A million years of music
Tomlinson

This book has at least two serious flaws. First of all, it does not talk much about music. A cursory perusal of the Internet produced more information on the history of music and musical instruments. Secondly, it is written in extremely difficult prose.

Looking at it as a novel perspective on human evolution, it is valuable. The musicologist Tomlinson takes exception to almost every expert who has written on the subject and produces some valuable insights.

Accentuating the positive, I am putting my caveats about its shortcomings into the first few comments on this review.

This book would be more popular if it were in English.

The author uses the most recondite vocabulary I have ever encountered in a book written for popular consumption. He seems never to use widely understood English words when there is a sufficiently obscure Latinate, foreign word or neologism to do the job.

brachiomanual gestures are those using arms and hands. Let's say call it that. Communicating like an Italian taxi driver.

dasein also does not appear in Kindle, being a German word favored by the philosopher Heidegger. Simple enough in German: Da means here and sein means being, or to be. The obscurity of using the German surely overwhelms whatever subtlety of meaning Heidigger may lend. My dust-covered unabridged Oxford English dictionary defines it as "in existentialism, especially that of Heidegger and Jaspers, human existence, the being of man in the world."

crudescence does not appear in the Oxford English dictionary that comes with Kindle, in dictionary.com or even the Oxford English dictionary. Recrudescence, obscure enough, means breaking out afresh. The first of three appearances is in this sentence: "In its material crudescence of gesture, the operational sequence represented for him a prosthetic externalization of cognition, anticipating other externalizations— those of all later technologies, or that of memory achieved much later in writing." I assume he means "in the form of gesture."

Tomlinson is presumably writing for graduate students in the areas of linguistics, anthropology, music, evolutionary psychology and the like. I am morally certain that such people have average verbal GRE scores somewhat below 700. They will find him difficult to comprehend. As Richard Feynman, a more gifted intellect than any of us, said, true intellect manifests itself in the ability to communicate difficult ideas as simply as possible.

Just for fun I put a three-page sample through the Flesch-Kinkaid reading level analysis available on the Internet. It scored 27 according to their ranking system, which is as follows:
90-100 : Very Easy
80-89 : Easy
70-79 : Fairly Easy
60-69 : Standard
50-59 : Fairly Difficult
30-49 : Difficult
0-29 : Very Confusing

Tomlinson's biography includes a vast number of authors whom I have reviewed and who have this ability. Among them are Robbins Burling, Steven Pinker, Stephen Jay Gould, Richard Dawkins, Tecumseh Fitch, Noam Chomsky and Charles Darwin. These men were confident that their intellect would be obvious simply through the ideas they communicated.

Though his prose would seem like a Calvin and Hobbes parody of academic writing, Tomlinson obviously has something to say. I am reviewing this book as if he does. Presumptuous as it may be of me to pretend that I understand it.

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Though the subject of the book is music, first half is dedicated to human evolution over the million year period under discussion.

Tomlinson discusses the species of extinct humans. The reader would benefit by a rough timeline such as this:
Homo habilis (2.1 - 1.5 million years BCE) form of Homo erectus
Homo erectus (2 million years BCE)
Homo egaster (1.9 to 1.4 million years BCE); form of erectus
Homo heidelbergensis (800,000 - 120,000 BCE)
Homo neanderthalensis (430,000 - 38,000 BCE)
Homo helmei (260,000 BCE) also homo sapiens or h. heidelbergensis
Denisovans, or homo sapiens denisova (550,000 to 100,000 BCE)Homo sapiens (200,000 BCE to present)

The above timeline incorporates gaps and overlaps, reflecting the lack of agreement among anthropologists and archaeologists about who was related to whom. The broad geographical dispersion and the paucity of fossils necessitates filling in the gaps by intelligent guesswork.

The specialists involved – paleontologists, anthropologists, linguists, evolutionary psychologists and so on – do a remarkable job of inferring capabilities and behavior from the available fossil remains and artifacts.

Tomlinson has a deep familiarity with the experts who have worked in these various disciplines. He finds that each breed of specialist tends to interpret human evolution through the lens of his own specialty. As none of these disciplines can claim Tomlinson, a musicologist, he has the freedom to assess the insights available from each. This book is a comprehensive and useful compilation of such insights.

