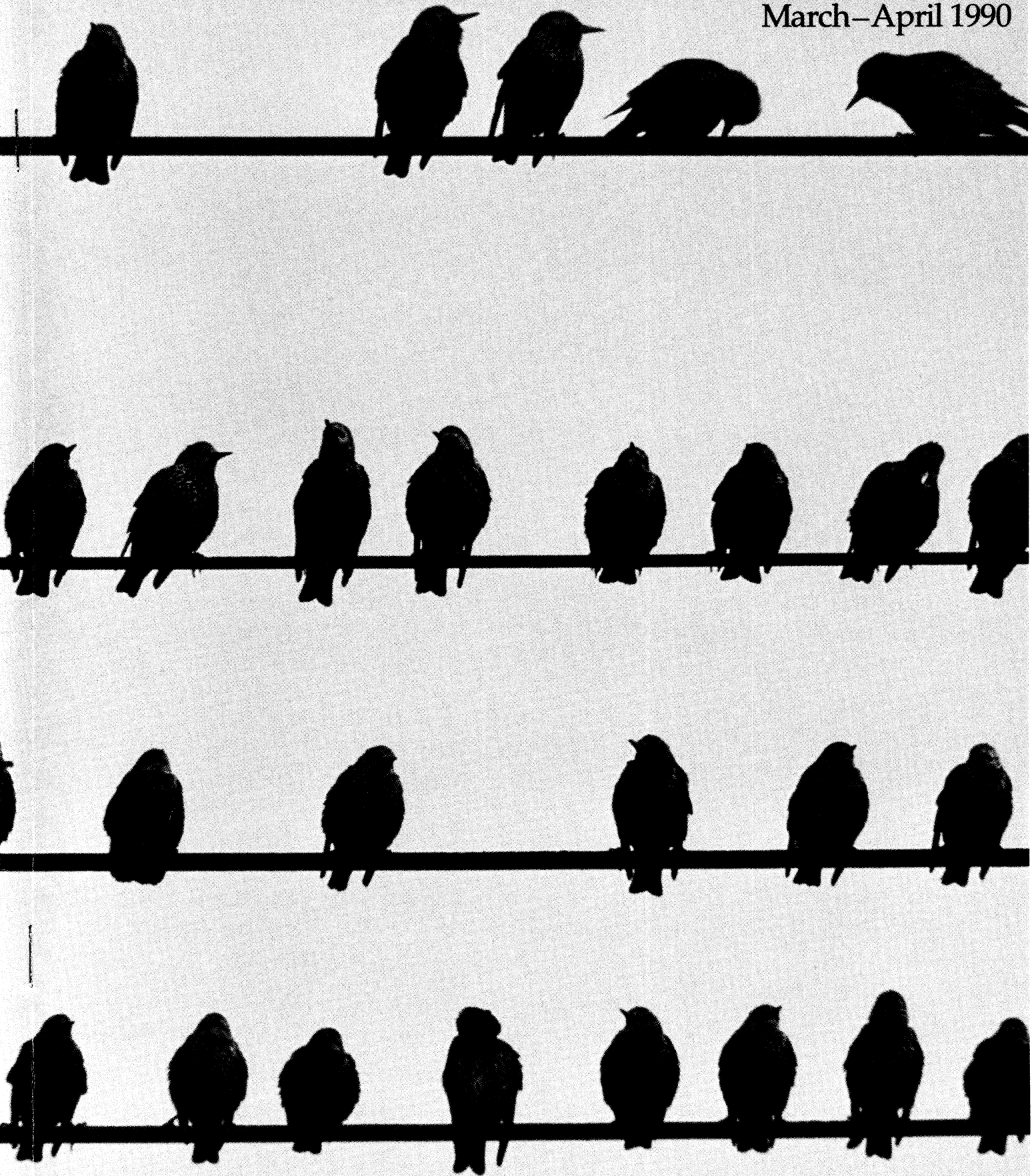


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Mozart's Starling

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On 27 May 1784, Wolfgang Amadeus Mozart purchased a starling. Three years later, he buried it with much ceremony. Heavily veiled mourners marched in a procession, sang hymns, and listened to a graveside recitation of a poem Mozart had composed for the occasion (1). Mozart's performance has received mixed reviews. Although some see his gestures as those of a sincere animal lover, others have found it hard to believe that the object of Mozart's grief was a dead bird. Another event in the same week has been put forth as a more likely cause for Mozart's funereal gestures: the death of his father Leopold (2).

The scholars who have reported and interpreted this historical incident knew much about Mozart but little, if anything, about starlings. To put the incident into better perspective, we will provide here a profile of the vocal capacities of captive starlings. Mozart's skills as a musician and composer would have rendered him especially susceptible to the starling's vocal charms, and thus we will also propose that the funeral and the poem are not the end of the story. Mozart may have left another memorial to his starling, an offbeat requiem for rebels.

Mozart's starling was a European starling, *Sturnus vulgaris*. The species was later introduced to North America on an artistic note. The birds were imported from England in the 1890s in an effort to represent the avian cast of Shakespeare's plays in this country (3). Fewer than 200 birds were released in New York's Central Park. Population estimates in the 1980s hovered around 200,000,000 birds, a millionfold increase, making starlings one of the most successful road shows in history.

