



WHAT HAPPENS IN YOUR BRAIN DURING A CONCERT?

Claire Meissner-Bernard^{1*} and Boris Gourévitch^{2*}

¹Sorbonne Université, INSERM, CNRS, NeuroSU, Paris, France

²Université Paris Cité, Institut Pasteur, AP-HP, INSERM, CNRS, Fondation Pour l'Audition, Institut de l'Audition, IHU reConnect, Plasticity of Central Auditory Circuits, Paris, France

YOUNG REVIEWERS:



CHARLOTTE

AGE: 9



ELEANOR

AGE: 11



ELIZABETH

AGE: 13



**GRADED
THE
AMERICAN
SCHOOL
OF
SAO PAULO**

AGE: 15

Humans have been making music for tens of thousands of years. But what happens in your brain when you listen to your favorite band or musician? In this article, you will follow the journey of sounds from the ears to the brain, where different regions work together as you listen to music. Music involves many brain functions such as sound processing, memory, emotions and movement. You will also discover that the brain can learn to recognize familiar patterns in music, which may help explain why music can make us feel happy, sad or even excited. Finally, you will explore what happens in the brains of the musicians when they play their instruments.

**MAX****AGE: 11****NOTE**

A single sound in music. Notes are combined to create songs or musical pieces.

SOUND

Vibrations that travel through the air—but also through water or solid objects—and can be detected by special cells in animals.

FREQUENCY

How fast something vibrates. The frequency of a sound determines its pitch—how high or low you perceive it.

PERCEIVE

How you interpret information from your senses. For instance, if a flute plays a sound, you perceive, among other things, the pitch and loudness of the note.

THE LANGUAGE OF MUSIC

Music is an important part of human life: a prehistoric bone flute found in Slovenia shows that humans were already making music 50,000 years ago! Imagine yourself at a concert by your favorite band or musician. Many things are happening in your brain as you enjoy the music. Let us first describe the main components of music. In simple terms, music can be thought of as a language common to all civilizations. The musical “letters” are **notes**, and each note corresponds to a specific **sound**. A sequence of notes becomes a melody. Notes are also organized in time, giving music its rhythm. Different notes are usually played together (chords), and these notes can originate from the same instrument or multiple sources such as a singer and a guitar. How can the brain make sense of all these different sounds? In the rest of this article, you will first learn what sounds are and how they can be translated into the brain’s language. Then, you will discover how musical information is processed by different parts of the brain.

HOW MUSIC IS TRANSFORMED INTO BRAIN SIGNALS

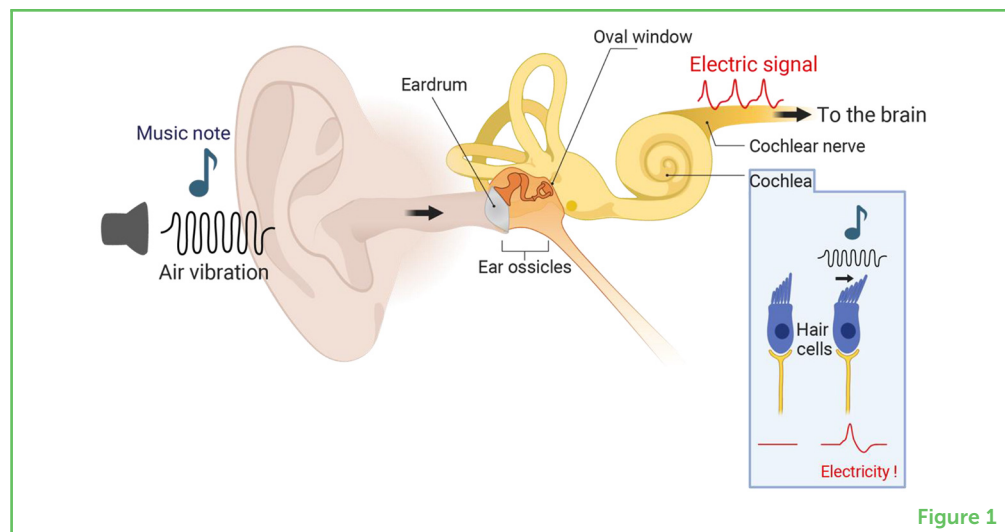
During a concert, sounds are produced when musicians make the air vibrate with their instruments. Similarly, if you touch the membrane of a speaker while it is playing music, you will feel it vibrate! The faster the vibration, the higher the **frequency** of the sound—and we **perceive** it as having a higher pitch. Note that two instruments, like a violin and a flute, can play the same note, yet sound very different. This is because, in addition to the note’s main frequency, instruments also produce extra vibrations at 2, 3, 4 (and more) times that frequency. These higher-frequency sounds, called harmonics, give each instrument its unique “color” or timbre.

