

Chapter 14

Singing, socializing, and the music effect

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INTRODUCTION

Close Encounters of the Third Kind

Scene: the Wyoming desert, with military and scientific experts standing near a gigantic keyboard while gazing at a hovering spaceship (Spielberg 1977, p. 279). The conversation is as follows:

Give her six quavers, then pause. She sent us four quavers, a group of five quavers, a group of four semi-quavers...

What are we saying to each other?

It seems they're trying to teach us a basic tonal vocabulary.

It's the first day of school, fellas.

Take everything from the lady.

Follow her pattern note for note.

Start with the tone:

Up a full tone.

Down a major third.

Now drop an octave.

Up a perfect fifth.

In this chapter, we consider the ways in which vocal and other forms of music may function to foster communication between otherwise disconnected individuals. We begin with a metaphorical example. The quotation above is from Steven Spielberg's movie and book, *Close Encounters of the Third Kind* (Spielberg 1977). In the story, scientists and government agents attempt to communicate with the alien crew of an approaching spaceship to effect an actual meeting after several close sightings. A 'third' kind of encounter is one involving actual contact, as opposed to seeing an alien ship or finding physical evidence of its presence on Earth. Their link is a synthesizer playing a simple five-note melody to the spaceship. When the space crew first matches melodies with the crew on Earth, a ripple of recognition overtakes the people on the ground, telling an outside observer that embryonic communication is stirring. When the space ship then negotiates a riff on part of the melody, both in sound and in light, a sense of communion settles over the crowd. The improvisation reveals the higher order properties of the

melody, unmasking a common code and conveying the frisson felt at this fictional intergalactic moment.

The word ‘communication’ has at its roots the idea of community and sharing. In this chapter, we contend that part of the fascination with nature’s sounds and music is the opportunity for shared moments. We do not try to solve the riddle of why such sharing is important or feels good. Instead, we focus on some components of the process by which that sensation of sharing is achieved. In all cases, we focus on individuals getting to know one another. First, we discuss the social dynamics of singing and listening in brown-headed cowbirds. In cowbirds, we see how a brief song, like a five-note melody, can serve as the foundation for messages as simple but influential as “You and I are alike” or “You’re the one”. Second, we turn to human infants and their caregivers as they go through the process of getting acquainted, where individuals with very different skill levels use musical sounds not to signal recognition, but involvement. Musical behavior by parents and children is a means of sharing knowledge and action, a way to say, “I am paying attention to you”. Finally, we look at humans and European starlings in an effort to dissect further how music can function to forge bonds between alien taxa, in this case, humans and birds. Here, the important concept is that of creating a shared context where the sounds or music serve as the link for the text, “I understand and I remember”.

SONG, GESTURE, AND COWBIRD RELATIONSHIPS

The Role of Song in a Brood Parasite

Interesting problems of recognition and communication occur on Earth without the need to consider extra terrestrial communication. When traveling to another country, especially if the language is different, it can seem like the first day of school all over again. Nonverbal communication becomes an even more important medium during everyday speech -- from pointing to pantomime to body posture. These codes, however, are not immune from cultural influence: rules exist regarding proximity and the meaning of certain gestures (Eibl-Eibesfeldt 1972). Successful use requires social learning including observation, imitation, and trial-and-error (Galef 1988). Non-verbal, or at least non-vocal codes are also not unique to humans - we have been studying a songbird that uses a combination of melodies and non-vocal gestures (West & King 1988; King et al. in press). The combination bears striking resemblances to the ways in which humans compound these communicative forms.

Brown headed cowbirds are brood parasites. The females lay their eggs in the nests of many other species and the young are never fed or cared for by their natural parents (Friedmann 1929). There are many questions that stem from the cowbird's unusual start in life and its deviation from parenting its own young. Many questions involve close encounters (Mayr 1974). How do cowbirds meet? How do males and females get together? Here we focus on the dilemma it poses for communication among cowbirds, especially with respect to courtship and mating: how do cowbirds assess members of their own species? And, given that males provide no resources other than sperm, how does a female choose a healthy and vigorous male? She cannot compare territories or nest sites, the quality of food, or signs of paternal behavior.

As it turns out, the one-second song of the male cowbird is part of the answer to both of these questions: finding a mate and discriminating among potential competitors (King & West 1977). Another part of the answer is how the song is combined with non-vocal behavior on the part of the singer and the recipient. In essence, what cowbirds orchestrate are performances, context-specific presentations of a species-typical melody, along with species-typical visual signals. To do so requires more than the male's ability to sing or the female's ability to discriminate among songs, it requires careful staging and sensitivity to the each other's social reactions.

