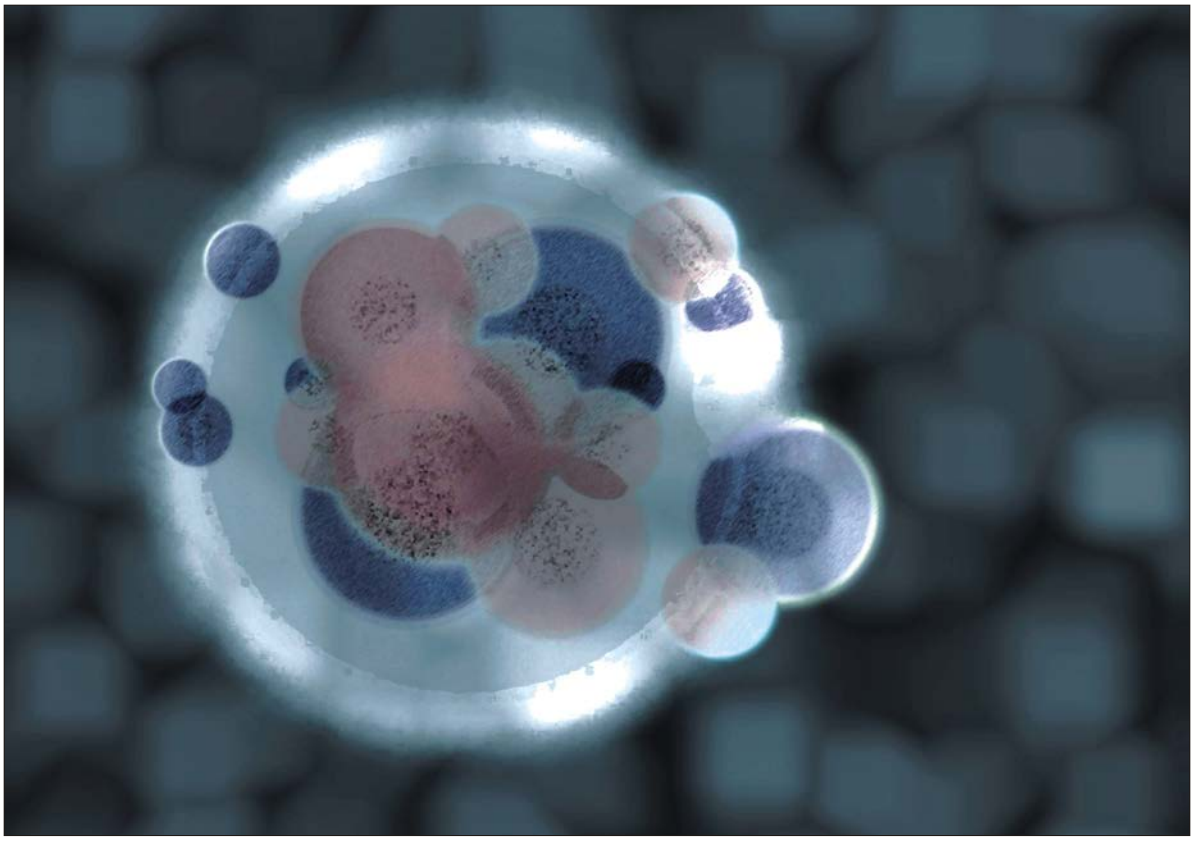

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Vocal Mimicry in Relation to Social Dominance in Hill Mynah *Gracula religiosa*

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Abstract: To study vocal mimicry in captive Hill Mynah *Gracula religiosa,* four experiments were conducted to examine 1) factors of development influenced the ability of learning 2) prior residence determined the ability of producing vocal mimicry 3) vocalization manipulated the social dominance. It showed that birds were able to well imitate if were hand-reared individually when they were less than five weeks old. No matter how good birds could do vocal mimicry after learning, if they were put into the resident aviaries, they almost stopped producing vocal mimicry. Dominance, through the prior residence played the important roles in this matter. Prior residence effect overcame other factors in the case that even resident birds produced fewer times of vocal mimicry, they still dominated the newcomers which used to be fluently vocal mimicry producers. Nevertheless, in initial grouping, with unfamiliar birds, ones which originally produced more times in vocal mimicry, had more advantage to get dominant position in captivity. These suggested that although prior residence overrode vocal mimicry ability, vocalization, anyhow, which led birds to gain dominance.