Your brain is made of billions of cells called neurons, which process the world around you using electrical signals. To interpret sounds, the brain must therefore transform air vibrations into electrical signals, similar to a microphone turning sound into an electrical signal. This transformation happens thanks to a specialized structure located at the back of the ear (**Figure 1**). First, the air vibrations hit a thin membrane called the eardrum. Next, a tiny chain of bones, called the ossicles, makes the eardrum’s vibrations stronger and passes them on by pushing a small membrane called the oval window, which leads into a snail-shaped organ called the cochlea. Inside the cochlea, tiny hairs move with the vibration. These hairs belong to a special type of cells—the hair cells—that can transform the hair movements into an electrical signal [1].

What is already remarkable at this stage is that low- and high-pitched sounds reach distinct parts of the cochlea. However, the hair cells in your ears are very fragile and can be permanently damaged by loud

Figure 1

Music is a succession of air vibrations. These vibrations reach the ear, which transform them into an electrical signal that can be processed by the brain.

**Figure 1**

AUDITORY SYSTEM

The sensory system responsible for your ability to hear. It consists of cells in your ears and brain that process sounds.

sounds over a long time or by natural aging. When this happens, the high-pitched sounds are usually lost first, which can make music and speech seem dull. The electrical signal from the hair cells then travels to the brain through the cochlear nerve. The **auditory system** is a very fast sensory system. Information travels from the ear to the brain in less than 25 milliseconds! That is as fast as a light bulb turning on when you press the switch!

OBSERVING BRAIN ACTIVITY

Even though you hear with your ears, it is your brain that makes sense of sounds. Scientists use special machines to see which parts of the brain are very active at a given moment. They can measure changes in blood properties inside the brain—without opening the skull—while a person is listening to music or even playing an instrument. Blood carries oxygen to brain cells so that they can function properly. When more cells are active, blood flow increases. This technique is called **functional magnetic resonance imaging**. With this and other tools, scientists can explore not only how we perceive music, but also why music makes us feel emotions and why we remember some musical pieces better than others.

HOW THE BRAIN INTERPRETS MUSIC

Signals from the ears are first processed by brain regions specialized in sound processing, and notably the auditory cortex, which is located just under the skull above your ears (**Figure 2**). Thanks to the auditory cortex, we can identify the pitch of instruments, follow rhythm and melody, and tell where music is coming from. Not everyone has the same ability to process sounds. For example, musicians and blind people have a particular focus on sounds, which can cause changes in the auditory cortex over time. Note that if you are watching and

not just listening to a concert, your brain also links what you hear with what you see. Try this: when you focus on one instrument in a band, you can hear it more clearly based on clues like its unique timbre, its location in space, and changes in sound that match the musician's movements.

Figure 2

Many different regions of the brain work together when you listen to music. The auditory cortex processes musical information, while the amygdala, hippocampus, and prefrontal cortex help you remember music and feel emotions.

