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Music in Human Life

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WHAT IS MUSIC?

It is surprisingly difficult to define the term "music." More specifically, it can be challenging to determine what is *not* music, and to explain why.

For example, is bird song music? It is beautiful and enjoyable to listen to, and bird song often features clear, catchy melodies. Some birds learn songs from one another, thereby developing diverse repertoires. Is it a problem that birds sing primarily to communicate and attract mates? Humans certainly make music for those purposes. Does the reason for singing determine whether a song counts as music or not? Can music even be made by non-humans, or is it a uniquely human phenomenon?

Let's consider another example. Are the noises of the city music? How about when they are carefully recorded and curated for release by a record company? In 1964, Michael Siegel issued an album entitled *Sounds of the Junk Yard*[1] on

Image 1.1: Is bird song music?
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Folkways Records. Does this enshrinement turn the sounds into music? Does your opinion change when you consider that the rock band Sonic Youth was directly inspired by *Sounds of the Junk Yard* and sought to replicate its sounds in their playing? How about when noises are painstakingly arranged into a collage by a composer? The 1952 work *Williams Mix*[2] by John Cage is made up entirely of pre-recorded sounds. How about when they are imitated by a musical instrument? Henry Cowell set out to capture the sounds of the New York subway with his 1916 piano composition *Dynamic Motion*[3]. Or when they are integrated into a concert work, such as the real car horns used in Gershwin's 1928 orchestral composition *An American in Paris*?

1.	Siegel's 1964 album *Sounds of the Junk Yard* has inspired musicians. This example is titled "Loading Pick-Up Truck."
2.	Cage's 1952 *Williams Mix* is made up entirely of real-world sounds that he recorded, organized, and assembled. Is this music?
3.	Cowell's 1916 *Dynamic Motion* imitates the sounds of the New York subway.

The broadest definition of music to date was provocatively set forth on August 29, 1952, by the American composer John Cage. He made his statement not in words but with a performance of a composition that is known as *4'33"*. The premiere of *4'33"* was given by pianist David Tudor, who came out onto the stage and proceeded to sit in silence at the keyboard for the time indicated in the title, interrupting his performance only to open and close the keyboard at predetermined time markers. The musical contents of the performance, therefore, were not sounds that emanated from the piano but rather the incidental sounds that audience members happened to perceive during the allotted time: rustling programs, whispers, laughter, a passing train. The composer certainly did not know what these sounds would be and exercised no control over them—and indeed, the sounds heard during performances today would in some cases have been unimaginable to the composer, who died in 1992. The object of this composition was to make the case that any sounds could be music as long as they were listened to as music. In other words, music is in the ear of the beholder. It is defined not by its source or by the intent of its creator. It is defined by the act of listening.

There is continued debate over how to define "music." The Google Dictionary definition—that is to say, the definition that one is most likely to come across—reads "vocal or instrumental sounds (or both) combined in such a way as to produce beauty of form, harmony, and expression of emotion." This describes most music, to be sure. But does music have to be beautiful? If so, who is the arbiter of what is beautiful? Does music have to express emotion? And what about music that is created not by voices or instruments but by computers (e.g. electronic dance music)? The above definition excludes a lot.

For a more clinical take, we can turn to Merriam-Webster, which describes music as "the science or art of ordering tones or sounds in succession, in combination, and in temporal relationships to produce a composition having unity and continuity." This definition is more difficult to criticise, but it still seems lacking. What about the power of music to make us cry, or dance, or become overwhelmed with nostalgia? What about the significance of music to personal and cultural identity? A dictionary definition certainly doesn't have to address these dimensions, but they are integral to a deeper understanding of what music really *is*.

THE POWER OF MUSIC

Although we might argue over what is and what is not music, there is no question that music is important. Its significance ranges from the historical to the cultural to the biological. Music has played a role in every documented human society of the past and present. The oldest instrument found to date is an ivory flute created about 43,000 years ago—clear evidence that music is not a recent development. But why did humans start making music? The answers to that question might be discovered by examining the extraordinary effects that making and listening to music has on our brains.

Image 1.2: This bone flute from the Geissenklösterle cave Germany is the oldest known musical instrument.
Source: Wikimedia Commons
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Music, Human Experience, and the Brain

All of our activities are governed by the amazing organ situated inside of our skulls and between our ears: the human brain. And it is clear to religionists and evolutionists alike that there is something distinctly different between humans and other animals. But what is that difference? What makes us capable of complex reason and emotion? What gives us the ability to have an awareness of our own thought processes? It can't simply be the *size* of our brains, as the brains of blue whales are much larger than those of humans, yet we don't credit them with equivalent intelligence. Conversely, gorilla brains are only a little smaller than human brains, and they are not capable of the extreme creative and processing power of humanity. So what is it that makes our brains different?

