

found that selection for more elaborate songs can drive the evolution of the capacity to learn throughout life (Creanza, Fogarty, & Feldman, 2016; Robinson, Snyder, & Creanza, 2019). We propose that this evolutionary paradigm in songbirds – that selection on a learned trait can drive evolution of the brain – provides a possible example of the phenomenon depicted in Savage et al. (Fig. 2, left panel): Musical features can act as an intermediary between social functions and their neurobiological underpinnings.

Savage et al. describe musicality as a “cognitive toolkit.” How might the framing of musicality as a set of tools affect our understanding of its evolution? Our lab modeled the evolution of bird-song features as culturally transmitted functional traits, similar to tools, wherein learners aim to imitate proficient tutors (Hudson & Creanza, 2021). Like other fitness-altering cultural traits, functional signals based on rhythmicity or pitch modulation could have gradually become more complex if learners preferentially choose tutors with complex signals. Over time, the cultural development of functional signals could elevate the minimum cognitive baseline to recognize and reproduce these signals, thereby influencing brain evolution to favor attention to and learning capacity for these acoustic features. In this context, elements of musicality might have been under selection for purposes other than the umbrella explanation of “social bonding.” Savage et al. describe the neural synchronization between auditory and motor brain regions during rhythm perception to explain the origins of dance, but only briefly mention other functions of coordinated behavior. Could rhythmic movement have functioned as a fitness-enhancing tool? Rhythmicity allows for synchronization of actions between individuals and for individuals to accurately predict the actions of others. It is thus conceivable that the development of rhythmicity would have facilitated a large repertoire of coordinated behaviors that could have impacted group survival.

Finally, both target articles discuss the hypothesis that musicality evolved through sexual selection, concluding that it is inadequate to explain the evolution of musicality. However, this hypothesis is framed from an intraspecific mate selection perspective, where females choose males with the most attractive musical displays. Studying the evolution of birdsong and its role in species recognition suggests another perspective: in our evolutionary past, could musicality have served an interspecific function, mediating the interactions between the ancestors of *Homo sapiens* and other hominin lineages? Although musicality appears to be uniquely human among extant species, Mehr et al. conjecture that the basic elements of musicality are ancestral to all primates – just as song is to all songbirds. Did musicality contribute to species recognition when our ancestors formed groups or selected mates, perhaps before the emergence of language? We are unable to know how much musical predisposition we shared with our evolutionary cousins – those we interbred with, and those we didn't. However, considering songbirds as a model system suggests that the evolutionary implications of musicality need not be limited to interactions within our own species.

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## Making music: Let's not be too quick to abandon the byproduct hypothesis

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### Abstract

It is premature to conclude that music is an adaptation. Given the danger of overextending the adaptationist mode of explanation, the default position should be the byproduct hypothesis, and it should take very strong evidence to drag us into the adaptationist camp. As yet, the evidence isn't strong enough – and the proposed adaptationist explanations have a number of unresolved difficulties.

Mehr et al. and Savage et al. have both put forward interesting and very reasonable adaptationist accounts of music – or more precisely, of certain aspects of musicality and musical behavior. I'm more sympathetic to such accounts than I was before. On balance, though, I think it's still premature to conclude that music is an adaptation, and more plausible to think that it's a byproduct. There are three main reasons for this.

First, a lot of the evidence adduced in favor of adaptationist explanations of music is equally amenable to a byproduct explanation. The cross-cultural universality of music is *consistent* with the claim that music is an adaptation – but it's also

