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Review

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Cross-cultural perspectives on music and musicality

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Musical behaviours are universal across human populations and, at the same time, highly diverse in their structures, roles and cultural interpretations. Although laboratory studies of isolated listeners and music-makers have yielded important insights into sensorimotor and cognitive skills and their neural underpinnings, they have revealed little about the broader significance of music for individuals, peer groups and communities. This review presents a sampling of musical forms and coordinated musical activity across cultures, with the aim of highlighting key similarities and differences. The focus is on scholarly and everyday ideas about music—what it is and where it originates—as well the antiquity of music and the contribution of musical behaviour to ritual activity, social organization, caregiving and group cohesion. Synchronous arousal, action synchrony and imitative behaviours are among the means by which music facilitates social bonding. The commonalities and differences in musical forms and functions across cultures suggest new directions for ethnomusicology, music cognition and neuroscience, and a pivot away from the predominant scientific focus on instrumental music in the Western European tradition.

1. Universals and contrasts in musical systems

Music is universal, transmitted through generations, usually performed in the presence of others, and of extreme antiquity.

While there is no inter-culturally valid definition of music, and the cover term *music* is found in only selected cultures, a number of presumptive universals indicate that musicality is a prominent and distinctive characteristic of humankind. All peoples engage in activities that we would call music, often in relation to play, and everywhere in relation to ritual. All peoples of the world sing, an activity recognized on the basis of context or by cultural consensus as different from speech. All peoples have some form of instrumental music as well, however rudimentary.

Music-making is necessarily a cultural performance because conventions about the structure of music, its instrumentation, context of performance and meaning are all learned. Music-making is a system of communication transmitted through ongoing transgenerational interaction.

Music-making is or implies a social performance, even when performed or listened to alone. The solitary performer often has an audience in mind. For example, when music students at North American universities practice alone in hermetic practice rooms, they are usually imagining an audience (J. Becker 2014, personal communication) [1]. Solitary music-making for personal pleasure is likely to evoke memories of learning the piece (when, where and from whom) and previous experiences of playing and hearing it. Musical pieces, like performers, are saturated with contextual, social memory.

In the Western industrialized world, music listening is commonly solitary, and iPods, earbuds and headphones are ubiquitous. The listener seems alone, but the music has an implied social context such as a symphony orchestra, a rapper before a live audience or a DJ at a club. Even a solitary basement

musician producing a multi-track composite performance is likely to invoke or imitate a social context.

An exception to the truism that music-making is a social performance is the deliberate use of music to shut out the world and create an alternate reality. At times, the iPod-solitary-listening reality can produce something close to a deeply spiritual or mystical experience.

I've walked that way for—I don't know how many years... and it's very boring, so having the music makes me see things that I would see everyday in a kind of new way—like a leaf falling or something. It might be like, 'Wow, a leaf has fallen!' [1].

Except for solitary, self-directed performances, music performances are political in the sense that they are situated and embedded within structures of power and influence. Where they are performed, by whom, and for whom reveal a great deal about the cultural and social status of the performer and the performance.

Who has creative and economic control?

Which people and assumptions dictate the terms, not only of the creative work produced by artists but also of the critical and scholarly writing about it?

What are the ways that the race, gender, class, sexual orientation, and generation of an artist shape his or her professional experiences and aesthetic choices? [2].

Because musical performances are socially and culturally situated, they come to be ethically saturated as well. Our deepest values may be implied by participation in a particular genre of music such as a hootenanny (populist), heavy metal concert (male machismo), rave (youth culture plus drugs) or European classical concert (upper-middle-class values and lifestyle). There are exceptions, of course, but the aforementioned stereotypes are more likely than not to apply to any given listener at a musical event. As Wittgenstein claimed, 'Ethics and aesthetics are one and the same' [3].

