



Beading for Beating: Body Percussion and the Interpersonal Origins of Rhythm

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Abstract. Standard models of the origin of rhythmic entrainment in humans posit a mechanism that is asocial and individualist. They argue that humans evolved the sensorimotor ability to synchronize body movements to externally-generated musical beats, but without any consideration for the source of those beats. A better model emphasizes the *interpersonal* origin of rhythm, in which entrainment evolves through mutual mechanisms of social interaction, and in which people are simultaneously the sound-source and the producers of entrainment during joint movements. The mutual model is multisensory, permitting interpersonal coupling through entrainment-cues based on sound, touch, and vision. Regarding sound, an important source of this is people's use of body percussion to aid in beating, especially during locomotor activities. I present ideas about the potential involvement of marine-shell-derived beads in generating percussive sounds for beating, since the use of beads dates back at least 100,000 years in human history. In addition, beads are used extensively by indigenous cultures in modern times in objects like leggings and rattles to generate body percussion during group dancing rituals.

The interpersonal model of the origin of entrainment

The standard model of the origin of rhythmic entrainment in humans is one based on "external" entrainment, in other words the synchronization of body movement to sounds that are generated external to the people who are engaged in the process of entraining. This can be seen quite commonly in everyday life when people dance to music in a discotheque. The beat that the people dance to is generated by musicians, not by the dancers themselves. Therefore, the aim of the dancers is to synchronize their movements to the strong beats in the music's metrical hierarchy. But they themselves have no influence over the beat itself. They can only be followers to the musicians, but never leaders or even co-equals.

We can think about this as an individualist model, since it does not posit any social connection between the dancers and the musicians. An extreme example of this can be found in the “dancing cockatoo” known as Snowball. He has demonstrated a compelling ability to entrain to the strong beats in recordings of pop music (Patel, Iversen, Bregman, & Schulz, 2009; Schachner, Brady, Pepperberg, & Hauser, 2009), for example the songs of the Backstreet Boys. Not only does Snowball have the ability to move parts of his body in synchrony with strong beats in the music, but he possesses a varied choreographic repertoire that engages his body in a diversity of manners, thereby qualifying as a true form of dancing (Jao Keehn, Iversen, Schulz, & Patel, 2019). My undergraduate students find videos of Snowball highly entertaining to watch.

But there is a major problem with the Dancing Cockatoo model of the origins of rhythm. We know that the Backstreet Boys have no place in the evolutionary history of cockatoos. Therefore, we have to ask the following question: who is generating the beat in the wild? Who serves as the role of musicians in the behavioral ecology of cockatoos? To the best of our knowledge, the answer is nobody. And so, Snowball’s impressive dance skills raise more questions than they answer. From a Darwinian perspective, one wonders how an individualist mechanism of entrainment to an unspecified external beat could be evolutionarily advantageous. Perhaps it could serve as a type of aesthetic display for courtship purposes. But this idea conflicts with both intuitive and scientific notions that interpersonal entrainment in humans – whether through group dancing or group chorusing – most likely evolved for the purpose of cooperative social coordination. In other words, it is far more connected with *group* displays than individual displays.

I have argued in detail in Brown (2022) that there are better ways of thinking about the origin of rhythm in humans than the Dancing Cockatoo model of audiomotor entrainment. Such models eschew entrainment to an “external” beat in favor of entrainment to an “internal” beat, in other words to a beat that is generated *by the performers themselves*. I will use the term “mutual” when referring to this type of internal entrainment. The phenomenon of mutual entrainment solves the problem of the external model since it provides insight into where the acoustic entrainment-signal comes from. It posits that this signal comes from the performers themselves as part of their

process of engagement in joint movement activities. An important source of such cues is “body percussion,” which refers to sounds that are generated either by the body itself (e.g., clapping the hands) or through the attachment of sound-generating devices to the body (e.g., shaking a rattle or banging stones together). The coordinated use of such body percussion can create acoustic *beating* for a group of people.