The cowbird's song is the beginning of the story: it is a one second vocalization with unique features. According to Greenewalt (1968), "this undistinguished bird, of unprepossessing appearance and habits is the undisputed winner in the decathlon of avian vocalization" (p. 119; **fig. 1**). Among the cowbirds' achievements in Greenewalt's extensive survey are: (a), the widest frequency margin between the two song phrases, covering nearly four octaves; (b) the highest maximum frequency of about 10.7 kHz; (c) a frequency spread of two octaves between the two voices, exceeded only by the American bittern; (d) one of the shortest notes, less than 2 msec; (e) the most rapid glissando covering 5-8 kHz in 4 msec; and (f) a modulating frequency in the 'high' voice exceeding 700 Hz. Allan & Suthers (1994) and Suthers (see Chapter 9) give more information on how singing comes about. Greenewalt (1968) confessed he had no idea as to the functional need for such accomplishments, deferring to 'madam cowbird' as a source of possible answers.

As it turns out, female cowbirds can give some answers to Greenewalt's question regarding function, but the song is not a lock-and-key mechanism to insure reproduction between

males and females. In 1977, we thought we had discovered such a failsafe mechanism, one that seemed to solve many of the cowbird's problems of mate identification, as well as show the song's critical connection during courtship (King & West 1977). In our work, we studied captive female cowbirds, in breeding condition, as judged by egg laying, but deprived of male companions. In typical courtship, a female would hear hundreds of songs in the first hours after dawn. But, in our setting, the females lived without males in sound attenuation chambers (picture a 1m³ FM radio booth) and heard only six songs per day. When we played back cowbird song to a female, as opposed to the song of another species, the sound literally went in her ear and down her spine. She arched her body and separated the feathers on her back, assuming the stereotypical stance used when mating (see Chapter 2). If one were looking for a graphic example of a melody creating chills or thrills, one need look no further. The response was unambiguous - females either responded with copulatory postures or paid so little attention to the playback song that their behavior did not reveal that a song had been played at all. Females did not respond to the songs of other species and did not respond equally often to the songs of all male cowbirds: some songs elicited far more responding. We defined such differences in the eliciting properties of males' songs as differences in song potency (West et al. 1979).

We have used the female bioassay to answer many questions about the nature of mate identification and its acoustic basis in cowbirds and met with considerable success (King & West 1990). But it would be wrong to think that knowing all one can about the song by playback will decipher male-female communication. In Spielberg parlance, the playback procedure achieves an encounter of only the first or second kind - our cowbirds were not actually encountering one another. Despite the power of the female bioassay to force answers about song perception, it requires highly abnormal conditions for its elicitation: females live with no males and hear only a handful of songs/day.

Non-vocal Responses Shape Vocal Development

Our data also now make it clear that it is not just song content, *what* males sing, that matters. Rather, song use, *how* males use their song, also plays a necessary role in competition or courtship. Indeed, the pragmatics of song use has come to dominate our attention in recent years because we discovered that male cowbirds do not necessarily know how to use their song to be effective communicators, even if they possess powerful song material.

Returning to the spaceship analogy, how the two crews used the five-note melody, the details of

timing and emphasis, were also important. What if the spaceship had played its melody and the Earth crew had waited too long to reply? But what is too long? Too short? How do we learn the pragmatics of communicating with melodies?

An important approach we have used to understand the importance of performance has been to videotape groups of males and females to look at interactions involving song, measuring behavior moment by moment. This view has proven invaluable for three reasons: it has revealed a tutorial role for female cowbirds; it has shown that courtship and competition have their roots in social encounters occurring many months prior to the breeding season; and it has allowed us to have a close encounter, that is, to experience what one second's worth of sound can accomplish.

Before explaining the full experience, some words about its parts. We have found that non-vocal responses from females to male song facilitate vocal development itself (Smith et al. 2000; King et al. in press). We allowed young male cowbirds to interact with one of two groups of adult females, a local one or a geographically distant group. We found that the non-singing females displayed two rapid responses to song, gaping and wing stroking. Wing stroking is a rapid and silent response to song in which the female flicks her wing away from her body: when gaping, a female arches her head and quickly opens and closes her beak. Both responses occur more when young males are with females from their local group and both occur more often when the male has shown attentiveness to the females by orienting his song in their direction. Females do other things as well, most noticeably, showing no change in behavior when a male sings, thus ignoring his overtures. The high rate of ignoring may explain why behaviors such as wing strokes and gapes seem so prominent to males when they occur.

