

The Sounds of Ancient Music

The songs of the world's first musical instruments would sound familiar to us.

When governess Maria von Trapp children a singing lesson in the Rogers and Hammerstein musical *The Sound of Music* (1959), she begins by laying out a pattern of seven notes and the intervals between them—"Do, a deer" and so on. She is using the diatonic, or heptatonic, seven-tone, scale. The rest of the song sets up a chord structure—so called "thirds"—that are integral to the long tradition of Western music. Later in the musical, the liturgical music of the convent is in the pentatonic scale, which contains five notes that can be played in major and minor variations, as well as other tonal "modes." The pentatonic scale is older than the heptatonic scale and is foundational to not only Western European music but is found in the earliest music of China, Japan, south Asia, sub-Saharan Africa, and in the music of the indigenous peoples of the Americas. The heptatonic scale differs from the pentatonic scale by adding two notes, typically the fourth and seventh above the "key note." These additional notes can create slight dissonances, but they are useful in creating chords that seem somewhat unresolved or unfinished, which are then resolved by a return to



AP PHOTO/DANIEL MAURER

"Purportedly the oldest handcrafted musical instrument, this approximately 35,000-year-old bird-bone flute was found in fragments in a cave in southern Germany in 2008 and reassembled by a team of archeologist at the Eberhard Karl University of Tübingen

the fundamental or "tonic" chord built on the key note.

In Hohle Fels Cave in southern Germany, about 300 kilometers northwest of the Austrian home of the von Trapps, archaeologist Nicholas Conard and colleagues at the Eberhard Karl University of Tübingen uncovered in 2008 the world's earliest known handcrafted musical instruments, including a flute made from the wing bone of a griffon vulture (*Gyps fulvus*). Pieces of the flute, which the team assembled, were scattered about a small plot. It had been polished and carefully carved with five holes which allow its user to play the notes of a pentatonic scale. There were several

other flutes found in the Swabian Alps of southwest Germany, all dating to between 35,000 and 43,000 years ago. This puts their human creators in the midst of the last long ice age, although there was an interval of warmer temperatures in Europe about the time these sites were occupied.

And in these caves of Europe 40,000 years ago, people were playing musical instruments. It is remarkable that the earliest flutes were tuned to a pentatonic scale, because this five-note scale is found nearly everywhere, on every continent, and in every time for which scholars can recreate early music from people's instruments or writing. In a series of lectures at Harvard University in 1973, Leonard Bernstein (1918–1990), musical conductor of the New York

Philharmonic Orchestra, opined: "[T]he universality of this scale is so well known that I'm sure you could give me examples of it from all corners of the Earth, as from Scotland, or from China, or from Africa, and from American Indian cultures, from East Indian cultures, from Central and South America, Australia, Finland ...now, that is a true musico-linguistic universal."

Almost all long-lived musical traditions have pentatonic scales at their base, but clearly all of the world's music does not sound the same or use the same basic chord structure. Different cultures or musical styles place emphasis on different

ratios between the frequencies of notes. Other traditions, such as the one that became popular during the European Renaissance, use notes that are not to be found in the seven tones of the heptatonic (seven-note) scale (or twelve, counting sharps and flats). The range of audible frequencies that fall between a pitch and the octave above, or below it, is infinite, but in the music of most Western cultures humans have divided that range up in consistent ways, usually making use of the “natural” harmonies of the pentatonic scale.

Contrary to structures in this Western paradigm is traditional Arabic music, whose melodic design is based on various “maqams.” Each maqam contains seven notes that are frequently unique to that form. A maqam primarily employs notes whose pitches are microtonally adjusted. The intervals that result may sound “out of tune” to western ears, and yet they are intentional. The centuries-long practice of music-making in Arabic culture is melodic rather than chordal so the use of overtones as part of the underlying harmonic structure of music is not applicable.

But why do chords elicit such a range of emotional response—from sad, to calm, to energized, to even combative and militarized? It has to do in part with how our brains process sound, and particularly the ratios between two sounds. The ratio of a tone and an octave above it is 1:2. The ratio of a perfect fifth is 2:3. For a major third it is 4:5, and a minor third is 5:6. All of those ratios are said to be “consonant,” and all sound pleasing to the western ear. Some ratios are more discordant, such as a minor second (15:16).

