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Recognition of brood-mate vocalizations by Northern Bobwhite (Colinus virginianus) chicks

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RECOGNITION OF BROOD-MATE VOCALIZATIONS BY NORTHERN BOBWHITE (*COLINUS VIRGINIANUS*) CHICKS

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ABSTRACT

Unrelated bobwhite quail (Colinus virginianus) chicks were hatched together and raised together. Each chick was tested in an arena with tape recorded separation, contentment and distress calls from a brood-mate and an unfamiliar chick of the same age. Chicks at one, six and 19 days of age gave significantly more separation calls in response to the separation calls of their brood-mates than they gave in response to the separation calls of the strange chicks. Since the chicks were not related, this ability to recognize brood-mate vocalizations is probably learned. Sibling recognition in quail might function in inbreeding avoidance.

INTRODUCTION

Sibling recognition has been the subject of a few recent studies in species ranging from tadpoles (Blaustein and O'Hara 1981) to mice (Porter et al. 1981) and macaques (Wu et al. 1980). Much of the discussion has focused on whether or not the ability to recognize siblings is innate or learned. There are some intriguing theories about behavior in social animals which would depend on this ability. For example, the theory of kin selection depends on discriminating kin from non-kin and then treating or affecting kin preferentially. In another theory, Bateson (1982) has recently proposed that individuals choose mates which represent an optimal balance between inbreeding and outbreeding. To do this they learn at a young age to identify close kin, and then as adults they choose a mate that is slightly different. The simplest evolutionary explanation of sibling recognition may be that it is useful in avoiding inbreeding with siblings.

Individual recognition in avian species is frequently based on vocalizations. There are many reports of such recognition between territorial neighbors (Falls and McNicholl 1979; Brooks and Falls 1975; and Krebs 1971), between mates (Mosely 1979; and Beer 1970), and between parents and chicks (Beer 1969; Busse and Busse 1979; and Evans 1970), but except for Radesater (1976) there are so far very few demonstrations of avian sibling recognition.

Northern bobwhite are highly social quail with a fairly rich vocal repertoire. The life history of the bobwhite led me to suspect that they might have the ability to recognize siblings. The precocial chicks hatch synchronously and soon after are led off the nest by the parents. A typical brood of 10 to 15 chicks may be reduced to eight or nine by the end of the summer. At this time the family is joined by one or two other families, unmated males, and/or unsuccessful pairs until there are

about 15 birds forming the winter covey. In the spring most pairs are formed from within this covey, although some males may change coveys (Agee 1957; Stoddard 1931; Rosene 1969; and review in Johnsgard 1973). Since siblings are, therefore, very often in the same covey, it might be important to recognize each other in order to avoid inbreeding and the possibility of inbreeding depression. In one laboratory study, breeding between sibling bobwhites did in fact result in a significantly reduced hatch rate (Nestler and Nelson 1945). There is no evidence as yet to indicate that bobwhites do avoid inbreeding, although Bateson (1982) has reported that Japanese quail (Coturnix coturnix) reared with their siblings seem to prefer their cousins when given a choice of cousin and sibling.

Stokes (1967) observed that adults can recognize mates on the basis of a particular separation call, the 'hoy-poo', and that individuals are attracted by this call when it is given by their covey members but are repelled by the same call given by birds from another covey. In this study I was interested in determining if bobwhite chicks learn to recognize the calls of their siblings, and if so, at what age this ability develops. The calls which I was interested in were the distress call which is given by a captured chick, the contentment call which is given while a chick is feeding and preening with its brood, and the separation call which is given by a separated chick and answered with more of the same by its brood-mates. This chick separation call has been shown to develop into the adult separation call.

METHODS

Three broods were raised, each from a separate batch of eggs, in an indoor animal room at the University of Wisconsin-Milwaukee Field Station. For the purposes of this paper, 'brood' refers to non-sibling chicks which were hatched together and raised together. Each brood was isolated visually and acoustically from any other quail.

The stimulus tapes were made from tape recordings of one chick. Each stimulus tape consisted of 50 sec of continual separation calling followed by 60 sec of silence, then 50 sec of continual contentment calls followed by 60 sec of silence, then 50 sec of continual distress calls followed by 60 sec of silence. A second stimulus tape, made from recordings of a same age chick from a different brood, was matched to the first for duration, amplitude, and number of calls as best as possible. Two such tapes were made for each of the three ages tested. Representative examples of each of the calls are given in Figure 1. These are from a six day old chick and there was very little change in any of the calls from day one to day 19.