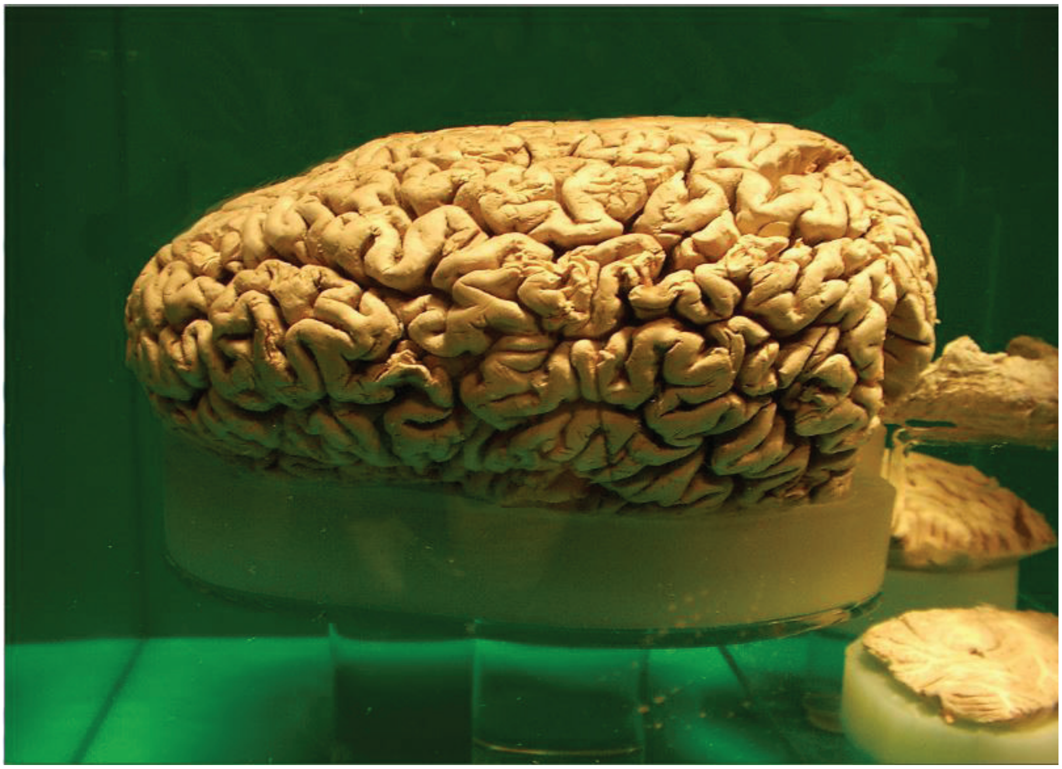

Image 1.3: This brain, which belonged to a sperm whale, is many times the size of a human brain.
Source: Wikimedia Commons
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What makes us human?

Consider just a few of the qualities that are claimed to be unique to humans. We recognize ourselves in the working order of things, and are capable of standing back as a spectator and seeing our part in the greater picture. In other words, we have *self-consciousness*, and are capable of making choices based upon that information. Scientists use the mirror test (whether or not an animal species recognizes reflections of themselves as self, rather than another animal) to measure self-consciousness. But there are many species of primates that recognize their reflections as self, so that characteristic isn't unique to humans. We have an appreciation of beauty and of aesthetic things, and are compelled as a species to create art. But there are birds who decorate their nests, exhibiting nuanced preferences for certain colors and items in the process—does this mean that they possess our same capacity for appreciation of aesthetics?

What about humor? All people possess a sense of humor (though some have less than others) and can appreciate and express humor. Not only does humor require intelligence and understanding of situational variables, but it also requires the ability to see the odd, absurd and ironic. But there are chimpanzees that "laugh" when they are tickled, and if you watch young chimps playing long enough, you will eventually see one pull a prank on another and run away "laughing."

Image 1.4: This satin bowerbird has decorated its courtship stage with a wide variety of blue objects. Bowerbirds appear to have a keen artistic sense and decorate with exquisite care.
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What about awareness of death? While many creatures exhibit behaviors we could characterize as mourning when they lose a beloved human or fellow animal, humans have elaborate funeral rituals upon death. The ancient Egyptians actually buried people with physical objects so that they would have things with them in the next life. But elephants[4] have been observed burying their dead (and the dead of other species) in addition to placing food, fruit, and flowers with their bodies. That sounds a lot like a funeral.

4.	This video captures elephants seeming to mourn a dead companion.

What about awareness of time? Humans experience sequence of events, form memories, and then predict future outcomes, and we have ways of measuring the passing of time in equal intervals (think second hand on a watch). Dogs and other animals certainly don't have clocks or devices, but they reliably know when it is dinner time. Is this because of biological processes, or do they, too, have some sense of time?

What about love? It is arguably one of the most important motivational forces in a human's life, but are we alone in this? Animals display behaviors that clearly indicate affection, but do they love each other the way we do? Cats will rub their companions and purr, whales can deliberately save seals from attack, and dogs display extraordinary altruism towards their owners and other creatures. In humans, these behaviors signal the thing we call love. Do animals experience it the way we do?