The vocal talents of starlings have been known since antiquity (4). The species possesses a rich repertoire of calls and songs composed of whistles, clicks, rattles, snarls, and screeches. In addition, starlings copy the sounds of other birds and animals, weaving these mimicked themes into long soliloquies that, in captive birds,

can contain fragments of human speech. Pliny reported individual birds, mimicking Greek and Latin, that "practiced diligently and spoke new phrases every day, in still longer sentences." Shakespeare knew enough about their abilities to have Hotspur propose teaching a starling to say the name "Mortimer," an earl distrusted by Henry IV, to disturb the king's sleep (*Henry IV, Part I*, act 1, scene 3). In the song cycle *Die schöne Müllerin*, Schubert set to music a poem in which a starling is given a romantic mission: "I'd teach a starling how to speak and sing, / Till every word and note with truth should ring, / With all the skill my lips and tongue impart, / With all the warmth and passion of my heart" (5).

Despite this wealth of anecdotal information, few scientists have studied the vocal behavior of starlings under the conditions necessary to separate fact from fiction. The problem with starlings is that they vocalize too much, too often, and in too great numbers, sometimes in choruses numbering in the thousands (a flock of starlings is labeled a murmuration).

Even the seemingly elementary step of creating an accurate catalogue of the vocal repertoires of wild starlings is an intimidating task because of the variety of their sounds. Other well-known avian mimics, such as the mockingbird (*Mimus polyglottos*), have proved as challenging, leaving unanswered key questions about the development and functions of mimetic behavior.

Some of the problems involved in the study of nonmimetic songbirds arise with mimics as well. Researchers must be able to find and raise songbirds from a young age or ideally from the egg under conditions in which their exposure to social and acoustic stimulation can be controlled. The birds must be observed for many months or sometimes years to capture fully the processes of cultural evolution and transmission of vocal motifs from generation to generation. And for all species, researchers must acquire expertise in the acoustic analysis of sounds to overcome their inability to hear much of the fine detail in avian vocalizations.

Because of these difficulties, many "definitive" pieces of work have been based on small sample sizes, often fewer than ten individuals, sometimes fewer than five. Larger samples are possible only with avicultural favorites, such as canaries (*Serinus canaria*) or zebra finches (*Poephila guttata*). Even with these subjects, research schedules must be accommodated to seasonal

Like echo-locating bats or dolphins, some birds may bounce sounds off the animate environment, using behavioral reverberations to perceive the consequences of their vocal efforts

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cycles. The kinds of vocalizations produced by a species can differ considerably throughout the year, with the most "interesting" sounds in the form of territorial or mating signals occurring for only a few months each year. In sum, songbirds are a handful.

Mimetic species add another layer of difficulty by including sounds made by other birds, other animals, and even machines. Thus, in addition to exploring how members of a mimetic species develop species-typical calls and songs—that is, vocalizations with many shared acoustic properties within a population—investigators routinely encounter individual idiosyncracies. Why does one starling mimic a goat and another a cat? Given the abundance of sounds in the world, what processes account for the selection of models?

Baylis (6) advocated studying just part of the mimic's repertoire as a first step, suggesting the example of mockingbirds frequently mimicking cardinals (*Cardinalis cardinalis*). Although mockingbirds mimic many species, cardinals are a favorite. Why? What consequences accrue for mimic or model? By focusing on one model-mimic system, scientists might answer a number of questions surrounding the nature and function of mimicry. Further control of the model-mimic system can be gained by exposing birds to human speech, a vocal code with a more favorable "signal-to-noise" ratio. This heightens the probability that investigators can detect mimicry and makes it easier to identify the origin of mimicked sounds and the environmental conditions facilitating or inhibiting interspecific mimicry (7). Here, the use of human language is not comparable to efforts with apes or dolphins aimed at uncovering possible analogues to human language. Rather, the use of speech sounds is more properly compared to the use of a radioactive isotope to trace physiological pathways. Thus, when a captive starling utters, "Does Hammacher Schlemmer have a toll-free number?" it is easier to trace the phrase's origin and how often it has been said than to trace the history of the bird's production of "breep, beezus, breep, beeten, beesix."

Over the past decade, we have studied nine starlings, each hand-reared from a few days of age (8). We have also collected information on the behavior of five other starlings (Fig. 1), raised under similar conditions by individuals unaware of our work and unaware of starlings' mimicking abilities when their relationship with the birds began (9). Although many questions remain about the species's vocal capacities, the findings shed light on Mozart's response to his starling's death.

The 14 starlings experienced different social relationships with humans. Eight birds lived individually in what is called interactive contact with the humans who

*Hier ruht ein lieber Narr,
Ein Vogel Staar.
Noch in den besten Jahren
Musst er erfahren
Des Todes bittern Schmerz.
Mir blut't das Herz,
Wenn ich daran gedenke.
O Leser! schenke
Auch du ein Thränchen ihm.
Er war nicht schlimm;
Nur war er etwas munter,
Doch auch mitunter
Ein lieber loser Schalk,
Und drum kein Dalk.
Ich wett', er ist schon oben,
Um mich zu loben
Für diesen Freundschaftsdienst
Ohne Gewinnst.
Denn wie er unvermuthet
Sich hat verblutet,
Dacht er nicht an den Mann,
Der so schön reimen kann.*

Den 4ten Juni 1787.



*A little fool lies here
Whom I held dear—
A starling in the prime
Of his brief time,
Whose doom it was to drain
Death's bitter pain.
Thinking of this, my heart
Is riven apart.
Oh reader! Shed a tear,
You also, here.
He was not naughty, quite,
But gay and bright,
And under all his brag
A foolish wag.
This no one can gainsay
And I will lay
That he is now on high,
And from the sky,
Praises me without pay
In his friendly way.
Yet unaware that death
Has choked his breath,
And thoughtless of the one
Whose rime is thus well done.*

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hand-reared them. Their cages were placed in busy parts of the home, and the birds had considerable freedom to associate with their caregivers in diverse ways: feeding from hands; perching on fingers, shoulders, or heads; exploring caregivers' possessions; and inserting themselves into activities such as meal preparation, piano lessons, baths, showers, and telephone conversations (Fig. 2). The humans spontaneously talked to the birds, whistled to them, and gestured by kissing, snapping fingers, and waving good-bye.