Music everywhere is believed to affect our emotions, to involve some kind of arousal, ranging all the way from mild pleasure or displeasure to profoundly transformed states of consciousness such as trancing [4,5]. Nevertheless, the scientific study of music and emotion has focused primarily on solitary listening, which is but one of many modes of listening across cultures [6]. Cross-cultural research in this domain is limited and largely restricted to listeners' categorization of intended and felt emotions by means of a small set of emotion words (e.g. happy, sad and scared) or facial expressions [7–9]. Even within a culture, listeners' perception of emotion differs markedly from their felt emotion, and the latter varies considerably with differences in listening context, experimenter- versus self-selected music and number of response alternatives [10–12].

(a) What is called music?

Many languages, including most North American Indian languages [13] and several languages in Africa such as that of the Basongye of Zaire [14] or the Tiv of Nigeria [15], have names for individual genres of music but do not have a cover term that includes all of their musical genres. Among the most important commonalities among musical systems of the world is the conjoining of music and ritual, often including dance and speech. The term for music frequently includes other activities as well. For example, Sanskrit *sangita*, Thai *wai khruu* [16] and *nkwa* of the Igbo of Nigeria [7] encompass music and dance as facets of the

same activity, making no clear terminological distinction between them.

Honest observers are hard pressed to find a single indigenous group in Africa that has a term congruent to the usual western notion of 'music'. There are terms for more specific acts like singing, playing instruments, and more broadly performing (dance, games, music); but the isolation of musical sound from other arts proves a western abstraction, of which we should be aware when we approach the study of performance in Africa [17].

The synonymity of music and dance may be recognized by the participants themselves, as in the case of the ritual dance of the Maring of Papua New Guinea at the *Kaiku* festival, in which the dance and ritual pledge are interdependent in transforming the natural order [18], and the *Candomblé* Afro-Brazilian religion, in which music is so ubiquitous that the same term encompasses what we recognize as music and religion [16].

By contrast, the chanting of religious texts in Judaism (*ta'ameh ha-mikrah*) and Islam (*qira'ah*), would be classified as musical by external observers but as recitation by the practitioners [16]. As with the preceding examples, however, the musical and ritual elements are mutually dependent facets of the performative activity.

(b) Statistical universals

Strictly speaking, there are no structural characteristics that have been identified in all known musical systems. Nonetheless, some characteristics have a wide distribution globally and are considered *statistical universals* [19].

Perhaps foremost among *statistical universals* is the idea of musicality itself, that everyone has the capacity or potential for engaging in a range of musical activities. Moreover, one does not just sing, but one sings *something* and that *something* can be identified in one way or another [20]. What is performed has an identity, a name or moniker that sets it apart from other musical acts and from any other kind of utterance. For example, what is sung may be considered a unit in a ritual, the creation of someone, performed by someone or performed at some particular place. Another statistical universal is the presence of musical units or phrases, identifiable by repetition or some form of redundancy. Repetition of units or phrases, whether identical or with variation, is widely represented in musical systems across the globe [21,22]. Musical units or phrases can be transposed and still retain their identity [19]. The musical phrase, or combination of phrases, is frequently made up of unequal intervals, often major seconds and thirds, and commonly combining to produce pentatonic scales [19,23,24]. While the idea of a scale is by no means universal, the analytical construction of 'scale' indicates that most musical systems in the world do not exceed seven notes within the octave.

The sense of octave equivalence is found wherever men, women and children sing together in unison. In Bali, Indonesia, the sense of octave equivalence is underlined by being deliberately undermined. Equivalent pairs of keys of Balinese bronze xylophones are carefully tuned so that the octave across each pair is 'out-of-tune' or 'stretched' to produce the desired 'beats' when both keys are struck simultaneously [25]. The deliberate use of beats in Bali and other musical cultures [26] is inconsistent with the claim that beats, which are typically avoided in Western music, are innately unpleasant [27,28].