What about language? Humanity is the only species that uses language, although we are clearly not the only species that communicates. So what is different about us? Animals communicate in many ways with one another, and some gorillas have been taught sign-language. Koko the gorilla reportedly understood over 2,000 spoken words and was able to use more than 1,000 signs to convey thoughts and emotions. She was even able to communicate compound ideas by using signs in ways they had not been taught to her. This certainly was a form of communication and language use, although Koko could never learn to speak. In addition, while some animals can understand words, sounds, and tone of voice, they do not comprehend syntax or communicate in complex sentences. Throughout history, human beings have devised hundreds of languages and endless dialects, despite the fact that we are born with no way to verbally communicate, at all. So what is it about our brains that makes them capable of complex language, when the composition of our brains is so similar to chimpanzees and gorillas?

Image 1.6: Bonobos Kanzi and Panbanisha are pictured here communicating with a pictorial "keyboard."
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Language and the Human Brain

It comes down to the structure of our brains and to what those structures do. Generally, the human brain can be divided into three regions: the **forebrain**, **midbrain**, and **hindbrain**. This characteristic is absent in most animals. Although the *size* of the brain itself does not determine complex intelligence, the size of the brain in relationship to the size of the body matters. Humans win the rodeo with the largest brain of all animals in comparison to the size of their bodies. In addition, the human brain has more neurons in its outermost layer (the **cerebral cortex**) than do other animals, and the insulation around nerve fibers in the human brain is thicker than that of other animals, enabling more rapid signal transfer between neurons. We literally *think better and faster*. But it is the structures responsible for language production and comprehension (Broca's and Wernicke's areas) that are unique to human beings. And, interestingly, both of these areas are heavily involved in the processing of music, which brings us to the crux of the matter: human beings are the only animals who employ "music" and "language". That is what separates us from every other species on the planet. And it seems as though we do these things because we have been endowed with neuroanatomical structures that are unique to us. So what do these two critical brain regions do? And how is music cognition different from language cognition?

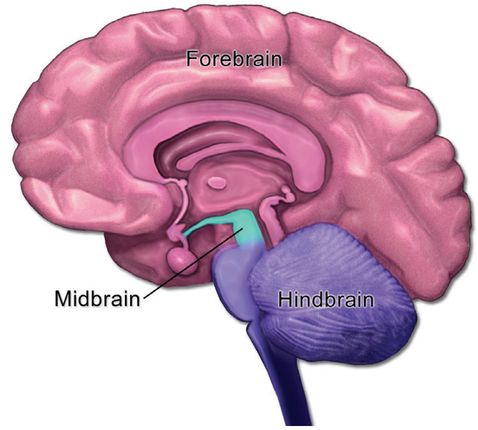

Image 1.7: These are the regions of the brain.
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Early investigators learned about particular regions of the brain that control speech by observing patients' limitations and then conducting postmortem exams. A French neurologist named Paul Broca observed a patient who understood language but who was unable to produce more than a few isolated words. When that patient died, Broca conducted a postmortem exam

Image 1.8: This engraving from ca. 1881 depicts Paul Broca, a French neurologist responsible for making foundational discoveries about language and the brain.
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and found a lesion in the man's forebrain in the **frontal lobe**. He deduced that this area was associated with the production of speech, and it was termed **Broca's area**. Persons with damage to Broca's area understand heard language and know what they wish to say but are unable to speak. They can't speak because Broca's area controls the *physical production of speech*. Essentially, our brains take in auditory stimuli, then Broca's area (in conjunction with Wernicke's area, which we will discuss in a moment) converts the stimuli to neuronal representations that are then translated into the physical motions involved in producing speech sounds. To put this more simply, that area of the brain helps us understand what we hear, formulate articulate thoughts and then convert them into speech.

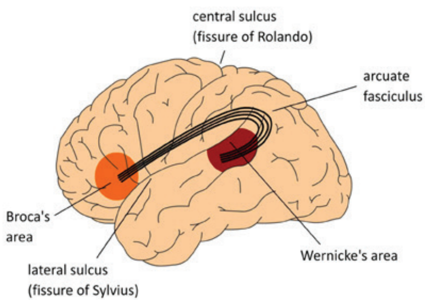

Image 1.9: Broca's area and Wernicke's area handle the input of sound, conversion of sound to understanding, and utterance of spoken language.
Source: Wikimedia Commons
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Image 1.10: The German physician Carl Wernicke, photographed here in the early 20th century, expanded on Broca's observations.
Source: Wikimedia Commons
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About ten years later, a neurologist named Carl Wernicke identified a similar, but different, problem in patients who were unable to comprehend language or to construct meaningful sentences, even though they did not experience difficulty in producing articulate words. In postmortem examination, he found lesions at the junction of the parietal, temporal, and occipital lobes. He deduced that this area, now termed **Wernicke's area**, had something to do with the understanding of language. Conjunctly, Broca's and Wernicke's areas handle the input of sound, conversion of sound to understanding, and utterance of spoken language. And these two areas are distinct to humans. The genuinely fascinating thing is that for many years, these areas were thought to be exclusively involved in the processing of language. But recent researchers have discovered through fMRI (functional magnetic resonance imaging) technology that the two language processing centers are activated during listening to and processing music, even when it contains no text. In other words, your two language centers fire when you are listening to instrumental music and are not processing language. How bizarre is that? Why might that be? How are music and language similar in such a way as to explain this phenomenon?

