I THE BEGINNING

1 An Introduction to Evolutionary Musicology

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Abstract

In this introduction to the new field of evolutionary musicology, we see that the study of music origins provides a fresh and exciting approach to the understanding of human evolution, a topic that so far has been dominated by a focus on language evolution. The language-centered view of humanity has to be expanded to include music, first, because the evolution of language is highly intertwined with the evolution of music, and, second, because music provides a specific and direct means of exploring the evolution of human social structure, group function, and cultural behavior. Music making is the quintessential human cultural activity, and music is an ubiquitous element in all cultures large and small. The study of music evolution promises to shed light on such important issues as evolution of the hominid vocal tract; the structure of acoustic-communication signals; human group structure; division of labor at the group level; the capacity for designing and using tools; symbolic gesturing; localization and lateralization of brain function; melody and rhythm in speech; the phrase-structure of language; parent-infant communication; emotional and behavioral manipulation through sound; interpersonal bonding and synchronization mechanisms; self-expression and catharsis; creativity and aesthetic expression; the human affinity for the spiritual and the mystical; and finally, of course, the universal human attachment to music itself.

Music Origins and Human Origins

What is music and what are its evolutionary origins? What is music for and why does every human culture have it? What are the universal features of music and musical behavior across cultures?

Such questions were the among the principal areas of investigation of the members of the Berlin school of comparative musicology of the first half of the twentieth century, as represented by such great figures as Carl Stumpf, Robert Lach, Erich von Hornbostel, Otto Abraham, Curt Sachs, and Marius Schneider.[1] After the 1940s, however, the evolutionary approach to music fell into obscurity and even disrepute. How this came to pass entails a long and very political history, one that has as much to do with rejection of racialist notions present in much European scholarship in the social sciences before the Second World War as with the rise of the cultural-anthropological approach to musicology in America during the postwar period.[2] Both influences were antievolutionary in spirit and led to a rejection of biological and universalist thinking in musicology and musical anthropology. Musicology did not seem to need an official decree, like the famous ban on discussions of language origin by the *Société de Linguistique de Paris* in 1866, to make the topic of music origins unfashionable among musicologists. It appeared to happen all by

itself. And with that, musicology seemed to relinquish its role as a contributor to the study human origins as well as any commitment to developing a general theory of music.

The current volume represents a long-overdue renaissance of the topic of music origins. If its essays suggest nothing else, it is that music and musical behavior can no longer be ignored in a consideration of human evolution. Music offers important insight into the study of human origins and human history in at least three principal areas. First, it is a universal and multifunctional cultural behavior, and no account of human evolution is complete without an understanding of how music and dance rituals evolved. Even the most cursory glance at life in traditional cultures is sufficient to demonstrate that music and dance are essential components of most social behaviors, everything from hunting and herding to story telling and playing; from washing and eating to praying and meditating; and from courting and marrying to healing and burying. Therefore the study of music origins is central to the evolutionary study of human cultural behavior generally.

Second, to the extent that language evolution is now viewed as being a central issue in the study of human evolution, parallel consideration of music will assume a role of emerging importance in the investigation of this issue as it becomes increasingly apparent that music and language share many underlying features. Therefore, the study of language evolution has much to gain from a joint consideration of music. This includes such important issues as evolution of the human vocal tract, the hominid brain expansion, human brain asymmetry, lateralization of cognitive function, the evolution of syntax, evolution of symbolic gesturing, and the many parallel neural and cognitive mechanisms that appear to underlie music and language processing.

Third, music has much to contribute to a study of human migration patterns and the history of cultural contacts. In the same way that genes and languages have been used successfully as markers for human migrations (Cavalli-Sforza, Menozzi, and Piazza 1994), so too music has great potential to serve as a hitherto untapped source of information for the study of human evolution. This is because musics have the capacity to blend and therefore to retain stable traces of cultural contact in a way that languages do only inefficiently; languages tend to undergo total replacement rather than blending after cultural contact, and thus tend to lose remnants of cultural interaction. In summary, these three issues, the universality and multifunctionality of music, the intimate relationship between music evolution and language evolution, and the potential of music to shed light on patterns of cultural interaction, are important applications of evolutionary musicology to the study of human origins and human culture.

The new field of "biomusicology" (Wallin 1991) places the analysis of music origins and its application to the study of human origins at its very foundation. As shown in figure 1.1, biomusicology comprises three main branches. *Evolutionary musicology* deals with the evolutionary origins of music, both in terms of a comparative approach to vocal communication in animals and in terms of an evolutionary psychological approach to the emergence of music in the hominid line. *Neuromusicology* deals with the nature and evolution of the neural and cognitive mechanisms involved in musical production and perception, as well as with ontogenetic development of musical capacity and musical behavior from the fetal stage through to old age. *Comparative musicology* deals with the diverse functional roles and uses of music in all human cultures, including the contexts and contents of musical rituals, the advantages and costs of music making, and the comparative features of musical systems, forms, and performance styles throughout the world. This field not only resuscitates the long-neglected concept of musical universals but takes full advantage of current developments in Darwinian anthropology (Durham 1991), evolutionary psychology (Barkow, Cosmides, and Tooby 1992), and gene-culture coevolutionary theory (Lumsden and Wilson 1981; Feldman and

