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MY FAVORITE THING

WHY DO WE LIKE THE MUSIC WE LIKE?

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A STUDY MADE THE newspapers and morning talk shows several years ago, claiming that listening to Mozart for ten minutes a day made you smarter ("the Mozart Effect"). Specifically, music listening, it was claimed, can improve your performance on spatial-reasoning tasks given immediately after the listening session (which some journalists thought implied mathematical ability as well). U.S. congressmen were passing resolutions, the governor of Georgia appropriated funds to buy a Mozart CD for every newborn baby Georgian. Most scientists found ourselves in an uncomfortable position. Although we do believe intuitively that music can enhance other cognitive skills, and although we would all like to see more governmental funding for school music programs, the actual study that claimed this contained many scientific flaws. The study was claiming some of the right things but for the wrong reasons. Personally, I found all the hubbub a bit offensive because the implication was that music should not be studied in and of itself, or for its own right, but only if it could help people to do better on other, "more important" things. Think how absurd this would sound if we turned it inside out. If I claimed that studying mathematics helped musical ability, would policy makers start pumping money into math for that reason? Music has often been the poor stepchild of public schools, the first program to get cut when there are funding problems, and people frequently try to justify it in terms of its collateral benefits, rather than letting music exist for its own rewards.

The problem with the "music makes you smarter" study turned out to be straightforward: The experimental controls were inadequate, and the tiny difference in spatial ability between the two groups, according to research by Bill Thompson, Glenn Schellenberg, and others, all turned on the choice of a control task. Compared to sitting in a room and doing nothing, music listening looked pretty good. But if subjects in the control task were given the slightest mental stimulation—hearing a book on tape, reading, etc.—there was no advantage for music listening. Another problem with the study was that there was no plausible mechanism proposed by which this might work—how could music listening increase spatial performance?

Glenn Schellenberg has pointed out the importance of distinguishing short-term from long-term effects of music. The Mozart Effect referred to immediate benefits, but other research *has* revealed long-term effects of musical activity. Music listening enhances or changes certain neural circuits, including the density of dendritic connections in the primary auditory cortex. The Harvard neuroscientist Gottfried Schlaug has shown that the front portion of the corpus callosum—the mass of fibers connecting the two cerebral hemispheres—is significantly larger in musicians than nonmusicians, and particularly for musicians who began their training early. This reinforces the notion that musical operations become bilateral with increased training, as musicians coordinate and recruit neural structures in both the left and right hemispheres.

Several studies have found microstructural changes in the cerebellum after the acquisition of motor skills, such as are acquired by musicians, including an increased number and density of synapses. Schlaug found that musicians tended to have larger cerebellums than nonmusicians, and an increased concentration of gray matter; gray matter is that part of the brain that contains the cell bodies, axons, and dendrites, and is understood to be responsible for information processing, as opposed to white matter, which is responsible for information transmission.

Whether these structural changes in the brain translate to enhanced abilities in nonmusical domains has not been proven, but music listening and music therapy have been shown to help people overcome a broad range of psychological and physical problems. But, to return to a more fruitful line of inquiry regarding musical taste . . . Lamont's results are important because they show that the prenatal and newborn brain are able to store memories and retrieve them over long periods of time. More practically, the results indicate that the environment—even when mediated by amniotic fluid and by the womb—can affect a child's development and preferences. So the seeds of musical preference are sown in the womb, but there must be more to the story than that, or children would simply gravitate toward the music their mothers like, or that plays in Lamaze classes. What we can say is that musical preferences are influenced, but not determined, by what we hear in the womb. There also is an extended period of acculturation, during which the infant takes in the music of the culture she is born into. There were reports a few years ago that prior to becoming used to the music of a foreign (to us) culture, all infants prefer Western music to other music, regardless of their culture or race. These findings were not corroborated, but rather, it was found that infants do show a preference for consonance over dissonance. Appreciating dissonance comes later in life, and people differ in how much dissonance they can tolerate.

There is probably a neural basis for this. Consonant intervals and dissonant intervals are processed via separate mechanisms in the auditory cortex. Recent results from studying the electrophysiological responses of humans and monkeys to sensory dissonance (that is, chords that sound dissonant by virtue of their frequency ratios, not due to any harmonic or musical context) show that neurons in the primary auditory cortex—the first level of cortical processing for sound—synchronize their firing rates during dissonant chords, but not during consonant chords. Why that would create a preference for consonance is not yet clear.