Linguists point out that language involves a kind of digital signaling, in which words are divided into phonemes, discrete sounds with no intrinsic meaning, only arbitrarily assigned symbolic meanings depending on how they are used in combination. Animal sounds, on the other hand, tend to be analog. The degree of a cat's comfort or discomfort is expressed by the volume of his purr or yowl.

In speaking, however, pitch is analog. It does not carry discrete meaning. A woman may pitch her voice higher when talking sweetly to a baby or angrily to her husband.

Cadence is likewise analog in speech. Different people speak in different cadences, and purposefully speaking slowly may, for instance, give gravity to the utterance.

Tomlinson points out that music has it the other way around. Pitch and cadence are discrete whereas the tonal quality is analog. A note is a note, whether played by a piano or a violin.

Not all qualities of language and music can be forced into this dichotomy. The digital qualities are fairly well defined, but there is a lot of room in the analog space for emotion in both language and music.

Building on this observation, Tomlinson looks into the evolutionary record for characteristics of minds required to produce either music or language. Inasmuch as far more study has been given to language and music, he naturally proceeds mostly from arguments put forth by scientists who have looked into the evolution of language.

Tomlinson points out that our human way of thinking has us asking end-directed questions such as "What is it for?" and "Why did they want to do this?" This is how humans think. We and execute plans we already have in mind. But animals don't plan – they just do. The early part of the book delves into the evolution of a mind capable of planning. There are several key concepts.

Shared attention is important. Two animals being focused on the same object, be it prey, a mate or a stone being worked, represents a major evolutionary jump.

Theory of mind is related. If one animal has a theory of what the other animal is thinking, they can anticipate what the other animal will do.

Cooperation grows out of shared attention and a theory of mind. Humans throughout the million years under consideration became increasingly good at group efforts, such as coordinated hunts for large mammals.

Tomlinson points out that other animals such as chimpanzees and wolves also hunt in groups. Their hunting differs in that it is basically each individual seeking his own immediate self-interest. They do not differentiate roles to be taken in the hunt, nor is there any protocol for sharing the spoils. These forms of behavior require the kind of future-orientation that is generally beyond the intellectual capability of nonhuman animals.

The material culture of the hominids under discussion included stones and fire – these leave the most easily found traces – and sticks, skins, and other less durable organic artifacts. Tomlinson devotes a lot of attention to stones.

Humanoids first started intentionally breaking stones to use as tools about 2.6 million years ago. They would break a few chips off in order to get a sharp edge.

Acheulean stone tools, used from 1.7 million years ago up until the dawn of agriculture, involved more chipping and demonstrated a characteristic bilateral symmetry. Though they improved slowly through the eons, what is most remarkable is their stasis – the fact that the same designs remained in use for so long. Tomlinson infers a great deal about the mental state of prehistoric humanoids from these tools.

We moderns would wrongly assume that a hominid would go about making stone tools the way we would. He would
(1) decide that he needed a tool, then
(2) choose the stone to make the tool, then
(3) make the tool, then
(4) keep the tool until he needed it.

Tomlinson would call this sequence by the term, operative chain, or Chaîne opératoire, coined by Frenchman Leroi-Gourhan in the nineteen sixties. However, he contends that the sequence described above involves considerably more abstraction, thinking-at-a-distance than those hominids were capable of. Their sequence might be:
(1) kill something edible,
(2) discover they need to cut it up,
(3) scout around for a rock to cut it,
(4) chip the rock to make it sharper, if necessary,
(5) butcher the animal,
(6) eat the animal and
(7) throw the rock away.

This operative chain does not involve planning. It does involve mimetic learning – one hominid observing another to learn how to sharpen rocks.

Tomlinson attributes the fact that the sharpened stones displayed bilateral symmetry to

cultural rather than aesthetic factors. They didn't plan it that way – they just did it that way.

Archaeologists note that the distance between where the rocks came from and where they were used tended to grow over the million years in question. This indicates an increase in (1) planning ahead and (2) trade.

Trade is a somewhat advanced form of cooperation – cooperation between groups.