consistent with the claim that it's a byproduct of other adaptations that are universal but not music-specific (e.g., emotional responsiveness to the prosody in speech, which cultures might independently "learn" to trigger with melodies). The complex design evident in music *could* come from biological evolution – but it could also come from cumulative cultural evolution; after all, smart phones and bureaucracies exhibit complex design as well, but are clearly not adaptations. Children take to music early and easily – but they also take to iPads and TV; sometimes ease of acquisition is a result of culture evolving for our minds, rather than the other way around. Damage to certain areas of the brain impairs the ability to make or appreciate music – but none of these areas is involved exclusively in music, and it's possible that the areas in question evolved primarily for their non-musical functions (which are presumably also impaired by damage to those areas). Music-like abilities in nonhuman animals show that traits of that kind *can* evolve – but they don't show that they necessarily did evolve in our species, as human culture can sometimes independently discover traits that evolved in other animals: The fact that leaf-cutter ants engage in something akin to agriculture doesn't imply that human agriculture is an adaptation; similarly, the fact that various nonhuman animals produce auditory displays doesn't imply that human *music* is an adaptation. In short, much of the evidence is ambiguous. Given the danger of overextending the adaptationist mode of explanation, the byproduct approach seems like the safer default position in lieu of more decisive evidence.

Second, the byproduct approach has a number of advantages over its adaptationist rivals. Uncontroversial adaptations, such as arms and the basic motivations, are found in all typically developing human beings and are reasonably similar across cultures, subcultures, and historical periods. Music, in contrast, varies greatly from place to place and from time to time, and many people spend little time making or consuming it. These facts are easier to square with a byproduct explanation than an adaptationist one. Even if one argues that certain *core* features of music are found in every culture, it remains the case that plenty of individuals within those cultures devote little time to music, whereas almost every individual has arms and the basic motivations. And even if one argues that, in *traditional* cultures, almost every individual devotes substantial time to music, the fact that many individuals in modern cultures do not is still surprising on an adaptationist account – after all, even in modern cultures, every typically developing human being uses language frequently, and it would be surprising on an adaptationist account of language if this were not the case.

Third and finally, the adaptationist accounts of music proposed in this dual treatment face a number of challenges that byproduct explanations do not. If stronger social bonds are adaptive, as Savage et al. argue, why not select directly for a tendency to bond more strongly, rather than a tendency to make and enjoy rhythmically patterned pitch-sequences and to bond with others who do the same? Regarding Mehr et al.'s account, does it seem plausible that raiding parties would be less inclined to attack a group that kept perfect time than an equivalently fierce group whose rhythms were slightly off, or that such a strategy would be particularly useful? Keeping time isn't important in chimpanzee territorial displays, so the closest animal analogy doesn't support the idea. Is music-making prowess a reliable way to assess a group's potential as allies? People could make beautiful music together but be hopeless at hunting, making tools, or doing anything else that might make an alliance valuable. Why not assess the valuable abilities directly, rather than assessing people's musical chops? If rhythm evolved for territorial signaling, why

aren't men notably more rhythmical than women, given that men have historically done the bulk of the territorial displaying and defense? If melody evolved for infant-directed song, why aren't women notably more melodic than men, given that women have historically done the bulk of the infant care? Although some studies suggest such differences (e.g., Miles, Miranda, & Ullman, 2016), the broader literature is mixed and it's certainly not obvious that the sexes differ much in these domains. Is infant-directed song a reliable signal of commitment in any evolutionarily meaningful way? It "tells" the baby that it has the parent's undivided attention at that particular moment, while the parent is singing the song. However, the fact that it has their attention in a context where it isn't especially costly to the parent doesn't guarantee that the parent will prioritize the baby if and when difficult trade-offs need to be made – for example, if the parent has to choose to invest either in the baby or in one of the baby's siblings. A peacock can't grow a decent tail unless it's in good condition; in contrast, it's easy enough to sing a baby a song then withdraw support later on, if one's circumstances change.

I don't claim that these difficulties are necessarily insurmountable, and I concede that some of the evidence presented in favor of an evolved contribution to human musicality is at the very least suggestive. However, the difficulties do hint that it's premature to accept an adaptationist account at this stage – and if I had to make a bet today, my money would be on the byproduct approach.

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## Pre-hunt charade as the cradle of human musicality

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### Abstract

Human language and human music are both unique communication systems that evolved in the human lineage. Here, I propose that they share the same root, they evolved from an ancestral communication system yet to be described in detail. I suggest that pre-hunt charade was this shared root, which helped organize and coordinate the hunt of early hominins.