We do know a bit about the infant's auditory world. Although infant ears are fully functioning four months before birth, the developing brain requires months or years to reach full auditory processing capacity. Infants recognize transpositions of pitch and of time (tempo changes), indicating they are capable of relational processing, something that even the most advanced computers still can't do very well. Jenny Saffran of the University of Wisconsin and Laurel Trainor of McMaster University have gathered evidence that infants can also attend to absolute-pitch cues if the task requires it, suggesting a cognitive flexibility previously unknown: Infants can employ different modes of processing—presumably mediated by different neural circuits—depending on what will best help them to solve the problem at hand.

Trehub, Dowling, and others have shown that contour is the most salient musical feature for infants, who can detect contour similarities and differences even across thirty seconds of retention. Recall that *contour* refers to the pattern of musical pitch in a melody—the sequence of ups and downs that the melody takes—regardless of the size of the interval. Someone attending to contour exclusively would encode only that the melody goes up, for example, but not by how much. Infants' sensitivity to musical contour parallels their sensitivity to linguistic contours—which separate questions from exclamations, for example, and which are part of what linguists call prosody. Fernald and Trehub have documented the ways in which parents speak differently to infants than to older children and adults, and this holds across cultures. The resulting manner of speaking uses a slower tempo, an extended pitch range, and a higher overall pitch level.

Mothers (and to a lesser extent, fathers) do this quite naturally without any explicit instruction to do so, using an exaggerated intonation that the researchers call infant-directed speech or motherese. We believe that motherese helps to call the babies' attention to the mother's voice, and helps to distinguish words within the sentence. Instead of saying, as we would to an adult, "This is a ball," motherese would entail something like, "Seeeeee?" (with the pitch of the eee's going up to the end of the sentence). "See the BAAAAAALLLLLL?" (with the pitch covering an extended range and going up again at the end of the word *ball*). In such utterances, the contour is a signal that the mother is asking a question or making a statement, and by exaggerating the differences between up and down contours, the mother calls attention to them. In effect, the mother is creating a prototype for a question and a prototype for a declaration, and ensuring that the prototypes are easily distinguishable. When a mother gives an exclamatory scold, quite naturally—and again without explicit training—she is likely to create a third type of prototypical utterance, one that is short and clipped, without much pitch variation: "No!" (pause) "No! Bad!" (pause) "I said no!" Babies seem to come hardwired with an ability to detect and track contour, preferentially, over specific pitch intervals.

Trehub also showed that infants are more able to encode consonant intervals such as perfect fourth and perfect fifth than dissonant ones, like the tritone. Trehub found that the unequal steps of our scale make it easier to process intervals even early in infancy. She and her colleagues played nine-month-olds the regular seven-note major scale and two scales she invented. For one of these invented scales, she divided the octave into eleven equal-space steps and then selected seven tones that made one- and two-step patterns, and for the other she divided the octave into seven equal steps. The infants' task was to detect a mistuned tone. Adults performed well with the major scale, but poorly with both of the artificial, never-before-heard scales. In contrast, the infants did equally well on both unequally tuned scales and on the equally tuned ones. From prior work, it is believed that nine-month-olds have not yet incorporated a mental schema for the major scale, so this suggests a general processing advantage for unequal steps, something our major scale has.

In other words, our brains and the musical scales we use seem to have coevolved. It is no accident that we have the funny, asymmetric arrangement of notes in the major scale: It is easier to learn melodies with this arrangement, which is a result of the physics of sound production . . . ; the set of tones we use in our major scale are very close in pitch to the tones that constitute the overtone series. Very early in childhood, most children start to spontaneously vocalize, and these early vocalizations can sound a lot like singing. Babies explore the range of their voices, and begin to explore phonetic production, in response to the sounds they are bringing in from the world around them. The more music they hear, the more likely they are to include pitch and rhythmic variations in their spontaneous vocalizations.

Young children start to show a preference for the music of their culture by age two, around the same time they begin to develop specialized speech processing. At first, children tend to like simple songs, where *simple* means music that has clearly defined themes (as opposed to, say, four-part counterpoint) and chord progressions that resolve in direct and easily predictable ways. As they mature, children start to tire of easily predictable music and search for music that holds more challenge. According to Mike Posner, the frontal lobes and the anterior cingulate—a structure just behind the frontal lobes that directs attention—are not fully formed in children, leading to an inability to pay attention to several things at once; children show difficulty attending to one stimulus when distracters are present. This accounts for why children under the age of eight or so have so much difficulty singing "rounds" like "Row, Row, Row Your Boat." Their attentional system—specifically the network that connects the cingulate gyrus (the larger structure within which the anterior cingulate sits) and the orbitofrontal regions of the brain—cannot adequately filter out unwanted or distracting stimuli. Children who have not yet reached the developmental stage of being able to exclude irrelevant auditory information face a world of great sonic complexity with all sounds coming in as a sensory barrage. They may try to follow the part of the song that their group is supposed to be singing, only to be distracted and tripped up by the competing parts in the round. Posner has shown that certain exercises adapted from attention and concentration games used by NASA can help accelerate the development of the child's attentional ability.