To understand the function of such female stimulation, we correlated female responsiveness with measures of vocal ontogeny. We found that juvenile males, exposed to more visual cues from local adult females, developed mature song faster and thus showed an earlier decline in practice than did males receiving less social feedback from the distant group of females. In addition, males housed with local females produced songs of higher potency. Even small differences in attentiveness within the local group had large effects: only very close encounters modulated song development and function. Thus, song ontogeny, and possibly the formation of local dialects, relies on cross modal communication, a non-imitative and cognitive means of song acquisition.

The greater use of wing strokes and gapes was also associated with the males and females who interacted in longer social bouts, suggesting that perhaps these responses also act to sustain attention between pairs, allowing communication to occur. It may be that the female's behavior reinforces such non-vocal aspects of performance even more than the song structure itself. Males who receive wing strokes repeat the song pattern that worked, but perhaps the reinforcement is for the act of repetition itself. A singular feature of many kinds of music is of course astute repetition.

The apparent look of disinterestedness on the female's face during many interactions may also be important. Males become very excited when the female departs from this demeanor and does something even so small as turning her head. We have found that even brief wing strokes or gapes can lead a male cowbird to levitate off his perch, hop excitedly toward the female, and sing whatever song elicited the female's movements. Thus, the contrapuntal use of acoustic and visual signals between males and females may serve to orchestrate the sustained kinds of interaction necessary for each sex to profit from the encounter.

Indeed, in all contexts, playback tests, aviary observations, and videotaped interactions, it is clear that there are rules to the ceremony of singing and listening. For the male's part, his performance is not only a rigorous outpouring of sounds but of other behaviors as females do not simply sit still and allow the male to entertain them. The pursuit of singing involves incredible effort to achieve a goal, often with no obvious success. Males run, fly, and walk after females, attempting to get close before they sing. They also use other behaviors to 'sneak' in a song, such as the head down display, a greeting display performed by both sexes. In the display, the male's and female's head can come into actual physical contact, at which point the male may try to switch rapidly into singing mode (**fig. 2**).

The sensitivity of the non-singing females to male song is also seen when females approach males, or fail to do so. Whether in aviaries or small enclosures, females are far, far less likely to get close to males than are males likely to approach females. Indeed, in general, the most 'positive' responses shown by a female, outside of the context of mating, are the absence of any 'negative' response. She does *not* fly away, sidle down the perch, walk off, or peck him. In nature, positive responses to mating songs are also rare. Males may sing thousands of songs between copulations even to a female with whom he has been paired for weeks.

Taken as a whole, the movements involved in singing interactions physically and psychologically resemble movements used by humans in non-vocal communication where nods of the head can have several different meanings and where seating orientation at 90° or 180° degrees has different meaning within and across cultures. Male cowbirds also seem to remember what they were singing when they received positive responses and retain the songs eliciting female responses for the future, just as humans show learning if head-nods are used strategically as reinforcement (Argyle 1972).

The overall quality of these interactions cannot, however, be truly appreciated in real time -- events occur too swiftly for the human ear or eye to take in the amount of acoustic/harmonic detail (Dooling et al. 2002). The presence of rhythm is, however, clearly apparent when audiotapes are slowed down, allowing us to share in some of the temporal fine structure. The one second male vocalization, when slowed to quarter speed sounds to humans like a melody produced with multiple instruments with a long exchange of frequencies, and ending with a series of undulating whistles, changing quickly in pitch and intensity. The female's social reaction also appears tied to the waves of sound: when responding with a mating posture, the sound first claims her head, then her back, and then her tail (**CD --**). Other movements seem part of the performance as well. For example, females often wipe their beak against a perch. The action is hardly noticeable in real time, and the sound of the motion only comes alive when interactions are played frame-by-frame. Are these beak movements incidental to the sound or part of a response, like tapping one's foot, snapping a finger, or humming? The ability of music to seize one's whole body would argue for considering the possibility that these movements are not independent of the sound events.