Key words: *Gracula religiosa*, Hill Mynah, prior residence, social dominance, vocal mimicry

INTRODUCTION

There are numbers of species of birds which mimic the other species' sounds in nature[1,2]. The Hill Mynah, *Gracula religiosa* was thought to be one of them[3]. However, many later reports have shown that wild mynahs hardly ever imitate other species[4-6]. Mynahs in aviaries imitated other species only when there were no mynahs nearby to imitate[4]. In the wild male mynahs imitated neighbouring males' calls and females imitated neighbouring females. The study was concluded that vocal mimicry had an intraspecific function in individual recognition and pair bond maintenance[4]. Nevertheless, some imitation of sounds from other sources occur occasionally in the wild. Wild mynah in Indonesia imitated a loud alarm call of gibbons and a loud spacing call of male langurs[7].

Most studies on vocal mimicry in captive Hill Mynahs have focused on conditioning[8-13] and neurophysiology[14-15]. Recently, there was a report about factors affecting competency on vocal imitation of Hill Mynahs in aviaries[16].

This study examined the influence of experience on the ability to mimic and also investigated the relationship between social dominance and vocal mimicry.

MATERIALS AND METHODS

This study was conducted at the Zoological Research Station, Ramkhamhaeng University, Bangna Campus and the Department of Biology, Faculty of Science, Ramkhamhaeng University, Main Campus, Bangkok, Thailand from 1998 to 2002. There were four experiments. The first examined the effect of experience, the second and the third followed the first and investigated the effects of social dominance on vocal mimicry by the individuals from Experiment 1, the fourth followed the third and determined which came first, between dominance and sound production of the individual from Experiment 1.

Hill Mynahs *G. r. intermedia* used in this study were donated by people who had them as cage pet[17]. Age of birds was determined by asking from the prior owners and identifying from characteristics of plumage and wattle colour[18,19]. The information obtained from the prior owners showed that they got five weeks old nestlings from poachers which took birds from their nests in the wild. However, sexes do not influence the vocal mimicry ability[16].

Experiment 1

Experience: The hand-reared nestlings of this species in individual cages, after learning Thai words and phrases before six months of age for a year, were the most effective group to show vocal mimicry[16]. Therefore, birds used in this study for producing vocal mimicry were five weeks old. There were three groups of Hill Mynahs in this experiment. Group 1 (n = 4) was raised in an outdoor aviary measuring 4x5x3 m with four three-years old Hill Mynahs and given practice listening to Thai phrases daily. These three-years old Hill Mynahs which were used as resident birds were also hand-reared nestlings before

Table 1: Treatment of Experiment 1

Groups	n	Age (weeks)	Raised in	Practiced thai phrases
1	4	5	Aviary with four resident adults	+
2	4	5	Individual cages	+
3	4	5	Aviary with four resident adults	+

Table 2: Treatment of Experiment 2

		Stages in Experiment 2			
Groups	Condition in Experiment 1	1	2	3	4
1	Aviary with resident adults	Individual cages	Aviary with resident adults	Individual cages	Aviary with resident adults
2	Individual cages	Aviary with resident adults	Individual cages	Aviary with resident adults	Individual cages

and never produced natural Hill Mynah sound[16]. Group 2 (n = 4) was raised separately in individual cage measuring 50x61x64 cm and taught Thai phrases daily. Birds of Group 3 (n = 4) were raised in an outdoor aviary and treated the same procedure as Group 1 (Table 1).

In the Experiment 1, birds of Groups 1 and 3 were raised and taught at the Zoological Research Station while birds of Group 2 were raised and taught at the Department of Biology in order to limit them not to hear adult birds' sound and then were transferred to the Zoological Research Station later for Experiments 2, 3 and 4.

Birds were taught for 12 months. Thai phrases[16] consisted of 2-3 syllables such as Thong Cha (called itself), Kaew Cha (called itself), Archarn Cha (called professor), Maae (called mother), Kwauy Kwauy (called buffalo), were taught six times a day, 30 min each time by keepers once in the morning and by tapes later during a day. All birds were taught the same and also had opportunities to hear non-language sounds (whistle, horn, motorcycle engine) and human conversation from outside their cages. The study was counted only sounds produced by birds and recognized as Thai words.

After 12 months of these procedures, each bird's sound production was assessed individually. These tests were conducted once a day during 0700-1000 h by four people simultaneously, one bird by one person for each group, one group at a time. Each bird was tested daily, 30 min each time, for two weeks.

