Music for solo world

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I spent six months as a Fulbright Visiting Scholar at Rice University, Houston, TX from January till June 2008. I worked in the Digital Media Center and used a concordancing tool to search for idiom This work was written for the World Music Pro-Seminar at the Wesleyan University. World Music in this context does not mean the music-brand that collects all different folkmusic on one shelf of a music store. World music at this seminar meant that we discussed articles that were connected to any kind of musical experience all over the world. Beside that, the title refers to a piece of Alvin Lucier, one of the legendary composition professors at the Wesleyan. In his early experimental work „Music for solo performer" Lucier was using the performer`s – mostly his own – brain waves and transformed them to a sonic experience.

The basic idea behind this paper is to compare the results of scientific music-brain researches with a composer's (myself) subjective definition of „music".

In 2001, I wrote my thesis paper at the Liszt Ferenc Music Academy in Budapest about „Inherited Music"[1]. It was a study about the potential differences between sound and music. - In that work I divided the common music-definition into two parts. I called all of the physical resonances „inherited music". By this I meant the part of a musical experience that exists in the outer world, that is to say every resonance that hits the ear and we (any of us) call it music. I call it inherited, because it is something that we receive from outside therefore it is not part of our inner world. However, musical experience has additional components that certainly happen inside the humans' body. I called these „personal music". By this I mean all of the emotions, memories, biological and biochemical processes that are attached to inherited music. A human's musical experience is the sum of these two. I wanted to find the difference in the material of these two types of resonances. I went through the different traditional building blocks and layers of music to see if any of them is ultimately needed to call a resonance „music". Of course, I was not able to find anything that could elevate any of the sounds to what could be considered as a mandatory musical element.

During my years of education I was told several times what constitutes an appropriate musical sound and what does not and what material can be used in a musical environment and what not. I knew that the western world – the western musical tradition as a unity and collective of a permanently developing musical system – has already delivered those revolutionary compositions and writings of the twentieth century that liberated the musical material from this school of thought. I wanted to confront my beloved teachers with these facts. Alas, they have not rewarded my endeavors very much (cum laude).

I found the definition of theater by Peter Brook a good analogy:

"I can take any empty space and call it a bare stage. A man walks across this empty space whilst someone else is watching him, and this is all that is needed for an act of theatre to be engaged." [2]

Following the analogy, any space can be a musical space as soon as someone is listening to what is going on there as music. However, I strongly felt that there must be some kind of proof that listening to music is different from listening to sounds. I decided to investigate this subject in the field of brain research.

The specific scientific area that studies the connection between brain and music is called „cognitive neuroscience of music".

Cognitive neuroscience is a blended academic research area, where scientists are examining the neural substrates of different mental processes. Neurosciences and psychology were the two origins of this field. During the past two centuries many sub-territories were formed with similar research areas such as cognitive psychology or psychobiology. Cognitive neuroscience is used since the 1990`s, when cognitive psychophysiologists started to use the functional MRI (fMRI), which is a specialized type of magnetic resonance imaging (MRI). This is a brain scanning technique that is able to detect and measure the different haemodynamic responses in the brain. This method allowed psychophysiologist to have a visible picture of the cognitive processes in the human brain. On the fMRI images one can see which part of the brain is active, as active neurons need more oxygen than inactive ones. In the activated area the blood flow increases in order to carry more hemoglobin, which carries the necessary oxygen. The only problem with this investigation is that there are several cognitive processes located in the same place. This is why it is challenging to find the exact location of musical processes in the human brain. There are other neuroimaging techniques as well, but fMRI is still the most popular due to its low invasiveness, lack of radiation exposure, and relatively wide availability. Researching music and analyzing the measurable brain activity that music triggers is a very popular cutting edge territory in cognitive neuroscience today. Scientific observation of the musical processes in the human body has older origins, however.

Herman von Helmholtz, a German physician, physicist, physiologist, physiological psychologist and philosopher had many important theories about hearing and the perception of pitches. He provided the first mechanical model of the cochlea, the auditory portion of the inner ear. Helmholtz had strong ideas about the physical background of consonant and dissonant sounds based on their harmonic structures. He published his studies about the sound perception in 1863 with the title Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik [3] (On the Sensations of Tone as a Physiological Basis for the Music Theory). In chapter XIII. he compares the physical and the aesthetical principles of music. He introduces that in the following way:

„In the whole of this research we have dealt solely with natural phanomena, which present themselves mechanically, without any choice, to all living beings whose ears are constructed on the same anatomical plan as our own."