Explicit procedures to teach human words using methods prescribed for other mimicking species were not used. Six of the eight caregivers did not know that such training would have an effect until the birds themselves demonstrated their mimicking ability, and two refrained because they were instructed by us to do so. The birds could obtain food and water (and avian companionship in five of eight cases) without interacting with humans.

Three other starlings lived under conditions of limited contact with humans. After 30 days of hand rearing by us, they were individually placed in new homes, along with a cowbird (*Molothrus ater*). They lived in cages, rarely flew free, and were passively exposed to humans. They heard speech but were not "spoken to" because they did not engage in the kinds of social interactions described for the first group. The final three starlings lived together in auditory contact with humans. They were housed in an aviary on a screened porch of the caregivers raising one of the freely interacting birds. As a result, their auditory environment was loosely yoked to that of the other bird.

The information gathered on the starling's mimicry

differed by setting and caregiver. Extensive audio taping was carried out for the nine subjects studied under our supervision. For three of the remaining birds involved in interactive contact, we used repertoires available in published works, supplemented by personal inquiries. For the last two we obtained verbal reports from caregivers.

Social transmission of the spoken word

The starlings' mimetic repertoires varied consistently by social context: only the birds in interactive contact mimicked sounds with a clearly human origin. None of the other subjects imitated such sounds, although all mimicked their cowbird companions, each other, wild birds, and mechanical noises. For the purposes of this article, we have elected to focus solely on the actions of the birds in interactive contact.

All of these birds mimicked human sounds—including clear words, sounds immediately recognizable as speech but largely unintelligible, and whistled versions of songs identified as originating from a human source—and mechanical sounds whose source could be identified within the households. For the three audiotaped birds, roughly two-thirds of their vocalizations were related to the words or actions of caregivers. The same categories applied to the remaining five birds, who mimicked speech, whistles, and human-derived or mechanical sounds (Table 1).

Many of the more impressive properties of the starlings' vocal capacities defy simple categorization. The most striking feature was their tendency to mimic con-

ected discourse, imitating phrases rather than single words. Words most often mimicked alone included the birds' names and words associated with humans' arrivals and departures, such as "hi" or "good-bye." All phrases were frequently recombined, sometimes giving the illusion of a different meaning. One bird, for example, frequently repeated, "We'll see you later," and "I'll see you soon." The phrase was often shortened to "We'll see," sounding more like a parental ploy than an abbreviated farewell. Another bird often mimicked the phrase "basic research" but mixed it with other phrases, as in "Basic research, it's true, I guess that's right."

The birds devoted most of their singing time to rambling tunes composed of songs originally sung or whistled to them intermingled with whistles of unknown origin and starling sounds. Rarely did they preserve a melody as it had been presented, even if caregivers repeatedly whistled the "correct" tune. The tendency to sing off-key and to fracture the phrasing of the music at unexpected points (from a human perspective) was reported for seven birds (no information on the eighth). Thus, one bird whistled the notes associated with the words "Way down upon the Swa-," never adding "-nee River," even after thousands of promptings. The phrase was often followed by a whistle of his own creation, then a fragment of "The Star-spangled Banner," with frequent interpositions of squeaking noises. Another bird whistled the first line of "I've Been Working on the Railroad" quite accurately but then placed unexpectedly large accents on the notes associated with the second line, as if shouting, "All the livelong day!" Yet another routinely linked the energetically paced *William Tell* Overture to "Rockaby Baby."

One category of whistles escaped improvisation. Seven of the eight caregivers used a so-called contact whistle to call the birds, typically a short theme (e.g., "da da da dum" from Beethoven's Fifth Symphony). This fragment of melody escaped acoustic improvisation in all cases, although the whistles were inserted into other melodies as well. One bird, however, often mimicked her contact whistle several times in succession, with each version louder than the preceding one (perhaps a quite accurate representation of the sound becoming louder as her caregiver approached her).

All the birds in interactive contact showed an interest in whistling and music when it was performed. They often assumed an "attentive" stance, as shown in Figures 1 and 2: they stood very quietly, arching their necks and moving their heads back and forth. The birds did not vocalize while in this orientation. Records for all eight subjects contained verbal or pictorial reports of the posture.

Clear mimicry of speech was relatively infrequent, due in large part to the birds' tendency to improvise on the sounds, making them less intelligible although definitely still speechlike. Other aspects of their speech imitations were also significant. First, the birds would mimic the same phrase, such as "see you soon" or "come here," but with different intonation patterns. At times, the mimetic version sounded like a human speaking in a pleasant tone of voice, and at other times in an irritated tone. Second, when the birds repeated speech sounds, they frequently mimicked the sounds that accompany speaking, including air being inhaled, lips smacking, and throats being cleared. One bird routinely preceded his rendition of "hi" with the sound of a human sniffing, a combination easily traced to his caregiver being allergic

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The audiotapes and caregivers' reports made clear, however, that nonsensical combinations (from a human speaker's point of view) were as frequent as seemingly sensible ones: the only difference was that the latter were more memorable and more often repeated to the birds. Sometimes, the speech utterances occurred in highly incongruous settings: the bird mentioned above blasted his owners with "Basic research!" as he struggled franti-

to birds. Finally, the quality of the mimicry of the human voice was surprisingly high. Many visitors who heard the mimicry "live" looked for an unseen human. Those listening to tapes asked which sounds were the starlings' and which the humans', when the only voices were the birds'.