Most musical systems are predominantly isorhythmic, which means that the same rhythmic configuration, once

established, tends to continue throughout. A given beat within an isorhythmic configuration is commonly subdivided into two or three units [19].

Certain ideas concerning music are also frequent across the globe. One of these is the belief that one's own system of music is *natural*. To consider one's music system as natural is to endow it with a kind of necessity or power that it might not be able to claim otherwise. But *naturalness* can be located in many different realms. One way in which naturalness is identified in Western music, as well as in India, the Middle East, and parts of sub-Saharan Africa, is on the basis of acoustics, the building of scales on the overtone structure of any single tone [29,30].

A different kind of link with nature, and thus with spiritual power, can be found in ideas about music of the Kaluli, an ethnic group of the highlands of Papua New Guinea. The Kaluli believe that human composers are reworking bird songs. Their most important ceremonial song genre consists of four descending tones in imitation of the call of the *muni* bird that can be heard as the voices of their deceased ancestors [31].

Another system of ideas concerning the naturalness of musical systems can be found in the lore surrounding Central Javanese court gamelan ensembles. Indic conceptions of power were imported into Java in the first millennium CE and were drawn upon by the sultans of Central Java to enhance their status. According to Indic cosmology, female energy, *sakti*, permeates the universe, is found everywhere for all time and is morally neutral. While we would consider this system of ideas a construct, for its practitioners it was a description of the natural world and the universe. To be an effective ruler in Java, the male sultan, through meditation, added to his effectiveness by attracting and assimilating cosmic *sakti*. In modern Indonesian, with its Indic past receding, *sakti* is simply translated as power. Any gamelan ensemble, but especially old palace gamelans, is believed to possess or embody *sakti*, in part because they are made of bronze, an alloy of copper and tin, that comes from the Earth and must be transformed by fire. In Java, blacksmiths and gong makers are believed to embody *sakti*, a necessary power to transform substances of the Earth, through fire, into wondrous objects such as the dagger, *kris*, or a gamelan instrument. A large palace ensemble will always include two large gongs, one female and one male. The female gong is considered to be older and more primal than the male gong and will always be used to end a piece. The division of a pair of male and female instruments extends to other paired instruments, the bronze xylophones of the ensemble as well as the gongs. Thus, the naturalness and power of a gamelan ensemble is attributed, in part, to its metaphoric iconicity with cosmic power [32].

(c) Scholarly and everyday ideas about the origins of music

Music is often ascribed to spiritual or supernatural aspects of the natural world. In the ancient and mediaeval worlds, east and west, music or sound was conceived as a primal source of the phenomenal world. Pythagoras and Plato formulated the Occidental theory of cosmic music, the relations between music intervals and numbers, the character of scales, the 'harmony of the spheres' and their influence on nature and society [33]. Scholars in ancient China created a complex system of relations between social phenomena, elements of

the calendar and relations between tones. 'The origin of music is in the very remote past. It was...rooted in the Grand Unity. The Grand Unity gave birth to...heaven and earth' (ca 239 BCE) [34].

In ancient India, sound itself was considered sacred in origin [35], and the Hindu aspiring for liberation or for association with a chosen deity performed a 'sonic act' informed by a 'sonic theology' [36].

Ancient theories of the relation of music to the cosmos have continuing influence, but commonplace notions about music and the supernatural also abound, such as Native American and African beliefs that dreams or visions are the sources of particular songs [37–40]. Related to the link of musical performance with special powers or supernatural forces is the widespread belief that music has profound effects on our minds and bodies and can ameliorate physical and mental problems [36,40–42].

(d) The antiquity of musical activities

A deep history to musical activities is suggested by their existence in all known human societies. They are key components of ritual activities, cosmologies and the management of social relationships—all core elements of maintaining human groups. This suggests shared mechanisms by which recognizable musical activities emerge inevitably in human societies despite divergent histories or that musical activities themselves are part of a shared history of human groups that pre-dates their divergence from one another.