I will explore the phenomenon of body percussion in more detail in the next section. For now, I will simply point out that the mutual model of entrainment – in which joint body movement among two or more individuals serves as both the source-source and the effector for entrainment – provides numerous conceptual advantages over the external model. From a purely sensorimotor standpoint, it provides *three* types of sources of entrainment cues: acoustic (body percussion), haptic (through body contact), and visual, either individually or in combination. Hence, it is a multisensory model, compared to the purely acoustic cuing of the external model. Next, the model places its conceptual focus on the specific evolutionary advantage attributed to entrainment for humans: cooperative action. Compared to the asocial mechanism of the Dancing Cockatoo, the mutual model is intrinsically social. Mutual entrainment is a form of joint action and partnering, one that leads to interpersonal coordination of movement during group rituals. The model is based on joint intentionality and the social motivation of humans to coordinate with one another, leading to socially rewarding emotions. Finally, the mutual model invokes another uniquely human capacity that is never mentioned in connection with the origin of entrainment in the music literature, namely gestural imitation. In many forms of group dancing, individuals perform their movements in unison such that they match one another’s choreographic patterns and timing features, much the way that humans are able to chorus in unison. The mutual model incorporates gestural imitation and time matching into models of entrainment in a way that the external model never does.

Beating through body percussion

As mentioned, the mutual model offers three sensory cues for entrainment: acoustic, haptic, and visual. While all of them can be effective for entrainment, acoustic cues probably offer the best means of creating beating.

They do so through the employment of body percussion. We can think about this happening in two major manners, as shown in Figure 1: body percussion itself and body-attached percussion. Body percussion includes familiar behaviours such as clapping and stomping, but can also involve vocal percussion (e.g., grunts, shouts), as seen in the dances of Māori warriors in New Zealand (Youngerman, 1974). Perhaps more common than these mechanisms are the use of body-attached percussion, such as leggings, percussive attachments to regalia, and the shaking of hand-held percussion instruments such as rattles or the hitting together of stones.

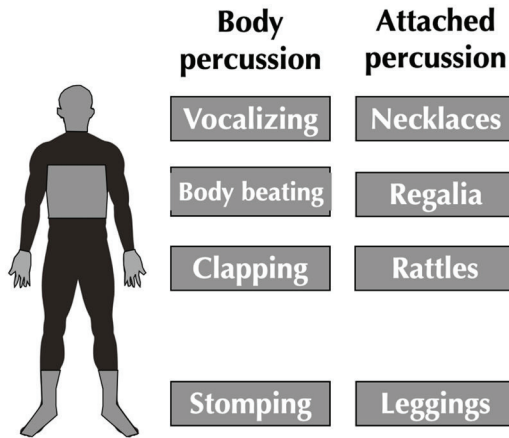


Figure 1. Two major forms of body percussion to generate beating. “Body percussion” refers to percussive sounds generated by the body itself. “Attached percussion” refers to percussive sounds generated by objects attached to the body. The two can work together. For example, stomping a foot while wearing a legging can generate body percussion from both sources.

Larsson (2014) pointed out that locomotion typically creates “audible sounds containing a number of qualitatively dissimilar acoustical events: isolated impulsive signals, sliding sounds, crushing sounds, and complex temporal patterns of overlapping impulsive signals” (p. 4). This idea need not apply to locomotion alone, but can be extended to include any kind of full-body movements that result in contact with the ground, by either standing in place (e.g. jumping, stomping) or moving about. This can be aided by shoes. William McNeill (1995) has discussed the importance of rhythmic entrainment for military drilling. A group of soldiers produces percussive sounds with the stomping sound of their boots when synchronously marching on

the ground. Even non-human animals, such as chimpanzees and gorillas, use body percussion to intimidate rivals and predators, for example through chest beating in gorillas.

Body percussion is mentioned here not just as an ancient feature of an evolutionary model but as a prominent contemporary feature of dance throughout the world, from indigenous cultures to large-scale societies. Dancers attach objects to their bodies or to their regalia that allow them to make sounds as they move. This is seen in the leggings attached to the bodies of dancers in many cultures, the sequins and coins that are attached to the belts and bras of belly dancers, the shoe taps of Flamenco and tap dancers, and the hand-held rattles, shakers and frame drums of native North American dancers and well beyond. This is in addition to the sounds that dancers can generate with their bodies alone through stomping, clapping, and vocalizing.

To cite one example, traditional Aztec dancers in Mexico wear leggings (called *chachayotes*) containing seeds of the ayoyotl tree that make a loud clank with each and every step that they take. Such dance performances are accompanied by people playing large barrel drums with mallets. A dancer wearing *chachayotes* around his/her legs generates an acoustic rhythm in a manner that can be indistinguishable from the rhythm generated by the person beating a drum with a mallet. The dancer's entire body becomes a percussion instrument, and this leads to a true blurring of the distinction between dancers and musicians, as well as that between dance and music. There is a tendency to call the person who plays the drum a "musician" and the person who moves with percussion attached to their body a "dancer," but in many cases the two are producing the identical acoustic rhythms. *Dance and music are simply two different means of creating rhythmic patterns.* In the case of sonorant dances like traditional Aztec dancing, they are in fact the same manner.

