We Got Rhythm; the Mystery Is How and Why

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In lovers' songs, military marches, weddings and funerals - every occasion where a degree of emotion needs to be evoked - music is an indispensable ingredient. Yet the ability to enjoy music has long puzzled biologists because it does nothing evident to help survival. Why, therefore, should evolution have built into the human brain this soul-stirring source of pleasure? Man's faculties for enjoying and producing music, Darwin wrote, "must be ranked among the most mysterious with which he is endowed."

Music is still a mystery, a tangle of culture and built-in skills that researchers are trying to tease apart. No one really knows why music is found in all cultures, why most known systems of music are based on the octave, why some people have absolute pitch and whether the brain handles music with special neural circuits or with ones developed for other purposes. Recent research, however, has produced a number of theories about the brain and music.

It could be that the brain perceives music with the same circuits it uses to hear and analyze human speech, and that it thrills to its cadences with centers designed to mediate other kinds of pleasure. Dr. Anne Blood and Dr. Robert J. Zatorre, of the Montreal Neurological Institute, recently took PET scans of musicians' brains while they listened to self-selected pieces of music that gave them "chills" of euphoria. The works included Rachmaninoff's Piano Concerto No. 3 and Barber's Adagio for Strings. The music, the researchers reported, activated similar neural systems of reward and emotion as those stimulated by food, sex and addictive drugs.

If music depends on neural circuits developed for other reasons, then it is just a happy accident, regardless of evolution, that people enjoy it. This is the position taken by Dr. Steven Pinker, a psychologist at Harvard University. Music, he writes in his 1997 book "How the Mind Works," is "auditory cheesecake" - it just happens to tickle several important parts of the brain in a highly pleasurable way, as cheesecake tickles the palate. These include the language ability (with which music overlaps in several ways); the auditory cortex; the system that responds to the emotional signals in a human voice crying or cooing; and the motor control system that injects rhythm into the muscles when walking or dancing.

That music can activate all these powerful systems at once is the reason it packs such a mental oomph, in Dr. Pinker's analysis. But since each of these systems evolved for independent reasons, music itself is no more an evolutionary adaptation than is the ability to like dessert, which arises from intense stimulation of the taste buds responsive to sweet and fatty substances.

But other evolutionary psychologists believe the faculty of enjoying music is no accident. Darwin suggested that human ancestors, before acquiring the power of speech, "endeavored to charm each other with musical notes and rhythm." It is because of music's origin in courtship, Darwin believed, that it is "firmly associated with some of the strongest passions an animal is capable of feeling."

In his theory of sexual selection, Darwin proposed that traits found attractive in courtship would enable their owners to get more genes into the next generation. The upshot would be the emergence of adornments that had no immediately obvious survival value in themselves, like the peacock's tail or the troubadour's ballads.

Darwin's ideas about music have been extended by Dr. Geoffrey Miller, an evolutionary psychologist at the University of New Mexico. Dr. Miller notes their potency in pointing to the opportunities open to popular musicians for transmitting their genes to the next generation. The rock guitarist Jimi Hendrix, for instance, had "sexual liaisons with hundreds of groupies, maintained parallel long-term relationships with at least two women, and fathered at least three children in the United States, Germany, and Sweden. Under ancestral conditions before birth control, he would have fathered many more," Dr. Miller writes.

Why on earth would nubile young women choose a rock star as a possible father of their children instead of more literary and reflective professionals such as, say, journalists? Dr. Miller sees music as an excellent indicator of fitness in the Darwinian struggle for survival. Since music draws on so many of the brain's faculties, it vouches for the health of the organ as a whole. And since music in ancient cultures seems often to have been linked with dancing, a good fitness indicator for the rest of the body, anyone who could sing and dance well was advertising the general excellence of their mental and physical genes to a potential mate.

"Music evolved and continues to function as a courtship display, mostly broadcast by young males to attract females," Dr. Miller writes in "The Origins of Music," a collection of essays by him and others. But other psychologists argue that Dr. Miller's courtship theory does not do full justice to another important dimension of music, its role in cementing social relationships and coordinating the activities of large groups of people. Dr. Robin Dunbar, of LiverpoolUniversity, has shown that monkeys spend a large amount of time grooming other members of their social group, so much so that they would scarcely have time to look for food if their 50-strong groups were to grow any larger.