[4, *p.234*]

In the rest of the chapter he describes different „homophonic“ musical cultures from the ancient Greeks to Arabic music and he introduces the concept of modal harmony. He understands and explains the different tuning systems and intervals of these traditions as well. He wrote his book in the same year when Wagner was in Vienna for the premiere of Tristan und Isolde (which was judged to be „unplayable“ by the musicians, so the performance was cancelled), when Hector Berlioz was able to finally present the whole Les Troyens à Carthage, Liszt wrote the Les Preludes and Brahms became the choir conductor at the Wiener Singakademie.

Although Helmholtz was certainly an original and open-minded scientist, he lived in a time when the relationship between „music“ and other „sounds“ was quite well-defined. Today we know that several musical traditions existed that did not fit into Helmholtz`s theories. An example would be the „ganga” a southern style of the Bosnian vocal tradition where two people or two groups are singing melodic lines in a close distance (approx. major or minor second). Before the last cadenza - exactly where there is usually a dominant chord in the western tradition – they close on unison, but than, as a final consonance, they open up again to a second, which has a richer timbre than the relatively thin unison. The energy that a close interval creates can give that „consonance“ what that particular musical style needs. Another example could be the traditional vocal music of Lan-yu. Lan-yu is a small island between Taiwan and the Philippines. Part of their songs are moving inside an approximate major second. Occasionally the people in the village are singing together. Men are singing relatively high and women are singing relatively low, so they are able to sing in the same major second range, and not in octaves as in many other traditions. The octave is an important phenomenon in many musical traditions, and it has useful theoretic aspects. When we hear two pitches in octave distance it sounds somehow similar. Usually we think that if a male and a female singer sing the same melody in a same kind of technique the result will be an octave. It seems that for the Lan-yu people that sound has a distance, so they rather sing in „real“ unison even if the male and female sound-producing techniques, the position of the vocal chords…etc are more different. I think this is an automatic decision made by their ears.

Of course many things have changed in the western music since Helmholtz. The sounds of the world and those of music have all changed a lot. After all music has slowly become a new unity, where all the separated traditions are affecting and touching each other. Western listeners have become a part of their own personal buffet-tradition that is slightly independent from their nationality. Everyone of us chooses something from the all-you-can-hear table, usually something that our friends are choosing. The effect caused by sound recording and musical globalization is not a new issue anymore, since generations of Leipzigers are being raised with „natural” knowledge of flamenco, and Texans know all about Hindustani music. In this summer I was working on a theater show in Ireland with selected members of the Youth Theater Association, the participants, ages 17-19 coming from all over Ireland. One evening I collected their mp3 players to upload materials for them to memorize. I scanned through their playlists and songs, and I found an amazing diversity of sounds. So-called musical styles and ancient traditions have formed a natural diverse unity with each other, with the only similarity being the use of an earplug, in order to listen to them. As I had the chance to improvise with the participants I recognized that this wide knowledge of different sound ideas have become a part of their everyday musical tradition. They are creative performing artists and most of them are musically educated. One can say that this is a limited and segragated example, but I think that the same existence of a private global tradition could be detected anywhere in the western part of the world.

The science scene today is also quite different from 1863. Cognitive neuroscience of music have become a very popular field in the past 20 years. Plenty of articles have been published about music and brain. Books have been written for the wider public to summarize the results of the different research. One of the most popular of them is the New York Times bestseller that came out at the end of 2007 by Daniel J. Levitin under the promising title This Is Your Brain On Music - The Science of a Human Obsession [5]. A second book The World in Six Songs - How the Musical Brain Created Human Nature [6] followed this in 2008 by the author.