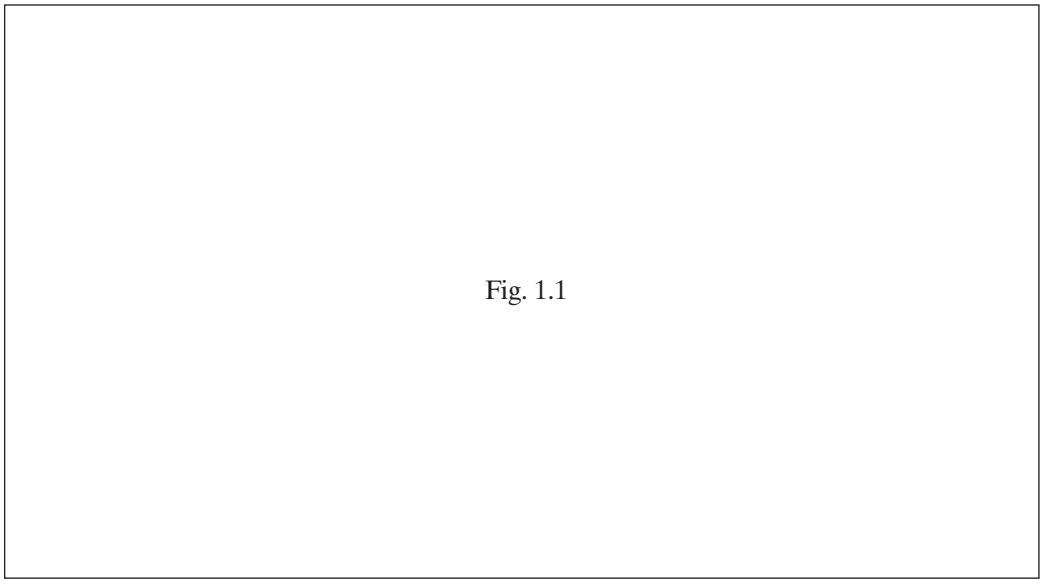

Figure 1.1
The science of biomusicology. The term "biomusicology" was coined by Wallin (1991). It comprises three principal branches, as described in the text: *evolutionary musicology*, *neuromusicology*, and *comparative musicology*. The synthetic questions that evolutionary musicology (the subject of this volume) addresses incorporate all three branches, as elaborated in the rest of the chapter. Not shown in the figure is a series of more practical concerns that fall under the purview of *applied biomusicology* (see text).

Laland 1996) in analyzing musical behavior from the standpoint of both natural selection forces and cultural selection forces.

To complete this picture of biomusicology, it is important to point out that each of these three major branches has practical aspects that contribute to what could be referred to as *applied biomusicology*, which attempts to provide biological insight into such things as the therapeutic uses of music in medical and psychological treatment; widespread use of music in the audiovisual media such as film and television; the ubiquitous presence of music in public places and its role in influencing mass behavior; and the potential use of music to function as a general enhancer of learning.

The theme of the current volume falls within the evolutionary musicology branch of biomusicology. The remainder of this chapter is devoted to providing an overview of the major issues and methods of evolutionary musicology. To those who are coming across these ideas for the first time (which, we suspect, is most readers), our overall message is quite simple: it is time to take music seriously as an essential and abundant source of information about human nature, human evolution, and human cultural history.

Major Issues in Evolutionary Musicology

This section presents some of the major topics in evolutionary musicology. It serves as an overview of these topics, allowing ensuing chapters to provide detailed theoretical perspectives on them.

The Question of Animal Song

The question what is music? is one that has no agreed-upon answer. For every structural feature that can be claimed as being a defining feature of music, one can always find (or dream up) a musical style that lacks this property. John Cage's composition *4'33"*, composed in 1952, is probably only the most extreme and postmodern example of this. (For those who do not know this piece, it consists of four minutes and thirty-three seconds of uninterrupted silence, to be performed by "any instrument or combination of instruments.") Because of these problems in defining music in purely structural terms, ethnomusicologists have usually preferred to focus on functional contexts and roles: music as an organized cultural activity. However, this easily leads to the conclusion that music is simply whatever people consider it to be. Clearly, such a definition is too open-ended and culture-specific to be useful, which is why a consideration of musical universals (discussed below) is going to assume a role

of increasing importance in biomusicology. Musical universals place the focus on what music *tends to be like* in order to be considered music, even if not every example has all the features of the majority of musics (properties such as sound in the case of *4'33"*!).

Modernist classical music aside, the important biological question of how music evolved remains. Biomusicology is a discipline defined in part by its commitment to exploring the relevance of modern biological knowledge about the evolution and functions of animal behavior to the question of the origins of human music and dance, and this includes the rich treasure of theory and observation provided by behavioral biology on topics such as animal vocalization, communication, emotive expression, and display. Just as the lack of a clear definition has not prevented musicologists from advancing our understanding of music, so too lack of a categorical means of sorting animal "songs" from animal "calls" has not prevented biologists from learning much about the more structurally complex forms of animal vocal displays—whether called song or not—that might in fact be relevant to our attempts to understand the beginnings and foundations of music in the course of anthropogenesis. Since singing behavior emerged independently, and in a variety of forms, on several occasions in the animal kingdom (see Marler, Slater, Jerison, and Geissmann, this volume), the question arises as to whether any of these instances of animal song is capable of shedding light on the genesis of singing and music in our own species. There is no a priori way of excluding the possibility, for example, that our distant forebears might have been singing hominids before they became talking humans, and if so, that hypothetical fact would surely have some bearing on the way we approach the question of the origins of music.