Dr. Dunbar believes that the much larger human groups, of
150 members or so, overcame the grooming barrier by developing a new kind of social glue, namely language. Group singing, or chorusing, may have been an intermediate step in this process, he suggests. He has preliminary evidence that singing in church produces endorphins, a class of brain hormone thought to be

important in social bonding, he said in an e-mail message. Others, like Dr. Edward Hagen of Humboldt University in Berlin and Dr. Gregory A. Bryant of the University of California at Santa Cruz, believe the role of music in human evolutionary history was not to create social cohesion but to signal it to rival groups. By putting on a better song-and-dance display, a group could show it had the coordination to prevail in a scrap, and could thus avoid a fight altogether, they write in an article available on the Web.

Male chimpanzees sometimes chorus in a call known as a pant-hoot, though usually to attract females to a new source of fruit they have found. For human ancestors, musical displays of this kind "may have formed the evolutionary basis for the musical abilities of modern humans," Dr. Hagen and Dr. Bryant write. The Pentagon's vigorous support of military bands - $163 million in 1997 - lends a certain resonance to this view.

The courting and social cohesion theories of music's origins assume that there are structures in the human brain that have evolved specifically to handle music. If no such structures exist, then Dr. Pinker's theory or something like it is correct. A leading clue that points to music-specific structures, yet is so far not conclusive, is that many features of music are universal as well as apparently innate, meaning present at birth. All societies have music, all sing lullaby-like songs to their infants, and most produce tonal music, or music composed in subsets of the 12-tone chromatic scale, such as the diatonic or pentatonic scales. Some of the earliest known musical instruments, crane bone flutes from the Jiahu site in China, occupied from 7000 to 5700 B.C., produce a tonal scale.

Dr. Sandra Trehub, of the University of Toronto, has developed methods of testing the musical preferences of infants as young as 2 to 6 months. She finds they prefer consonant sounds, like perfect fifths or perfect fourths, over dissonant ones. A reasonable conclusion is that "the rudiments of music listening are gifts of nature rather than products of culture," she wrote in the July issue ofNature Neuroscience.

But although certain basic features of music, such as the octave, intervals with simple ratios like the perfect fifth, and tonality, seem to be innate, they are probably not genetic adaptations for music, "but rather appear to be side effects of general properties of the auditory system," conclude two Cambridge scientists, Josh McDermott of the Massachusetts Institute of Technology and Dr. Marc Hauser of Harvard, in an unpublished article. The human auditory system is probably tuned to perceive the most important sounds in a person's surroundings, which are those of the human voice. Three neuroscientists at Duke University, Dr. David A. Schwartz, Dr. Catherine Q. Howe and Dr. Dale Purves, say that on the basis of this cue they may have solved the longstanding mysteries of the structure of the chromatic scale and the reason why some harmonies are more pleasing than others.

Though every human voice, and maybe each utterance, is different, a certain commonality emerges when many different voices are analyzed. The human

vocal tract shapes the vibrations of the vocal cords into a set of harmonics that are more intense at some frequencies than others relative to the fundamental note. The principal peaks of intensity occur at the fifth and the octave, with lesser peaks at other intervals that correspond to most of the 12 tones of the chromatic scale, the Duke researchers say in an article published last month in the Journal of Neuroscience. Almost identical spectra were produced by speakers of English, Mandarin, Persian and Tamil. The Duke researchers believe the auditory system judges sounds to be pleasant the closer they approximate to this generalized power spectrum of the human voice. "A musical tone combination whose power is concentrated at the same places as a human speech sound will sound more familiar and more natural," Dr. Schwartz said.

Some people are unable to appreciate music, raising the question of whether some music-specific faculty has been damaged. People who are tone deaf also fail to hear pitch changes in the human voice, so this deficit does not seem specific to music. Some patients have music agnosia, an inability to recognize familiar melodies, even ones to which they know the lyrics. But the brain has to store memories about music somewhere, and the music agnosia patients could have incurred memory damage that just happened to hit the music archive, Mr. McDermott, of M.I.T., said.

"Any innate biases on music must derive from something in the brain, but at present there is little evidence for neural circuitry dedicated to music," Mr. McDermott and Dr. Hauser conclude.

Dr. Zatorre, of the Montreal institute, takes a similar view. The brain has evolved faculties for perceiving sounds, organizing events in time and maintaining memory stores, he said. "Once you've got all that hardware in place, it can be used for a lot of different purposes. But I don't think it follows that music was selected for."

Whether music is cheesecake, courtship or cohesion, its mystery remains unbreached.

http://www.nytimes.com/2003/09/16/science/16MUSI.html?ex=1064812231&ei=1&en=c8c82da51017678a