Experiment 2

Social dominance: Two groups of birds from Experiment 1 were used in this experiment, Groups 1 and 2. In four successive four-week periods, these birds were combined and separated to determine the influences of social situations on the use of imitations of Thai sounds already learned. The four stages were repeated with the same birds (Table 2). In stage 1, birds of Group 1 were transferred to individual cages for four weeks. Birds of Group 2 were transferred to aviary with four three-years old resident birds for four weeks. In stage 2, birds of Group 1 were transferred to aviary with same four three-years old resident birds for four weeks and birds of Group 2 were transferred to individual cages for four weeks. Stage 3 was conducted the same as stage 1 and stage 4 was the same as stage 2. Each bird's vocal production was assessed daily during the last two weeks of each four- week stage. Procedures for testing vocal production followed those used in Experiment 1.

Experiment 3

Prior residence: This experiment followed Experiment 2. In this experiment, the effect of prior residence on vocal mimicry was tested in order to consider if age was the factor or not because in Experiments 1 and 2, the resident birds were adult birds. Therefore, only four birds of Group 1 were kept in an aviary for four weeks. After birds of Group 1 were the resident birds, birds of Group 2 were put into this aviary. They were together for another four weeks. Each bird's vocal production was assessed daily during the last two weeks as Experiment 2.

Experiment 4

Dominance hierarchy: This experiment followed Experiment 3. In this experiment the relationship between vocal mimicry and dominance in initial grouping was studied. Birds of Groups 2 and 3 from Experiment 1 were put simultaneously into a new aviary. All eight birds were unfamiliar to each other and to the aviary. They were together for four weeks. In the last two weeks, each bird's vocal production was assessed daily as Experiment 2.

The differences of the ability to produce vocal mimicry between stages in Experiment 2 and between groups in Experiments 3 and 4 were tested using Student's t-test.

RESULTS

Experiment 1

Experience: Birds in Groups 1, 2 and 3 which were taken from nests when they were only five weeks old, did not produce any sounds like Hill Mynahs in the wild. Birds of Group 2 produced Thai sound fluently (25.43±3.89 times h^{-1} and Fig. 1) while birds in Groups 1 and 3 which were kept in aviaries with three-years old resident adults and taught same Thai phrases did not produce vocal mimicry in this experiment.

Experiment 2

Social dominance: In Experiment 1, birds of Group 1 which had been kept in a large aviary with four three-years old

Table 3: The comparison of the ability to produce vocal mimicry (times h^{-1}) between stages in Experiment 2

Birds	Between stages	t	df	n	Significance (p)
Group 1	1 × 2	35.73	110	4	< 0.001
	2 × 3	-29.42	110	4	< 0.001
	3 × 4	33.78	110	4	< 0.001
Group 2	Exp 1 × Stage 1	39.78	110	4	< 0.001
	1 × 2	-38.18	110	4	< 0.001
	2 × 3	38.36	110	4	< 0.001
	3 × 4	-34.23	110	4	< 0.001

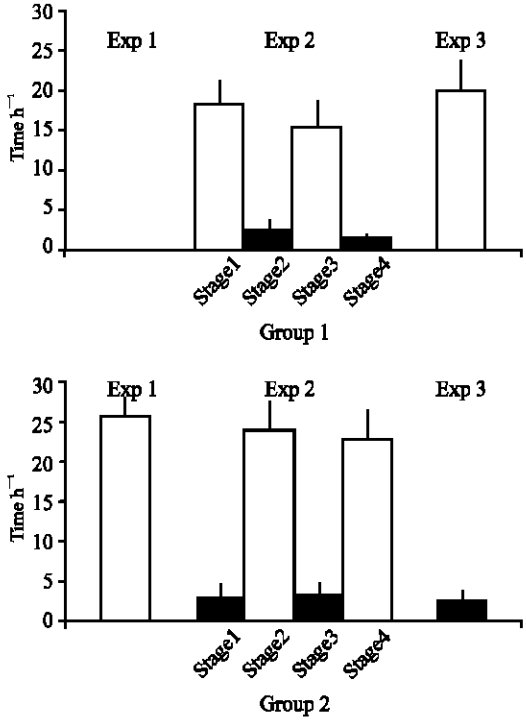

Fig. 1: The frequency (M±SD) of producing vocal mimicry (times h^{-1}) of birds of Groups 1 and 2 in Experiments 1, 2 and 3

resident birds, did not show any vocal mimicry. In stage 1 of Experiment 2, they were separated into individual cages, where they produced significantly more vocal imitation (18.21±3.04 times h^{-1} and Fig. 1). The results were similar in both Groups 1 and 2. Whenever they were kept individually they produced more vocal mimicry significantly compared to when they were put into aviary already occupied by three-years old resident birds, their vocal mimicry decreased significantly (Fig. 1 and Table 3).