To come to a better understanding of such issues will require addressing many important questions. Does song have common functional roles? Do common selection pressures and selection mechanisms explain the repeated occurrence of song? What is the relationship between the singing style and habitat of the singing animal? What is the relationship between the singing arrangement and social structure of the species? Where singing serves more than one function for a species, how do the different vocal styles or vocal forms correlate with their presumed roles? Do common generative and perceptual principles underlie the various forms of song? What kinds of neural changes and specializations mediate the emergence of singing behavior in singing species? To what extent does song acquisition depend on learning, and what is the social arrangement for this learning when it is necessary? Where social learning is involved, do song forms evolve culturally? Many of these questions are addressed in part II entitled "Vocal Communication in Animals."

Music Evolution versus Language Evolution

Not only does music have an ambivalent relationship with animal song, but it has an equally ambivalent relationship with human language. Thus, the question what is music? has not only phylogenetic significance in terms of the question of animal song, but also evolutionary-psychological significance in terms of the evolutionary relationship between the two major vocal-communication systems that emerged in the human line. Whereas the debate about the status of animal song will probably always come down to a philosophical consideration of how music and song should be defined, the language-music relationship represents a much more tractable question at many levels of analysis. We predict that this will become one of the central issues in the areas of music psychology, intonational phonology, and biomusicology in years to come, which is why a large part of this volume is devoted either directly or indirectly to the topic.

Many parallels exist between music and language at the structural level (discussed extensively by Brown, this volume). The major question for the purposes of this book deals with the evolutionary basis of the connection. There are at least three possible interactive theories for the evolution of music and speech: that music evolved from speech, that speech evolved from music, or that both evolved from a common ancestor. As Erich von Hornbostel wrote in 1905: "The close correlation between language, music, and dance has already occupied the attention of earlier theoreticians. Spencer (1857) considered singing to be emotionally intensified speaking; for Darwin (1871), it was the inherited and mellowed remnant of the courting periods of our animal ancestors, from which language derived at a later stage; Richard Wagner (1852) believed that language and music issued from a common source, that of speech-music" (p. 270).[3] Unfortunately, despite the age of this issue, it is still too early to predict its resolution. However, we suggest that a consideration of music will be central to any study of speech and language evolution in the future.

In addition, at least five other points have a bearing on this question. First, changes to the human vocal tract thought to underlie the evolution of speech (see Frayer and Nicolay, this volume) are just as relevant to the evolution of human singing. In fact the distinction between speaking and singing is best thought of as a difference in degree rather than a difference in kind. This is demonstrated nicely by intermediate cases, such as heightened speech, *sprechstimme*, *recitativo*, and poetic discourse, that blur the distinction between speaking and singing. At a more fundamental level, tone languages, which comprise more than half of the 5,000 languages spoken in the world today (Fromkin 1978), bring

together music's use of level tones and pitch contours with language's role in generating semantic meaning. Thus, it is not unreasonable to think that evolutionary changes in the human vocal tract were adaptations for singing rather than for speaking, or perhaps even adaptations for joint musical and linguistic vocalization processes in the form of tone languages.

Second, the human brain, and most especially the human cerebral cortex, has undergone tremendous expansion in size compared with previous hominid stages, and at least some of this expansion is proposed to be driven by the evolution of human linguistic capacity (Deacon 1992; see Jerison, Falk, Bickerton, and Merker, this volume). However, there is an alternative candidate for a structurally complex, syntactically rich, acoustically varied, socially meaningful human function that might have driven this brain expansion, namely, music. Therefore, the relationship between the cerebral localizations of music and language is essential for understanding the evolutionary relationship between these two important human functions.

In this regard, it is interesting to point out that three arrangements for localization of music and language in the brain have been reported (reviewed by Falk, this volume): that music and language share cerebral representation; that they have overlapping representations in the same hemisphere; and that they have corresponding (i.e., homologous) localizations in the opposite hemispheres. As Falk points out, this issue is further complicated by the discovery that lateralization effects for music and language differ between the sexes, with greater degrees of lateralization in the brains of men. However, to the extent that linguistic function is seen as driving at least some evolutionary brain expansion and that lateralization of function is seen as being an important concern in human brain evolution, then the shared, overlapping, and/or corresponding localizations of music and language in the cerebral hemispheres of this expanded human brain would seem to provide an important test case for evolutionary theories of both brain expansion and brain asymmetry. What are the important similarities and differences between music and language and how are they manifested in the respective localizations and lateralizations of these functions in the human brain?

Third, structural accounts of language evolution usually present a dichotomy between gestural theories and vocal theories of language origin, where such theories are either seen as mutually exclusive accounts of language evolution or as sequential accounts in which vocalizing is viewed as a replacement for gesturing (Corballis 1991; Armstrong, Stokoe, and Wilcox 1995; Beaken 1996; Rizzolatti and Arbib 1998). In this regard, a parallel consideration of music has much to offer toward understanding this question, as musical expression tends to be

inextricably linked to movement and gesture in the context of most group rituals. In musical rituals, gesture and vocalizing function as coordinated, mutually reinforcing processes at both the individual and group levels, rather than serving as sequential or alternative manifestations of communicative intentions (see Dissanayake, this volume). Extension of these ideas might offer important insight into the origins of language-based communication. And in fact it seems quite plausible to assume that gesturing and vocalizing occurred in parallel during language evolution just as they most certainly did during music evolution (see Molino, this volume).