What is the function of coordinated group displays that incorporate body percussion? The function is typically described in relation to the dual facets of ingroup cooperation and outgroup competition (Brown, 2000). On the one hand, activities like group dancing and chorusing can create pleasurable feelings of belonging to a group, strengthening the group itself. Synchronous activities such as these create a symbolic feeling of unity for group members (reviewed in Savage et al., 2021). However, cohesion is also a prerequisite for

group defense: people have to cooperate in order to compete. Cooperative group displays not only strengthen a group internally, but amplify external lines of demarcation with other groups, enhancing competitive feelings of ethnocentrism. In addition, I have argued previously (Brown, 2007) that coordinated acoustic displays can produce the illusion of inflated group size, a phenomenon that is known in the animal communication literature as “the Beau Geste effect” (Harrington, 1989).

Jordania (2014) has argued that the driving force for the evolution of group-coordinative behaviors like music and dance had less to do with competing human groups as with predatory animal species via an aposematic function. He proposed that human chorusing evolved as a vocal “mobbing” mechanism against predatory species, itself a precursor to the war cry of inter-group human conflicts. The elements of Jordania’s group-display system include the following features: 1) making sounds together in perfect synchrony and with strong dynamic accents; 2) singing in a low register; 3) chorusing either in octaves, in consonant harmony, or in a dissonant harmony; and 4) incorporating stomping, drumming, and the hitting together of stones, hence body percussion. The latter idea implies that the earliest stone tools might have been used not only for hunting and food processing, but also for noise-making and thus defense against predators. All of these behaviours are accompanied by a psychological transformation that Jordania refers to as the battle trance, in which soldiers “do not feel fear or pain, and where they can disregard their personal safety in the interests of their friends and the common goal” (p. 126). This state creates a psychological readiness for combat, one that is achieved through rhythmic behaviours related to music and dance.

The point of Jordania’s model is that group-coordinative behaviors need not have only group-internal effects, but can have an impact external to the group through group displays, including effects on predatory animal species and competing human groups. Given the fact that the creation of stone tools is a defining feature of our species dating back to around 2.5 million years ago (Stout & Chaminade, 2012), then Jordania’s proposal that the hitting together of stones was used for defensive purposes could potentially be an ancient practice. In fact, he has argued that the defensive use of stones may have predated their use as tools in the conventional sense. Larsson (2015)

discusses the evolutionary significance of tool-use sounds. While his focus is on the origins of language, tool-use sounds could also be used percussively for the purpose of defense.

In such a short essay, I will not have the space to review the myriad examples of body percussion in animals, from chest beating in gorillas (Wright et al., 2021), to “tap dancing” in blue capped cordon blue birds (Ota, Gahr, & Soma, 2015), to branch shaking in many primate species, to buttress drumming in chimpanzees (Arcadi, Robert, & Boesch, 1998). The latter is a long-distance signal in which chimpanzees use their hands to bimanually beat the buttress of a tree. It is typically accompanied by vocal pant hooting by the animal. Fitch (2012) has speculated that this behaviour may be a homologue of hand drumming in humans.

Beading for beating

If one looks at the “attached percussion” column on the right side of Figure 1, one finds something common across the items. Many, if not all, of them are constructed using collections of *beads* as the percussive element to create sounds. Beads are found in necklaces, attachments to regalia, leggings, and hand-hold rattles. This leads us to the topic of marine shells, which are thought to have been used as forms of personal ornamentation and social display for more than 150,000 years in human cultures (Bednarik, 2015; Kuhn & Stiner, 2007; Sehassseh et al., 2021; Steele et al., 2019) and perhaps as much as 500,000 years (Joordens et al., 2015). Tiny shells, for example those of sea snails, were used as beads 75,000 years ago (Henshilwood, et al., 2004). Preferences for certain sizes and shapes of shells are seen in various ancient cultures, for example an affinity for rounded (basket-shaped) shells (Rogers, 2018; Stiner, 2014). Some of these shells were naturally perforated, whereas others show signs of being intentionally perforated by humans. These perforations allowed the shells to be strung together into necklaces (Bar Yosef Mayer et al., 2020). Evidence suggests that such necklaces were hung over clothing as a type of body ornamentation. In many cases, the shells were pigmented with red ochre, whose use for body ornamentation may go back as much as 200,000 years in human history. The archaeologist Ian Watts (2010) argued that the “habitual use of red ochre seems to be a hallmark of the spread of modern humans across the world”. Ochre was used

to pigment not only the human body, but many other types of objects that ancient humans used, including the marine shells used for beading. While we do not understand why ancient people donned necklaces, we can imagine that they served functions related to personal ornamentation, as well as ritual purposes, such as marking the social status of a person.

