 7-8 days and 15-16 days after hatching. These physiological results imply that the young move actively in this period.

The social and behavioral values of the recognition between siblings of gulls are as follows: First, it enables them to avoid the attack of other adult gulls; second, it reduces the chances of missing out from their parents' food supply; third, it enables them to find their nests in an environment of dense nests, increasing their survival rate (Evans, 1970; Noseworthy and Lien, 1976; Beecher and Beecher, 1983); and lastly, it prevents damage from feed competition due to adopting neighboring young gulls (Burger 1988; Pierotti *et al.*, 1988). Therefore, the period for recognizing their siblings is a crucial factor in their survival rate, and so it is reported that recognition between siblings needs to develop before the young can move around other nests actively (Evans, 1970; Beecher and Beecher, 1983; Holmes and Sherman, 1982). The young black-taled gulls can get social and behavioral benefits from their recognition of their siblings in the mass breeding place at the period of active movement.

The habitat of black-tailed gulls is unique when compared to those of other gulls. They form their nests in the middle areas between the habitats of herring gulls and black-legged kittiwakes that make their habitats on flatland and cliffs, respectively. Due to these characteristics of their habitat, further research on the recognition between their siblings is required.

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LITERATURE CITED

Beecher, I. M., and Beecher, M. D. 1983. Sibling recognition in bank swallows (*Riparia ripara*). Zeitschrift fur Tierpsychologie 62: 145-150.

Beecher, M. D. 1988. Kin recognition in birds. Behavior Genetics. 18: 465-482.

Beer, C. G. 1969. Laughing Gull chicks: recognition of their parent`s voice. Science. 166: 1030-1032.

Beer, C. G. 1970. Individual recognition of voice in the social behaviour of birds. *In* D. S. Lehrman, R. A. Hinde and E. Shaw (eds.), Advance in the study of behaviour. Vol. 3. Academic Press, New York. pp. 27-74.

Beer, C. G. 1979. Vocal communication between Laughing Gull parents and chicks. Behaviour 70: 118-146.

Burger, J. 1974. Breeding adaptations of the Franklin's Gull (*Larus pipixcan*) to a marsh habitat. Anim. Behav. 22: 521-567.

Burger, J., M. Gochfeld, and W. I. Boarman. 1988. Experimental evidence for sibling recognition in Common Terns (*Sterna hiundo*). Auk. 105: 142-148.

Busse, K., & K. Busse. 1977. Pragungsbedingto Bindung von Kustensees Chwalbenkuken (*Sterna paradissaea* Pont) an die Eltern und ihre Eahigkeit, sie an der stimme zu erkennen. Z. Tierpsychol 43: 225-238.

Chung, H. 2000. Behavioral development of begging and recognizing parents' mew call in Black-tailed Gull (*Larus crassirostris*) chicks. Master Thesis, Korea National University of Education, Cheongju.

Evans, R, M. 1970a. Imprinting mobility in young Ring-billed Gulls (*Larus delawarensis*). Anim. Behav. Monger. 3: 193-248.

Evans, R. M. 1970b. Parental recognition and the "Mew call" in Black-billed Gulls (*Larus bulleri*). Auk. 87: 503-513.

Evans, R. M. 1973. Differential responsiveness of young Ring-billed gulls and herring gulls to adult vocalization of their own and other species. Can. J. Zool. 51: 759-770.

Evans, R. M. 1975. Responsiveness of young herring gulls to adult "mew call". Auk. 92: 140-143

Evans, R. M. 1980. Development of behaviour in seabirds: an ecological perspective: Marine Birds. *In* J. Burger, B. L. Olla and H. E. Winn, (eds.), Behaviour of Marine Animals. Vol. 4. Plenum, New York. pp. 271-322.

Godfray, H. C. J. 1991. Signalling of need by offspring to their parents. Nature 352: 328-330

Halpin, Z. T. 1991. Kin recognition cues of vertebrates. *In* P. G Hepper (ed.), Kin recognition. Cambridge University Press, Cambridge. pp. 220-258.

Hamilton, W. D. 1964. The genetical theory of social behaviour. Journal of Thoretical Biology 7: 1-52.

Holmes, W. G., and P. W. Sherman. 1982. The ontogeny of kin recognition in two species of ground squirrels. American Zoologist 22: 491-517.

Hutchison, R. E., J. G. Seteven. and W. H. Thorpe. 1968. The basis for individual recognition by voice in the Sandwich Tern (*Sterna sandvicensis*). Behaviour 32: 150-157.

Kwon. Y. S. 1999. The breeding biology of the black-tailed gull (*Larus crassirostris*). M. Sc. Thesis. Kyung Hee University, Seoul.

Noseworthy, C. M. and Lien. J. 1976. Ontogeny of nesting habitat recognition and preference in neonatal herring gull chicks, *Larus argentatus* Pontoppidan. Anim. Behav. 24: 637-651.

Palestis, B. G. and J. Burger. 1999. Individual sibling recognition in expermental broods of commontern chicks. Anim. Behav. 58: 375-381.

Park, S. R. and D. S. Park. 1997. Acoustic communication of the Black-tailed Gull (*Larus crassirostris*): the structure and behavioral context of vocalizations. Korean J. Biol Sci. 1: 565-569.

Park, S. R. and H. Chung. 2002. How do young Black-tailed Gulls(*Larus crassirostris*) recognize adult voice signals? Korean J. Biol. Sci. 6: 221-225.

Penny, R. L. 1968. Territorial and social behaviour in the Adelie Penguin., *In* O. L. Austin Jr. (ed.), Antarctic bird studies Antarct. Res. Ser. No. Washington, D.C., Am. Geophys. Union. pp. 81-131.

Pieroti, R., D. Bruton, and E. C. Murphy. 1988. Parent-offspring and sibling-sibling recognition in young herring gulls (*Larus argentatus*). Toxicological Science 43: 156-160.

Rho, J, R. 1993. The study of the kin recognition between offspring and parent and behaviour on Black-tailed Gull (*Larus crassirostris*) at Hong Island on Kyung-Nam in Korea. Master Thesis. Korea National University of Education, Cheongju.

Shugart, G. W. 1977. The development of chick recognition by adult Caspian Terns. Proc. Colon. Waterbird Group 1: 110-117.

Smith, W. J. 1977. The behaviour of communicating Cambridge. Harvard University Press, Mass.

Stevenson, J., R. E. Hutchison, J. Hutchison, B. Bertram, and W. R. Thorp. 1970. Individual recognition by auditory cues in the Common Tern (*Sterna hirundo*). Nature (London). 226: 562-563.

Tinbergen, N. 1953. The Herring Gull's world. Collins, Lodon.

Triver, R. L. 1971. The evolution of reciprocal altruism. Q. Rev. Biol. 46: 35-57.

Tschantz, B. 1968. Trottellummen, die Entstehung der personlichen Beziehungen zwischen Jungvogel und Eltern. Z. Tierpsychol. suppl. No. 4.

Witt, V. H. 1977. Zur Verhaltens biologie der Korallenmowe *Larus audouinii*. Z. Tierpsychol 43: 46-47.

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