Connections Between Speech and Music

What two things do you think of most easily when someone asks, "What is music?" Probably variation in pitch (frequency) and rhythm (time), even though those are not the only elements of music. Is there a pitch and a rhythm to speech? Read that question aloud to yourself, and note the fact that not all words are the same pitch. This is because we emphasize more important words and increase pitch when asking a question. Read it again and note the fact that not all of the words are the same speed or length, due to the fact that we vary the rhythm of speech sounds. And not only that: there is a **syntax** (the orderly arrangement of sounds in a system) to both language and music. They behave similarly in that the arrangement of sounds is predictable and conforms to patterns. And there we have it. Our brains are uniquely constructed for the successful intake, conversion, and execution of *language and music*. And the reason other animals can't and don't make music or speech (some animals make musical sounds, but the construction of these sounds doesn't conform to syntactical rules, so these sounds aren't actually music in the way we understand it) is because their brains lack the two areas involved in the processing of orderly sound systems. How crazy is that?

But what does this really mean about the nature of music and speech? It suggests that those are the two primary things that make us human and that distinguish us from all other creatures on the planet. That's a significant point. But music isn't only processed in Broca's and Wernicke's areas, although speech primarily is.

Before we examine that, however, we need to discuss how the brain is generally structured. The brain is divided into three main parts: the **cerebrum**, the cerebellum, and the brain stem. The cerebrum is the part that gives the brain its wrinkled appearance. It is divided into a left and right hemisphere separated by the **corpus callosum**, a bundle of fibers that transmit messages from one side of the brain to the other. The cerebrum performs higher functions like receiving and analyzing sensory input such as touch, sight, and sound, and also processes reasoning, emotion, memory, and fine motor control. Both Broca's and Wernicke's areas are situated in the cerebrum. The cerebellum is located under the cerebrum. It primarily coordinates muscle movements, and processes the body's position in space for purposes of balance. The brainstem is the most evolutionarily primal area of the brain—one that we share with other primates. The brainstem performs primarily autonomous functions—those that don't involve voluntary thought, like heart rate, breathing, body temperature, digestion, swallowing, coughing, and vomiting. You

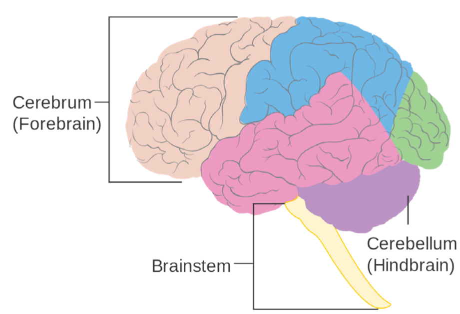

Image 1.11: The brain is divided into the cerebrum, the cerebellum, and the brain stem.
Source: Wikipedia
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can see that as you move upward from the brainstem, the functions of the brain become more complex.

Now that we've handled some of the less-interesting technical information about the way the brain is structured, let's go back to the cerebrum, where most complex brain function occurs. If we can arrive at an understanding of the way the cerebrum is divided and what kinds of information are processed in each area, it will help us to understand the differences in the way the brain processes language and music—perhaps the two most significant markers of what it is to be human. As previously mentioned, the cerebrum is divided into a left and right hemisphere that communicate with one another across the corpus callosum. Not all functions of the two hemispheres are shared. In general, the left hemisphere controls the physical motion on the right side of the body and the right hemisphere controls the physical motion on the left side of the body. Also, in general terms, the left hemisphere processes speech, comprehension, arithmetic, and writing. The right hemisphere controls creativity, spatial ability, and artistic and musical skills. This explanation is a bit misleading, however.

If you look down at a brain from the top, you can see it is divided into two distinct hemispheres. But if you look at the brain from the side, you can see that each hemisphere has distinct fissures that divide the brain into chunks, called lobes. Each hemisphere has four lobes. Moving from front to back, they are the frontal, parietal, temporal, and occipital lobes. Each can be divided even further into areas that serve specific functions (like Broca's and Werneike's areas). But it is important to understand that no lobe or area of the brain functions in isolation. There are complex networks between the lobes of the brain and between the hemispheres that interact to process information. In that sense, our brains are the most complex computers on the planet! We'll quickly take a look at what is generally processed in each lobe before circling back to talk about the differences between language and music processing in the brain.