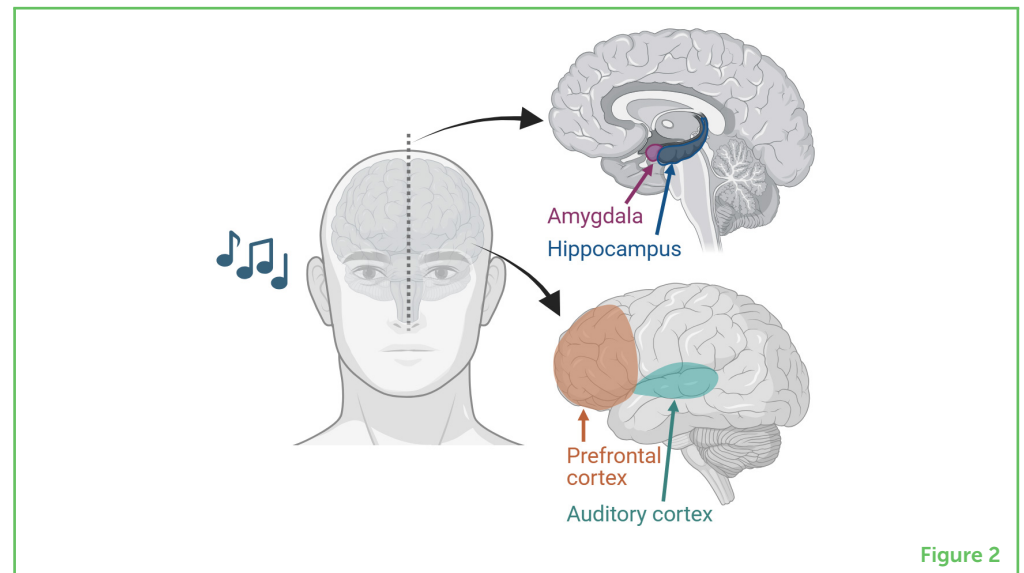


Figure 2

EXPECTATION

What you think will happen next. For example, if you see many clouds in the sky, you might expect it to rain soon.

MUSICAL PATTERN

A specific organization of notes. For example, clapping twice and then snapping your fingers once forms a musical pattern when repeated.

STATISTICAL LEARNING

Your brain's way of figuring out patterns without you even noticing, like learning what comes next in a sentence or a song just by hearing people speak or sing.

HOW MUSIC INFLUENCES YOUR FEELINGS AND BODY

Music has the power to evoke strong emotions [2]. Some pieces will make you happy, while others will bring tears to your eyes. But how can a succession of sounds evoke such emotions? One idea is that musical **expectations** play a big role. You can make some guesses about what will happen next in a piece of music because you have heard similar **musical patterns** before. For example, in a melodic pattern, certain notes often follow each other; and in a rhythmic pattern, notes have a similar organization in time (think of a drummer in a rock song). When you listen to music, your brain can recognize and memorize patterns that occur regularly. This is called **statistical learning** and it also applies to language.

What is the link between statistical learning, expectations, and emotions? Well, as we said, when you hear a sentence or a new piece of music, you tend to guess what will come next. Depending on whether your guess is right, wrong, or delayed, you will experience pleasure, boredom, tension, or suspense. Let us first take an example from language: hearing "red sugar" might sound more surprising and disturbing than "white sugar" because it is not a familiar pattern. Now imagine the singer suddenly singing out of tune during the concert: this typically feels unpleasant, in part because the note is unexpected and does not belong to the set of notes you are used to [3]! In your brain, two regions—the amygdala and the prefrontal cortex—are particularly involved in processing expectations

and handling emotions (Figure 2). It turns out that they are in close communication with the auditory cortex!

Emotion-related brain areas also connect to parts of the brain that control bodily functions like heart rate, breathing, and digestion. This helps explain how emotions can have strong effects on the body. You can experiment with it yourself: take a stopwatch and measure your heart rate. Then listen to a piece of music that makes you feel sad and measure your heart rate again. Is there a difference? Sad music can sometimes slow your heart rate and even dry your skin! Furthermore, the next time you listen to sad music, recall how you felt beforehand—many people tend to listen to sad music when they are sad. Conversely, when people feel like dancing with friends, they usually listen to fast, rhythmic music. Your feelings and musical choices are tightly interconnected!