The particular phrases that were mimicked varied, although a majority fell into the broad semantic category of socially expressive speech used by humans as greetings or farewells, compliments, or playful responses to children and pets (see Table 1). Several of the starlings used phrases of greeting or farewell when they heard the sound of keys or saw someone putting on a coat or approaching a door. Several mimicked household events such as doors opening and closing, keys rattling, and dishes clinking together. One bird acquired the word "mizu" (Japanese for water), which she routinely used after flying to the kitchen faucet. Another chanted "Defense!" when the television was on, a sound that she apparently had acquired as she observed humans responding to basketball games.

Caregivers reported that it took anywhere from a few days to a few months for new items to appear in the birds' repertoires. Acquisition time may have depended on the kind of material: one of the birds in limited contact, housed with a new cowbird, learned its companion's vocalization in three days, while one bird in interactive contact took 21 days to mimic his cowbird companion. The latter bird, however, repeated verbatim the question, "Does Hammacher Schlemmer have a toll-free number?" a day after hearing it said only once.



Figure 1. Kuro is a starling who was hand-reared in captivity. Living in daily close contact with the Iizuka family, she has spontaneously developed, like other starlings in similar circumstances studied by the authors, a rich repertoire of imitations of human speech, songs, and household sounds. Here Kuro listens to whistling. (Photo by Birgitte Nielsen; reprinted by permission of Nelson Canada from *Kuro the Starling*, by Keigo Iizuka and family.)

Starlings copy the sounds of other birds and animals, weaving these mimicked themes into long soliloquies that, in captive birds, can contain fragments of human speech

Some whistled renditions of human songs also appeared after intervals of only one or two days. An important variable in explaining rate of acquisition and amount of human mimicry may be the birds' differential exposure to other birds. The three birds without avian cage mates appeared to have more extensive repertoires, but they were also older than the other subjects.

The birds did not engage much in mutual vocal exchanges with their caregivers—that is, a vocalization directed to a bird did not bring about an immediate vocal response, although it often elicited bodily orientation

and attention. Thus, the mimicry lacked the "conversational" qualities that have been sought after in work with other animals (10). As no systematic attempt had been made to elicit immediate responding by means of food or social rewards, reciprocal exchanges may nevertheless be possible. Ongoing human conversation not involving the starlings, however, was a potent stimulus for simultaneous vocalizing. The birds chattered frequently and excitedly while humans were talking to each other in person or on the telephone.

The starlings' lively interest and ability to participate in the activities of their caregivers created an atmosphere of mutual companionship, a condition that may be essential in motivating birds to mimic particular models, as indicated by the findings with the birds in limited and auditory contact. The capacity of starlings to learn the sounds of their neighbors fits with what is known about their learning of starling calls, especially whistles, in nature. They learn new whistles as adults by means of social interactions, an ability that is quite important when they move into new colonies or flocks (11). Analyses of social interactions between wild starling parents and their young also indicate the use, early in ontogeny, of vocal exchanges between parent and young and between siblings (12). Thus, the capacities identified in the mimicry of human speech and their dependence on social context seem relevant to the starling's ecology.

Other mimics and songsters

Studies of another mimic, the African gray parrot (*Psittacus erithacus*), also indicate linkages between mimicry and social interaction (13). This species mimics human speech when stimulated to do so by an "interactive

modeling technique" in which a parrot must compete for the attention of two humans engaged in conversation. Extrinsic rewards such as food are avoided. The reinforcement is physical acquisition of the object being talked about and responses from human caregivers. Such procedures lead to articulate imitation and often highly appropriate use of speech sounds. Pepperberg reports that one bird's earliest "words" referred to objects he could use: "paper," "wood," "hide" (from rawhide chips), "peg wood," "corn," "nut," and "pasta" (14). The parrot also employed these mimicked sounds during exchanges with caregivers in which he answered questions about the names of objects and used labels identifying shape and color in appropriate ways. The parrot's use of "no" and "want" also suggested the ability to form functional relationships between speech and context, a capacity perhaps facilitated by the trainer's explicit attempts to arrange training sessions meaningful for the student.

Explanations of mimicry of human sounds in this and other species originate in the idea that hand-reared birds perceive their human companions in terms of the social roles that naturally exist among wild birds. Lorenz and von Uexküll elaborated on the kinds of relationships between and among avian parents, offspring, siblings, mates, and rivals (15). In the case of captive birds, humans become the companion for all seasons, with the nature of the relationship shifting with the changing developmental and hormonal cycles in a bird's life.

Mimics are not the only birds to show clear evidence

of the effects of companions on vocal capacities. Two examples from nonmimetic species are relevant. In the white-crowned sparrow (*Zonotrichia leucophrys*), the capacity to learn the songs of other males differs according to the tutoring procedure used. For example, young males learn songs from tape recordings until they are 50 days of age but not afterward. They do acquire songs well after 50 days from live avian tutors with whom they can interact, copying the song of another species, even if

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they can hear conspecifics in the background. The potency of social tutors has led to a comprehensive reinterpretation of the nature of vocal ontogeny in this species (16). We tried tutoring nine of the starlings using tapes of the caregiver's voice singing songs and reciting prose. There was no evidence of mimicry, except that one bird learned the sound of tape hiss. And thus, if we had relied on tape tutoring, as has been done with many species to assess vocal capacity, we would have vastly underestimated the starlings' skills.