While the archaeology literature mainly discusses beads in relation to personal ornamentation, I would like to speculate that beads also served a *beating* function in human cultures during group dance rituals, just as they do in modern times. As mentioned in the previous section, dancers in indigenous cultures employ all of the types of body percussion described in Figure 1. I would like to propose that, if beading with marine shells did indeed emerge 150,000 years ago or earlier in human history, such beads could have been attached to the bodies of dancers for the purpose of creating body percussion to aid in beating. I strongly believe that the first percussion instrument of human history was the human body itself. While percussive sounds can be achieved through the use of body parts alone – for example, by stomping the feet on the ground or clapping the hands together – they can also come about by attaching sound-generating objects to the body or by holding hand-held rattles. It is thus quite possible, although completely unverified, that beads from marine shells could have comprised a key component of the body percussion of ancient dance rituals and helped contribute to the rhythmic pulse of group dancing. In other words, *beading could have contributed to beating*, exactly as it does in modern times in many indigenous cultures.

Conclusions

The mutual model of the origins of interpersonal entrainment provides a parsimonious evolutionary narrative since the achievement of mutual entrainment through the use of body percussion allows for sound generation and motor entrainment to co-evolve. To the extent that dance does have a connection with instrumental music, it is far more frequently connected with percussion music than with melodic music, most commonly drumming. The mutual model of entrainment argues that *dancers were the first percussionists* and probably the first percussion instruments as well. According to this view, a distinct class of percussion musicians later evolved by shifting the primordial body-percussion mechanisms – which included objects attached to the leg, held in the hand, or attached to one's clothing, in addition to

body-percussive mechanisms such as clapping and stomping – to individuals dedicated to playing percussion instruments in the absence of dancing, as was described earlier for the arrangement of traditional Aztec dancing. The mutual model argues for a social origin of rhythmic entrainment, rather than the typical individualist perspective. Social interaction becomes both the cause and effect of entrainment. The mutual model offers a multisensory and multi-effector mechanism in which body percussion serves as a mutually-generated acoustic cue for entrainment. I argued that body percussion in ancient humans may have received an important contribution from the use of marine shells to serve as beads that were attached to the body in some form. According to this scenario, beading contributed to beating in rhythmic acts of mutual entrainment through group dancing.

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The Role of Pitch in Choral Singing as an Intraspecific Defense Strategy

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Abstract. It has been proposed that music could have evolved as an aposematic display against predators (Jordania, 2011). By the same token, Hagen and Bryant (2003) have argued that music together with dance could have acted as a credible signal of coalition quality that evolved directly from territorial defense signals. Most recently, Mehr et al. (2021) have suggested that musical rhythm could have served as an extra-group deterrent, but also as an “invitation” to create cooperative alliances with other groups. They have also proposed that pitch could have been used in credible parents-infant signaling. However, as hominins’ choral singing was probably composed of culture-specific pitch variants which had to be acquired by means of strenuous learning within the group, pitch could also have become an important part of acoustic signaling used as an extra-group defense strategy. From this point of view, culturally invented schemes of pitches could have served as the hallmarks of group identity by the means of indicating group size and consolidation. As such, choral singing could have deterred other groups or individual competitors. This idea can extend the scope of hominins’ musical defense strategies as mentioned above. However, while Jordania’s hypothesis is focused on the defense strategy against predation, and Hagen’s view is concentrated mainly on musical rhythm as a source of extra-group signaling, the proposed idea adds to these defense strategies the use of pitch structure as a deterring signal against intra-species competitors.