The test arena consisted of a white plywood box, 40 cm wide by 115 cm long, and 40 cm deep, lined with brown paper. The length of the box was divided into thirds with pencilled lines. A heat lamp identical to that in the home cage was placed above each end. Tape-recorded calls of either a brood-mate or a stranger were played on one of two tape recorders through speakers placed at either end of

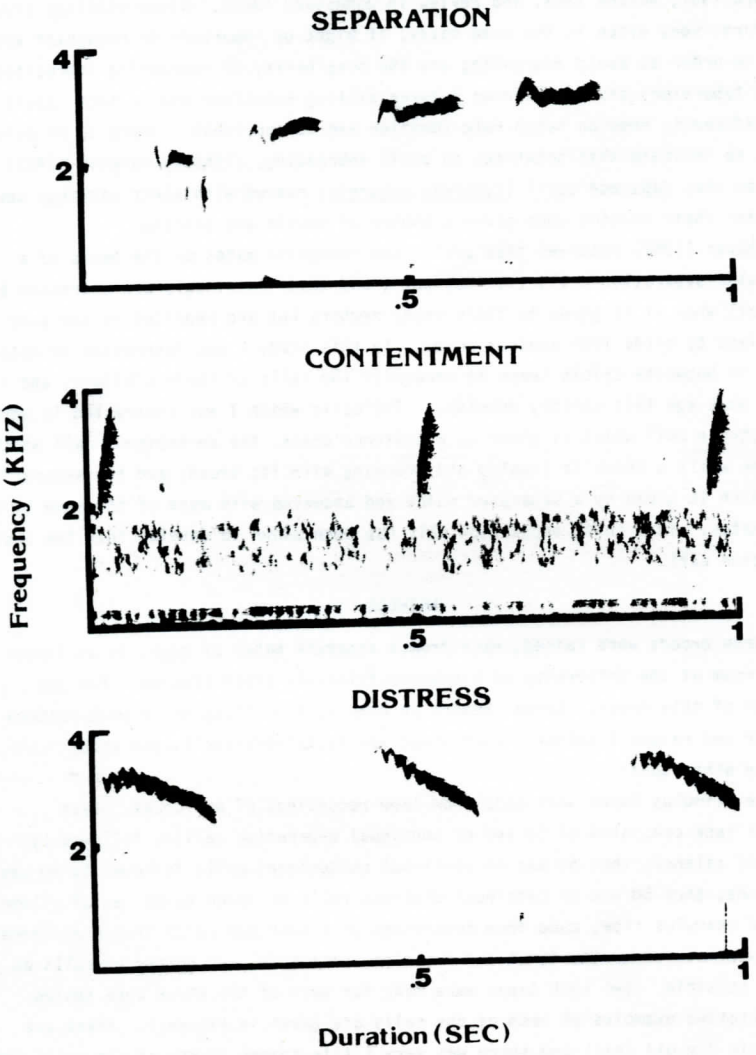

Figure 1. Representative calls from a six day old chick.

the arena. An assistant and I sat next to the box and looked down on the chick. We controlled one tape recorder, labelled A or B so that we would not know which tape played the brood-mate calls and which the stranger calls. We each recorded four different behavioral responses.

The chicks were tested at one, six, and 19 days of age. Each chick was placed individually in the arena and allowed to explore for up to 5 min. Stimuli were presented in the following manner: half of the chicks heard their brood-mate first and the other half heard the stranger first; half of the chicks heard the stranger out of the speaker at one end and the brood-mate out of the speaker at the opposite end and half of the chicks heard the reverse; for each chick the order of presentation of separation, contentment, and distress calls was randomized. For each type of call both the stranger and brood-mate tapes were played before moving on to the next call. The responses recorded were number of separation, distress, and contentment calls, time spent moving or still, and time spent in either third of the arena. The experiment was performed twice, with two different broods.

RESULTS

During the exploration period and silences between the periods of calls, the common response was to walk or run up and down the arena, pace back and forth along a wall, and give alternating distress and separation calls. A small number of chicks responded by crouching in one spot and remaining there still and quiet. In general, chicks tended to remain active and vocal during separation tapes although the rate of vocalizing decreased. During contentment tapes, both movement and vocalizations were greatly reduced, and during distress tapes the chicks were usually silent and still. Movement and vocalizing increased again during the 60 sec of silence following each 50 sec of stimulus calls. The chicks would cock their heads and give the appearance of listening to the tapes but did not orient to the sound either by their movement or position in the arena.