Levitin, beside being a scientist and a professor at McGill University, has worked as a recording engineer, producer, sound designer and stand up comedian, he wrote jokes for Jay Leno and the comic strip Bizarro, but for shorter periods of his life he worked professionally as an automobile mechanic, graphic designer, typographer, chauffeur, product manager, data analyst, dishwasher, computer operator, television repairman, and wood stove salesman. He writing is clear and amusing. He provides plenty of information about the human brain and its predictable and usually measurable responses to musical activity. I cannot tell if he is right or wrong in his scientific findings, but as a composer I find some of his statements arguable. In the chapter called *Anticipation* he writes about tonal expectation and he shares the following idea:

„Modern composers such as Schönberg threw out the whole idea of expectation. The scales they used deprive us of the notion of a resolution, a root to the scale, or a musical "home," thus creating the illusion of no home, a music adrift,

perhaps as a metaphor for a twentieth-century existentialist existence (or just because they were trying to be contrary).“
[5, p.114]

Although I am not the biggest fan of the music of Arnold Schönberg and I do not consider his music as the holy origin of „Neue Musik”, I know that his idea about the twelve tones was a necessary and very important step in the development of western music that led to the final liberation of the hierarchic relationship between the resonances of music and those of other sounds. I always wondered why it has taken about 150 years until someone came up with the idea that all of the pitches has the same relationship to each other, when the actual physical appearance on the piano was already equalized.

To say that modern composers are throwing out the idea of (tonal) expectation seems as silly to me as to say that gothic composers, like Leoninus has thrown out melody, or that composers of the Manheim school, e.g. Stamitz expelled the beauty of ornamented music from their work.

This is only one example when I feel hat there is a gap between what neuroscientists think of music, how they define what music is, and what my idea of music is. To me Schönberg and other modern composers have perhaps slightly shifted the levels of tonal expectation and have changed a few things in their traditional way of writing music, but they still wrote music that is much closer to Mozart than what the bigger part of the musical universe has created, including modern electro dance music, Lan-yu or many other ethnic examples.

To mea greatand importantmusical experiencewas to read the *lecture on nothing* [7]. by JohnCage I was 17 years old, whenhis writing gave me a possibility to open upmy ears. This is an important part of my personal musical tradition. By the way, it hasnot much to do with tonalexpectations.

Let me put aside these differences between the various conceptions of music and continue the investigation from another angle.

My son is 6 months old. I think he is very interested in sounds and is usually curious about my musical ideas. I have two basic tools for making music when we are playing. Whistling and snapping. I am not always able to catch his attention with them, but these are the tools that work the best. When I whistle, I often use different bird-like signals and free glissandi, without any context of scale, melody, or any concept of a periodic time structure. He really enjoys them just like someone enjoys music. When I snap, I usually play simple complementary pulsations both of my hands. When I slowly start to accent the sounds of one hand and make a hierarchical pulsation, my son looks at that hand even if I do not make any extra arm movement. When I slowly shift the dominance to the other hand, he turns his head there and focuses on that hand. It is the same if I hide behind him and he cannot immediately see my hands. I would describe both of his experiences (listening to my whistling and snapping) as „music”. I can not find anything identical in these two sound creations, except that daddy is doing them.

As far as I can judge, he gives different responses to musical sounds. He is moving his body (physical response), smiling (emotional response) and turning his head into different directions, following the rhythm (intellectual response). Of course, this is not a strict scientific experiment, but is a valid piece of experiment nevertheless.

If I examine this short example I can find a few basic difficulties that any musical research confronts. How can we examine music in human brain if:

1. The sounding material of music is very diverse.
2. The different responses of the listener are not necessarily given to the music. (My son smiles, moves and turns his head as a response for other, non-musical events as well.)
3. Sometimes the same music triggers a totally different response.

At times, I whistle and snap „in vain“. My musical intention never reaches its aim. My son is not interested at the moment. Something similar could happen to all of us. Just imagine, that you are driving home, and you turn on a music piece (from loudspeakers usually), something you used to like to listen to. You let it roll for 5-10 minutes, but than you concede that it is not what you need right now. You turn it off. It was certainly the same set of timbres, rhythm, carstereo…etc. as when you listened to it before, but it is obvious that in that particular moment it would not provide you with any musical experience. You are not the same. The sound of the running engine, with a few low frequency accents as you hit the dividing line of the emergency lane on the edge of the highway is a much more suitable auditive experience for you.