Frontal lobe processing determines personality, behavior, emotions, judgment, planning, problem solving, speech (Broca's area), fine body movement, intelligence,

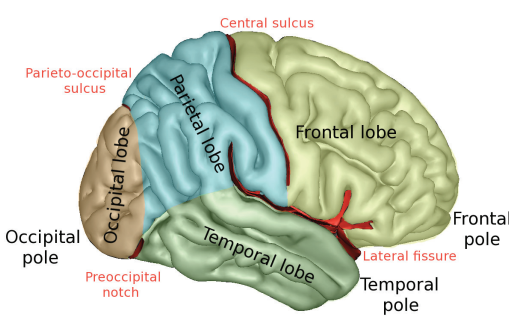

Image 1.12: This diagram illustrates the lobes of the human brain.
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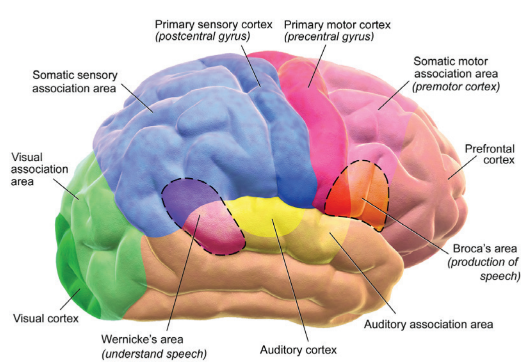

Image 1.13: This diagram illustrates the functional areas of the human brain.
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concentration, and one of the other defining characteristics of human beings: self-awareness. You can see that the frontal lobe (put your hand up to your forehead—that's where the frontal lobe is) handles most of the things that make you, well… *you*. This is why traumatic injury to the frontal lobe from head-impact is often absolutely devastating to the individual. You can lose what it is to be you if that area is damaged. The parietal lobe processes senses of touch, pain, and temperature, and interprets signals from vision, hearing, motor input, memory, and spatial perception. It also plays a role in the interpretation of language and words. Moving further back, the temporal lobe handles the understanding of language (Wernicke's area), memory, hearing, sequencing, and organization. And finally, the occipital lobe interprets visual stimuli, including color, light, and movement. Whew! That was a lot of information about our highly complex human brain.

So let's go back to examine language processing a little more deeply. First, our ears take in sound waves and translate them into electrical impulses that travel through nerves to different parts of the brain. The first place they go is the auditory cortex in the temporal lobe, where the sound is translated into neuronal representations (basically, your brain's "image" of the sounds). The neuronal representations are then transmitted to the areas of the brain involved in interpreting them and deciding what to do with them. In the case of speech that is only heard, the auditory cortex and Werneike's area are primarily involved. In the case of language that is read and interpreted, the visual cortex and Werneike's area are primarily involved. In the case of speech that is produced, Werneike's area transmits neuronal representations to Broca's area, which converts them into spoken language with involvement in the motor cortex. But if language and music are so similar, what is different in the way that the brain processes language and music?

Well, to begin with, language processing is fairly isolated. As we've discussed, depending on the type of language activity a person is engaging with, there are a few areas primarily involved in processing the information. In the case of music cognition, however, the brain lights up like a Christmas tree. There is activity all over the place: in both hemispheres, in all four lobes, in the cerebellum, and even in the brain stem. With the advent of fMRI, we can see which areas of the brain light up as a person is engaging with music. As in the case of language, it depends upon the way in which you are engaging with music. But the one thing that is consistent is that no matter how you are engaging—whether you are listening passively, or listening actively (listening *and* thinking about what you are listening to), whether you are hearing music with or without words, whether you are playing music, reading music, writing and composing music, or improvising music—a unique neural network lights up all across the brain. Normally unrelated areas of the brain work in synchronicity to process music, even when they do not coordinate to process any other type of information. That is pretty crazy! Even the brain stem—the part of the brain that handles automatic and subconscious processes—assists in music cognition.

So here we come to the crux of it. The human brain is an incredibly complicated computer. It handles incomprehensible amounts of information every second, and is more complex than the brains of other animals. There are two primary things that separate us from all other animals on the planet: language and music. Our brains are structured differently than are those of other animals, and it is these specialized structures that allow us to engage in language and music. But while language processing is complex, music cognition is even more complex, involving more brain regions and involving activity in both hemispheres, all lobes, the cerebrum, and the brainstem.

Beyond this, music also activates the limbic system within which emotions and feelings are processed. It is capable of eliciting sympathetic emotional response from listeners even in the absence of words, and our memory systems are intrinsically woven into the brain's processing of music. This is why music can be used to "bring back" patients with Alzheimer's[5], and why you can remember a song even if you haven't heard it for 40 years. Suddenly, you'll find yourself singing along and wondering how in the world you still have that information in there—but it's in there because the retrieval pathways were laid down in more than one way. You won't remember a poem or a story, or any other information, the way you remember music. For this reason, it is a profound educational tool: information can be entrained quickly and permanently when connected to music. Think about how many things were taught to you as a child through song, beginning with learning your letters! The A-B-C song is the most commonly taught song in the U.S. (and many other places have their own version) because it is such an effective way of teaching children to remember otherwise unfamiliar and disconnected information (the sound of each letter and the order in which they occur in the alphabet). If it is such a profound educational tool because of the effects on memory and retention, how else can music be used?