At one, six and 19 days of age the chicks gave significantly more separation calls in response to the separation calls of their brood-mates than they did to the separation calls of strange chicks. The Mann-Whitney U test was performed on the first and second replicates at each age to determine whether there were significant differences between the two replicates (for sample sizes $n_1 = 3$ and $n_2 = 7$, $T = 16.5$, $p > .05$). The Wilcoxon Matched-pairs Signed Ranks test showed that the number of separation calls given to the separation calls of brood-mates and strangers differed significantly ($n = 10$, $p \leq .01$, one-tailed at all ages). In 26 out of 44 tests scored the chicks gave more responses to their brood-mate, while in four tests the chicks gave more responses to the stranger. In 13 of the tests the chicks gave no response to either, although only one chick was silent at all three ages. In nine of the 30 responses, the intensity of response to the brood-mate or stranger differed by only one call, and the remaining 21 responses were all stronger towards the brood-mates.

No significant differences occurred in the numbers of distress or contentment calls given, or in the amount of time spent at either end of the arena, or in the amount of time spent moving about the arena during the playing of the separation calls.

One day old chicks gave significantly more separation calls in response to the contentment calls of brood-mates than to strangers (Wilcoxon Matched-pairs Signed Ranks test: $T = 0$, $p \leq .01$, one-tailed). At days six and 19, however, the chicks tended to remain silent during and after the contentment tape recordings. There were no other significant differences in responses given to contentment calls between brood-mates and strangers.

No significant differences occurred in any behavioral responses given to distress calls.

DISCUSSION

This experiment suggests that some bobwhite chicks are able to recognize brood-mates by their separation calls within their first day of hatching. This effect, although present in each of the six trials (two replicates each at three ages), is weakened by the high number of non-responders. Some possible explanations for non-responders are the experimental conditions may have been too artificial to elicit normal behavior, the testing period of 50 sec may have been too short, some other response such as heart beat rate might have been a more sensitive measure, or the effect may actually be a weak one. Normally when a chick is separated it calls back and forth with several members of its brood. In this experiment it was only 'answered' by one chick, which may have been perceived as just another lost chick. It would be interesting to repeat this experiment using recordings of entire broods. Although there are theoretically benefits to be derived from sibling recognition, there are also potential benefits to bobwhite chicks to remain responsive to unfamiliar quail. Parent mortality and separation from the brood are ever present hazards, and in such instances survival is still possible if chicks are adopted by another family (Stoddard 1931).

I cannot readily explain the finding that chicks responded differentially to known and unknown contentment calls at day one, but not at six or 19 days. Perhaps by day six they learned that a separation call is not an appropriate response to contentment sounds.

It is not surprising that chicks responded to the separation calls since it develops into the 'hoy-poo' by which adults can recognize mates and covey members (Stokes 1967). The fact that chicks did not respond to contentment or distress calls does not necessarily mean that they could not recognize siblings by these calls. It might even be expected that the contentment call, a soft contact note, would have a quieting effect on the subject chick. Likewise, a chick in distress signifies nearby danger and so the best response might be no response. Lorenz (1970) cites a similar lack of response to sibling distress calling by domestic

fowl chicks. In bobwhite chicks, the onset of contentment and distress calls did, in fact, tend to inhibit whatever calls the six and 19 day old chicks had been giving.

I expected that a lost chick, hearing a brood-mate, might move towards the sound, or might increase its moving about in an attempt to find the chick. The chicks did not seem to do any kind of orienting inside the arena and it may be that the experimental arena was just too artificial.

Since, in this study, brood-mates were not genetic siblings, this ability to recognize brood-mates could not have been inherited. In domestic chicks (Grier et al. 1967) and Japanese quail (Lien 1976) there is evidence to suggest that pre-hatch exposure to particular sounds influences later responses. Vince (1966) has shown that bobwhite embryos communicate with mechanical sounds and vocalizations a day or two before hatching, and I have recorded two embryos giving separation-like calls the day before hatching. It may be that bobwhite embryos learn to recognize the vocalizations of siblings even before hatching. The present study does not show whether chicks recognize each sibling individually, or whether they recognize a particular characteristic which all brood-members share.

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