The earliest direct evidence of musical activities is necessarily limited to the earliest evidence of musical instrument use. In many musical traditions, however, musical behaviours are not synonymous with instrumentation, and much instrumentation would not preserve archaeologically. For example, among the Blackfoot and Sioux Native Americans [38,43], the Aka and Mbuti African pygmies [44,45], the Yupik of southwest Alaska [46] and the Pintupi-speaking Australian Aborigines [47], the melodic content of music is largely provided by the voice, with instrumentation primarily being percussive. When instruments are used, they are often made from natural, biodegradable materials that would not preserve archaeologically under most conditions and are supplemental to the use of the body for producing melodic and rhythmic content.

This means that archaeological evidence for musical activities, in the form of preserved instruments, is unlikely to represent the earliest musical activities or their extent. Nevertheless, it is clear that the earliest populations of modern humans (*Homo sapiens*) to enter Europe, more than 40 000 years ago (y.a.), were engaged in musical activities. The oldest known pipes or flutes come from the sites of Geissenklösterle, Hohle Fels and Vogelherd in the Swabian Jura of Germany [48–51]. These are made from swan bone, vulture bone and mammoth ivory. All come from layers associated with Aurignacian technologies, among the earliest tool types produced by modern humans in Europe, and in the case of the Geissenklösterle examples, the layers have recently been re-dated to 43 150–39 370 cal bp (calibrated, or calendar, years before present) [52]. The bird bone examples are made from modified radius and ulna bones (lower arm/wing bones). Bird bones are light and naturally hollow, so are relatively easily worked. The lower wing bones of large birds, such as vultures, eagles, swans and some geese, are of sufficient

size to function as multi-pitch pipes. These have had the ends (epiphyses) removed and finger holes prepared by thinning the bone surface and piercing or boring a hole with a sharp tool [4,53]. For the mammoth ivory examples, a far more laborious process was used to produce a somewhat larger equivalent to the bird bones. The ivory was soaked to separate its laminar layers, cut in half along its length, the central core removed and the two halves re-sealed with airtight resin glue, having had finger holes bored along the length [48,49].

Further examples associated with Aurignacian technologies are known from Spy, Belgium (what may be 'panpipes') [54,55], Abri Blanchard [56,57] and Isturitz, France [53,58–60], which suggest widespread musical activities at that time. Given the sophistication of the production techniques and the association with some of the earliest *Homo sapiens* populations in Europe, it seems likely that these represent part of a behavioural repertoire that pre-dates their arrival in Europe. These instruments constitute the first of an extensive record of pipes and other instruments from throughout the Upper Palaeolithic period (from around 45 000 y.a. until around 12 000 y.a., at the end of the last ice age). In several cases (e.g. Isturitz, Mas d'Azil), these instruments were found at sites that were focal points for large gatherings at particular times of the year [55,61].

As noted, melodic instruments were a small part of the sound-producing traditions, with melody being principally provided by the voice, and instruments being primarily percussive. Were this the case among Palaeolithic human populations as well, then the record of bone pipes would represent a small proportion of the instruments produced and used, and that, in turn, would represent a small proportion of the musical activities carried out.

While pipes are perhaps the most readily recognized and best preserved instruments from Upper Palaeolithic contexts, other possible sound-producers are known from this period. These include rasps ('scraped idiophones') [62–66], bullroarers ('free aerophones') [61,62], struck bones (osseophones) [67,68] rocks, and stalactites and stalagmites (lithophones) [69–73]. All are well-known forms of sound production in ethnographic contexts. For example, bullroarers have been used in Australia, Africa, North America, New Guinea, and among the Maori of New Zealand and the Sami of Scandinavia. Their use often has sacred and religious associations, and their powerful religious roles in ancient Greece are also well documented [74–79]. Similarly, the use of 'rock gongs' or 'singing stones' has been documented in historical and contemporary contexts in the Canary Islands [80], Sweden [81], India [82,83], Bolivia, south-east Asia, Australia and Africa [78,84]. 'Rock gongs' produce a single tone or multiple tones depending upon where they are struck. As would be expected from their extensive geographical and temporal range, their uses are varied, including signalling (the sounds can be heard over distances of several miles) and accompanying ritual, singing and dancing [78,82,83].