5. This video details the experience of Henry, a man with Alzheimer's Disease, who remembers who he is through the use of music.

MUSIC AND HUMAN DEVELOPMENT, LEARNING, AND WELLNESS

Due to the information that we have gained from the field of neuroscience, the use of music therapy has exploded in the past decades. **Music therapy** is the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a licensed music therapist. And because music is processed all over the brain, music therapy can be utilized to rehabilitate patients suffering from a broad host of disorders, ranging from traumatic brain injury to cerebral palsy, from learning disabilities to Parkinson's Disease. It can be used to regain voluntary movement or return speech skills when they have been lost because of a blood clot or stroke. And the remarkable thing is how genuinely effective these interventions are.

The Field of Music Therapy

It is important to talk about what music therapy *is*, and what it is *not*. Although all people can participate in music, and music teachers spend time creating music and working with students, board certified music therapists are the only individuals who participate in an allied health profession that is research-based, and that, in the words of the American Music Therapy Association, "actively applies supportive science to the creative, emotional, and energizing experiences of music for health treatment and educational goals." Music therapy is applied in either an educational or clinical context, and music therapists must hold a music degree(s) and a degree in music therapy. The degree involves clinical internship and certification by the board of the American Music Therapy Association (AMTA). Licensing involves many hours of training in order to understand which musical activities to apply in a given context, and it may be used to improve individuals' functioning, health, or wellbeing.

So why does music therapy work? Because it is a stimulus that activates every major region of the brain simultaneously. Because music processing occurs globally in the brain, it develops more comprehensive and stronger neurologic processes. According to Sharon Graham, founder and director of the Tampa Bay Institute for

Image 1.14: Here, a music therapist works with a patient who is recovering from traumatic brain injury.
Source: Military Health System
Attribution: Caitlin Russell
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Music Therapy, "Music is used as a stimulus when one encounters trauma, disease or disorder, and is the most powerful non-pharmacological tool we have to address any deficits that arise."

What is music therapy used for? The possibilities are almost limitless! It may be used for physical rehabilitation and facilitating movement, because when we hear rhythmic information, the motor cortex in our brains is activated: It is for this reason that you are compelled to move on the beat when you hear a peppy song. Have you ever noticed how people unconsciously coordinate themselves in time when music is played? Pay attention when music is playing outdoors—nearly everyone will begin to walk at the same tempo as the music. The funny thing is that they don't even realize they are doing it! The activation of the motor cortex can be utilized by music therapists to increase motor function and voluntary movement in people with Parkinson's and Multiple Sclerosis and in physically injured veterans.

Music therapy may be used to facilitate improvement of mood and reduction of depression. This works for multiple reasons, not the least of which is that music is enjoyable. However, it also works because we have an immediate physiological response to the music we enjoy. Engaging with liked music causes the release of serotonin and dopamine- neurotransmitters in the brain, which leads to feelings of happiness and well-being. It also releases norepinephrine, which can result in a sense of alertness and euphoria. The act of singing, in particular, releases endorphins—the "feel good" chemicals in the brain. Choral singing (singing in a group with others) has been shown to cause the release of oxytocin, which enhances feelings of trust and bonding and results in reduction of depression and loneliness. One study recently indicated that choral singers have lower levels of cortisol, indicating lower stress, while multiple studies have indicated that singing relieves anxiety and contributes to quality of life. And the best part is, you don't have to be a good singer to reap the rewards: A 2005 study indicated that group singing "can produce satisfying and therapeutic sensations even when the sound produced by the vocal instrument is of mediocre quality."

Image 1.15: This music therapist is visiting Renown Children's Hospital in Reno, Nevada.
Source: Wikimedia Commons
Attribution: Dara Crockett

Studies have indicated that music can be used to reduce insomnia and to reduce the perception of pain, and it can be used as part of a rehabilitation protocol after injury or surgery. One study from the General Hospital of Salzburg found patients recovering from back surgery had higher rates of healing and less pain when exposed to music. Music therapy can be used with older adults to lessen the effects of dementia and Alzheimer's Disease and it can be used to restore speech when aphasia (loss of ability to speak) occurs as a result of injury or stroke. Congresswoman Gabrielle Giffords used music therapy to regain speech after surviving a gunshot wound to her brain. Interestingly, music can also be used to reduce the symptoms of asthma, can be used in premature infants to improve sleep patterns and to increase weight gain, and can be used to help people with Down's Syndrome or Autism when speech is limited. In fact, it seems that there is little that music therapy cannot be utilized to improve. So what should we take away from all of this? That music is awesome, of course, and that everyone should engage with music actively throughout the course of their lives.

Why do (and should) humans make music?