The earlier Paleolithic technologies were evidence of a degree of cooperation within the group of hunter gatherers. It took some level of coordination to hunt large mammals. Though Tomlinson does not go into it, today's Stone Age people are a model of how it is done. When the Kayapó Indians locate a herd of peccary, one or two Indians will remain in place while the rest circle around downwind and set up an ambush hiding behind trees. When all is in place, the first couple will stampede the peccary, who follow game trails past the trees to where the others kill them with clubs.

This kind of cooperative behavior was obviously required to drive mammoths into box canyon and kill zones or over cliffs. Such cooperation requires shared attention – focus on the prey – and a theory of mind – what the others are thinking.

This cooperation also required trust and some deferred gratification. Rather than setting up on the carcass and pushing one another aside to devour it raw, some members of the group would occupy themselves sharpening stones, others perhaps dismembering the kill and carrying it away, and yet others preparing a cooking fire and watching the children. By working together all would eat, and eat better, than if it were every man for himself. Or, as Leroi-Gourhan would have had it, sauve qui peut.

Tomlinson and all the experts he cites concur that this was done without symbolic language as we know it. The hominids would have communicated by sound and gesture. Increased levels of cooperation would have increased the amount of information to be conveyed, leading to refinements in sound production and gesture.

Evolution must be seen as a continual process, with each intermediate step providing some benefit. Qualitative rather than quantitative changes, such as the advent of theory of mind or the switch from analog-to-digital and speech and music, demand explanation.

Theory of mind – one mind perceiving what is going on another – may have been presaged by the discovery of mirror neurons in monkeys. Researchers in the nineties noticed that one monkey observing another monkey performing an action triggered the

same neurons as would've been activated had the monkey himself performed the action. One mind is able to appreciate what the other is doing.

Thus, for instance, one hominid could picture what another was thinking in forming a stone tool or butchering some prey.

Here we come up against another of Tomlinson's frequently used words – diectic. It means situational. Over the million years in question, hominids became less focused on their immediate context and better able to generalize and anticipate. Instead of sharpening stones for this kill, they might carry around sharpened stones anticipating a kill. Instead of cooperating this time, they would anticipate ongoing cooperation. Thus, their actions and cooperation would be less and less ad hoc and more and more planned.

Practice and training are uniquely human traits. Humans practice throwing stones and spears. Leopards don't practice ambushing antelope – they just do it. Practice entails thinking at a distance, envisioning a scenario that is not immediately at hand.

As an aside, one thing missing from Tomlinson's work is an analysis of early childhood. Darwin himself said that ontology recapitulates phylogeny. The development of the individual echoes the evolutionary past of the species. Sarah Blaffer Hardy, Judith Rich Harris and certainly Jean Piaget have observations worth investigating.

In the chapter on the Neanderthals, Tomlinson notes the parallels in the development of the Neanderthals and Homo sapiens. Whether they were distinct species are not, their intellectual and cultural development paralleled each other and increasing sophistication.

He focuses on the Lavallier stone production by both groups in the period around three hundred thousand years ago. Chipping stones that proceeded from a haphazard, at approximately two one that was clearly preplanned and systematically undertaken.

The raw materials, workable stones, were transported over longer and longer distances. This implies purpose, preplanning. It may as well imply treat among groups.

The manufacturing process went by steps. The first was to knock edges off of a smooth stone to achieve the right outline. Knocking off the sides resulted in a regularly shaped core.

At that point the direction of the blows, and quite likely the instruments used to make

them, changed to sidewise. The craftsman chipped off long thin bits in order to make a bilaterally symmetric sharp edged object.

The third step of manufacture appears to be one very well placed and powerful stroke to knock off a large flat sheet of stone, convex on one side from the long thin chips having been removed, and flat on the other.

Tomlinson notes by this technique a number of useful tools might be struck from the same stone. Robust choppers from the core, and sharp scrapers from the chips.

And now finally to music.

The Lavallier stone production described above represents nested hierarchies of operations. The first hierarchy is to produce the core, ship it into a convex shape, and break off a flat blade. Within each step of this hierarchy one can imagine crafting and shaping stones to use as fulcrums, supports and hammers; separate strokes for small and big chips; processes to further refine useful flakes produced by the chipping process.