We highly recommend this route of watching or listening to singing interactions, at half or quarter speed, as a means to 'experience' song more in the way that the birds may see and hear it, given their superior temporal resolution of light and sound (Hailman 1977; Dooling et al. 2002). Such procedures have also been useful for researchers of human non-verbal behavior (Eibl-Eibesfeldt 1972). The value is seeing the experience as a dynamic flow of events across participants and across sensory modalities. Nelson & Marler (1990) have talked of the concept of 'just-meaningful differences' in the 'signal space' for song perception; this may also be true for perception of interactions. Our work suggests that scientists must beware of their own reductionistic tendencies to make sure they do not take apart the very thing they want to study, in

this case, the higher order construct of a perceptual grouping of sights and sounds that comprises a unified performance.

In sum, the effects of melodious sounds in cowbirds are at once simplex and complex. Simple, in that the female responds with an unambiguous response to sound during a crucial context, but complex in that the synchrony seen at that time is built out of thousands of cross modal interactions throughout the year.

SONG, MUSIC, AND HUMAN DEVELOPMENT

The Mozart Effect

In cowbirds, social recognition develops by way of small, seemingly mundane social reactions to the ubiquitous singing attempts of males. These social mechanisms of development have often been overlooked because they are *not* special or specialized. The everyday behavior of males and females creates contingencies – infrequent but reliable social feedback – in which gradual learning can take place. As we will see, musical elements in the speech of human adults to infants creates opportunities for social learning, but the effects of exposure to musical speech are more subtle than might be supposed.

We stress the possible subtlety because currently popular musical methodologies with humans suggest there are simple ways to use music to inoculate children against low IQ, poor spatial reasoning, and other cognitive problems. These techniques fall under the mesmerizing name of the ‘Mozart effect’ (the www.mozarteffect.com website’s logo is “Explore, Learn, Shop”). The websites promise brain enrichment for infants, youngsters, and adults. But the ‘Mozart effect’ is most effective in telling us how vulnerable humans are to using any aids to facilitate communication when dealing with a creature so unlike themselves in terms of size, experience, sensory capabilities, and emotional tendencies. Who wouldn’t want a pre-packaged solution with so august a name? No wonder, the ‘effect’ in which exposure to classical music purports to enhance performance on intelligence tests has attained the status of an urban myth, a myth sustained by toy companies, technology gurus, and writers of parenting manuals.

But mere exposure to music is not a catalyst of infant cognitive development. A look at the actual experiments reveals a very different picture of the so-called effect. In the original study, college students (not infants) participated in three spatial reasoning tasks from an IQ test (Rauscher et al. 1993). Before they participated in the reasoning task they heard either 10

minutes of (1) a Mozart sonata (Sonata for Two Pianos in D Major), (2) a relaxation tape, or (3) silence. Students who had heard Mozart performed better on the reasoning task than students who had heard the relaxation tape or nothing. Their performance corresponded to about an 8-9 point increase in spatial IQ. The effect disappeared within about 10-15 minutes. The same authors (1995) replicated the effect with a measure of spatial reasoning: subjects viewed diagrams of a piece of paper which is folded and cut; they were asked to select a diagram which represented the appearance of the paper after it is unfolded. In this replication, subjects showed better spatial reasoning ability after listening to the same Mozart sonata than if they had listened to 10 minutes of Philip Glass's *Music With Changing Parts* or after 10 minutes of silence.

The findings garnered widespread attention, including everything from the development of a 'Baby Mozart' video to former Georgia Governor Zell Miller requesting funding for classical music CDs for each infant born there. Despite the attention, attempts to replicate the original findings have failed (Steele et al. 1999). The observed short-term changes in spatial reasoning appear to be the result of changes in arousal or mood (Steele 2000; Thompson et al. 2001). College students who listened to an Albinoni adagio, music of similar complexity to Mozart but slower and sad, did not show increases in spatial reasoning ability (Thompson et al. 2001). In the original study by Rauscher and colleagues, listening to Mozart probably increased arousal and positive mood while hearing the relaxation tape or silence decreased arousal. Boredom and negative mood decreased performance on the tasks. To test this hypothesis, Nantais & Schellenberg (1999) assessed spatial reasoning in college students after listening to 10 minutes of music, by either Mozart or Schubert, and after 10 minutes of silence. Music improved spatial-reasoning performance relative to silence. However when, in a second experiment, the silence was replaced with a narrated Stephen King story, students performed equivalently on the spatial reasoning task in both conditions. In addition, students were asked to rate whether they had preferred listening to the music or the story. Spatial reasoning scores were higher for the preferred condition.

Other research by Rauscher and her colleagues has investigated the influence of music lessons on spatial reasoning. In this study, preschool children were given 6 months of piano lessons or computer lessons (Rauscher et al. 1997). Relative to controls, children who received piano instruction showed more improvement on solving jigsaw puzzles, an age-appropriate

spatial reasoning task. This research, in which children played an active role in their development, has been largely ignored by the media.