A child has still slightly different hearing than an adult. He can hear much higher and also less lower frequencies than us. His brain is not as wired yet; his habits and preferences are not clearly formed and patterned in his brain yet. The adult brain has much more expectations, so-called top down processes, than a child. It also means probably that a child has a more fresh and direct relationship to sounds. (This holds true even if we know now that children may be born with musical preferences based on their in utero auditive experiences. Alexandra Lamont`s ingenious study [8] shows that children will unfailingly prefer those songs at the age of one that were played for them in the womb every day. They are able to chose the one song out of many similar ones and will prefer to listen to that.)

I never snapped or whistled to my son daily through his gestation so I have not „pre-wired” him. I may be wrong but I see his case as an average example of music listening. His reactions to whistling and snapping have consistently been the same since the first time I was doing them. (All my other attempts of having some kind of musical activity have met with less interest on his part. That is why these two remained on the repertoire.)

What is so far known about the musical and sound experiences of the human brain is briefly the following: sounds are being distributed throughout the entire human brain, almost. Practically every important part of the brain is responding one way or other to a sound experience. The resonance that is percept by the ear is devided into frequency bands and being transformed into electrical information after the cochlea. The information is carried afterwards to the primary auditory cortex, known as the Broadmann area 41 and 42. The information then is partly provided to different areas mainly in the temporal lobe. This is the path that every sound makes in the auditory system, independently of its content. The mind always wants to identify the sound and it produces different answers to the sound. For example, if one hears a familiar sound and recognizes it as the sound of a violin, then a part of the brain where all information connected to the cognitive concept of the violin is stored will be activated. Depending on what information is stored in the brain connected to a particular sound, we will act in certain ways. If we recognize the sound as a violin, we may delight in it. If we think it is a lion, we may start running, especially if we are in a jungle, and not in the movie theater. If the sound sequence contains periodic rhythmic elements then the cerebellum (the lateral cerebellum and the vermis) is involved. Cerebellum is traditionally said to be the most important part of sensory perception, coordination and motor control. Different areas in the cerebellum are activated if you studied a particular instrument that is being played by someone else. If the sound contains a recognizable melodic line, or any pitch material, then plenty of new territories are opened up. The pitch perception is an important and very useful research area since Helmholtz, and it has gotten some fascinating results. Based on an fMRI image we can tell what is the exact single pitch that someone is listening to, and what is the chord progression that you are familiar with. The brain has different activities when you suddenly hear a „strange" chord in a familiar tonal cadence, and so on. This is a huge and wonderful territory of neurosciences. As far as I experimented, I can listen to a particular pitch or series of pitches and may be able to recognize a familiar melodic line without having musical enjoyment. A few days ago I had a strange experience with a single pitch. It was a single note, which was sounded on a piano and was played by Dan St. Clair. He, Andrew Greenswald, Marcelo Rilla and I were performing a Falling River piece by Anthony Braxton. It was an open form improvisation based on Braxton's graphic score and his language music system.

At the end of the piece Dan was playing on the strings, inside the piano. If you improvise, you usually know when a piece is „done". It is clear that the process, or your thought, has reached a point of rest where you can finish the improvisation, or at least suspend it until the next performance. We arrived to a moment like that. I think that I would have felt the same if I were sitting in the audience and not standing on stage with my instrument, always moveless. We were hanging in that few seconds of emptiness that a music piece can leave behind. I felt that the piece was over. We released our concentration and arrived back to a non-musical state of mind. Dan pulled his hands back from over the strings, and released them down, but he accidentally hit one key on the piano. It was a high pitch. To me it was a nonmusical event, although it was played on a piano. Andrew, however, said afterwards that for him it was definitely a musical event, because his ears were still open for continuing the concert. The same phenomenon can happen many times over: two people are listening to the same thing, and while it is music for one of them, it is nothing more than accidental noise for the other.

It seems to me finally, that the music I am searching for in the brain is something to do with emotions. Music then must be a feeling/emotion that can be attached to certain sounds. I have tried to understand the neuroscientific basis of this idea.

