COMMENTARY

Cross-cultural convergence of musical features

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Singing, rhythmic movement to music, and musical instruments, blown or struck, are pervasive, with a deep history (1). Ethnomusicologists do not dispute the existence of core abilities that support a variety of musical activities across cultures, but they are generally averse to notions of universals involving musical structure or form (2). In their view, the music of every culture is unique, being governed by systematic but arbitrary conventions. Although scientists who study music focus primarily on cognitive and neural processes (3), they regard universal musical features as an empirical question, as do Savage et al. (4) in PNAS. To date, however, scientists have relied almost exclusively on convenience samples of Western listeners and Western instrumental music, limiting the potential generality of their findings. Savage et al. apply rigorous classification criteria and phylogenetic comparative methods to a large global set of musical recordings, documenting an impressive list of musical features that are near-universal (i.e., statistical universals). The authors also identify a number of feature dependencies and music-making contexts that have high prevalence rates. The findings of Savage et al. raise provocative questions about musical structure, functions, and origins.

Savage et al. (4) failed to find absolute universals or features that were evident in every musical performance in their global sample. Nevertheless, they identify several statistical universals or features with a wide geographic distribution. In the pitch domain, those features include discrete pitches, a limited pitch set (seven or fewer pitches), division of the octave into unequal intervals, and small intervals. In the rhythm domain, these universals include an isochronous beat (i.e., equal timing between beats), two- or three-beat subdivisions (e.g., duple or triple meter), and limited duration values. The division of continua, such as pitch and duration, into discrete elements permits the generation of infinite patterns from finite elements and facilitates pattern recognition and learning (5). An isochronous beat enables predictive timing, which is necessary for synchronized performances.

Savage et al. (4) found that performances occurred primarily in groups that featured male vocalists and instrumental accompaniment (also by males). Group musical activity enhances social cohesion, mediated in part by oxytocin and endorphin release (6). With respect to sex disparities in musical performance, these are a likely consequence of social structure rather than biology (7). Egalitarian participation in music is evident in egalitarian societies, such the BaYaka Pygmies of central Africa (8), who engage in extended bouts of energetic singing (Fig. 1).

The sampling procedure adopted by Savage et al. (4) drastically reduced the possibility of identifying absolute universals. Instead of culture or language group as the unit of analysis, the authors used individual recordings as units of analysis without regard to their importance or frequency of occurrence in the culture of origin. Accordingly, a single instance of music lacking a particular feature (e.g., the voice) would rule out that feature as an absolute universal. The sampling scheme of Savage et al. was motivated by the diversity of music within cultures, but its effect was to reduce the similarities across cultures. The eminent ethnomusicologist Bruno Nettl claims, on the basis of qualitative rather than quantitative analysis, that all societies have vocal music, some music with a regular pulse or meter, and some music with only three or four pitches (9). If Nettl's claims are verifiable in the Savage et al. (4) dataset, then they must be considered

Fig. 1. After singing all night, these young BaYaka mothers continue singing well into the morning. Each sings a different melody to construct the polyphonic song. Indongo, Republic of Congo, 2010. Image courtesy of Jerome Lewis (University College London, London) and MIT Press (8).

Author contributions: S.E.T. wrote the paper.

The author declares no conflict of interest.

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absolute rather than statistical universals. The authors can probe their data for other absolute universals. In addition, the Savage et al. recordings could be categorized by function or use (e.g., lullabies, children's songs, laments, dance songs), and those categories examined for universal features within musical genres. Western adults can distinguish foreign lullabies from comparably slow songs (10), an ability that must be based on common lullaby features across cultures.

The research of Savage et al. (4) is relevant to questions about the biological and cultural origins of music. Because the evolutionary history of music is not readily amenable to scientific study, Honing et al. (11) proposed a research program involving comparative or cross-species study of aspects of musicality. Only humans possess the full suite of abilities that constitutes musicality, but some components may be evident in closely related species, implicating biological precursors, or in distantly related species, implicating convergent evolution. A comparative approach to musicality faces numerous challenges, including the identification of candidate skills for study and credible means of distinguishing biological from cultural contributions to human musicality. Even though Savage et al. (4) focus largely on musical products rather than processes, their universals provide some guidance for comparative investigations.

Discrete pitches, a limited pitch set, small intervals, and an isochronous beat enhance the learnability of patterns for human listeners (5), and they may do so for nonhuman learners as well. Those features may have helped bullfinches cement their reputation as singers of human songs. After long-term exposure to German folk tunes that were whistled, hand-raised bullfinches succeeded in reproducing the pitch and temporal patterns of 25- to 50-note sequences in solo and antiphonal contexts (alternate singing) with their human tutor (12). Moreover, the birds did so in a manner that implied chunking and hierarchical representation of the patterns. Beat perception and synchronization, also thought to be uniquely human, has been demonstrated in parrots (13) and a few other species, albeit with child-like (i.e., imperfect) proficiency.

The music of any era is influenced by cumulative cultural transmission over generations, centuries, or even millennia (5). The process of intergenerational transmission is constrained by limitations of the learner or what is known as the "learner bottleneck" (5). That process can be viewed as a sieve, with only a subset of the melodies heard—for example, those with a small pitch set, small intervals, an isochronous beat, and repeated musical figures—passing from one generation to the next. The result, as borne out by computational and experimental studies of iterated learning (14), is increased regularity and communicative efficiency along with increased tailoring of the input (music in this case) to the processing capacities of learners. Rather than survival of the fittest, the process is more like survival of the simplest, accounting for the convergence of musical features across time and culture. Each generation introduces innovations or embellishments, but those innovations must face the test of intergenerational transmission. The musical materials used by Savage et al. (4) include traditional as well as contemporary recordings. On the basis of intergenerational transmission models (5, 14), one would predict greater evidence of universal features in older than in newer recordings.

The findings of Savage et al. raise provocative questions about musical structure, functions, and origins.

Despite transmission pressures toward structural unity, the music of each culture can remain distinctive by its use of unique pitch values and timbres, different means of blending the contributions of performers, and various ornamental devices involving sound (e.g., imitation of animal vocalizations), body decoration, gesture, and dance (8).

Repetition, a ubiquitous feature of music (15), receives limited attention in the Savage et al. (4) analysis. In contrast to repetition in speech, which is annoying unless it emanates from young children, repetition in music, including repetition with variation, occurs at multiple time scales, contributing to the pleasure, emotional force, and memorability of music (15). It is not surprising, then, that music figures prominently in many cultural rituals (16).

Unquestionably, the most intriguing and most puzzling aspect of music is its attraction for our species. Musical experiences, even in the solitary contexts afforded by current technology, provide pleasure and evoke social imagery. When musical activities involve synchrony or coordination with others, the result is enhanced cooperation in infancy (17), childhood (18), and adulthood (19). Progress in understanding the motivational basis of musical engagement will shed light on the origins of music.

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