Introduction

Explaining the evolutionary origin of human musicality, i.e. the set of abilities enabling the recognition and production of music (Fitch, 2015; Honing, 2018), undoubtedly requires pointing to the adaptive value (or values) of music. One of the functions of communication that is often present in nature is deterrence. The deterrence strategy is common in nature because it usually benefits individuals who deter. In many cases, an individual that deters,

even if the deterrence is credible (e.g., as in the case of rattlesnake rattle), reduces the risk of injury or death as a result of an attack by a predator. Deterrence is also used against sexual competitors or conspecifics fighting for other resources such as food or shelter. If a deterring signal is credible, the ability to recognize it appropriately is also adaptive for a deterred individual as it avoids the same risks such as injury or death. This deterrence strategy is called aposematism. Although the category of aposematism is usually referred to visual signals, it may also refer to communication using other senses, such as olfactory (Eisner & Grant, 1981) or auditory (Hristov & Conner, 2005). Since music is a form of sound communication, an aposematic display against predators has been indicated as its possible adaptive function (Jordania, 2011). Aposematic signals can also be directed against conspecifics in case some individuals of the same species compete for certain resources. Following this logic, Hagen and Bryant (2003) have argued that music together with dance could have acted as a credible signal of coalition quality that evolved directly from territorial defense signals. More recently, this idea has been developed by pointing out how different musical features can serve different deterrent functions. Mehr et al. (2021) have suggested that musical rhythm could have served as an extra-group deterrent, but also as an “invitation” to create cooperative alliances with other groups. They have also proposed that pitch could have been used in credible parents-infant signaling. However, as hominins’ choral singing was probably composed of culture-specific pitch variants such as different pitch intervals which had to be acquired by means of strenuous learning within the group, pitch could also have become an important part of acoustic signaling used as an extra-group defense strategy. After all, listening to a well aligned sounds in terms of unknown pitch patterns can be interpreted as signals of long-lasting coalition. Additionally, singing together can be also a good indicator of the number of singing individuals. From this point of view, culturally invented schemes of pitches could have served as the hallmarks of group identity by the means of indicating group size and consolidation. As such, ritualized choral singing could have deterred other groups or individual competitors. The aim of this short paper is to indicate that the use of pitch as extra-group deterrent can extend the scope of hominins’ musical defense strategies as mentioned by Jordania or Hagen and his colleagues. However, while Jordania’s hypothesis

is focused on the defense strategy against predation, and Hagen's view is concentrated mainly on musical rhythm as a source of extra-group signaling, the proposed idea is focused on another defense strategy i.e. the use of pitch structure as a deterring signal against intra-species but extra-group competitors.

Harmonicity of sound, signaling, and aposematism

Sound as a by-product of animals' activity can be a reliable cue of animals' presence, distance, direction of movement, size etc. In contrast to cues, sound signals are the sources of information which are produced intentionally by a sender in order to elicit a response in recipients (Laidre & Johnstone, 2013). The usefulness of sounds with a harmonic structure as carriers of information results from their acoustic properties. The characteristic of each harmonic sound is that the frequencies of its partials are integer multiples of the fundamental frequency. This property of harmonic sounds allows them to be easily distinguished from other sounds present in the environment (Horowitz, 2012). As a result of this, harmonic sounds can be not only an important cue of animals' presence but have also become a frequently used element of intentional communication. In fact, the use of harmonic sounds as signals is a widespread strategy among vertebrates including mammals (Hauser, 1996). Humans also use harmonic sounds in their intentional vocalizations such as laughing, crying, speaking and singing. It has been proposed that harmonic sounds can play the role of both cues and signals in music (Huron, 2015). However, while the adaptive function of pitch in crying, laughter and speech is beyond doubt, its biological function in music is still a matter of dispute. The popular claim that pitch structure processing in music is a by-product of linguistic ability (Lerdahl & Jackendoff, 1983) does not explain the specificity of the experience of musical pitch. In contrast to speech intonation, pitch in music is perceived as a sequence of discrete units, which allows to interpret music in terms of the Humboldt system (Merker, 2002). Therefore, if this musical pitch specificity is the result of natural selection, it must have served some adaptive function. The adaptive functions of music proposed so far include sexual display (Darwin, 1871; Miller, 2000; Ravignani, 2018), strengthening social bonds (Dunbar, 2012; Harvey, 2017; Savage et al., 2021a; Storr, 1992) including mother-infant bonds (Dissanayake, 2001;

Falk, 2004), informing about group cohesion (Hagen & Bryant, 2003; Hagen & Hammerstein, 2009; Mehr et al., 2021), and deterring predators (Jordania, 2011). It is worth emphasizing that the adaptive functions indicated here are not mutually exclusive and could have contributed to a different degree in the selection of various elements of human musicality (Harrison & Seale, 2021; Savage et al., 2021b).