Tomlinson uses the terms compositional and combinatorial; creating new elements and creating novel combinations of known elements.

Music also involves nested hierarchies. There are hierarchies of rhythm. Tomlinson doesn't name them so I will take a stab: the whole composition, stanzas, lines, measures and notes. These nested hierarchies will include repeating metrical elements.

The notes themselves follow hierarchies. There are the regularities of the total distances, octaves and fractions of octaves. There are overtones or harmonics, and predictable musical chords.

He returns frequently to the theme of tension and relaxation, upbeat and downbeat in music. I assume this will lead to the notion of resolution – giving a sense of completion to a piece of music. Anticipating a resolution, or a relaxation implies expectations for the future. Future orientation, we have learned in the past few chapters, is a hallmark of a more evolved mind.

However far my characterization of music may be from the mark, one can see that the human animal was creating increasingly complex structures in his material environments. It is reasonable to assume, and there is evidence to support the hypothesis that he was doing so in the mental realm as well.

Tomlinson suggested shift from analog-to-digital. The elements are arranged in the stone tool making hierarchy were essentially digital – discrete operations being combined – rather than an analog process of simply striking with more force or from a somewhat different angle.

There was evidently an increasing level of cooperation among hominids during this proto-linguistic period. Though they did not possess language, there was more and more information to share, more activity to be coordinated. It obviously would've favored the evolution of more efficient modes of communication. This would have meant the discrete/digital/symbolic mode, and it would have applied equally to music as language.

Early on Tomlinson writes about entrainment the ability of one organism to put itself in sync with another organism. Picking up rhythm is an obvious form of entrainment. However, before the advent of music we were learning behaviors such as manipulating our material environment – sticks and rocks – by observing each other. Conversation is another form of entrainment, having its own rhythm and expectations of alternation between listening and speaking.

"music may be described in the broadest sense as organized acoustic informational flows not in themselves symbolic but always constrained by the surrounding operation of symbols."

Tomlinson writes about increasing levels of organization, iconography, indexation and symbolism. Each case is a relationship: the original and the abstraction. Importantly, each of the three requires a third party to perceive the relationship for to be meaningful at all.

In language there are increasing levels of structure. Words are clearly symbols, abstract representations of concrete realities. They are hierarchically organized, subject to rules of grammar per Noam Chomsky.

And now the question of music. A musical tone is not a symbol. Music is not built of signs and symbols, yet it has structure, hierarchies of increasing complexity even though there is no meaning. It symbolizes nothing.

A recurring theme is that human evolutionary progress was offloaded from our genome into our culture. Progress no longer depended on changing genetics, and was therefore speeded up. In the process, human communications became freer, with our gesture calls no longer controlled genetically.

A similar thing happened in music. With the link between our verbal expressions and our genome weakened, we could leave it to culture to broaden the repertoire of musical noises we created.

Pitch is fundamental to music. The fundamental of a scale is more commonly a relative rather than absolute frequency. Once established, the relationship of the other notes falls in place.

The octave – doubling the frequency – appears to be universal. Subdivision of octaves into scales may differ from culture to culture, but it is systematic and quite universal.

Evolutionarily, the offloading of sound production from genetic control to cultural control made humans free to innovate with sound. We discovered that we liked intervals at which the harmonics make us comfortable: the musical fifth (3:2), fourth (4:3) and major third (5:4).

Though Tomlinson does not mention it, Robbins Burling, one of the authors he favors, deals with the chicken and egg problem. What came first? The ability to understand speech, or the ability to produce it? He makes a strong case for the former. Tomlinson might also ask whether the ability to perceive subtle differences in musical tone, preceded the ability to produce them.

Tomlinson notes that whereas in language, symbolic meaning became stronger as the symbols became more abstract, the opposite is true with music. Whatever indexical meanings tones may have had as animal calls were abstracted away during the development of music. Notes now carry no meaning.

Music and language evolved independently, simultaneously, and alongside humanoids' increasing ability to work with stones and other materials. All these cases entail nested hierarchies of discrete, repetitive steps. A general mental capacity for handling abstractions was applied to language, music, and our social and material existence.