The developmental trajectory, in children, of first preferring simple and then more complex songs is a generalization, of course; not all children like music in the first place, and some children develop a taste for music that is off the beaten path, oftentimes through pure serendipity. I became fascinated with big band and swing music when I was eight, around the time my grandfather gave me his collection of 78 rpm records from the World War II era. I was initially attracted by novelty songs, such as "The Syncopated Clock," "Would You Like to Swing on a Star," "The Teddy Bear's Picnic," and "Bibbidy Bobbidy Boo"—songs that were made for children. But sufficient exposure to the relatively exotic chord patterns and voicings of Frank de Vol's and Leroy Anderson's orchestras became part of my mental wiring, and I soon found myself listening to all kinds of jazz; the children's jazz opened the neural doors to make jazz in general palatable and understandable.

Researchers point to the teen years as the turning point for musical preferences. It is around the age of ten or eleven that most children take on music as a real interest, even those children who didn't express such an interest in music earlier. As adults, the music we tend to be nostalgic for, the music that feels like it is "our" music, corresponds to the music we heard during these years. One of the first signs of Alzheimer's disease (a disease characterized by changes in nerve cells and neurotransmitter levels, as well as destruction of synapses) in older adults is memory loss. As the disease progresses, memory loss becomes more profound. Yet many of these old-timers can still remember how to sing the songs they heard when they were fourteen. Why fourteen? Part of the reason we remember songs from our teenage years is because those years were times of self-discovery, and as a consequence, they were emotionally charged; in general, we tend to remember things that have an emotional component because our amygdala and neurotransmitters act in concert to "tag" the memories as something important. Part of the reason also has to do with neural maturation and pruning; it is around fourteen that the wiring of our musical brains is approaching adultlike levels of completion.

There doesn't seem to be a cutoff point for acquiring new tastes in music, but most people have formed their tastes by the age of eighteen or twenty. Why this is so is not clear, but several studies have found it to be the case. Part of the reason may be that in general, people tend to become less open to new experiences as they age. During our teenage years, we begin to discover that there exists a world of different ideas, different cultures, different people. We experiment with the idea that we don't have to limit our life's course, our personalities, or our decisions to what we were taught by our parents, or to the way we were brought up. We also seek out different kinds of music. In Western culture in particular, the choice of music has important social consequences. We listen to the music that our friends listen to. Particularly when we are young, and in search of our identity, we form bonds or social groups with people whom we want to be like, or whom we believe we have something in common with.

As a way of externalizing the bond, we dress alike, share activities, and listen to the same music. Our group listens to this kind of music, those people listen to that kind of music. This ties into the evolutionary idea of music as a vehicle for social bonding and societal cohesion. Music and musical preferences become a mark of personal and group identity and of distinction.

To some degree, we might say that personality characteristics are associated with, or predictive of, the kind of music that people like. But to a large degree, it is determined by more or less chance factors: where you went to school, who you hung out with, what music they happened to be listening to. When I lived in northern California as a kid, Creedence Clearwater Revival was huge—they were from just down the road. When I moved to southern California, CCR's brand of quasi-cowboy, country-hick music didn't fit in well with the surfer/Hollywood culture that embraced the Beach Boys and more theatrical performance artists like David Bowie.

Also, our brains are developing and forming new connections at an explosive rate throughout adolescence, but this slows down substantially after our teenage years, the formative phase when our neural circuits become structured out of our experiences. This process applies to the music we hear; new music becomes assimilated within the framework of the music we were listening to during this critical period. We know that there are critical periods for acquiring new skills, such as language. If a child doesn't learn language by the age of six or so (whether a first or a second language), the child will never learn to speak with the effortlessness that characterizes most native speakers of a language. Music and mathematics have an extended window, but not an unlimited one: If a student hasn't had music lessons or mathematical training prior to about age twenty, he can still learn these subjects, but only with great difficulty, and it's likely that he will never "speak" math or music like someone who learned them early. This is because of the biological course for synaptic growth. The brain's synapses are programmed to grow for a number of years, making new connections. After that time, there is a shift toward pruning, to get rid of unneeded connections.