What are the characteristics of live tutors that make them so effective? The studies of white-crowned sparrows suggest that it is not the quality of the tutor's voice, but the opportunity for interaction. Indeed, we have studied a case where voice could not be a cue at all because the "tutor" could not sing. In cowbirds, as in many songbirds, only males sing. Females are frequently the recipients of songs and display a finely tuned perceptual sensitivity to conspecific songs (17). We have documented that acoustically naive males produce distinct themes when housed with female cowbirds possessing different song preferences. We have also identified one important element in the interaction. When males sang certain themes, females responded with distinctive wing movements. The males responded in turn to such behavior by repeating the songs that elicited the females' wing movements. Such data show that singers attend to visual, as well as acoustic, cues and that tutors can be salient influences even when silent. In this species, the social, as distinct from the vocal, conduct of a male's audience is of consequence.



Figure 2. Kuro adopts a listening posture during a music lesson, with neck arched and head moving back and forth. (Photo by Birgitte Nielsen; reprinted by permission of Nelson Canada from *Kuro the Starling*, by Keigo Iizuka and family.)

Studies of another avian group, domestic fowl (*Gallus gallus*), also direct attention to the importance of a signaler's audience (18). In this species, male cockerels produce different calls in the presence of different social companions. Emitting a food call in the presence of food is not an obligatory response but one modulated by the signaler's observations of his audience. Similar findings with cockerel alarm calls indicate the need to consider the multiple determinants of vocal production. Taken as a whole, the findings reveal that, for many birds, acoustic communication is as much visual as vocal experience.

Mozart as birdcatcher

Mozart knew how to look at, as well as listen to, audiences, especially when one of his compositions was the object of their attention. After observing several audiences watching *The Magic Flute*, he wrote to his wife, "I have at this moment returned from the opera, which was as full as ever. . . . But what always gives me most pleasure is the *silent approval!* You can see how this opera is becoming more and more esteemed" (19). Mozart's enjoyment of the less obvious reactions of his audience suggests that, like a bird, he too was motivated not only by auditory but by visual stimuli. The German word he used can be translated "applause" as well as "approval," suggesting his search for rewards more meaningful than the expected clapping of hands. We now turn to the case of Mozart's starling and to the kinds of social and vocal rewards offered to him by his choice of an avian audience.

Mozart recorded the purchase of his starling in a diary of expenses, along with a transcription of a melody whistled by the bird and a compliment (Fig. 3). He had begun the diary at about the same time that he began a catalogue of his musical compositions. The latter effort was more successful, with entries from 1784 to 1791, the year of his death. His book of expenditures, however, lapsed within a year, with later entries devoted to practice writing in English (20). The theme whistled by the starling must have fascinated Mozart for several reasons. The tune was certainly familiar, as it closely resembles a theme that occurs in the final movement of the Piano Concerto in G Major, K. 453 (see Fig. 3). Mozart recorded the completion of this work in his catalogue on 12 April in the same year. As far as we know, just a few people had heard the concerto by 27 May, perhaps only the pupil for whom it was written, who performed it in public for the first time at a concert on 13 June. Mozart had expressed deep concern that the score of this and three other concertos might be stolen by unscrupulous copyists in Vienna. Thus, he sent the music to his father in Salzburg, emphasizing that the only way it could "fall into other hands is by that kind of cheating" (21). The letter to his father is dated 26 May 1784, one day before the entry in his diary about the starling.

Mozart's relationship with the starling thus begins on a tantalizing note. How did the bird acquire Mozart's music? Our research suggests that the melody was certainly within the bird's capabilities, but how had it been transmitted? Given our observation that whistled tunes are altered and incorporated into mixed themes, we assume that the melody was new to the bird because

Table 1. Sounds mimicked by starlings

Greetings and farewells		
<i>hi</i>	hey there	I'll (we'll) <i>see you soon</i>
<i>good morning</i>	<i>c'mon, c'mere</i>	breakfast
<i>hello</i>	go to your cage	it's time
<i>hey buddy</i>	night night	
Attributions		
<i>you're a crazy bird</i>	nutty bird	you're gorgeous
<i>good girl</i>	rascal	see you soon baboon
<i>pretty bird</i>	you're kidding	baby
<i>silly bird</i>		
Conversational fragments		
it's true	OK	have the kids called
I suggest	I have a question	<i>whatcha doing</i>
that's right	defense	what's going on
basic research	thank you	all right you guys
because	<i>right</i>	this is Mrs. Suthers
I guess	who is coming	calling
Human sounds		
<i>sighing</i>	<i>sniffing</i>	kissing
<i>coughing</i>	<i>lip smacking</i>	wolf whistle
<i>throat clearing</i>	<i>laughing</i>	
Household sounds		
<i>door squeaking</i>	alarm clock	dishes clinking
<i>cat meowing</i>	telephone beep	gun shots
<i>dog barking</i>	keys rattling	

Categories refer to social contexts in which humans produced the sounds, not necessarily the ones in which starlings repeated them. *Italicized entries were imitated by four or more birds.*

it was so close a copy of the original. Thus, we entertain the possibility that Mozart, like other animal lovers, had already visited the shop and interacted with the starling before 27 May. Mozart was known to hum and whistle a good deal. Why should he refrain in the presence of a bird that seems to elicit such behavior so easily?

A starling in May would be either quite young, given typical spring hatching times, or at most a year old, still young enough to acquire new material but already an accomplished whistler. Because it seems unlikely to us that a very young bird could imitate a melody so precisely, we envision the older bird. The theme in question from K. 453 has often been likened to a German folk tune and may have been similar to other popular tunes already known to the starling, analogous to the highly familiar tunes our caregivers used. But to be whistled to by Mozart! Surely the bird would have adopted its listening posture, thereby rewarding the potential buyer with "silent applause."

