

## ON THE BIOLOGY AND EVOLUTION OF MUSIC

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I SUGGEST THAT THE QUESTION of whether music is an adaptation has been overemphasized in recent discussions of the biology and evolution of music, because the subtleties of this question combine with our poor fossil record for musical abilities of extinct hominids to render many of the key facts necessary to answer it empirically inaccessible, for now and perhaps forever. Thus the “adaptation question” seems a poor choice as a defining issue for the new but rapidly growing field of biomusicology. This field will be better served if we treat this and similar evolutionary questions as “intuition pumps” to help generate testable hypotheses that spur further experimental work on living animals (in both laboratory and field) and humans. In addition to work on music perception, studies of production in animals such as songbirds and humpback whales will play an important role. Finally, I suggest that the distinction between culture and biology made by many in the field creates a false dichotomy: like birdsong learning, human musical ability is better treated as an “instinct to learn” with biological and cultural aspects intimately intertwined.

**Key words:** biomusicology, birdsong, comparative method, evolution of music, instinct to learn

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THE PAPERS BY JUSTUS AND Hutsler (J&H) and McDermott & Hauser (M&H) will function as excellent antidotes to overly glib discussions of “cognitive adaptations” in evolutionary psychology. J&H provides an admirably clear, logical, and well-formulated framework for addressing adaptive issues, while M&H correctly stress the importance of comparative data for addressing these questions. Future attempts to make convincing adaptationist arguments about music should heed both papers. Both the distinctions proposed, and the conclusions reached, echo those that my colleagues and I have independently drawn concerning the evolution of language and music (e.g., Fitch, 2005, 2006; Fitch, Hauser, & Chomsky,

2005). Thus, I will restrict my comments to two elaborations on the basic points the papers have already made so clearly.

First, I ask why researchers in biomusicology have taken the question of music as an adaptation so strongly to heart, whether to embrace the notion (Brown, 2000; Miller, 2000) or to reject it (Pinker, 1997). As J&H point out, the question of whether music is an adaptation raises strong feelings, a sign perhaps that the debate is not simply an empirical one. I think questions about the origin of music are worth asking by scientists to the extent that they are answerable scientifically. The direct fossil data are sparse: Given the transitory nature of musical performance, we are extremely unlikely to ever know what kind of musical behavior our hominid ancestors engaged in. Did Australopithecines sing? Did *Homo erectus* drum? Did Neanderthals dance? These questions, however fascinating, will probably never be answered with certainty. The oldest concrete and undisputed evidence for music (contra M&H) are the 36,000-year-old bone flutes from Geissenklösterle (Hahn & Münzel, 1995); are Aurignacian and associated with modern *Homo sapiens* (the Neanderthal “flutes” cited remain controversial (D’Errico, Villa, Llona, & Idarraga, 1998)). A simpler form of music, limited to singing, dancing, and drumming on hollow logs, would leave no fossil record at all. Because direct fossil data are lacking, and will remain so, the greatest value of an evolutionary perspective may be to provide a theoretical framework within which to frame modern empirical research, rather than as an end in itself.

Darwin ranked human musical abilities “amongst the most mysterious with which he is endowed” (Darwin, 1871) because music is a human universal that has no obvious function. Music thus cries out to be explained as an adaptation, or dismissed as a spandrel. Darwin’s own conclusion was more subtle than either of these extremes. He suggested that modern music is a “fossil” of a former adaptation: an earlier hominid communication system or “musical protolanguage.” This is an idea of considerable merit that has been rediscovered by many subsequent authors (e.g., Brown, 2000; Jespersen, 1922; Livingstone, 1973; Mithen, 2005; Richman, 1993). If Darwin’s plausible hypothesis were true, what would

be the implications for the question of whether music is an adaptation? It would not be an adaptation (because its core original function has been usurped by language), nor a simple exaptation or spandrel (because it *once* was an adaptation, honed to its past function). It would not be a vestigial trait, like the appendix or male nipples, of no selective import at all, because music still carries a physiological cost, plays an important role in human affairs like mating and socialization, and retains powerful effects on our behavior and physiology. Thus, if heritable and truly useless, musical behavior should be a target of selection to disappear, like a cave fish's eyes (for detailed argument see Fitch, 2006). One begins to sense that categories like "adaptation" and "exaptation" may provide an imperfect fit for music. If Darwin's musical protolanguage hypothesis is even partially correct, music is none of these things. It is an ex-adaptation, a "fossil" of a former evolutionary regime, a biologically grounded cognitive domain whose current use is neither the same as its original function, nor completely different. Even a staunch musical adaptationist will acknowledge that many aspects of contemporary musical practice (e.g., iPods, playing brass instruments) are "exaptations," relative to any hypothesized protomusic (perhaps limited in earlier stages to singing and drumming). Rather than arguing about whether such music "counts" as an adaptation or not, we might better ask "who cares?" Why does it matter?

If such questions cannot be answered empirically, it seems to me a mistake to declare them "central" to the growing field of biomusicology. In my opinion the proper role of evolutionary theorizing in such cases is to generate testable predictions: to act as a guide for seeking new data. There are many interesting questions raised by Darwin's hypothesized link between music and language evolution that can be tested, by exploring and comparing the cognitive, neural, and genetic mechanisms underlying musical and linguistic abilities in modern humans (e.g., Koelsch & Siebel, 2005; Zatorre & Peretz, 2001). Does individual variability in musical talent correlate with linguistic ability (or perhaps just with phonological ability)? How do the relevant neural/genetic mechanisms overlap? It is surprising that we still don't know the answers to such basic questions. Even the impact of musical ability on reproductive success—a prerequisite if music indeed is a currently functioning adaptation—remains unknown. Solid, empirically grounded answers to such questions will be valuable regardless of the eventual fate of evolutionary hypotheses that inspired them. I suggest that such research provides the proper focus for a future biomusicology, and that the adaptation question is best seen as an "intuition

pump" to drive such research, rather than a central preoccupation of the field.