Neuroplasticity is the ability of the brain to reorganize itself. Although in the last five years there have been some impressive demonstrations of brain reorganization that used to be thought impossible, the amount of reorganization that can occur in most adults is vastly less than can occur in children and adolescents.

Of course, there are individual differences. Just as some people can heal broken bones or skin cuts faster than others, so, too, can some people forge new connections more easily than others. Generally, between the ages of eight and fourteen, pruning starts to occur in the frontal lobes, the seat of higher thought and reasoning, planning, and impulse control. Myelination starts to ramp up during this time. Myelin is a fatty substance that coats the axons, speeding up synaptic transmission. (This is why as children get older, generally, problem solving becomes more rapid and they are able to solve more complex problems.) Myelination of the whole brain is generally completed by age twenty. Multiple sclerosis is one of several degenerative diseases that can affect the myelin sheath surrounding the neurons.

The balance between simplicity and complexity in music also informs our preferences. Scientific studies of like and dislike across a variety of aesthetic domains—painting, poetry, dance, and music—have shown that an orderly relationship exists between the complexity of an artistic work and how much we like it. Of course, complexity is an entirely subjective concept. In order for the notion to make any sense, we have to allow for the idea that what seems impenetrably complex to Stanley might fall right in the "sweet spot" of preference for Oliver. Similarly, what one person finds insipid and hideously simple, another person might find difficult to understand, based on differences in background, experience, understanding, and cognitive schemas.

In a sense, schemas are everything. They frame our understanding; they're the system into which we place the elements and interpretations of an aesthetic object. Schemas inform our cognitive models and expectations. With one schema, Mahler's Fifth is perfectly interpretable, even upon hearing it for the first time: It is a symphony, it follows symphonic form with four movements; it contains a main theme and subthemes, and repetitions of the theme; the themes are manifested through orchestral instruments, as opposed to African talking drums or fuzz bass. Those familiar with Mahler's Fourth will recognize that the Fifth opens with a variation on that same theme, and even at the same pitch. Those well acquainted with Mahler's work will recognize that the composer includes quotations from three of his own songs. Musically educated listeners will be aware that most symphonies from Haydn to Brahms and Bruckner typically begin and end in the same key. Mahler flouts this convention with his Fifth, moving from C-sharp minor to A minor and finally ending in D major. If you had not learned to hold in your mind a sense of key as the symphony develops, or if you did not have a sense of the normal trajectory of a symphony, this would be meaningless; but for the seasoned listener, this flouting of convention brings a rewarding surprise, a violation of expectations, especially when such key changes are done skillfully so as not to be jarring. Lacking a proper symphonic schema, or if the listener holds another schema, perhaps that of an aficionado of Indian ragas, Mahler's Fifth is nonsensical or perhaps rambling, one musical idea melding amorphously into the next, with no boundaries, no beginnings or endings that appear as part of a coherent whole. The schema frames our perception, our cognitive processing, and ultimately our experience.

When a musical piece is too simple we tend not to like it, finding it trivial. When it is too complex, we tend not to like it, finding it unpredictable—we don't perceive it to be grounded in anything familiar. Music, or any art form for that matter, has to strike the right balance between simplicity and complexity in order for us to like it. Simplicity and complexity relate to familiarity, and *familiarity* is just another word for a schema.

It is important in science, of course, to define our terms. What is "too simple" or "too complex"? An operational definition is that we find a piece too simple when we find it trivially predictable, similar to something we have experienced before, and without the slightest challenge. By analogy, consider the game tic-tac-toe. Young children find it endlessly fascinating, because it has many features that contribute to interest at their level of cognitive ability: It has clearly defined rules that any child can easily articulate; it has an element of surprise in that the player never knows for sure exactly what her opponent will do next; the game is dynamic, in that one's own next move is influenced by what one's opponent did; when the game will end, who will win, or whether it will be a draw is undetermined, yet there is an outer limit of nine moves. That indeterminacy leads to tension and expectations, and the tension is finally released when the game is over.

As the child develops increasing cognitive sophistication, she eventually learns strategies—the person who moves second cannot win against a competent player; the best the second player can hope for is a draw. When the sequence of moves and the end point of the game become predictable, tic-tac-toe loses its appeal. Of course, adults can still enjoy playing the game with children, but we enjoy seeing the pleasure on the child's face and we enjoy the process—spread out over several years—of the child learning to unlock the mysteries of the game as her brain develops.