To summarize, we wish to argue that, in humans, music is about active modulation of behavior, not the regulation of intelligence. The so-called Mozart effect is the epitome of a passive effect and it also a good example of a non-social approach to cognitive influence. As noted earlier with cowbirds and playbacks, the effect relies on Spielberg's encounters of the first or second kind, only indirect exposure with no active involvement.

Infant-directed speech

The distinction is important because human caregivers and infants are very different creatures in the same way that male and female cowbirds are different in terms of sensory and motivational capacities and thus the task of negotiating encounters is neither an automatic nor stress-free experience. Infants' sensory and motor systems are immature; they do not see, hear, react to, or remember their world as adults do. As in indication of the differences between adults and infants, cultures around the world have evolved a different vocal code to use in communication. Adults and children use a special form of speech, called infant-directed or ID speech, when talking to infants. As compared to adult-directed (AD) speech, ID speech is characterized by slower rate, higher mean fundamental frequency (F_0), exaggerated prosody (greater F_0 variability), simplified syntax, and shorter utterances (Fernald & Kuhl 1987; Fernald 1992; **CD --**). This register is used in most cultures when addressing infants, though it is also used with pets and institutionalized elderly adults (Culbertson & Caporael 1983), organisms that also have different sensory and cognitive demands.

The pitch contours of ID speech give it a melodious quality, and from the first days of life infants prefer to listen to ID over AD speech (Cooper & Aslin 1990). Many experiments have assessed the relative influence of ID and AD speech by measuring how long infants will look at a visual stimulus, usually a black-and-white checkerboard, when exposed to recordings of an adult speaking in each style. Selective visual orientation produced by ID speech has been shown to persist over at least the first nine months (1-month-olds, Cooper & Aslin 1990; 4-month-olds, Fernald 1985; 4-5 and 7-9 month-olds, Werker & MacLeod 1989).

Across languages and cultures, the pitch contours of ID speech convey similar messages to infants (Fernald 1989, 1992; Papousek 1992). Prohibition such as "don't do that," is signaled by abrupt rising or falling pitch. Soothing an infant is accomplished through the use of lower,

slowly falling pitch contours. Lullabies contain similar acoustic characteristics (Trehub & Trainor 1998). In play with babies, we use phrases containing high, exaggerated pitch modulation to get infants' attention and to label objects. The consistency with which we adjust our pitch to match a message allows prelinguistic infants to learn that all the noise coming from adults' mouths has functional consequences – that certain kinds of sounds predict particular emotions and actions on the part of adults.

Infant-directed speech serves to organize an infant's attention. The acoustic characteristics of ID speech create arousal, which is evidenced by increased looking time to a visual stimulus when listening to speech (Kaplan et al. 1995b). Infant-directed speech also creates a special form of arousal called 'sensitization'. Sensitization is a cause of 'dishabituation' in which a visual stimulus that has become boring suddenly, after exposure to ID speech, becomes interesting again (Kaplan et al. 1995a). ID speech has been shown to help infants learn about the relationships between things. For example, infants demonstrated better learning of sound-checkerboard and sound-face contingencies when arousing tones or ID speech predicted the visual stimuli, versus AD speech (Kaplan & Fox 1991; Kaplan et al. 1996).

These findings led to an investigation of the ID speech of depressed mothers and the possible consequences for their infants. Mothers diagnosed as depressed produced speech that was flatter and less variable in pitch – they had less F_0 variability than did non-depressed mothers (Kaplan et al. 2001). Infants listening to depressed ID speech did not learn associations between the speech and a face as well as infants listening to non-depressed ID speech (Kaplan et al. 1999, 2002). Infant-directed speech may also make the sound structure of language, known as phonology, more salient to young learners. When we speak to infants, we exaggerate our vowels, making them more distinct from each other (Kuhl et al. 1997).