Musical pitch and social bonding

Although rhythm is usually indicated as the most important feature of music, which is responsible for its social consolidation power (Tarr et al., 2014), it seems that pitch may play an equally important role in consolidation by means of music (Wagner & Hoeschele, 2022). This is probably possible thanks to specific properties of pitch structure as a part of music. The use of pitch in music is based on culture-specific rules. These rules govern the organization of pitch at many levels from the musical pitch system to specific melodies. The musical pitch system is acquired in the process of enculturation in a similar way to the acquisition of the mother tongue (McMullen & Saffran, 2004), which makes it a reliable indicator of belonging to a given group. The ability to recognize a culture specific pitch system is based on our sensitivity to tuning i.e. detecting the small deviations from the fundamental frequency of harmonic sounds (F_0) that are parts of a particular musical pitch system. Recognizing that someone is singing out of tune is based on this ability. Nevertheless, people are quite tolerant of intonation when they recognize the structure of intervals that make up a particular melody. It is believed that this tolerance is related to zonal pitch hearing (Rakowski, 1999), which involves treating sounds within a certain frequency range as belonging to one musical pitch pattern (pitch class). Also the knowledge about the distribution of pitch classes in a given musical culture is acquired effortlessly by means of statistical learning (Curtis & Bharucha, 2009). This knowledge is crucial for intuitive recognition of tonal errors in native music by contemporary humans. However, hominins had not been able to learn implicitly the pitch class distribution in conspecific vocalizations before they became musical species. In the previously proposed Baldwinian scenario of music origin, our ancestors had first invented the use of vocalized pitches as the parts of a 'consolidating ritual' (Podlipniak, 2016). In this scenario, the learning of invented vocaliza-

tions by pre-musical hominins was strenuous and time consuming. Under these circumstances, singing a particular sequence of pitches was proof of the effort put into tedious communal learning, which could inspire mutual trust among group members and, in consequence, strengthen social bonds.

Pitch structure as a deterring signal against intra-species competitors

The harmonic sounds of consolidating ritual could have been at the same time a cue of group size and inform about potential danger to conspecifics and other species. Since cues are often transformed by natural selection into signals (Laidre & Johnstone, 2013) the vocalized pitch sequences could have become an intentional aposematic display. While the recognition of the abovementioned differences between pitch distribution in different musical cultures could have helped to check at distance the group consolidation by conspecifics, other species have probably been unable to infer much information about singer's consolidation from musical pitch sequence. However, for hominins forming competing groups listening to a well-coordinated homophonic chorusing could have induce awe and fear. This could have been possible because hominins had been endowed with the ability to recognize pitch sequences. Without the ability to implicitly learn pitch sequences, however, each well-coordinated collective singing of pitch sequences was evidence of many hours spent by a given group learning a particular melody together as part of a consolidation ritual. In this way, behavior whose primary function had been group consolidation could have become a deterring signal against intra-species competitors. It is also probable, that the same selective pressures (recognition of free riders, group consolidation, deterring conspecifics) acted as the reason for the evolution of sensitivity for tuning. The volitional control of f_0 certainly required a lot of effort from hominins, as did the creation and retention of precise patterns of musical pitch intervals in long-term memory. As spectral synchronization, especially synchronization of F_0 , became the hallmark of group identity, a well synchronized (in terms of pitch) singing could have acted as a social glue for in-group members and as a deterrent for out-group individuals. The main source of these different reactions was the difference between musical knowledge of members and non-members of a particular group. Musical knowledge (cognitive patterns)

acquired during long-lasting communal rituals specific to a particular group became an implicit tool for identification “friend-or-foe.”

Conclusions

The proposed adaptive function of musical pitch does not have to be the sole explanation for the emergence of the ability to use and recognize discrete pitch categories. On the contrary, the complexity of human musicality and the fact that pitch perception serves many different communicative functions in humans today suggest that different aspects of these abilities may have evolved due to different functions (Podlipniak, 2022), and that the path leading to their development did not have to resemble a straight unidirectional trajectory. The fact that currently pitch in speech (speech intonation) is not used as a tool for spectral synchronization between simultaneous vocalizations, as is often the case in music, does not necessarily mean that our ancestors’ ability to volitionally control F_0 was solely responsible for one adaptive function that we attribute to speech. However, more research is needed to identify what functions hominins’ use of pitch may have had before the development of human musicality as we know it today.

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