My second point has to do with the value of research on animal communication systems like bird or whale "song" for understanding human music. Given their focus on music perception, both papers neglect the issue of music *production* (without which music isn't there to be perceived). Thus, for example, the neural-network studies cited by J&H show that complex harmonic structures can be learned by a general purpose system, but beg the question of where such acoustic structures come from in the first place. Although it is often said that tonal, harmonic sounds are "ubiquitous" in the natural world, most inorganic sounds (falling trees or rocks, wind or water noise, vibrating natural objects) are not tonal (they do not contain integer harmonics). The natural sounds that have harmonic structure are essentially limited to vocalizations created by other animals—the main sounds of biological interest for most species. Even the basic proclivity of the auditory system to seek tonality—its "desperate search for pitch"—may thus represent an ancient adaptation to the characteristics of the voice, whose evolution began with the first terrestrial vertebrates (or before). A general-purpose neural network will surely not, by itself, generate (or prefer) tonal sounds, diatonic scales or complex harmonic structures, any more than a goldfish able to distinguish Bach from the blues (Chase, 2001) will ever generate such sounds.

I agree with M&H that controlled laboratory studies of animal auditory perception provide a crucial basis for understanding music perception. In an important sense different musics represent cultural "adaptations" to various basic, primitive aspects of the auditory system that we inherit as mammals or vertebrates. However, if we acknowledge that the complete study of music should include production as well as perception, we will search for insights from neural nets, goldfish, or monkeys in vain. Fortunately, as long recognized, a different set of species are highly relevant to the production side of music: the complex, learned vocalizations—"songs"—of birds and marine mammals. These species have convergently evolved behavior systems with important similarities to human song. They close the loop between perception and production. Although there are many lessons to be learned from such species I will focus on one, concerning the relationship between learned vocalization, innateness and culture, because it corrects misapprehensions that might be drawn from both papers. Studies of music-like behavior in other species indicate that the culture/biology distinction provides an unproductive way to frame the problem of music acquisition.

It is better to see music as an “instinct to learn,” fueled by certain perceptual proclivities and channeled by various constraints. I will focus on birds here, because they are better studied (for details, see Fitch, 2006).

Birdsong is indisputably an adaptation, but it is not innate. While many bird species have innate vocalizations requiring no environmental input for normal production (from the cheeps of ducklings to the more complex “songs” of cranes) many other bird species need to hear conspecific vocalizations in order to sing normally (Marler & Slabbekorn, 2004). Young songbirds raised in acoustic isolation produce only highly abnormal attempts at singing as adults. Vocal learning is also strikingly observed in the ability of many bird species raised by humans to learn human sounds (e.g., talking parrots, mynahs, or starlings). This ability to imitate arbitrary sounds raises an interesting problem: How does the young bird, surrounded by songs of many different species, know which sounds to imitate? The answer, discovered by seminal research by Peter Marler and colleagues, is that young birds have an innate template for their species specific song: a proclivity to attend to and imitate certain types of song and not others. Deprived of sounds fitting this template, the bird will imitate whatever else is in the environment. But given songs of its own species the bird will unerringly imitate those, and for most species only those. Thus, the bird’s adult song is neither innate, nor entirely learned—it is “channeled” by a species-specific set of proclivities and constraints. Birdsong results from an “instinct to learn” particular types of songs (Gould & Marler, 1987; Marler, 1991).

I join Marler and many other students of animal behavior in suggesting that the notion of an “instinct to learn” provides an appropriate model for music acquisition in humans (and language acquisition as well). Indeed, although birdsong is often compared to human language, Marler cogently argues that the more apt comparison is with music (Marler, 2000). By hypothesis, we too are born with a certain set of proclivities (e.g., for tonal and rhythmic sounds arranged in interesting structures,

with particular favored frequencies and tempos) and constraints (e.g., on repetition rates, frequency limits, number of notes in a scale, basic consonance and dissonance judgments). These, together with basic learning and imitative abilities, constitute an instinct to learn that forms the (rather fuzzy) outer limit of what “counts” as human music. This conception explains the joint facts that music is universal among human cultures, but highly variable between them. Just as bird or whale song in different regions differentiates into “dialects,” human music will diversify within the broad limits set by the human instinct to learn (presumably shared more or less identically by all humans). Within the biologically facilitated range, music is free to “evolve” as a cultural entity, together with the social practices and contexts of any given culture.

Thus, whether we call it “animal music” or not, an important lesson from other species possessing complex, learned vocalization is that attempts to separate music into “cultural” and “biological” components will be futile. These are hopelessly entangled aspects of human biology. It is precisely the human ability to acquire complex novel aspects of our environment (acoustic and otherwise) that constitutes a core adaptation of our species. This ability is responsible for the great diversity of human music, and our ecological and technological success in other domains. Music, language, and culture may all be seen as special cases of this ability, which is our birthright as humans. Although humans clearly take this ability to a new level, studies of animal “song” show that it is not entirely without precedent. Thus, comparative studies of animal “song” production and perception can play a crucial role in understanding the evolution of human music.

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