(e) Music and social organization

Conjoining music, dance and ritual language within an event that addresses the existential concerns of the community is the most universally valued of musical activities. Owing to the entrainment of human bodies in a group, a musical event that is a ceremony or a ritual, even a small communal or family gathering, necessarily becomes an enhancer of community spirit. Making music together is simultaneously building a community together, which is considered by

many to be the most adaptive and evolutionarily significant aspect of musical experience worldwide [85–88].

Among the Pintupi-speaking Aborigines of Australia [89], musical activities are an important part of interactions with neighbouring groups during the dry seasons [90,91]. The Yupik of southwest Alaska achieve 'socially lubricating' functions through music whose lyrics and dance actions diffuse tension through teasing or relating comic events [46]. Both of these peoples, hunter-gatherers in very different environments and separated by many thousands of miles, believe that their musical activities directly influence the world around them, that they have come from the land and that they are akin to the other fauna in their environment [43,44,46,89].

Although there is some variation in the permissible roles of individuals and genders in musical activities, the activities are often inclusive, with little distinction between performers and audience. All who are present participate in the activity in some capacity. For the Aka and Mbuti equatorial African pygmies, music is a communal, cooperative activity, with no one considered a specialist musician [44]. Songs related to hunting are typically performed by men [91], and performances related to rites of passage are typically performed by women [44]. For all other music and dance performances, persons of any age or gender may participate [92]. Similarly, for the Blackfoot and Sioux native Americans, gender roles and specific responsibilities were delineated in music used for ritual purposes, but a wide cross-section of the community participated in the second-most common use, social dancing [43].

Songs also function as a repository of knowledge and cultural values that can be transmitted across persons and generations, as with the Alaskan Yupik, the Australian Pintupi-speaking Aborigines and many other groups [46,89]. In rural Vietnam, for example, a number of traditional songs provide detailed guidance for planting and harvesting crops [93]. The *Alphabet Song* and counting songs in many cultures continue to play an important didactic role in childhood.

2. Music and group cohesion

Although it is highly likely that the social aspects of musical engagement account for the perpetuation of music across cultures and millennia [86,88], these aspects have received considerably less attention in psychology and neuroscience than the perceptual, cognitive and emotional processes of solitary listeners and the neural correlates of these processes [94–97]. Progress in documenting the everyday music listening habits of Western adults [1,41,98,99] has not been matched by progress in delineating the consequences of various listening contexts for arousal, emotion regulation and well-being. Even when emotional responsiveness is of principal interest, music that evokes episodic memories or extra-musical associations is commonly excluded [11] despite the impact of such associations on listeners' emotional experience.

(a) Musical caregiving

Music is ubiquitous in caregiving. Carers across cultures sing to infants and have done so from time immemorial [100]. Their lullabies to soothe infants and induce sleep are typically simple, melodically, rhythmically and lyrically [101–104], and they are readily identifiable across cultures [105]. Lullabies are commonly performed with rhythmic movement (e.g. rocking) and touch [106], so the child's introduction to

music is multimodal even in cultures where solitary listening is the norm.

Lullabies are the songs of choice in caregiving contexts with almost constant physical contact between carer and infant, which often involves limited face-to-face contact [107]. High levels of contact maximize infants' comfort and safety in the challenging conditions of the developing world [108,109]. An exception to this practice involves the BaYaka Pygmies of Central Africa where a mother typically responds to a howling baby by yodeling even louder while rhythmically patting the baby's back [110]. Lullaby lyrics in most cultures express praise and affection for infants but, at times, stressed carers use the privacy of the dyadic context and non-comprehending listener to give lyrical expression to their personal difficulties [100,111], with potentially soothing consequences for singers and listeners.