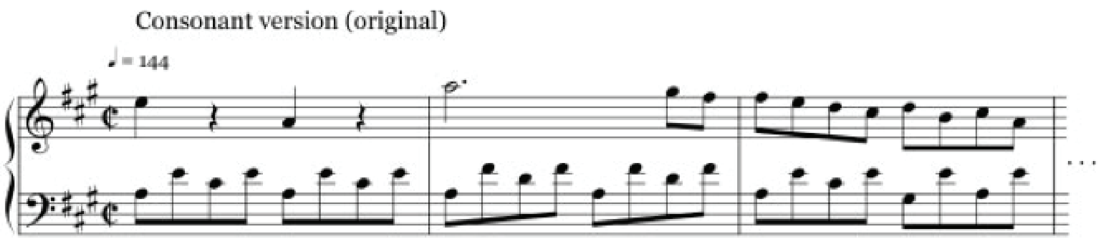
I was very exited when I found an article from 2006 in the Brain Magazine. It was called: Emotional responses to unpleasant music…[9] It is maybe something, that correlates with my idea, Someone knows that there is something that we call music but we do not like, or do not perceive it as music in a certain moment, although it is used to be called music by other ones. Maybe there will be someone in a big white gown, who will say:

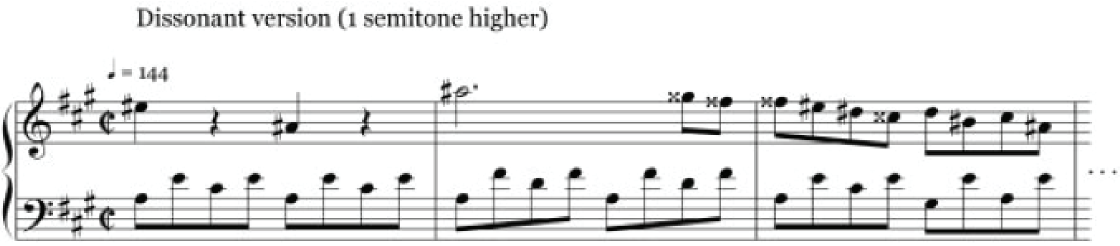
"Yes, music is what you think it is; you may like it and then it is music, or you may dislike it and then it is not music to you. It is different to all of us, depending mostly on what you have on your personal buffet-tradition plate; you know, the one you took from the all-you-can-hear table. Hey, if you want, you can try out some more. Maybe you will like it…"

The article about the unpleasant music starts like this:

"Although musical preferences may vary across individuals, most ordinary listeners readily recognize that playing two adjacent keys on a keyboard, forming a minor second in musical terminology, constitutes unpleasant musical experiences. These musical experiences are elicited by dissonance."

The article is about an experiment where „dissonant music” was introduced to normal people and to people with brain damage, whose parahippocampal cortex was substantialy resected. The latter group heard the „unpleasant” music pleasant, while the former heard it terribly dissonant. What was the unpleasant music?