Given that whistles were learned quite rapidly by the starlings we studied, it is not implausible that the Vienna starling could have performed the melody shortly after hearing it for the first time. Of course, we cannot rule out a role for a shopkeeper, who could have repeated Mozart's tune from its creator or from the starling. In any case, we imagine that Mozart returned to the shop and purchased the bird, recording the expense

27. May 1784 Vogel Stahlr 34 Kr.



Das war schön!

Piano Concerto no. 17 in G Major, K. 453



Figure 3. Wolfgang Amadeus Mozart was also the delighted owner of a pet starling. He recorded the purchase of the starling in an expense book, noting the date, price, and a musical fragment the bird was whistling. The pleasure he expressed at hearing the starling's song—"Das war schön!" (that was beautiful!)—is all the more understandable when one compares the beginning of the last movement of his Piano Concerto in G Major, K. 453, which was written about the same time. Somehow the bird had learned the theme from Mozart's concerto. It did however sing G sharp where Mozart had written G natural, giving its rendition a characteristically off-key sound.

out of appreciation for the bird's mimicry. Some biographers suggest an opposite course of transmission—from the starling to Mozart to the concerto—but the completion date of K. 453 on 12 April makes this an unlikely, although not impossible, sequence of events.

Given the sociable nature of the captive starlings we studied, we can imagine that some of the experiences that followed Mozart's purchase must have been quite agreeable. Mozart had at least one canary as a child and another after the death of the starling, suggesting that it would not be hard for him to become attached to so inventive a housemate. Moreover, he shared several behavioral characteristics with captive starlings. He was fond of mocking the music of others, often in quite irreverent ways. He also kept late hours, composing well into the night (22). The caregivers of the starlings we

The mimicry of vocal acts such as lip noises, sniffs, and throat clearing brought to the attention of caregivers routine dimensions of their own behavior that they rarely took notice of

studied uniformly reported—and sometimes complained about—the tendency of their birds to indulge in more than a little night music.

The text of Mozart's poem on the bird's death suggests other perceptions shared with the caregivers. Mozart dubbed his pet a "fool"—the German word could also be translated as "clown" or "jester"—an attribution in keeping with the modern starlings' vocal productions of "crazy bird," "rascal," "silly bird," and "nutty bird" and the even more frequent use of such terms in the written description of life with starlings. Mozart gets to the heart of the starling's character when he states that the bird was "not naughty quite, / But gay and bright, / And under all his brag, / A foolish wag." And thus, when we contemplate Mozart's emotions at the bird's death, we see no reason to invoke attributions of displaced grief. We regard Mozart's sense of loss as genuine, his epitaph as an apt gesture.

No other written records of Mozart's relationship with his pet are known. He may have said more, given his prolific letter writing, but much of his correspondence during this period has been lost. The lack of other accounts, however, cannot be considered to indicate a lack of interest in his starling. We are inclined to believe that other observations by Mozart on the starling do exist but have not been recognized as such. Our case rests in part on recent technical analyses of the original (autograph) scores of Mozart's compositions, investigations describing changes in handwriting, inks, and paper. Employing new techniques to date paper by analyzing the watermarks pressed into it at the time of its manufacture, Tyson (23) has established that the dates and places assigned to some of Mozart's compositions can be questioned, reaching the general conclusion that many pieces were written over an extended period of time and not recorded in his catalogue until the time of completion. The establishment of an accurate chronology of Mozart's compositions is obviously essential to those attempting to understand the development of his musical genius. It also serves our purposes in reconstructing events after the starling's funeral.

One composition examined by Tyson is a score entered in Mozart's catalogue on 12 June 1787, the first to appear after the deaths of his father and the starling. The piece is entitled *A Musical Joke* (K. 522). Consider the following description of it from a record jacket: "In the first movement we hear the awkward, unproportioned, and illogical piecing together of uninspired material . . . [later] the andante cantabile contains a grotesque cadenza which goes on far too long and pretentiously and ends with a comical deep pizzicato note . . . and by the concluding presto, our 'amateur composer' has lost all control of his incongruous mixture" (24). Is the piece a musical joke? Perhaps. Does it bear the vocal autograph of a starling? To our ears, yes. The "illogical piecing together" is in keeping with the starlings' intertwining of whistled tunes. The "awkwardness" could be due to the starlings' tendencies to whistle off-key or to fracture musical phrases at unexpected points. The presence of drawn-out, wandering phrases of uncertain structure also is characteristic of starling soliloquies. Finally, the abrupt end, as if the instruments had simply ceased to work, has the signature of starlings written all over it.

Tyson's analysis of the original score of K. 522

indicates that it was not written during June 1787, but composed in fragments between 1784 and 1787, including an excerpt from K. 453. This period coincides with Mozart's relationship with the starling. A common interpretation is that *A Musical Joke* was meant to caricature the kinds of music popular in Mozart's day. Writing such music, a course of action urged on him by his father, might have earned Mozart more money. And thus, the composition has also been interpreted in regard to the father/son relationship (25). Tyson disputes this view on the basis of the physical nature of the autograph score, as much of it was written before Leopold's death, and the lack of solid evidence that Mozart's relationship with his father was bitter enough to cause him to commemorate his first and foremost teacher with a parody.

Although we do not presume to explain all the layers of compositional complexity contained in K. 522, we propose that some of its starling-like qualities are pertinent to understanding Mozart's intentions in writing it. Given the propensities of the starlings we studied and the character and habits of Mozart, it is hard to avoid the conclusion that some of the fragments of K. 522 originated in Mozart's interactions with the starling during its three-year tenure. The completion of the work eight days after the bird's death might then have been motivated by Mozart's desire to fashion an appropriate musical farewell, a requiem of sorts for his avian friend.