Fourth, functional accounts of language evolution make reference not only to individual-level representational and communicative capacities but to driving forces related to group function and social interaction capacities (see Ujhelyi and Richman, this volume). Most current theories make explicit reference to the idea that language evolution has some privileged status with relation to the evolution of human group structure and its underlying social relationships (Dunbar 1996). This is certainly no less true of music, and again we see that the situation is even clearer for music than it is for language. In fact, the relationship between social structure and musical form/expression has been much better studied in ethnomusicology than has the relationship between social structure and linguistic form/expression in sociolinguistics (e.g., Lomax 1968). Thus, to the extent that the evolution of linguistic structure (i.e., syntax) is thought to depend on certain behavioral arrangements between people, as reflected in the nature of human group structure, much important information about this can be gleaned by considering how similar processes operated to mold important structural features of music, such as pitch blending and isometric rhythms. The issue of music evolution raises as many essential questions about the evolution of human social structure as does the issue of language evolution.

Finally, although songs do not fossilize, and no musical notation systems exists before the Sumerian system of 3,500 years ago, large numbers of musical artifacts have been discovered throughout the world. In 1995, what is perhaps the oldest one so far—a fragment of a putative bone flute—was found at a Mousterian site in Slovenia and determined to be about 44,000 years old (see Kunej and Turk, this volume). It is probably safe to assume that musical instruments are at least as old as anatomically modern humans if not much older. They reflect the human capacity to make socially useful artifacts, no less interesting than the capacity to make weapons or hunting implements, and no less revealing than the capacity to paint images on the walls of caves.

So with regard to communicative vocalizing, vocal anatomy, brain mechanisms controlling vocalizing and symbolic gesturing, lateralization

of brain function, the hominid brain expansion, tool production, tool use, social structure, group rituals, evolution of syntax, and the like, analysis of music origins provides many avenues for addressing critical questions related to the origins of language and the evolution of human social behavior.

Selection Mechanisms for Music

This discussion of the evolution of culture raises several important questions about the evolution of music. What is music for? under what conditions did it evolve? what types of selection pressures led to the evolution of human musical capacity? It seems quite clear that no known human culture lacks music and that all human beings are capable of creating and responding to music. Furthermore, neurological studies demonstrate the brain's specificity for music (Peretz 1993; Peretz and Morais 1993), again suggesting that musical capacity represents a specific biological competence rather a generalized cultural function. Yet, music is a highly multifunctional adaptation; it serves a large diversity of functional roles in all cultures. The logical question then becomes whether we can ascertain anything about the selection pressures that led to the evolution of this function by analyzing music's many roles in contemporary human cultures.

Many functional accounts for the origins of music have been proposed, and include everything from its uses in promoting domestication of animals and coordinating human social activity, to its roles in sexual display and parental care. If anything, such a diversity of roles would seem to discourage any simple determination of its underlying selection pressures. However, a number of evolutionary hypotheses are presented in this book. They fall into a few categories. First, several authors hold that music evolved by sexual selection, in other words that it evolved as a courtship device in the service of mate selection, a proposal closely connected to theories of singing in nonhuman animals, as many examples of animal song are thought to play a role in either intrasexual or intersexual selection (Darwin 1871; Andersson 1994). Such concepts can be found in the chapters by Slater, Payne, Merker, Miller, and Todd. Second, several authors link music's adaptive role to its ability to promote coordination, cohesion, and cooperation at the level of the social group. Such ideas can be found in the chapters by Geissmann, Ujhelyi, Brown, Richman, Dissanayake, and Freeman (see also Brown in press). Third, Dissanayake (this volume) proposes a parental care hypothesis in which music evolved to increase individual fitness by means of increasing offspring survival through improved parent-offspring communication. Finally, a number of contributors discuss the origins of music in terms of homology with language rather than in terms

of adaptive consequences per se. For example, Ujhelyi, Molino, Jerison, Falk, and Brown propose that the emergences of music and language are in some way linked during human evolution.

These notions are likely to harbor different predictions about the nature of musical form and performance style, and might actually explain complementary features of music. In this connection it is important to emphasize that present-day uses of music need not bear one-to-one correspondence to its uses at its origins, and furthermore, that several speciation events intervene between the present day and the time when our distant forebears parted company with chimpanzees on their evolutionary journey. That is, music's multifunctional nature may reflect the action of many selection pressures, and there is thus every reason to entertain a spectrum of selectionist hypotheses at this early stage in the exploration of the origins of music.