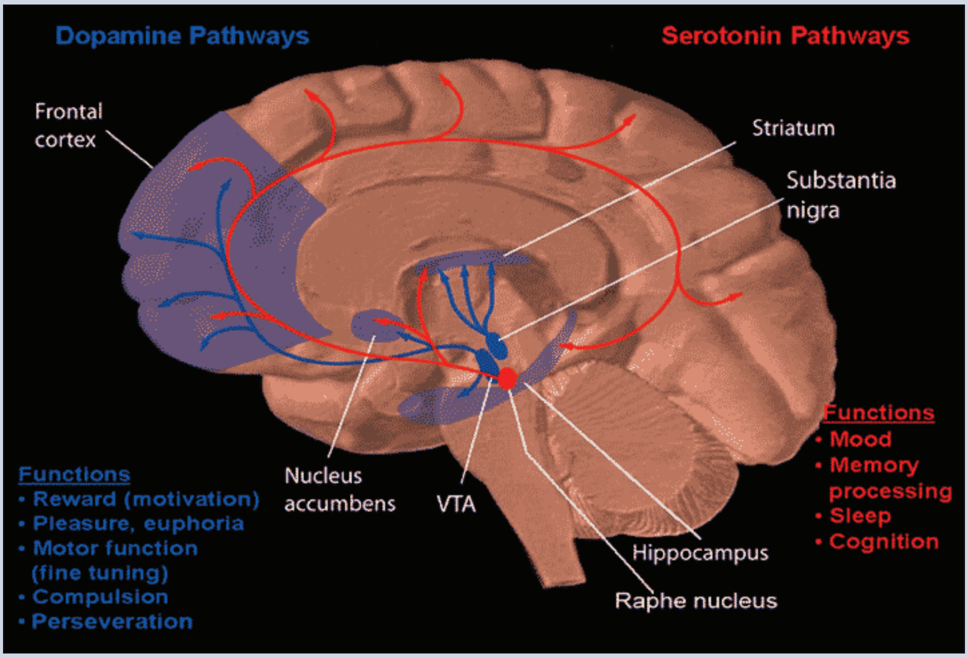


In the second example the right hand of the piano is written one semitone higher, in Ax major. (Actually, I would rather write it simply in Bb major, than it would be easier to read. But this is beside the point.) I understand that the aim of this research is to analyze a process of perception in the brain and not to analyze music. It is absolutely understandable, acceptable and most honourable. My only sadness is that the text operates with an incorrect musical terminology. The short sheet above does not sufficiently present the possible dissonances of the minor second interval, because it is nothing else than a bitonal distortion of a classical musical example. This music kept its original idioms, forms and shape even after the „operation”, only perhaps lost some of its original charm. On the other hand the minor second is a common and widely used musical interval e.g. in Bluebeard’s Castle from Bartók, or the folk musical examples that I already discussed above. By the way here is an early „unpleasant” example from W. A. Mozart (K.331):

Although I cannot agree with the terminology, the basic idea that sounds are connected to the part of the brain that is responsible for the emotions is a really joyful result. It seems that if a sound involves us emotionally than it activates the frontal lobes, the amygdalas and the nucleus accumbens. These territories are known as a part of the same dopamine pathway. Dopamine is a neurotransmitter that is activated to reinforce the feelings of reward (motivation). It plays an important role in almost every addiction, like nicotine or the opioids.

So. Listening to music may be rewarded with a nice dopamine flash from our mesolimbic pathway, just like a nice meal or a cocaine snort if one is addicted to it. There is one problem with this investigation, however. It is hard to measure the dopamine in the human brain. I can not ask someone at Carnegie Hall to give me a piece of his mind, to test if he likes the concert or not.

In 2004, two scientist from Japan published an article in the magazine Brain Research, with this title: „Music improves dopaminergic neurotransmission: demonstration based on the effect of music on blood pressure regulation” [10]. Denetsu Sutoo and Kayo Akiyama were examining the effects of the music on rats. They had the chance to conduct research that will be hopefully never conducted on humans.



They worked with spontaneously hypertensive rats. Hypertensive in this case means that the rats` blood pressure is higher than that of a normal animal. „Spontaneous" usually means something like self-generated, but in this context it means that these animals were gene-manipulated to be subjects for different research that can hopefully save many human lives. It was already known that music could reduce blood preassure. It was also known that calcium increases dopamine level. The researchers' idea was to put these things together. Their hypothesis was that if these rats will listen to music for a while their blood pressure will decrease, their calcium level will increase, and the researchers will be able to find increased dopamine level in their brain after the experiment. Rats were made to listen to Mozart's Adagio from Divertimento in D major (K.205) continuously for 120 minutes through a speaker in their cage. After the experiment they were anesthetized and perfused intracardially, their brain were removed, frozen and sectioned. I know this could be very important for those who are waiting for a new medicine while suffering from a hopeless disease, but Mozart and the sectioned brain seems to me as a scene from any film of Rainer Werner Fassbinder. The fact that this is not a film makes me sad, and it is really hard to accept that we are able to kill for getting such information. The experiment was successful and the hypothesis has been proved. Music increases the dopamine level in rats` brains.

I am not sure that listening to a Mozart adagio for 120 minutes is what I would call an ultimate musical experience. But if it help to raise dopamine level, it is certainly useful. (Parkinson's disease is for example caused by the insufficient formation and action of dopamine.)

In 2003 [11] and 2005 [12], so one year before and after the two Japanese researchers, Professor D.J.Levitin and V. Manon made an interesting study in the same field. In 2005 They could indirectly (without measuring the concrete dopamine level) prove that the same effect could happen in humans when they listen to what they like. They used small segments of classical musical excerpts that are usually known as beloved musical examples (e.g. Beethoven's IX. Symphony, which is not the most innocent and positive musical example, either, according to film history).