In social interactions, the melodious vocalizations of adults function to regulate the interactions of infants and their caregivers. When engaged in face-to-face interactions, mothers and infants take turns vocalizing (Anderson et al. 1977; Papousek et al. 1985). The synchrony of vocal turn-taking is regulated by both mother and infant, with each partner's behavior predictive of the other's (Jaffe et al. 2001). In two recent studies we have investigated the role that siblings play in infant development by measuring infants' reactions to sibling-produced ID speech. We have found that the ID speech produced by siblings is more interesting to infants than that produced by mothers. Children with siblings also react differently than singletons (Goldstein et

al. in press b). Seven-month-old infants will also crawl to be closer to their older siblings when the siblings are vocalizing than when they are not (Goldstein et al. in press a). ID speech thus enables caregivers, older siblings, and infants to share attentional space. Creating a cognitive and social space that is occurring at the right sensory speed for the infant may bring information into the realm of ‘just meaningful differences’ (Nelson & Marler 1990) as we noted earlier for birds.

In summary, musical speech to infants has many important functions, as it predicts the behavior of caregivers, organizes infant attention, facilitates associative learning, and regulates social interactions. Infant-directed speech and singing create a framework in which adults and babies, despite being very different organisms, can learn about each other and establish the earliest building blocks of communication. As any parent can tell you, not all close encounters between parent and child are mutually satisfying. What infants want can be fantastically puzzling and if music helps in only a small percentage of interactions, it serves a conspicuously important function.

BIRDSONG AND MUSIC: CROSS SPECIES INSPIRATIONS

A Starling in a Human Household

In this section, we explore further the idea of music and sounds as ways of creating relationships, but in this case, the participants are European starlings and humans. It may seem odd or futile to some to ask about starlings’ effects on another species or vice versa, but in the context of this book, exploring the function of musical sounds in nature, it is an adventure not to be missed.

Cowbirds and human infants appear to establish a shared pattern of recognition through social interactions -- so do starlings (Chaiken et al. 1997; Hausberger 1997). But the focus in cowbirds on getting a song just right does not seem to be the basis of vocal effects in starlings. A mature male cowbird produces less than 10 seconds of sound he can call his own, mostly in the form of song types, stable acoustic patterns. A starling may have 50–70 song types called motifs embedded in long strings of sounds lasting many minutes (Chaiken et al. 1993). An entire cowbird song would represent one starling motif.

We did not set out to study European starlings - we were seduced by this species when we attempted to use it as a heterospecific companion for cowbirds in studies on song learning.

Starlings could sing, imitate, and interact but presumably provide no species typical experiences to young cowbirds. We obtained our first starling about the time we raised our first human infant and thus we were coping with all the learning necessary to communicate with our son.

Starlings are talented mimics increasing their repertoire by using the sounds of other birds, other animals, man made machines and humans themselves (West et al. 1983; West & King 1990). The Latin scholar Pliny, for example, reported that he taught European starlings to repeat Latin and Greek phrases. When we began our work with starlings, we did not know of Pliny's attempts. Until life with our first starling, we were totally unaware of the species' ability to mimic human sounds. As will be seen, these sounds include human words but we did not and do not consider starlings' mimicry of human speech sounds as fundamentally different from any other sounds the starlings choose to imitate. At no time, were we trying to understand if starlings could be taught an anomalous communication system as has been done in a fascinating way with parrots (Pepperberg 1988; see Chapter 13). We were using the knowledge that starlings will include human sounds as a way to bring some control to their dazzling array of mimicking possibilities. What we wanted to know is the same as what we wanted to know in cowbirds and humans: how do starlings use sounds in social interactions? How do they choose them? And what effect do they have? But, in this case, the social partner was a human (West et al. 1983; Engle 2000).

In our view, singing or vocalizing is to starlings what foraging is to cowbirds or fussing is to human infants, a way to find new sources of stimulation. One reason for such replenishment in starlings is to improve the condition of their repertoire. In nature, large repertoires confer an advantage on male starlings' fitness; they produce more offspring and grand offspring (Eens 1997).

Our first starling did not learn to mimic sounds under our guidance although he was under our care. Until he produced something that sounded like "good morning" we were completely unaware of how much he had observed us as we were busy observing infant cowbirds and humans. But it was easy to forget the bird's scientific role as he sat with us while we had our morning coffee, took a shower with someone in the household, mimicked human infant cries, and attempted to join a lab meeting (**fig. 2**). His growing repertoire also showed a decidedly human influence, as did those of other birds we studied. Endearing terms and domesticity were especially strong themes, a reflection perhaps of the family 'zeitgeist'.

The starlings' mimicry suggested to us that the motivating conditions for vocal learning in this species and others are not simple: sounds heard most frequently by the birds, such as "no" or "here's some lettuce," were not present in their mimicry and sounds only rarely heard seemed over-represented, such as "defense, defense" chanted after overhearing a televised basketball game. Our impression was that the starlings threw out sounds and watched what happened. They learned quickly that mimicking "hi there" led to human approach more often than sounds that were unintelligible from humans' point of view. The shaping was bi-directional: if humans did not pay attention to the sounds, the starlings' experimentation and improvisation continued. The key to beginning to understand the rules for acquiring human mannerisms has several parts: access, acquired salience, and seeing the consequence of one's actions.