If music can help rewire a brain that has been damaged or is limited in some way, it can also be used to create new brain growth and increase processing efficiency in all students. This is why there is a strong correlation (relationship) between studying music and higher grades in other subject areas. In 2015, the

Image 1.16: Studying music can lead to higher achievement in other areas.
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Every Student Succeeds Act replaced No Child Left Behind, and for the first time codified music as part of a core, well-rounded academic experience with which all children should be provided. The current academic environment focuses on and prizes primarily STEM subjects, but we have learned that it is actually the A in STEAM (Arts) that provides training ground for the things employers say they prize more than subject-matter knowledge: creativity, initiative, and the ability to generate new solutions to problems not previously encountered. No child should go through school without access to these subjects.

Humans have engaged in music for as long as we have written history. Even before humans had the ability to write down the music they were creating and performing, they produced written descriptions documenting the fact that they valued music. The Biblical authors wrote about people engaging in music by playing instruments, dancing, and singing. Clearly, music was a part of those ancient cultures. We don't know what that music sounded like, because they didn't have a system to write it down, but we know they were doing it.

We also know that humans have been "musicking" since *long before* written history, as evidenced by prehistoric bone flutes found in various parts of the world. The existence of these instruments suggests that music may actually have preceded formalized spoken language as we understand it, and certainly preceded writing. To put this in perspective, humans were creating and playing instruments when wooly mammoths and saber tooth tigers roamed the earth. And to make that fact even more intriguing, when researchers blew through those flutes, they heard the pentatonic scale still in use in elementary school music today. Why would those early humans have created music, when the primary objectives were to eat, not die from the elements, and not be eaten? We can't answer this question definitively, but one theory is that they were imitating the sounds they heard in nature. Another is that humans utilized music to coordinate themselves in time together (think: *one, two, three - pull!*). Yet another is that music simply feels good and touches something spiritual in humans. We will likely never know. All we can say for certain is that music is one of the things that separates us from every other animal on the planet, including our closest relatives, and that it was part of human experience before modern humans existed.

One final consideration is that it appears as though music and language acquisition skills are innately learned by humans. No one sits down with children and attempts to formally teach them to produce language or music. They simply learn those things by listening to and imitating the sounds being used in their environment. All humans in all cultures the world over uniformly amass both language and music skills simply by being immersed in an environment in which those systems are being used. And this tells us that our brains are *hardwired* for success with those two systems. Even if we didn't have fMRI scans to show us that, we can deduce it from the informal experiences of babies. Studies have even shown that newborn infants who have had no experience in the world whatsoever recognize and respond to essential musical elements. These elements, which will be described and discussed in the next section, include tonic and dominant (I and V in the scale—the two most important chords) and meter (the way beats are grouped and divided). How is it that babies' brains are able to do this with no training? *It's hardwired!*

Music and Innate Aptitude

We have all seen that some people seem naturally to have more musical ability than others. Some children seem born singing beautifully, while others struggle to develop musical skills. We tend to look at children who sing early and well, and think, "Oh, she's so *talented*." But that perception can be a little misleading, and here's why.

Researchers have indicated that there are two primary things that contribute to musical ability. One of them is **aptitude**, which is defined as the ease and speed with which your brain processes certain kinds of information. Aptitude is innate. You're born with it. It is woven into the development of the grey matter in your brain as you are developing in your mother's womb. Strangely, research indicates that aptitude is developmental until somewhere around age eight or nine. In other words, the ease and speed with which your brain is able to process certain types of information is formative until you reach age nine, at which time it stabilizes. From that point forward, you will be reliant on whatever aptitude you developed during your earliest years. This doesn't mean you can't learn to do new things or develop new skills. We can all learn to do things within whatever aptitude we possess. It just means that the ease and speed with which we work doesn't fundamentally change beyond that point.

Image 1.17: Everyone has an aptitude for music, even though some people have a greater aptitude than others.
Source: Wikimedia Commons
Attribution: User "Sungmin Yun"

Interestingly, the same is true of aptitude for language, which makes sense, because the two systems are so intrinsically similar. Research has indicated that the same developmental window (birth to age nine) exists for language aptitude. For both of these, early exposure, and early development, are critical for the rest of the life of a human being. How do we know language aptitude stabilizes at that age? Obviously, it would be horribly unethical to lock children up for the first nine years of their lives and expose them to little or no language to see what would happen. We can't do that. We do, however, have multiple stories of severe neglect that shine some light on what happens when children don't develop language aptitude while they are young.

In one particularly famous case, a young girl was born to an abusive father who kept her chained to a potty chair or in a crib, and rarely let anyone speak to her or interact with her. Because there was no interactivity with the sound system, this child did not learn to speak. When she was rescued, around age 12, she was immediately taken into custody, and teams of researchers attempted to teach her to speak. She learned the use of some nouns and verbs and was able to communicate simple things, but she never learned the complex grammar that all children innately learn simply by hearing language spoken around them and having people interact with them using language. In fact, researchers estimate that all she could achieve was the basic communicative ability of Koko the gorilla (who had limited ability to form compound or complex thoughts, and did so with sign language). Why was this? Because a child's aptitude for certain kinds of processing is developmental, and is developed, during the first years of life. Once that developmental window closes, the child is working with established aptitude.