Such an interval sounds tense and unsettled. The two tones of this minor second ratio, played again and again in the musical composition by John Williams in the 1975 film *Jaws*, makes audiences feel apprehensive, fearful. Neuroscientists have recently found that consonant pairs of tones have a higher “syn-



Portrait (ca. 1845) by Kuniyoshi, Utagawa (1797-1861) of the fictional hero Goshaku Somegoro playing the shakuhachi, a bamboo flute developed in Japan in the sixteenth century, and derived from the xiao, an ancient end-blown bamboo flute from China

aptic weight” than dissonant pairs, meaning they have a greater impact on the neural network of which they are a part. The correlation of synaptic weights and level of consonance is high. Neuroscience confirms what ancient Greek theorists, such as Pythagoras (ca. 570–ca. 490 BCE) and his followers worked out, based on

what sounded best to them. There are those, however, who believe the concepts of consonance and dissonance may be as much cultural as neurologic. Western listeners will perceive a minor second (e.g., C–D \flat) played simultaneously or a major second (C–D natural) played in the same manner as dissonant intervals,



Governess Maria (Julie Andrews) giving the von Trapp children a music lesson in the 1965 Robert Wise film musical, *The Sound of Music*

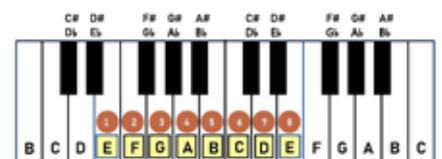
but if one hears a constant repetition of the former for a minute or two, resolution to the latter will often be identified as consonant.

In creating any interval, it makes no difference what tone you start on. Human hearing at birth can differentiate sounds from about 20 to 20,000 hertz (Hz) or vibrations per second, although this range continues to diminish throughout life. A child can sing a song they know, say, “twinkle, twinkle, little star,” starting on any of the limitless tones in their vocal range. The interval between the notes is what matters, not the pitch of the beginning tone itself. During the Baroque Era from the seventeenth to mid eighteenth centuries, there was no standard reference point for tuning notes. It ranged from around A-415 (415 vibrations per second for A above “middle C”) up to as high as 466Hz. Instruments tuned to A-415 sounded approximately a half step (minor 2nd) lower than modern instruments playing the same music. Many modern orchestras in the United States currently tune to A-440. The specific frequency chosen is decided upon by each ensemble. Rather than adhere to the standard of A-440, some orchestras in the U. S. tune to A-442. While two vibrations per second may seem

undetected, it is easily discernable to musicians. European orchestras often prefer 443 or even higher. The reasons for preferring a higher tuning pitch are many, but in general the tonal color of the ensemble is brighter. Regardless of the specific frequency chosen for A, the music played will have the same structure and harmonies.

When ethnomusicologists began studying the world’s musical traditions, they found other things that were striking. One of the scales widely used in Greek traditional music—the Phrygian mode—is nearly identical to a scale

Phrygian Mode



The phrygian mode, as with the C major scale, contains no sharp or flat notes (no black keys on the piano) but starts with the third note of the C major scale.