An intriguing part of life with starlings was being able to trace the course of sound from its original condition to its 'starlingized' version. The starlings routinely rearranged and edited and otherwise changed the sounds they heard so that a phrase such as "we'll see you later" eventually diverged into many phrases including "see ya later," "see you," and "we'll see, we'll see". Several of our starlings honored us by quoting the phrase, "basic research," but even that was vulnerable to interpretation, morphing into "sick research" and then simply "sick, sick".

Starlings seem to see any setting as potential vocal turf. The most obvious sign that they are in a music-making mode was when they were quiet, cocking their head to and fro listening to whistles, music, or maybe the teapot. They did not vocalize at these times but later repeated parts of what occurred while in their listening posture, a posture found in zebra finches and perhaps other birds as well. In zebra finches, there is also a connection between assuming a listening posture (the bird flies near another bird, stretches his neck forward, and freezes in that position) and learning the songs of another finch species, at least in juveniles (ten Cate 1986).

Indeed, the best way to quiet a noisy starling is to feed him a new sound; he or she must stop vocalizing to digest the vocal bite. Whistles are probably most effective, or sounds from instruments such as recorders, which, of course, have been used for centuries to train birds to sing. But taken as a whole, the work in our lab suggests that starlings need new sounds (mimicked or created) as building blocks for vocal learning. In understanding why some sounds persist, we propose a form of social sonar, bouncing vocal bits off a social (or vocal) sounding board and observing the sounds and sights returned to them. The social requirement seems

strong as studies of starling development and mimicry suggest that learning from live tutors, compared to tape tutors, is much more effective (Chaiken et al. 1997).

Mozart's Starling

We are not the only people to have been befriended by starlings; the Internet now has many sites for starling 'owners'. And there are several books on life with starlings (Corbo & Barras 1983). The words others use to describe their relationship are congruent with our experiences: the birds are seen as comical, smart, and attentive (Suthers 1982). If we had not studied starlings, it would be easy to dismiss some of the anecdotes and the general emotional tone. But, we do have a musical collaborator of sorts to confirm our observations of starlings. Our expert witness to their charms is the quite well known human mentioned earlier in another context, Wolfgang Amadeus Mozart.

Upon finding Mozart had owned a starling, we embarked on a time travel adventure back to the 1700's in search of an answer to questions about his pet. One of us (MJW) first discovered Mozart's starling looking through a biography of the composer and noting in the index to the book, an entry entitled "Mozart buries his starling" (Hildesheimer 1983). Further reading, however, revealed that historians and musicologists did not share our opinion that a starling would be an ideal companion to Mozart. They believed his burial for his starling bird (who lived three years), the poem he read at the occasion, and the funeral garb of his guests was further evidence of his immaturity, the genius that never grew up. Some also complained that his behavior might make more sense if the bird had been something else, a lark, perhaps, or a nightingale. It is important to understand that Mozart scholars study everything about this great man – his left ear lobe is the subject of a set of scholarly and medical papers (Davies 1989).

When he had bought the bird, it could whistle part of his Concerto in G major, K. 453, an accomplishment Mozart noted in his diary. Thus, the beginning of their relationship contains a mystery in and of itself, as the piece had not yet been performed in public. Throughout his life, plagiarists plagued Mozart, and we wonder if he bought the bird to remove a vocal copyist from the public scene. A major disappointment, however, was that the research we did revealed no musical tribute to a bird we were sure Mozart had loved.

The answer came when we turned from reading books and searching through documentary evidence about his life to listening to music composed at or about the time Mozart had owned his starling. We looked especially around the time of the bird's death, which

occurred in May of 1787, also near to the time of Mozart's father's death. Leopold was his son's first and foremost teacher and critic.