Middle-class European and American mothers, having the luxury of focusing on intellectual and social stimulation, place infants in secure devices (e.g. seats and swings) and engage in face-to-face play [112]. Their singing and melodious speech enables them to 'keep in touch' with infants [113]. The songs of choice in such contexts are lively play songs, with lullabies commonly reserved for bedtime routines [100]. Regardless of carers' choice of songs, their manner of performance, featuring higher than usual pitch level, slower than usual tempo and warm vocal tone, is discernible to naive listeners within and across cultures [114–117]. The maternal performing style is also individually distinctive. Mothers sing a few songs repeatedly and in a highly stereotyped manner—typically with identical pitch level and tempo [118]. The result is a distinctive dyadic ritual that eases the burdens of caregiving, enhances infants' sense of security and cements carer–infant bonds.

Aspects of the maternal singing style are similar to the intimate, group-involving style of singing that Lomax [119] identified in highly integrated communities around the world. That style has been linked to the blurring of boundaries between the self and others [120,121]. Mothers' face-to-face singing modulates the arousal levels of contented infants [122] and is more effective than maternal speech at reducing the high arousal of distressed infants [123]. Even with auditory-only materials from unfamiliar mothers, songs recorded in an infant's presence engage infants more readily than comparable recordings that lack an infant audience [114,124].

(b) Music in communal contexts

Music listening evokes pleasure even in the solitary, unnatural context of the laboratory or scanner [97,125,126]. The pleasure and social consequences are amplified, however, when music is experienced with family or peers [127] and even more so when music features active involvement as in singing, drumming or dancing [128]. Communal musical experiences and collective rituals in general enhance social cohesion and prosocial behaviour [86,129,130], presumably through jointly experienced elation and synchronized action [87,131,132].

(c) Synchronous arousal

Heightened arousal strengthens social bonds among those who engage in collaborative rituals regardless of the presence or absence of music, positive affect or overt physical coordination. For example, extreme rituals that include beating, mutilation or excessive exertion intensify social bonds

among participants and empathic observers, as reflected in the extent of their identification, cooperation and coordinated physiological activity [133–135]. In the annual fire-walking ritual of a small rural village in Spain, fire-walkers walk barefoot across glowing red coals as friends, relatives and thousands of visiting spectators look on. The arousal of the fire-walkers' friends and relatives becomes synchronized with that of the fire-walkers, as reflected in the microstructure of their cardiac activity [134]. The arousal of unrelated spectators, although elevated, does not exhibit the signature cardiac features of the fire-walkers and related observers. Incidentally, music may well prime participants (fire-walkers and audience) for the main event because it is preceded by the fire-walkers dancing around the glowing coals, and each fire-walker is summoned to the challenge by a trumpet call.

Communal musical experiences are typically of moderate emotional intensity, but examples of intense performances with positive valence are common among the BaYaka Pygmies of the Central African Republic [110]. They engage in extended bouts of vigorous singing, dancing and story-telling, in contrast to the reported low frequency of high-intensity rituals and high frequency of low-intensity rituals [130,133]. For enjoyable musical rituals rather than punitive non-musical rituals, intensity may be compatible with high frequency. For the BaYaka Pygmies, musical activities play a critical role in the maintenance and intergenerational transmission of their egalitarian and cooperative values and practices [110].

High-intensity rituals, including loud, long-sustained singing and trancing are also found in charismatic Christian congregations, especially Pentecostals. Originally from the US, Pentecostal congregations, with hours-long musical services, are now found worldwide [136].