The Evolution of Meter

One of the most distinct features of music, with reference to both animal song systems and human speech, is its use of isometric rhythms. The human ability to keep time should be distinguished from the ability of most animals (including humans) to move in a metric, alternating fashion. What is special about humans is not only their capacity to move rhythmically but their ability to *entrain* their movements to an external timekeeper, such as a beating drum. This is a key feature of both music and dance, and evolutionary accounts of music must explain the emergence of this ability of humans to synchronize their movements in a rhythmic fashion to that of conspecifics or other external timekeepers. Neurological studies reveal that this ability is dissociable from the capacity to produce and perceive the tonal features of music (Peretz 1990; Peretz and Kolinsky 1993). So a "modular" view of musical capacity (see Imberty, this volume) would suggest that metric timekeeping is a distinct feature of the human brain, one that most likely evolved in the context of groupwide music and dance rituals. This topic is discussed further by Merker and Molino (see also Brown in press).

Absolute Pitch

Absolute pitch is described as "the ability attach to labels to isolated auditory stimuli on the basis of pitch alone" (Ward and Burns 1982), and is demonstrated by a person's ability either to recognize or produce specific tones without need of a pitch reference (as is required in the case of relative pitch among trained Western musicians). It is curious, given the general human capacity for categorical perception of sensory stimuli (such as in the case of speech sounds and color categories), that so few people have absolute pitch. What seems to be beyond dispute at this

point is that absolute pitch acquisition depends obligatorily on musical exposure and training during what is thought to be a critical period in cognitive development, somewhere between the ages of 3 and 6 (reviewed in Takeuchi and Hulse 1993). One explanation for why so few people have absolute pitch is that it is a genetic trait, and several pedigree analyses of families containing members having this ability concluded that it is an autosomal dominant genetic trait (Profita and Bidder 1988; Baharloo et al. 1998). Suffice to say that the search for the absolute pitch gene is now under way.

This suggestion of a genetic basis for absolute pitch should not be accepted uncritically, however, as it raises a large number of as-yet-unaddressed evolutionary issues, including the significance and role of absolute pitch-processing capacities in nonhuman species (D'Amato 1988; Hulse, Takeuchi, and Braatan 1993) and in human nonmusicians (Halpern, 1989; Levitin 1994), as well as the importance of cultural exposure to music on the expression of absolute pitch at the *population* level. Absolute pitch might be nothing more than a general human capacity whose expression is strongly biased by the level and type of exposure to music that people experience in a given culture.

Musical Universals

We conclude this section of major topics in evolutionary musicology with a discussion of musical universals. Since Chomsky, linguistics has been preoccupied with the study of universals, both grammatical and phonological. In the case of ethnomusicology, universals have been a subject of great skepticism, as they are seen as smacking too much of biological determinism, and therefore of denying the importance of historical forces and cultural traditions in explaining the properties of musical systems and musical behavior. However, the contemporary biocultural view of social behavior (e.g., Boyd and Richerson 1985; Durham 1991) calls for a balance between genetic constraints on the one hand, and historical contingencies on the other. The idea of musical universals does nothing if not place all of humankind on equal ground, acting as a biological safeguard against ethnocentric notions of musical superiority. In this balancing act between biological constraints and historical forces, the notion of musical universals merely provides a focus on the *unity* that underlies the great diversity present in the world's musical systems, and attributes this unity to neural constraints underlying musical processing (see Trehub and Imberty, this volume, for discussions of innateness in musical processing).

Regarding the common viewpoint in musicology that maintains that the search for musical universals is a fruitless endeavor not (merely) because the enterprise is marred by biological determinism but because

there are no universals to be found,[4] it is critical to emphasize Bruno Nettl's important point (this volume) that universals need not apply to *all* music. Certainly a feature that is found in three out of four musical styles in the world is of great interest to anyone studying the evolution of music. As a preview to a universal theory, let us just mention that octaves are perceived as equivalent in almost all cultures, that virtually all scales of the world consist of seven or fewer pitches (per octave), that most of the world's rhythmic patterns are based on divisive patterns of twos and threes, and that emotional excitement in music is universally expressed through loud, fast, accelerating, and high-registered sound patterns. There is clearly fertile ground for a discussion of structural and expressive universals in music (see Arom, Mâche, and Nettl, this volume; Brown, submitted). It is simply wrong to say that a demonstration of musical universals denies anything of the uniqueness or richness of any culture's particular forms of musical expression. If anything, it protects this uniqueness against ethnocentric claims that some cultures' musics are "more evolved" than those of other cultures, claims frequently heard even in contemporary times.

Methods in Evolutionary Musicology

The evolutionary musicological issues discussed thus far are amenable to scientific analysis by a host of empirical techniques, as well as by formal modeling and computer simulation (an example being provided by Todd, this volume). For theory building to be fruitful, it must ultimately be based on empirical evidence, and in this section we focus on the principal methods that are available to evolutionary musicology.

The Comparative Method and Analysis of Animal Song

Whether or not animal song is viewed as a type of music, it is important to analyze the behavioral-ecological and generative factors that unite it with human music as common adaptations. This includes three major areas of study: acoustic analysis of song, neurobiological analysis of song production and perception, and behavioral-ecological analysis of singing behavior and its associated displays. The first applies the standard methods developed for the acoustic analysis of musical and speech sounds to the realm of animal vocalizations, such as frequency analysis, spectral analysis, and a number of modern computer-based methods for discriminant and correlational analysis. Powerful as these methods are as aids in acoustical characterization and statistical classification of sounds, much remains to be done to bridge the gap between the working tools of the biologist and the powerful notational system developed in

the Western musical tradition, which is the chief working formalism of the musicologist. We believe that bridging this methodological gap will allow a number of problems in evolutionary musicology to be addressed with new precision and to be illuminated by new sources of comparative data (e.g., Szöke and Filip 1977).