Chapter 6 covers the period of 100,000 to 20,000 years ago.
The Pleistocene has generally been fairly cool, with some interspersed warm periods.

The major Homo sapiens migration out of Africa seems to have been 50 to 60,000 years ago. However, there is ample evidence that the earlier migration that were either pushed back by the others – Neanderthals – or ended up with some interbreeding.

There is evidence of the population bottleneck about 70,000 years ago, with only a few thousand breeding pairs of Homo sapiens. A warm period followed and there may have been may have been population pressure forcing our ancestors northward through the Levant.

It is agreed that innovation takes place in larger hominid groups. As the bands grew the number eighty people or so, they were more brains at work with innovation and a greater tendency to abandon innovations that didn't work. More people also meant more contacts with other human groups. All of this accelerated cultural development.

The archaeological record success that Homo sapiens invaded Europe several times in the last 50,000 years only to be pushed back by adverse climate changes. Heinrich events, the breaking off of huge icebergs from the Laurentide ice sheet in what is now Canada, could result in decades of frigid weather.

Rather than a picture of continuous improvement in the civilization of Homo sapiens in Europe, we see a seesaw of advance and retreat, with new populations largely replacing the ones that were decimated by cold weather. Only in the last cold spell, about 20,000 years ago, did the same population seem to stick it out and survive.

Tomlinson writes that "The epicyclic mechanism is missing from the models of climate, ecosystem, and human demography discussed above. In these, cultural innovations and their accumulation function as no more than additional elements within the networks of feedback. The independent, external action of systematized cultural archives is not taken into account."

He makes the extremely valid point that human society, almost uniquely, evolves on the basis of its accumulated knowledge. The new directions taken by our culture reflect not only our genetic makeup but our cultural inheritance.

He downplays the genetic part of co-evolution. He would like to say that genetic diversity among Homo sapiens is decreasing as various branches merge and interbreed. For this he does not give much evidence. Moreover, he goes out of his way not to acknowledge the differentiation that evolution has brought to the human genome. North Asians are different. Moreover, they are smarter than other human populations, an observation that this reviewer suspects Tomlinson would be extremely loath to admit.

Tomlinson repeatedly makes the point that as intelligent as we are, we have a tendency to independently reinvent things. He gives agriculture as a case in point. It was a good idea that sprang up independently in the Levant, China and Mexico. Other authors

would add New Guinea and the Andean Highlands. He sees progress as a seesaw. Two steps forward, one step backward when the ice makes you retreat; two innovations, one forgotten only to be reinvented later by others.

He writes "The epicycles help to explain another basic feature of late hominin evolution, which I mentioned earlier: the widening distance between genetic capacity and phenotypic behavior." He correctly notes that we did not do all of the things that our intellect would allow us to do. On the other hand, he seems to refuse to notice that our genetic capacity has expanded to support new forms of behavior.

The evolutionary psychologists whom he disparages write that colder climates forced human groups to invent clothes, shelters, and advanced group hunting strategies that were not necessary and Africa. After the dawn of agriculture the changes people themselves made to their niches favored rapidly growing intelligence. They needed to master agriculture, the accounting for stored wealth, command and control over increasingly large political entities, commerce with strangers and a host of other skills. The people who were forced to do this got smarter. And it was not everybody. The human genome diverged.

Though Tomlinson repeatedly rejects a Eurocentric account of the Neolithic Revolution, the sites that he refers to are mostly in Europe: Pyrenees, South France, the Danube Valley. He postulates that similar developments were taking place elsewhere but the archaeological evidence simply has yet to be found.

Tomlinson does not cite authors such as Luigi Cavalli Sforza and Spencer Wells who offer detailed maps of human expansion out of Africa. They put the split between North Asians and Europeans in the timeframe of 40,000 to 30,000 years ago. That is to say, that Europeans and Asians at that point in time were pretty much of a single gene pool, one which was already about 20,000 years distant from their African cousins.

Certainly a rapidly evolving culture was vastly important in transmitting technology and social behavior. However, it was supported by an equally rapidly evolving genome, one which led among other things to measurably larger brain cases among the North Asians and Europeans.