They made fMRI pictures of those brain parts that are participating in the mesolimbic dopamine pathway. Beside the normal musical examples, which meant that they played the first 23 seconds of a classical composition, they used some „scrambled" sound files as well. It was a random series of random samples of random length (max 350ms) of the same piece. The samples were played with a short linear crossfade of 30ms. Menon and Levitin used this to decompose the logical and temporal continuity of the pieces without losing their basic pitches and timbre. These sound examples were judged to be unpleasant by certain listeners, but the activation level of the nucleus accumbens, and other parts of the limbic pathway was about the same. This could mean that it is not the rhythmic and melodic content that activates our rewarding system. I had the chance to listen to some of the scrambled files. (I found them much more interesting and enjoyable than their originals, but this is not the point of the research.)

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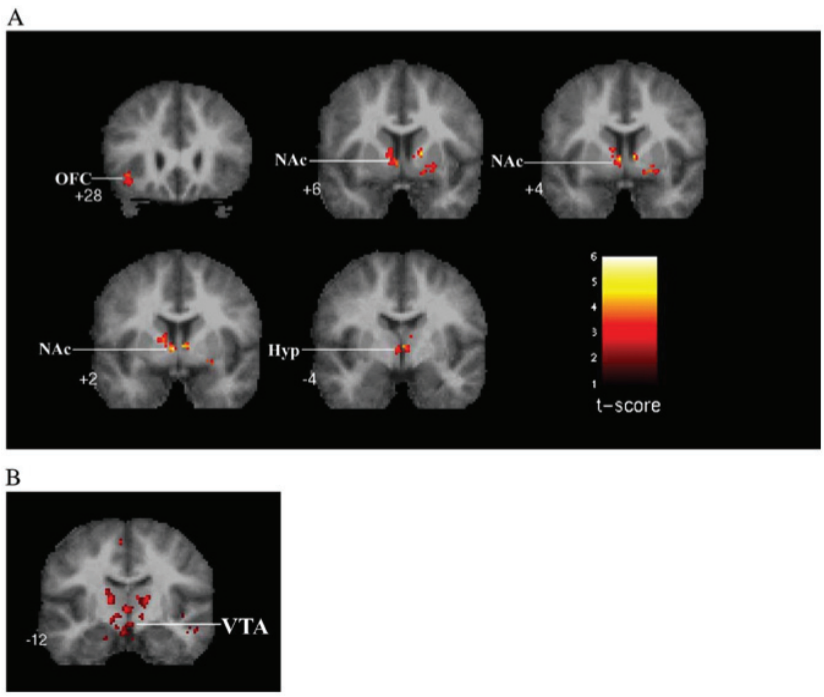

Fig. 2. Task-related group activation during music, compared to scrambled music. Activation of the nucleus accumbens (NAc) and a network of related mesolimbic structures including the ventral tegmental area (VTA), the hypothalamus, and orbitofrontal cortex (OFC) are shown. (A) All activations were significant at $P < 0.01$, corrected for multiple comparisons, except (B) the VTA, a difficult to image structure, which was significant at $P < 0.05$ (corrected). The NAc is located immediately lateral to the base of the septum pellucidum, the hypothalamus adjoins the third ventricle, and the VTA is located medial to the substantia nigra, pars compacta. The Talairach coordinates (in mm) of each section are shown at the bottom left of each panel. Activation is shown superposed on group-averaged high-resolution structural images.

It seems, finally, that I received an answer for my question, which is the following:

„IS THERE ANY UNIVERSAL HUMAN BRAIN ACTIVITY THAT CAN DIFFERENTIATE BETWEEN LISTENING TO MUSIC AND LISTENING TO ANY OTHER SOUND?"

It seems that there are sounds that make us feel comfortable and satisfied.

If we feel comfortable and satisfied with our activity then our dopamine (and serotonin) pathways become activated.

As final evidence we can say that when certain resonances of the surrounding material (which can be water, air, depending on where we are) of the outer world are hitting our ears, we hear sounds. Our ears and our auditory cortex unpack the sounds and send them to different parts of the brain. If a certain sound contains information that we are able to enjoy, then our mesolimbic system and its dopamine pathway is getting activated, so we call the sound MUSIC.

I am satisfied with this answer, although I know that both music and neuroscience are more complicated and sophisticated than this simplified question and answer.

Maybe because my profession is to work with music that does not yet exist, and to work with sounds that existon the borderlands of realand imaginary, the musicthat I was searching for in the human mind is only supported by soundsand not sound itself. It is an inner experienceequallyaccessible for all human beings.

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