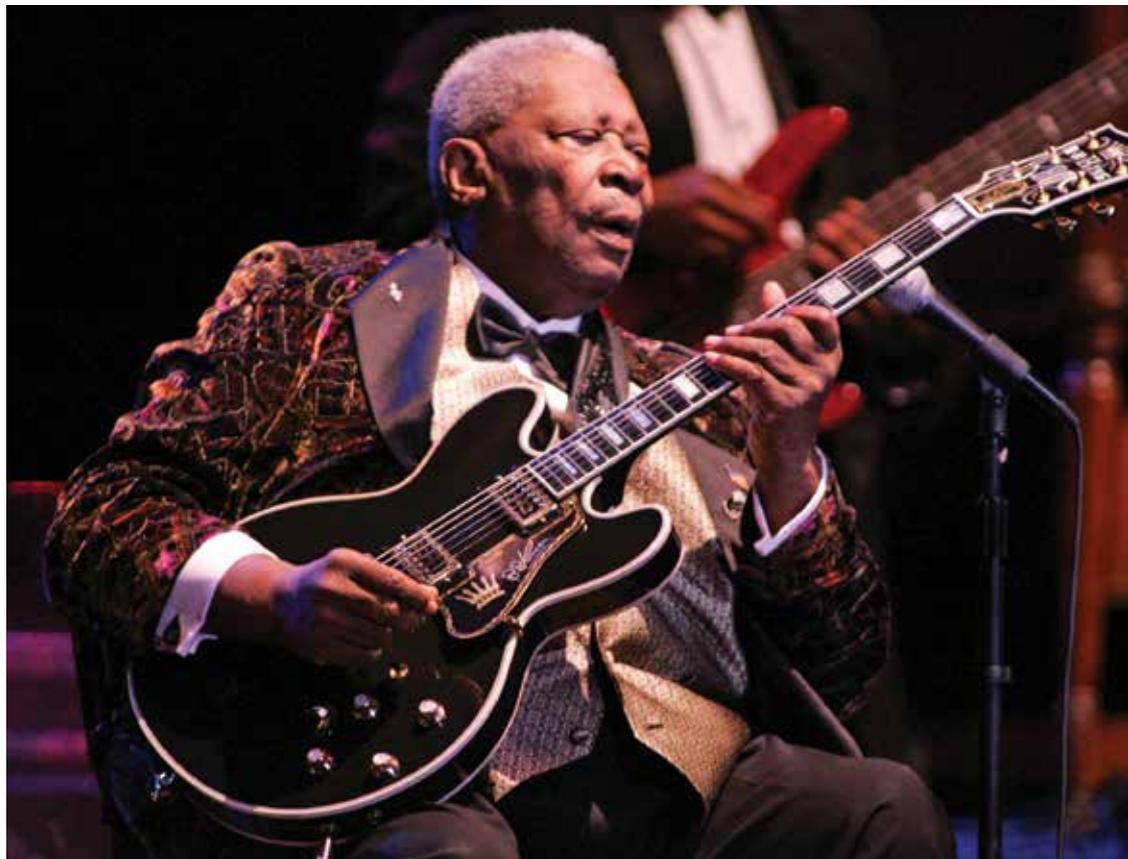


Musical theorist Guido de Arrezzo (991-1033 CE), who helped standardize Western musical notation, is shown here demonstrating a “monochord,” a single-stringed device used to show how changing the length of a vibrating string changes its pitch

widely used in Japanese music, the *In* scale. The *In* scale contains several altered intervals, giving Japanese music a very distinctive sound to Western ears, yet it mirrors one known in Greek music from 2,500 years ago. It is heard in other musical traditions, including the Gunakri music of Hindustan and the Carnatic music of south India. It is also very close to a scale used in highland Andean flute music.

Do these traditions share a common ancestor? Possibly, because we are all related members of a relatively recent branch of human evolution. However, music scholars doubt it. More likely it is because of the utility of certain kinds of scales in making music.

A pentatonic scale's five notes contain no dissonant notes, so staying within the pentatonic scale allows overlapping chords and scales that work well together. This compatibility makes the scale great for improvisation. A fine example is the melody of "Amazing Grace," built entirely on a pentatonic scale. Yet another good example is blues music, and the jazz styles that came out of it. The "blues scale" is a pentatonic scale with one additional microtonally flattened note, a "blue" note. usually the third or seventh tone above the first note of an ascending normal diatonic, 7-note scale (e.g., CDEFGAb). A blue note cannot be played accurately on a piano due to its microtonal nature, although it is often implied by playing the two closest pitches to it. It can be played on a guitar, bass, harmonica, or other instruments by "bending" or modulating another note to find that particular resonance. As singer-song writer Marvin Gaye (1939–1984) once said, "There's got to be other notes some place, in some dimension, between the



MICHAEL BUSH / DREAMSTIME

Noted musician, singer, songwriter B. B. King in 2010 playing the blues, a genre of music that uses semi-tone "blue notes" not found on a traditional Western diatonic scale but is common in West African music

cracks on the piano keys." That kind of blue note, not found in a traditional Western diatonic scale, is common in West African musical styles and among traditional Arabic music. The tradition came to the Americas, but the exact African linkage was lost during centuries of slavery. Its influence, however, can be heard in the blues, jazz, rhythm and blues, and rock and roll that evolved.

Musical expression is constantly changing, with each generation bringing its own creativity to the enterprise. Perhaps, every older generation laments the changes made by the younger ones, even back to cave-dwelling times. But some aspects of music are remarkably conservative and slow to change. When Maria taught the von Trapp children the "Do-Re-Mi" scale she was using a method for teaching singers from nearly one thousand years earlier. In the early eleventh century, Italian musical theorist Guido d'Arrezzo (ca. 990–1050) helped standardize the staff, clefs, and notation of Western musical transcription, which

allowed people to record and easily teach songs. He developed an instruction method that referred to a Latin hymn, "Hymn to St. John the Baptist." He used the first sound from each line of the song to represent a particular note: "**U**t queant laxīs, **R**esonāre fibrīs, **M**īra gestōrum, and so on to have the series *ut, re, mi, fa, sol, and la*. In the seventeenth century, Italian musical theorist Giovanni Battista Doni (1594–1647) changed the "ut" to "do" in the musical system called "solfège" in French (a word made from the "so" and "fa" of the scale).

The person who made and played that flute 40,000 years before could have accompanied the von Trapp children on his or her instrument, and might have appreciated the song's melody and satisfying harmonies.

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