(d) Synchronous action

Although synchronous action is not a prerequisite for the formation or maintenance of social bonds, synchronous activity in groups of Buddhist chanters and Hindu devotional singers results in greater identification, trust and generosity among participants than does the non-synchronized activity of cross-country running groups [137]. The lesser prosocial consequences of cross-country running are inconsistent with the contention that social bonding arises from the energetic aspects of music-making [128].

Prosocial consequences are evident even when synchronous activity occurs without music. For example, three initially unfamiliar individuals who walk in step evaluate one another more favourably than similar threesomes who walk together but not in synchrony [138]. According to historian William McNeill [139], the military practice of marching in step no longer has the significance it once had for battle formation, but it is maintained because of the sense of unity it fosters among marchers from diverse political, religious and socio-economic backgrounds.

The prosocial consequences of synchronous activity are evident in early childhood. After 4-year-old children engage in cooperative play that includes singing and playing percussion instruments, they exhibit more prosocial behaviour than 4-year-olds who engage in similar cooperative play without music [140]. Infants move rhythmically but not synchronously to rhythmic music [141]. By seven months of age, however, they are sensitive to specific patterns of movement experienced when moved by others but not to movement

patterns that they simply observe [142]. By 14 months of age, they are sensitive to movement patterns observed as well as experienced. After observing an adult bouncing synchronously with their own bouncing, they offer more assistance to that adult than to one who engaged in non-synchronous bouncing [143].

(e) Imitation

Synchronous action is one route to social bonding and prosocial behaviour in childhood and adulthood. Imitation is another. An important pillar of our musicality and of our ritual propensity in general is our ability to imitate or provide a high-fidelity copy of the vocal and bodily actions of others [144,145]. Ordinary interpersonal interaction often involves unconscious mimicry or low-fidelity copying that is prompted by prosocial attitudes of the mimic and has prosocial consequences for the person mimicked [146]. Such mimicry is presumed to arise from our motivation to conform or be like others [145,147,148]. Similar affiliative motivations seem to underlie young children's production of exact imitations of the actions of others [149] and their enhanced responsiveness to individuals who imitate their actions [150]. For example, 18-month-old infants initiate more play with adults who imitate their actions than with those who interact without action imitation [151]. The motivation to act like others reaches a high plane in musical and ritual activity where the form is primary and the immediate function is secondary or inconsequential [145].

(f) Music, meaning and communication

For members of many small communities, past and present, musical rituals have meanings that are transparent within the native community but opaque to others. There may be different levels of meaning as well, holistic meanings about particular rituals, like a call for rain or for animals to present themselves for the hunt, and specific meanings linked to individual elements, like the gender of a gong. Music theorists

and scientists consider these meanings extra-musical, according to them lesser significance than intra-musical meanings involving the internal structure of music. But these so-called extra-musical meanings are highly conventionalized, unlike the idiosyncratic extra-musical meanings (e.g. 'our song') that are typically subsumed under this category. Although music lacks communicative specificity in comparison with language, its power sometimes exceeds that of language in social, emotional and spiritual domains. In live contexts, moreover, music can communicate to greater numbers of individuals and over greater distances than language can.

Laboratory studies of isolated listeners and music-makers have yielded important insights into sensorimotor and cognitive skills and their neural underpinnings, but they have illuminated little about the significance of music for individuals, peer groups and communities, and for cultural evolution. Some experimental anthropologists, evolutionary biologists and evolutionary psychologists are beginning to make inroads into these issues by using precise measurement techniques with naturally occurring groups of music-makers and listeners [128,137].

The commonalities and differences in musical forms and functions across cultures suggest new directions for ethnomusicology, music cognition and neuroscience, and a pivot away from the predominant scientific focus on instrumental music in the Western European tradition. Empirical and field studies of ecologically valid music in diverse settings can complement traditional laboratory research, generating richer conceptions of human musicality than those currently available (e.g. see other papers in this volume). Social cognition [152] and iterated (person-to-person) learning [153] are considered to make vital contributions to the evolution of language. Their role may be even greater in the evolution of music.

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