HOW THE BRAIN REMEMBERS MUSIC

You probably noticed that you can remember a song or a piece after hearing it just a few times. Scientists are still figuring out how melodies are learned and stored in the brain, but one region, called the hippocampus, is thought to play a key role in this process (Figure 2). For example, a piano player can sometimes play around a thousand notes per minute and remember them all by heart! The brain likely manages this by making use of the regular patterns we mentioned before (e.g., repeating rhythms or sequences of notes). Since you cannot remember everything, you select what seems most important to you. Think about this: you probably remember the melody more than the exact instruments playing along with it. Research also shows that things that are deeply emotional, scary, happy, or surprising are best memorized [4]. Music evokes strong emotions, which might explain why we can remember so many songs. This also shows that brain regions involved in emotions and memory closely work together.

HOW THE BRAIN CREATES MUSIC

In the brains of the musicians you listen to, additional regions are activated [5]. When playing an instrument, musicians move and coordinate different muscles of their arms and bodies, which involves several brain regions like the motor cortex and cerebellum (Figure 3). The movements they make on their instruments, such as strumming guitar strings, create the famous air vibrations that reach your eardrum! These movements can also involve the sense of touch and the somatosensory cortex when, for instance, a guitarist applies their fingers on the strings. Furthermore, when musicians read a sheet of music, they use the sense of sight, which activates the visual cortex (Figure 3). Musicians rely on what they read on the sheet and what they hear to adjust their subsequent movements, and this

illustrates the need for the visual, auditory, and motor systems to work together. Scientists do not yet fully understand how different brain areas communicate. One idea is that groups of neurons in one area can fire together in rhythm, and in this way they activate groups of neurons in another area.

Figure 3

Many different regions of the brain work together when a musician is playing. Movements are generated by the motor cortex and cerebellum, touching the instrument involves the somatosensory cortex, and visual information from the sheet of music is processed by the visual cortex.

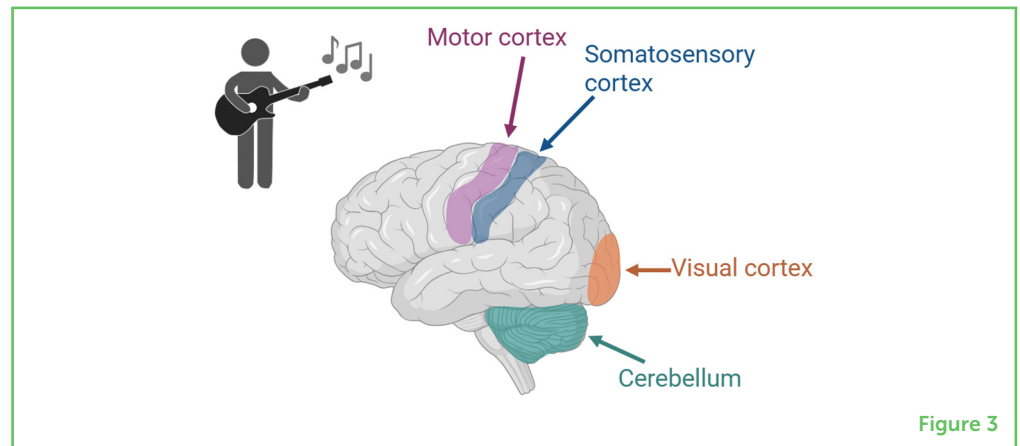


Figure 3

TAKE-HOME MESSAGES

During a concert, musicians create sounds—air vibrations that are transformed in your ears into electrical signals, the language of the brain. In a piece of music, these sounds often form patterns that are thought to generate expectations, trigger emotions, and help us remember melodies. Listening to music is a complex process, involving many brain regions that work together, just like the musicians who are playing! Therefore, studying how humans process music helps scientists gain a deeper understanding of how the brain works.