To many adults, Raffi and Barney the Dinosaur are the musical equivalents of tic-tac-toe. When music is too predictable, the outcome too certain, and the "move" from one note or chord to the next contains no element of surprise, we find the music unchallenging and simplistic. As the music is playing (particularly if you're engaged with focused attention), your brain is thinking ahead to what the different possibilities for the next note are, where the music is going, its trajectory, its intended direction, and its ultimate end point. The composer has to lull us into a state of trust and security; we have to allow him to take us on a harmonic journey; he has to give us enough little rewards—completions of expectations—that we feel a sense of order and a sense of place.

Say you're hitchhiking from Davis, California, to San Francisco. You want the person who picks you up to take the normal route, Highway 80. You might be willing to tolerate a few shortcuts, especially if the driver is friendly, believable, and is up-front about what he's doing. ("I'm just going to cut over here on Zamora Road to avoid some construction on the freeway.") But if the driver takes you out on back roads with no explanation, and you reach a point where you no longer see any landmarks, your sense of safety is sure to be violated. Of course, different people, with different personality types, react differently to such unanticipated journeys, musical or vehicular. Some react with sheer panic ("That Stravinsky is going to kill me!") and some react with a sense of adventure

Figure 22.1.

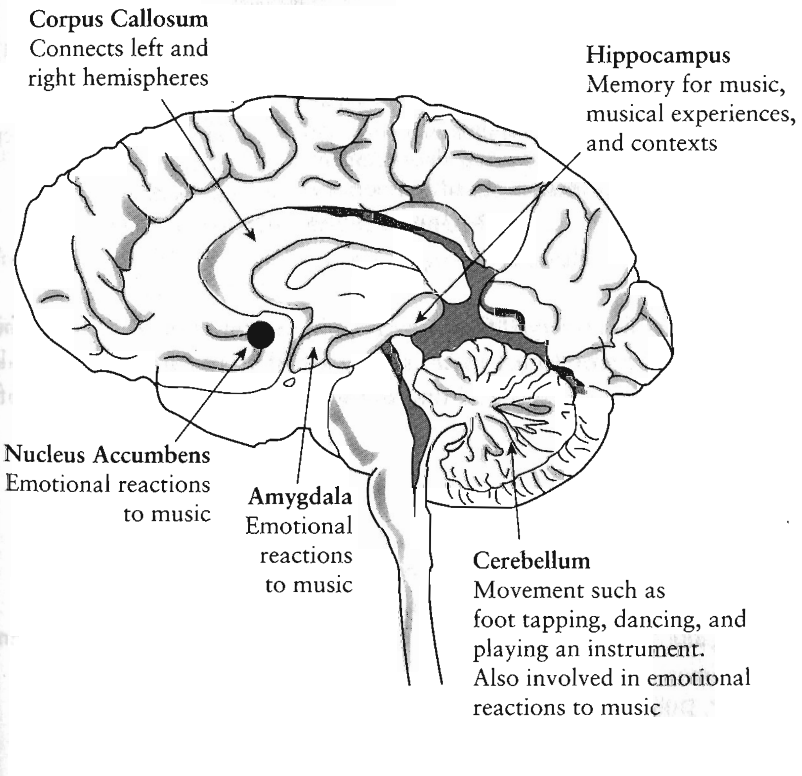
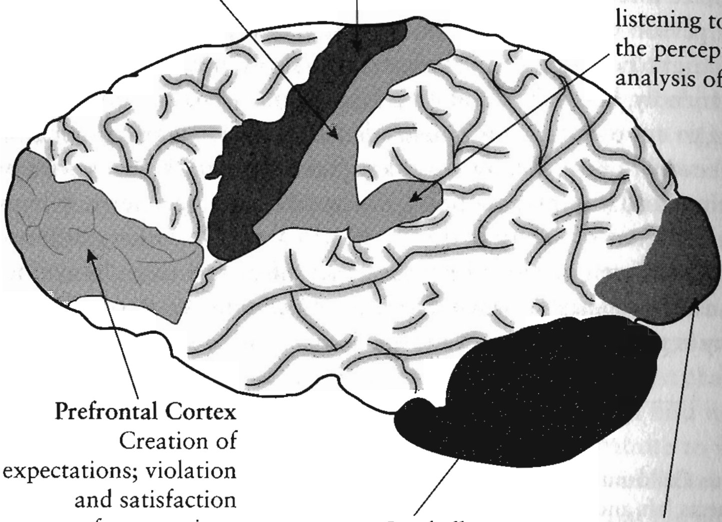


Figure 22.2.



at the thrill of discovery ("Coltrane is doing something weird here, but what the hell, it won't hurt me to stick around awhile longer, I can take care of my harmonic self and find my way back to musical reality if I have to").

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