Among the musical works entered in Mozart's autograph scores for June 1787 was one that attracted our attention, K 522, entitled in English, "A musical joke". Experts in the field saw it, at worst, as a backhanded gesture of frustration by Mozart towards his father, as his father had urged Mozart to compose music more popular to paying patrons. At its best, the piece was earmarked as a parody of bad composing, "a marvelous and malicious prank" concluded a recent biographer (Gutman 1999, p. 668). It may well be these things but it may be something more. Further research into the chronology of Mozart's compositions revealed that the musical joke was not written in June of 1787, but over a three-year period beginning in 1784, the year of the starling's acquisition. It even contained part of K. 453, the music that had brought the two together. As much as any of Mozart's biographers know about his life or music, it is doubtful few have ever paid attention to a starling in a rococo mood, hence their inability to link K. 522 to the starling (Gutman 1999).

But, when we listen to K. 522 (especially the Presto, with a nine measure trill), we hear the autograph of a starling. There is the fractured phrasing of the entire serenade, tiresome repetitions and an eccentric ending, sounding as if the instruments had ceased to work. These features would all be well known to starling 'experts'. The repeated trill is also of considerable interest because it sounds so much like the contact whistles starlings owners used 200 or so years later (CD --). Lorenz first noted such whistles in jackdaws (Lorenz 1957). An intriguing feature to us was that they escaped improvisation in all cases we know of.

Another possible explanation for K. 522 of course is that Mozart was having a bad spell. After all, his father (and starling) had recently died. But an entry placed in his autograph scores soon thereafter argues against such a hypothesis: the piece is one of Mozart's most beloved: K. 525, "Eine kleine Nachtmusik".

CONCLUSIONS

There is no other way to describe the feelings we had when discovering Mozart's starling in his music other than in terms such as those in the prologue from the film and book, *Close Encounters*. To be able to reach across time and hear something Mozart heard is as indescribable as meeting members of a different planet and finding you share something fundamental and

intimate. We believe this is the case for other music-animal sound connections that Luis Baptista spoke about with such fondness (Milius 2000). When we hear a familiar refrain from nature, even if we do not at once recognize the source, we make a connection. Moreover, the familiarity of half of the equation, either the music or the sound from nature, may facilitate our memory of both. Humans are better at remembering test words when heard as music rather than as speech, as long as the music has a repetitive quality. If the melody is not repeated or if a new melody accompanies new texts, recall is no better than when the text is heard as prose (Wallace 1994).

Perhaps the starlings were so good at mimicking domestic parts of life because domesticity contains the necessary repetition. Every day we eat breakfast, go to work, shower, and so on. Starling song, like that of many passerines, has much internal repetition, thus setting up its melody for recall. Perhaps the internal rhythm reflects that in the wild, hours and days are spent doing similar things. For a colonial species, some kind of modulatory vigilance system to broadcast the state of the group may be useful for all members, not so much as ‘passwords’ but as ‘watchwords’.

We have argued that music is a social and cognitive means of involvement, a simple, acoustic means to allow two groups or two or more individuals to assess whether a social relationship exists and perhaps to keep it going. Music is special because social interaction is special and any medium that brings individuals together can be mutually reinforcing. It is important to remember that in the real world, not just movies, music can have impressive effects on human behavior. Long time observers of Central Park in New York City say the biggest crowd ever assembled for a music event was in 1991 for a Paul Simon concert – over 750,000 people (McFadden 1991). No national issue galvanized the crowd except the chance to hear and sing music probably heard and sung many times before. By comparison, the Reverend Billy Graham drew a third of the Simon’s crowd. Three quarters of a million people to hear one man and his band play popular folk music is formidable testimony to the effect of music.

So what can music do? It can bring together often unfamiliar individuals into a common Umwelt. Such a coming together may be trivial when it is two friends singing in the car to their favorite song or deeply mysterious when hearing a song one has not heard for 30 years and realizing the words and notes are all still there in a cognitive reservoir.

Some of the government probes the U.S.A. have sent into outer space have contained music – diverse selections from whales to the Beatles to Bach (Sagan 1978). Is the music a way

to represent our cultures or to make our cultures inviting? We would like to think the latter is primary because nature's music shows animals at their best - we look, listen, and say, "there are no words for this". It is that shared emotion that creates the music effect.

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FIGURE LEGENDS

Figure 1: Sonograms and amplitude traces of brown-headed cowbird song. Song (1) is calibrated on a log scale to show the fine detail in the introductory notes, the part of the song to which the female is most sensitive: songs 3, 4, and 5 show linear (A) and log (B) renditions of three additional male cowbird songs.

Figure 2: Examples of starling mimicry from a two-year-old male starling. The upper panel shows mimicry of the introductory notes of a brown-headed cowbird song on the left with the same notes by a cowbird on the right. The bottom panels show starling mimicry of speech, a squeaky door, and two examples of whistling by the starling.