The second area, the neurobiology of song, was developed as a natural extension of the pioneering acoustic and developmental studies of birdsong by Thorpe in the 1950s (see Thorpe 1961). A highly successful paradigmatic combination of experimental methods and questions allowed investigators such as Konishi (1965), Nottebohm (1967), and Marler (1970) not only to refine knowledge of the mechanisms of birdsong but to elucidate their neural substrates (Nottebohm 1989; Konishi 1994). This involves a description of the song-specific nuclei and neural pathways underlying song production and song perception in singing species, as well as consideration of the ontogenetic mechanisms and sex differences that underlie the development of these song pathways, especially in the case of sexually dimorphic species, which includes most singing species other than humans. Unfortunately, the impressive advances made in the study of the structure, development, and mechanisms of birdsong have not been duplicated in any other singing species, and from the standpoint of evolutionary musicology it is urgent to extend the paradigmatic power of avian studies to the analysis of other singing species.

The third area includes analysis of the behavioral contexts during which singing occurs, as well as the presumed functions and meanings of animal song and its associated display behaviors. A major goal of this research is to establish the link between song function and structure, in other words, to relate communicative meaning to acoustic sound patterns. Catchpole and Slater (1995) and Hauser (1996) provide promising approaches to the question of meaning in animal communication systems (see also Marler, Slater, Whaling, Geissmann, Hauser, Ujhelyi, and Payne, this volume), and it is hoped that such approaches will be exploited in future work on the behavioral ecology of animal song.

Physical Anthropology and Musical Archeology

The study of both fossils and artifacts will contribute to an understanding of music evolution in a manner that has already greatly benefited the study of language evolution. New findings in the reconstruction of hominid vocal anatomy and brain anatomy will contribute to an understanding of not only the evolution of speech but to parallel understanding of the evolution of singing (see Frayer and Nicolay, this volume). In addition to these inferences based on the vocal and cognitive capacities of our hominid ancestors, a crucial aspect of the reconstruction of musical history lies in the study of musical artifacts themselves. Musical

archeology is a relatively young discipline that promises to supply important new information about the origins of music. It is represented in this volume by Kunej and Turk's analysis of what may be the oldest musical instrument discovered to date. They demonstrate both the difficulties and the promise of this approach to the evolution of music. But in addition, excavation and study of a rich and diverse assortment of stone, bronze, ivory, and clay musical artifacts from all parts of the world are helping to fill the historical gap between the Paleolithic horizon[5] and modern-day music making (e.g., Hickman and Hughes 1988; and the series of volumes put out by the Study Group on Musical Archaeology of the International Council for Traditional Music).

Music-Language Comparative Analysis

One important area for future research in biomusicology will be the interface between music and language and the evolutionary roots of this relationship. This work will come as much from the study of phonology and sign language as from the study of music and dance. Intonational phonology is now developing mature theories for the analysis of intonation in all languages. This includes autosegmental theory for the analysis of tone (Goldsmith 1990, 1995; Ladd 1996) and metrical phonology for the analysis of rhythmic patterns in speech (reviewed in Kiparsky and Youmans 1990). Such studies will benefit as well from the cognitive psychological approach, which will help elucidate the cognitive mechanisms of both acoustic and expressive processing in music and speech. Although most of this research will focus on contemporary linguistic and musical function, it will unquestionably provide insight into and fuel speculations about the intertwined evolutionary origins of music and language.

Human Brain Imaging

Undeniably one of the most important sources of new information for the field of biomusicology will be the ever-expanding array of studies using both structural and functional brain-imaging techniques in humans. Such techniques have already demonstrated their potential to elucidate brain areas mediating both the production and perception of music, including tonal, rhythmic, and emotive aspects of music processing (reviewed in Sergent 1993; Peretz and Morais 1993; Hodges 1996).

Such studies will provide great insight into the localization and the lateralization of these functions, as well as touch on such important issues as ontogenetic development, sex differences (Hough et al. 1994), musical performance (Sergent et al. 1992), the effects of musical training on brain structure (Schlaug et al. 1995a; Elbert et al. 1995; Pantev et al. 1998), neural correlates of skills such as absolute pitch (Schlaug

et al. 1995b; Zatorre et al. 1998) and musical score reading (Nakada et al. 1998), the effects of disease and aging on brain structure and function, and so on.

As mentioned, a key evolutionary question deals with the neurobiology of metric timekeeping, and it is predicted that the analysis of brain areas underlying meter will be a central area of interest for both music and speech (Penhune, Zatorre, and Evans 1998). Also, the relationship between the localizations of musical function and language function in the brain will be a central concern in mapping studies. This will touch especially on the domains of intonational phonology and metrical phonology, where the greatest potential for overlap between music and language seems apparent (Jackendoff 1990; Pierrehumbert 1991).