ACKNOWLEDGMENTS

Figures 1 to 3 were created with biorender.com. This work was supported by the “Fondation pour l’Audition” (FPA IDA03) and the Agence Nationale de la Recherche “FATIGAUDIT” (ANR-21-CE34-0012).

AI TOOL STATEMENT

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

REFERENCES

1. Hudspeth, A. J., and Corey, D. P. 1977. Sensitivity, polarity, and conductance change in the response of vertebrate hair cells to controlled mechanical stimuli. *Proc. Natl. Acad. Sci.* 74:2407–11. doi: 10.1073/pnas.74.6.2407
2. Koelsch, S. 2014. Brain correlates of music-evoked emotions. *Nat. Rev. Neurosci.* 15:170–80. doi: 10.1038/nrn3666
3. Meyer, L. B. 1956. *Emotion and Meaning in Music*. Chicago, IL: University of Chicago Press.
4. Dolan R. J. 2002. Emotion, cognition, and behavior. *Science* 298:1191–4. doi: 10.1126/science.1076358
5. Zatorre, R., Chen, J., and Penhune, V. 2007. When the brain plays music: auditory–motor interactions in music perception and production. *Nat. Rev. Neurosci.* 8:547–58. doi: 10.1038/nrn2152

SUBMITTED: 10 January 2025; **ACCEPTED:** 11 November 2025;
REVISED: 19 September 2025; **PUBLISHED ONLINE:** 03 December 2025.

EDITOR: Jazmín Cevalco, University of Buenos Aires, Argentina

SCIENCE MENTORS: Analía Arévalog, Paola Angelini, and Tom Parry

CITATION: Meissner-Bernard C and Gourévitch B (2025) What happens in your brain during a concert? *Front. Young Minds* 13:1558659. doi: 10.3389/frym.2025.1558659

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

COPYRIGHT © 2025 Meissner-Bernard and Gourévitch. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

YOUNG REVIEWERS

CHARLOTTE, AGE: 9

My name is Charlotte, I am 9 years old and will be going into 4th grade. I enjoy soccer, swimming, and finding four leaf clovers and have found 77 so far! In school I love art, reading and writing.



**ELEANOR, AGE: 11**

My name is Eleanor I am 11 years old and will be going into 6th grade. I enjoy soccer, swimming and musical theater. My favorite subject in school is English language arts and I love to read especially the City Spies series. Some of my favorite hobbies are catching lady bugs and cooking for my family.

**ELIZABETH, AGE: 13**

Hi! I am a fun, dynamic, curious girl. Every opportunity is a new adventure: how to say no??? from climbing mountains, to diving into the sea, or diving into science, I want to try, explore and understand everything. I love swimming, skiing, reading, theater shows, traveling And I am sure the list will get longer and longer the more I explore. I am calm and peaceful, but I always say my opinion and I like a good debate. I look forward to use this skills as a reviewer, and learn a lot.

**GRADED THE AMERICAN SCHOOL OF SAO PAULO, AGE: 15**

We are a class of Neuroscience students in Sao Paulo, Brazil. We are enthusiastic about learning about the brain and behavior and are excited about reviewing a scientific article!

**MAX, AGE: 11**

My name is Max, I am 11 years old and will be going into 6th grade. I enjoy reading, hanging out with friends and fishing. My favorite hobbies are theater and gymnastics. My favorite subjects are math and English language arts.

AUTHORS**CLAIRE MEISSNER-BERNARD**

Claire is a young scientist fascinated by the brain and currently combining teaching and research at the Sorbonne University in Paris, France. She focuses on how information is stored in the brains of vertebrates, but she also studied how sounds are processed in the brain, and how exposure to different musical traditions influence musical expectations. In her spare time, she enjoys playing the piano.

*cmeissnerbernard@gmail.com

**BORIS GOURÉVITCH**

Boris is a senior scientist long interested in how long-term exposure to noise or music can impact not only the ear but also the brain, for instance in its way of responding to new sounds. He is currently doing research in Paris, France. In his spare time, he enjoys playing the saxophone in the oldest concert band in Paris.

*boris@pi314.net