We come to the first evidence of music only in the last 10% of this book purportedly on music. Ancient flutes or recorders have been found in European caves, dating as far back as perhaps 43,000 years. Some were made from long, hollow wing bones of big birds such as swans, others from hollowed out mammoth tasks.

It is probable that many other forms of instruments were made from more perishable materials such as bamboo. As a child I made trumpets from kelp found on the beach; they could certainly have done the same. Nonetheless, the European artifacts are all that remain.

Surprisingly absent from the account are other forms of instruments. Why not drums? Horns, like the Hebrew shofar, made from animal horns? Why is there no mention whatsoever of singing? If they did not appear in the archaeological record, this very absence would seem worthy of note.

In the matter of pitch, that is, musical notes, it as much as his account ends at 20,000 years ago there no mention of how tonal music is distributed in today's world. In the Orient there is pentatonic music. In the West the Greeks had a seven note scale which has been superseded by a twelve tone scale. The tribal chants of Africa and Native Americans seem to this nonmusical reviewer not to be tonal in the same sense. Whatever convergent evolution Tomlinson may have seen prior to civilization seems in part to have reversed itself.

Pitch discrimination has been recognized as an aspect of general intelligence since Spearman pioneered intelligence testing a century ago. It is no coincidence that the countries that Lynn and Vanhanen find to be the most intelligent on average also have the most elaborate musical traditions, as shown by the number of musical instruments they have innovated, the complexity of musical chord combinations and so on.

There are strung instruments, horns and flutes throughout Eurasia. In Africa there were little more than drums. American Indians had wind instruments, panpipes and flutes such as the quena of the Andes.

The element of music that is most widespread, rhythm, has not been found to have any strong correlation to intelligence. Rhythm, or entrainment as Tomlinson would have it, has been part of the hominid toolkit for the best part of the past million years.

There is mention in the book of drumming but no evidence mentioned of archaic drums or any other percussion. He uses the word embouchure, or mouth placement, a term relevant for wind and brass instruments but never mentions trumpets, shofars, or any wind instrument other than the pipes found in caves. No hint of reed instruments. No hint of pitched percussion instruments such as cymbals or bells.

The Internet, on the other hand, provides pictures of percussion instruments 167,000 years old, drums 30,000 years old, pan pipes 30,000 years old, a bull-roarer 17,000

years old. Along with, of course, the pipes that Tomlinson mentions.

Bull roarer – Ukraine
Pan pipes – Canada
Quena – Andes

I surmise – and I am sure Tomlinson knows better than I, and I wish it were in the book – that musical instruments spread throughout the world following the same paths of expansion as human populations.

The evidence we see is that percussion instruments such as drums are universal. They are probably the most archaic.

Pitched instruments may have originated in the caves of Europe. And, as Tomlinson suggests, they may have been invented independently several times.

Simple pitched instruments, such as flutes and pan pipes, appear to have spread throughout Europe. They may have spread to the Americas across the Bering Strait, or instruments such as the pan pipes found in Canada and the quena of the Andes may have been invented independently.

More complex wind instruments, such as reed instruments and bugle/trumpets, seem to be confined to Europe. They are probably later developments.

Stringed instruments appear to be confined to Eurasia. Tomlinson – please tell me I'm wrong.

Pitched percussion instruments such as bells and cymbals can be made of shells, but metal seems to be the better material. They would probably date, therefore, from the Bronze Age or so.

This is all conjecture by a nonmusician. Tomlinson would surely tell me I'm wrong. The challenge is to inform his readership what is right.

Though Tomlinson uses the term epic cycle 135 times in the book, its meaning remains unclear to me. An Internet search reveals that only one author tends to use the term – Tomlinson himself. His journal articles do not further elucidate the matter. This is what he says: "For now, we may think of these systems as networks of conditions

redirecting in certain ways the basic feedback loops of niche construction. Their dynamics can provide not merely additional strands in those loops but other external circuits outside them, sprouting like Ptolemaic epicycles from the cycles of cultural transmission and accumulated archives. These, then, can stand alongside the coevolutionary feedback cycles, feeding forward into them and altering their give-and-take. The effect of such epicyclic dynamics is not a neo-Lamarckian one in which learned behavior is assimilated as such into the genome; instead they generate complex, novel interrelations in the coevolution of organism and niche."