Comparative Musicology

Finally, a great beneficiary of the evolutionary approach to music will be musicology itself, especially ethnomusicology. Darwinian anthropology and evolutionary psychology will provide many new evolutionary models of music, several of which are presented in this volume, that will be testable in comparative musicological studies. We believe that musicology has much to gain from these new models, and should not shy away from evolutionary approaches to culture. Testing such models will require a highly cross-cultural approach to the five following major aspects of musical events:

1. Selection of who the *musicians* of a given culture are: their age and sex; do all people participate in musical events or are musicians and nonmusicians segregated? are the singers and instrumentalists of a given culture the same people? if segregation exists in any of these areas, how are the roles determined? what is the status of musicians in a culture? etc.

2. The *contexts and contents* of musical rituals: when, where, and how musical events occur; the organization of ceremonies involving music; song texts and other supporting narratives; myths and symbolisms; coordination of music with dance, poetry, theater, storytelling, trance, mime, etc.

3. The *social arrangement of musical performance*: solo versus group performance arrangement; gender or age specificity of particular musical forms; responsorial versus antiphonal choral singing arrangement; degree of soloist domination in instrumental performance; etc.

4. *Musical reflectors of this social arrangement* (Lomax 1968): use of monophonic versus heterophonic versus polyphonic versus homophonic multipart arrangements; use of measured versus unmeasured rhythmic patterns; the predominant vocal style of a culture; etc.

5. The *mode of transmission* of musical knowledge from generation to generation: how musical repertoires of a culture are organized; the nature of musical pedagogy; use of a musical notation system; tolerance versus intolerance to change; use of guided improvisation in pedagogy and performance; etc.

Analysis of these five broad factors does not depend so much on new methods in ethnomusicology as on a new commitment to a comparative approach to musical behavior, performance style, and meaning. But in addition to this, comparative musicology must seriously return to the issues of musical universals and classification to understand not only the deep evolutionary roots of music but how contemporary musical systems undergo change and stasis from historical and geographic perspectives. In fact, this applies as much to the behavioral and semiotic levels of music as to its acoustic level. This need will become all the greater as the degree of intercultural influence and overlap increases in the third millennium.

Music Evolution: Biological versus Cultural

It is unfortunate that the term "music evolution" (like the term "language evolution") has such an ambiguous meaning, as it refers both to biological evolution of a capacity and to cultural evolution of that capacity's output. In other words, the term refers both to the biological emergence of music through evolution of the capacity to make it (an evolutionary psychological consideration) as well as to the historical changes in musical systems and styles that occur over time and place (a comparative musicological consideration). This distinction highlights differences in the nature and dynamics of biological and cultural evolution. This section looks at music evolution from the standpoint of cultural evolution and tries to tie it in with the biological evolution of musical capacity during hominid evolution (see also Molino, this volume).

One way to think about this issue is from the perspective of Darwinian theories of culture (Durham 1990, 1991, 1992), which are "particulate" theories that view cultural objects as *replicators*; in other words, as objects capable of being reproduced and transmitted to future generations. According to such theories, the basic unit of cultural replication is the "meme" (Dawkins 1982; Durham 1991). A meme can refer to any kind of cultural object, for example, a musical instrument, song text, musical style, musical myth, or scale type, so long as it is capable of being replicated and transmitted culturally. Because a given meme in a culture usually has many related forms (e.g., several different designs for the same instrument; several different performance styles of a given

musical genre; different scale types or rhythms for a given musical style, etc.), Darwinian theories of culture posit that differential replication of memes is dependent on the process of *cultural selection* (a process analogous to but different from natural selection), whereby certain forms of a meme are transmitted to future generations while others become extinct. Let there be no confusion: cultural objects are not biological species, and cultural selection (according to cultural consequences) is not natural selection (according to reproductive consequences). However, the Darwinian mechanics of replication, variation, and selection can be thought of as operating in both spheres in a formally analogous fashion, thus making these theories both parsimonious and attractive.

The final topics to be addressed in this chapter are musical classification and the reconstruction of musical history. To what extent is it possible to talk about monophyly in world musics in the same manner that this notion is seriously debated in the field of linguistics? It is important to point out that any discussion of the evolution of musical styles throughout the world depends strongly on a theory of musical classification, and that this topic has been all but taboo in musicology, a situation we hope will be rectified in the coming years. The concept of musical classification has unfortunately suffered the same fate as many other evolutionary ideas in musicology, as it has been seen as depriving cultures of the individuality and specialness of their musical styles. This kind of thinking, despite its good intentions, will only perpetuate the state of isolation that musicology has faced for many decades with regard to the question of human origins. Clearly, some kind of balance must be found between the need of ethnomusicologists to preserve the image that the music of a given culture is individual and special, and the important need of evolutionary musicologists to use music as a tool to study human evolution. There is no question that classification is an artificial activity, one that downplays individual differences for the sake of large-scale coherence. As such, it has the potential to offend the sensibilities of people through its tendency to lump together musical styles that transcend ethnic and political barriers. However, classification should not be viewed as an academic exercise for its own sake, or as a device for suppressing and denigrating cultures, but as an important tool for understanding the deep roots of musical styles and thus human cultural behavior in general. No evolutionary approach to music can avoid the topic of classification in some form. Nor should it.