In another famous case, a child was kept contained in a room with a television on all day. The child was hearing language spoken regularly, but by abstract people on the television. In other words, no one was interacting with the child while using language. Interactivity is critical—just *hearing* language isn't enough. That child did not learn to speak just by listening. In the same way, music aptitude is not developed simply by listening. Children must hear others around them singing and see them moving rhythmically, and others must interact with them as they do these things.

In addition to aptitude, the thing that most determines a person's skill is **achievement**. This is what an individual *does* with the aptitude they have. Do they learn to sing and play an instrument? Do they learn to read and write? Do they regularly engage in creating music? If the answer is yes, then chances are, their achievement (or skill) will be relatively high. Does high innate aptitude automatically mean a person will have high achievement? No. There exists only a correlation between the two variables—not a causative relationship. A child may be born with lower aptitude but work her entire life and emerge as a person with relatively high skill after years of training. By the same token, a child may be born with relatively high aptitude but never engage with it or use it. That child is likely to have much lower achievement than the one who worked at it. Interestingly, the same seems to be true of language.

And in both cases, there is no such thing as a person with *no* aptitude. I've frequently heard people say: "Oh, I can't sing." My usual response is: "Yes, you can. Everyone can." Usually when people make statements like that, what they actually mean is: "I don't sing *well*." But our society has robbed so many people of their birthright by fooling us into thinking that music is something only the most talented and skilled should do while everyone else watches, and, as a result, these people believe their aptitude is so low that they just shouldn't do it. Knowing what we do about music and the brain, and about the benefits of engaging in music over the course of a lifetime, this is a pretty tragic thing! If I told you that simply singing, reading music, playing an instrument, or writing music over the course of a lifetime could decrease the likelihood of developing Alzheimer's when you are older, would you change your mind about whether or not you should pursue it? (I hope so!) All humans have aptitude for music and for language. This aptitude is generally distributed along a bell curve. There are people with higher aptitude and people with lower aptitude. But none of us have no aptitude, because it is a matter of our brain structure.

In fact, they had to search the world over to find only ten or so people to participate in a study in *amusia* (a condition in which the brain simply doesn't organize musical sounds into meaningful patterns). In people with amusia, the brain takes in sound, but it is disorganized and the individual can't perceive the structure. In other words, they don't hear music, they hear *noise*. While a normal individual might hear a beautiful symphony, an individual with amusia might perceive the sounds of New York City on a busy day. Obviously, both people *hear* the same thing, but one person's brain organizes the sound meaningfully into melody, harmony, phrases, meter, and other elements, while the other's brain doesn't organize it at all. What a terrible thing! Can you imagine not being able to listen to and enjoy music? Not being able to play a song back in your mind? Not being able to tap on a beat because your brain doesn't perceive the organization of meter and rhythm? Imagine how colorless life would be! Fundamentally, what I am telling you is this: *Of course you can sing and learn to play an instrument, and learn to read or write music*. Do you know how I know? Because you can listen to and enjoy music. Your brain is organizing the sound, which means you have the fundamental capacity to engage with it.

Music and Human Flourishing

So what does all of this together tell us? Music is important to the human species and always has been. Though you may remember a poem or a story, the way you remember words differs from the way you remember music. This difference is why music, like literature, belongs in the curriculum. Because information can be entrained quickly and permanently when connected to it, music is a profound educational tool. It is something that engages all areas of the brain at once, and no other activity does that.

Image 1.18: It's never too late to get involved in music!
Source: Flickr
Attribution: Garry Knight
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Music can be used to train and grow the brain and build connections between areas, or to rehabilitate and heal individuals. It assists in the formation of long-term memories and in the retrieval of stored information, increases processing efficiency in other modes of cognition, and assists the brain in coordinating normally unrelated brain regions. It is for these reasons that music is one of life's most miraculous phenomena. It has probably been with us for the totality of our existence as a species. And despite the fact that there are a limited number of pitches and rhythmic patterns, people throughout history, in every corner of the globe and every culture ever recorded, have engaged in the creation and performance of music that is unique to them. It truly is part of our human birthright and deserves to again take its place as a *critical curricular offering* in all of our schools.

And you know what else? Even if you didn't learn to read music, sing, or play an instrument while you were in school, it's not too late! Researchers tell us that you can begin at literally any point in life and still see benefits. It truly isn't about how well you do it—it is that you regularly do it over time. So go join an ensemble or find some private lessons!

RESOURCES FOR FURTHER LEARNING

Print

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Murph, Megan Elizabeth. "Max Neuhaus, R. Murray Schafer, and the Challenges of Noise." Ph.D. dissertation, University of Kentucky, 2018.

Patel, Aniruddh D. *Music, Language, and the Brain*. Oxford University Press, 2010.

Sacks, Oliver. *Musicophilia: Tales of Music and the Brain*. Revised and expanded edition. Vintage, 2008.

Online

American Music Therapy Association: https://www.musictherapy.org/

Alive Inside documentary: http://www.aliveinside.us/