Experiment 3

Prior residence: This experiment was tested if the resident effect or influence of age which affected vocal mimicry. When birds of Group 2 which originally produced very fluently vocal mimicry were put into the aviary where birds of Group 1 were the resident birds, birds of Group 2 produced significantly less vocal mimicry than birds of Group 1 (t = 32.73, df = 110, n = 8, p<0.001 and Fig. 1). Whenever birds of Group 2 started producing sound, they were attacked by birds of Group 1.

Experiment 4

Dominance hierarchy: In initial grouping, when birds of Groups 2 and 3 were unfamiliar to each other and kept in new aviary where was unfamiliar to both groups, birds which produced more vocal mimicry (Group 2 = 21.73±3.38 times h^{-1}) chased and pecked the ones which produced less vocal mimicry (Group 3 = 3.86±2.95 times h^{-1}) (t = 21.49, df = 110. n = 8 and p<0.001). Birds of Group 2 dominated[20-23] birds of Group 3. Whenever the latter started to produce vocal mimicry, the dominant birds (Group 2) chased and made more sound. Consequently, the subordinate birds (Group 3) almost stopped producing vocal mimicry.

DISCUSSION

Development of vocal mimicry: As previously reported, wild Hill Mynahs rarely imitated other species' sounds unless they were prevented from hearing their own species' sounds[4-6]. However, in captivity they are very effectual in vocal mimicry[4]. A reasonable series of explanations for this finding has been proposed. First, Hill Mynahs kept in the cages do not have species-specific calls to learn, so they have to mimic. All birds in this study were caught before joining flocks of their own species consequently, they did not produce natural Hill Mynah sound. Second, sounds which Hill Mynahs naturally make are similar in tone, context and pitch to human sounds. Finally, when young Hill Mynahs are reared and fed by humans, they apparently imprint especially on human sounds. Hill Mynahs taught by keepers produced more vocal imitation than taught by tape cassettes although the difference was not significant[16].

Both hand-rearing from an early age and individual isolation were important for development of vocal mimicry in Hill Mynahs (Group 2 in Experiment 1). It is remarkable that birds of Group 1, although taught Thai in Experiment 1, did not produce Thai sound when they were with the resident adult birds in an aviary. Only when they were separated individually in stages 1 and 3 of Experiment 2, they did produce imitation of Thai sound. Observations showed that birds of Group 1 were subordinate to the adult birds during Experiment 1. These adult birds occasionally chased them. It is likely that social dominance affects the vocal expression through either age or prior residence or both.

Social dominance influenced vocal mimicry: The results from Experiment 2 showed that trained Hill Mynahs in subordinate social positions[20-23] hardly produce vocal mimicry. Birds of Groups 1 and 2 produced imitations freely when caged individually but decreased or ceased imitations when introduced into another group's aviary when they were subordinate. In several studies of other species, prior residence in an aviary has an overwhelming influence on social dominance[24-28]. When birds of Group 1 were in their resident aviary (Experiment 3) they dominated newcomers (Group 2) and tried to prevent them from producing any sound.

In captive white-throated sparrows, testosterone-treated birds sang more when dominant and often ceased singing altogether when shifted to groups in which they were subordinate[29]. Likewise, in Hill Mynahs prior residence by its influence on dominance in turn influences vocal mimicry. In Experiment 3, the result showed the effect of prior residence on vocal mimicry when age was not a factor.

Vocalization influenced social dominance establishment: Experiment 4 was designed to determine which came first, between dominance and sound production. The result indicated that in initial grouping, with unfamiliar birds and aviary, birds of Group 2 which produced more vocal mimicry dominated birds of Group 3 which produced less vocal mimicry. In this case, all birds in the group which originally produced more vocal imitation were dominant. Thus an ability to imitate seems related to a chance of dominating the others.

In summary, captive Hill Mynahs are very efficient mimics. They are able to imitate if individuals are hand-reared from an age of five weeks and kept in isolation from conspecifics. Prior residence determines dominance and thus the production of vocal mimicry. In addition, the ability to produce vocal influences a bird's chance of dominating rivals when prior residence is not a factor.

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