Let us consider briefly the only serious hypothesis put forth to explain the evolution of contemporary global musical styles. It is based on a concept proposed by Alan Lomax (1980) in a paper that summarized the results of his "cantometrics" approach to musical classification in the 1960s. This hypothesis is almost certainly wrong in detail, but gives

serious food for thought about the origins of musical styles. It begins with a comparative look at musical performance style in 233 world cultures. Based on an analysis of a diverse set of structural and performance properties for 4,000 songs, Lomax was able to classify the performance styles of the 233 cultures into 10 basic families. Next, he discovered that two of these ten model styles stood out for their highly contrastive nature. One is thought to have emerged in eastern Siberia and the other in sub-Saharan Africa. The former is characterized by "male dominated solos or rough unison choralizing, by free or irregular rhythms, and by a steadily increasing information load in various parameters—in glottal, then other ornaments, in long phrases and complex melodic forms, in increasingly explicit texts and in complexly organized orchestral accompaniment." The latter, by contrast, is "feminized, polyvoiced, regular in rhythm, repetitious, melodically brief, cohesive, well-integrated, with rhythmically oriented orchestras" (Lomax 1980:39–40).

Lomax's major hypothesis is that the phylogenetic tree of musical style had two evolutionary roots, one in eastern Asia and the other in sub-Saharan Africa, and that *all contemporary musical styles emerged as either offshoots or blends of them*. This idea certainly has great intuitive appeal, yet contrary to it are the results of Eric Minch and Steven Brown (unpublished data) showing that unrooted phylogenetic trees generated from Lomax's own cantometric data set of musical performance style do *not* place the Siberian style (and its offshoots) and the African style at opposite ends of the tree, as predicted by Lomax. Thus, this "biphyletic" hypothesis is almost certainly incorrect in detail. However, given the fact that it is the first and only one of its kind in the published literature, it will certainly function as a useful null hypothesis against which future models will be tested.

The cultural evolutionary issues discussed in this chapter, including musical universals, classification, replicators, and the musical map of the world, are critical concerns that contemporary ethnomusicology has either ignored or simply rejected. In our opinion, ethnomusicology has not met its calling. It is time for an evolutionary-based musicology to revive these forgotten issues if there is to be any hope of using the outstandingly rich database we have about music and musical behavior to enlighten music's own biological origins. "Mythology is wrong. Music is not the merciful gift of benevolent gods or heroes," wrote Curt Sachs in 1948. However, musicologists for the better part of the twentieth century operated under the illusion that music was simply a merciful gift, one whose origin was never questioned. It is time now to start asking questions about the origins of music, and in doing so, to address fundamental questions about the origins of our species.

The Future of Evolutionary Musicology

It is hoped that this brief introduction to the major issues and methods of evolutionary musicology sets the stage for the many essays that are to follow. Evolutionary musicology has great potential to contribute to the study of so many questions of interest to contemporary scholars. We realize that a research career in the field requires a technical training in both music and biology, and that few people up till now have either acquired the necessary double background or (like musical physicians) have taken the time to apply their two areas of training to the synthetic questions that biomusicology addresses. It is our hope that this situation will change in coming years, and that the next generation of students will realize the great rewards that await them in making the extra effort to develop training both in the arts and in the experimental sciences such as biology.

The future of evolutionary musicology is beginning now. In the same way that the current chapter is the beginning of this book, so too this book is the beginning of a new field devoted to the analysis of music evolution, both its biological and its cultural forms. We conclude this introduction by saying that just as music brings us in touch with the very deepest levels of our emotions, so too the study of music evolution has the potential to bring us in touch with the very deepest aspects of our humanity, our origins, our reasons for being.

Let the discussions begin.

Notes

1. See Nettl and Bohlman (1991) for an excellent discussion of the history of the Berlin school, especially the essays by Blum, Christensen, Ringer, and Schneider.

2. It is unfortunate that so few of the works of the Berlin school have been translated into English. It is very important that musicology come to terms with its own history and see it in proper perspective. There is no question that much scholarship in comparative musicology was permeated by racialist notions about the superiority of European tonal music, and that much faulty reasoning was used in creating "unilinear" evolutionary arguments about the origins of musical systems. This was no less true of much theorizing in sociology or anthropology at the time. Yet, this comment must be balanced by the realization that the comparative musicologists succeeded in bringing recordings and analyses of non-European musics to the European public for the first time, thus educating Western people about these musics in a way that no scholarly anthropological text could have done. Racialism should not be confused with racism, and it must be emphasized that despite their use of dated terms such as "primitive cultures" and "primitive music," the comparative musicologists wrote about the musics of non-Western cultures with nothing less than respect. It is a credit to the members of the Berlin school that they were attempting to develop a general theory of music, one that applied to all human beings and all musics. The spirit of this universalist approach to music and musical behavior unquestionably permeates this entire volume. In sum, we believe that it is high time that the Berlin school of comparative musicology be viewed beyond the racialism that was so predominant in all areas of

scholarship at the time, and be seen for the truly seminal contribution it has made to musicology, and especially to the type of universalist thinking that evolutionary musicology is once again trying to revive.

3. Unfortunately, we have not been able to track down this 1852 reference to Wagner.

4. Consider the following quotation by George List (1971): ". . . the only universal aspect of music seems to be that most people make it. And that is about the only universal involved. I could provide pages of examples of the non-universality of music. This is hardly worth the trouble. Every ethnomusicologist could do the same. . . . since we are unlikely to ever find the universals."

5. For an excellent French-language review of the musical archeology of the Upper Paleolithic, see Dauvois (1994).

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