Last words

We have offered these observations on starlings and on Mozart for two reasons. First, to give music scholars new insights with which to evaluate one of the world's most studied composers. The analyses of the autograph scores and recent reinterpretations of Mozart's illnesses and death demonstrate the power of present-day knowledge to inform our understanding of the past. We have provided the profile of captive starlings as another way to gain perspective on Mozart's genius.

Second, we hope to spark further interest in the analysis of the social stimulation of vocal learning. Although the role of social companions in motivating avian vocal learning is now well established, the mechanisms by which social influence exerts its effects have only begun to be articulated (26). Part of the problem is defining the nature of social contexts. To say birds interact is to say something quite vague. Interact how? By fighting? By feeding? By flocking? By sitting next to one another? Measuring sound waves is easy compared to calibrating degrees of social influence. Moreover, social signals are multi-modal. The species described here make much use of visual, as well as vocal, stimulation. By what means do they link sights and sounds? Why are only certain linkages made? Answering these questions is the next challenge for students of communication.

One of the founders of the study of bird song, W. H. Thorpe, speculated that birds' imitation of sounds represents a quite simple cognitive process: "The essence of the point may be summed up by saying that while it is very difficult for a human being (and perhaps impossible for an animal) to see himself as others see him, it is much less difficult for him to hear himself as others hear him"

Figure 4. Relationships between starlings and human beings appear to reflect the behavior of birds in the wild. Hand-reared starlings interact with their human companions in terms of the social roles of wild birds. In particular, they learn by observing vocal and other responses to their own expressive efforts. (Photos by Birgitte Nielsen.)

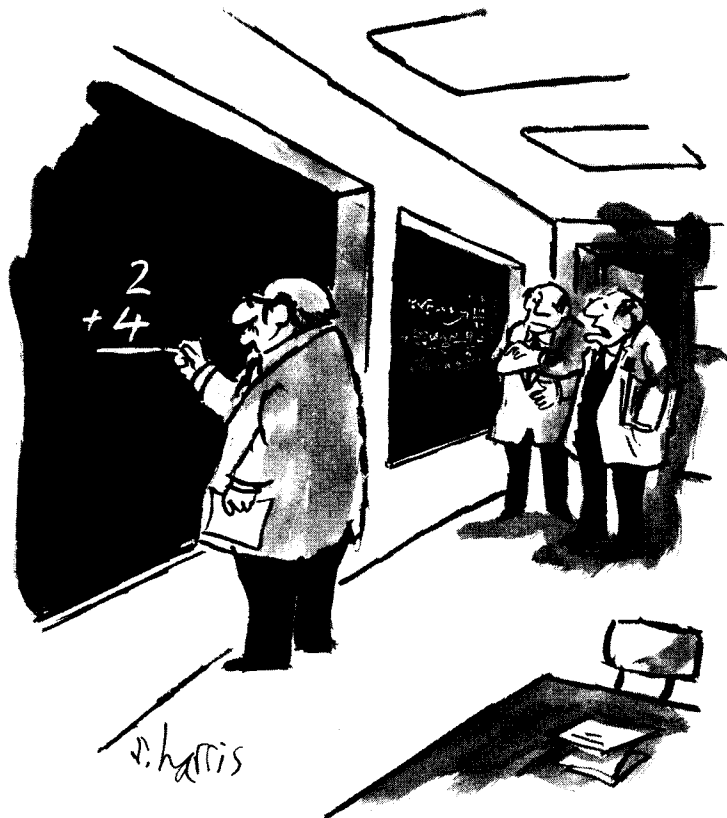


(27). Although we recognize the law of parsimony in Thorpe's remark, we are led by the evidence to seek a phylogenetic middle ground between self-awareness and vocal matching. We propose that some birds use acoustic probes to test the contingent properties of their environment, an interpretation largely in keeping with concepts of communication as processes of social negotiation and manipulation (28). An analogy with the capacities of echo-locating animals may be appropriate. Like bats or dolphins emitting sounds to estimate distance, some birds may bounce sounds off the animate environment, using behavioral reverberations to gauge the effects of their vocal efforts. They are not using Thorpe's behavioral mirror, necessary for self-reflection, but instead a social sounding board with which to shape functional repertoires.

In the case of our starlings, we also conclude that social sonar works two ways: human caregivers cast many sounds in the direction of their starlings and were often educated by the messages returned. The mimicry of vocal acts such as lip noises, sniffs, and throat clearing brought to the attention of caregivers routine dimensions of their own behavior that they rarely took notice of. The birds' echoing of greetings, farewells, and words of affection conveyed a sense of shared environment with another species, a sensation hard to forget (Fig. 4). The caregivers' sadness in response to the illnesses, absence, or death of their avian companions also suggests that they had been beguiled by the chance to glimpse a bird's-eye view of the world. Most found themselves at a loss for words. And thus we turn to Mozart for fitting emotional expressions—his poem, his *Musical Joke*, and his appropriately grand burial for a "starling bird."

References

1. G. Nottebohm. 1880. *Mozartiana*. Breitkopf and Härtel.
- O. E. Deutsch. 1965. *Mozart: A Documentary Biography*. Stanford Univ. Press.
2. O. Jahn. 1970. *Life of Mozart*, trans. P. D. Townsend. Cooper Square.
- B. Brophy. 1971. In *W. A. Mozart. Die Zauberflöte*. Universe Opera Guides.
- W. Hildesheimer. 1983. *Mozart*, trans. M. Faber. Vintage.
- P. J. Davies. 1989. *Mozart in Person: His Character and Health*. Greenwood.
3. F. M. Chapman. 1934. *Handbook of Birds of Eastern North America*. Appleton.
- E. W. Teale. 1948. *Days without Time*. Dodd, Mead.
4. E. A. Armstrong. 1963. *A Study of Bird Song*. Oxford Univ. Press.
- C. Feare. 1984. *The Starling*. Oxford Univ. Press.
5. R. Dyer-Bennet, trans. 1967. Impatience. In *The Lovely Milleress (Die schöne Müllerin)*. Schirmer.
6. J. R. Baylis. 1982. Avian vocal mimicry: Its function and evolution. In *Acoustic Communication in Birds*, vol. 2, ed. D. E. Kroodsma and E. H. Miller, pp. 51-84. Academic Press.
7. D. Todt. 1975. Social learning of vocal patterns and models of their application in grey parrots. *Zeitschrift für Tierpsychologie* 39:178-88.
- I. M. Pepperberg. 1981. Functional vocalizations by an African Grey Parrot (*Psittacus erithacus*). *Zeitschrift für Tierpsychologie* 55:139-60.
8. M. J. West, A. N. Stroud, and A. P. King. 1983. Mimicry of the human voice by European starlings: The role of social interactions. *Wilson Bull.* 95:635-40.
9. H. B. Suthers. 1982. Starling mimics human speech. *Birdwatcher's Digest* 2:37-39.
- M. S. Corbo and D. M. Barras. 1983. *Arnie the Darling Starling*. Houghton Mifflin.
- K. Iizuka. 1988. *Kuro the Starling*. Nelson.
- M. S. Corbo and D. M. Barras. 1989. *Arnie and a House Full of Company*. Fawcett Crest.
- A. DeMotos, pers. com.
- W. R. Fox, unpubl. data.
- A. Peterson and T. Peterson, pers. com.
10. I. M. Pepperberg. 1986. Acquisition of anomalous communicatory systems: Implication for studies on interspecies communication. In *Dolphin Behavior and Cognition: Comparative and Ethological Aspects*, ed. R. J. T. Schusterman and F. Wood, pp. 289-302. Erlbaum.
11. M. Adret-Hausberger. 1982. Temporal dynamics of dialects in the whistled songs of sedentary starlings. *Ethology* 71:140-52.
- . 1986. Species specificity and dialects in starlings' whistles. In *Acta 19th Congr. Intl. Ornithol.*, vol. 2, pp. 1585-97.
12. M. Chaiken. 1986. Vocal communication among starlings at the nest: Function, individual distinctiveness, and development of calls. Ph.D. diss., Rutgers Univ.
13. I. M. Pepperberg. 1988. An interactive modeling technique for acquisition of communication skills: Separation of "labeling" and "requesting" in a psittacine subject. *App. Psycholing.* 9:59-76.
14. Pepperberg. Ref. 7.
15. K. Lorenz. 1957. Companionship in bird life. In *Instinctive Behavior: The Development of a Modern Concept*, ed. C. H. Schiller, pp. 83-128. International Universities Press.
- J. von Uexküll. 1957. A stroll through the world of animals and men. In *Instinctive Behavior: The Development of a Modern Concept*, ed. C. H. Schiller, pp. 5-82. International Universities Press.
16. L. F. Baptista and L. Petrinovich. 1984. Social interaction, sensitive periods, and the song template hypothesis in the white-crowned sparrow. *Animal Behav.* 36:1753-64.
- L. Petrinovich. 1989. Avian song development: Methodological and conceptual issues. In *Contemporary Issues in Comparative Psychology*, ed. D. A. Dewsbury, pp. 340-59. Sinauer.
17. A. P. King and M. J. West. 1988. Searching for the functional origins of song in eastern brown-headed cowbirds, *Molothrus ater*. *Animal Behav.* 36:1575-88.
- M. J. West and A. P. King. 1988. Female visual displays affect the development of male song in the cowbird. *Nature* 334:244-46.
18. P. Marler, A. Dufty, and R. Pickert. 1986. Vocal communication in the domestic chicken. II. Is a sender sensitive to the presence of a receiver? *Animal Behav.* 34:194-98.
- S. J. Karakashian, M. Gyger, and P. Marler. 1988. Audience effects on alarm calling in chickens (*Gallus gallus*). *J. Comp. Psychol.* 102:129-35.
19. E. Anderson, ed. 1989. *The Letters of Mozart and His Family*, p. 907. Norton.
20. Jahn. Ref. 2.
21. Anderson. Ref. 19, p. 877.
22. F. Niemtschek. 1956. *Life of Mozart*, trans. H. Mautner. Leonard Hyman.
- Jahn. Ref. 2.
- Davies. Ref. 2.
23. A. Tyson. 1987. *Mozart: Studies of the Autograph Scores*. Harvard Univ. Press.
24. W. A. Mozart. *A Musical Joke*. Liner notes by P. Cohen. Deutsche Grammophon. 400 065-2.
25. Ref. 2.
26. Ref. 16.
27. W. H. Thorpe. 1961. *Bird-Song*, p. 79. Cambridge Univ. Press.
28. D. W. Owings and D. F. Hennessy. 1984. The importance of variation in sciurid visual and vocal communication. In *The Biology of Ground-dwelling Squirrels: Annual Cycles, Behavioral Ecology, and Sociality*, ed. J. O. Murie and G. R. Michener, pp. 167-200. Univ. Nebraska Press.



"He was very big in Vienna."