Link to original article in German: www.zeit.de/gesundheit/zeit-doctor/2023-11/herz-kreislauf-system-musik-blutdruck-herzfrequenz-effekte

English translation below (with the help of DeepL):

Cardiovascular system

"Music is like Tai Chi for the autonomic nervous system"

Heartbeat, breathing, blood pressure – music affects our unconscious bodily processes. Mathematician Elaine Chew is researching how music can protect against illness.

Interview: **Tom Kawinkel** and **Claudia Wüstenhagen**
7 November 2023

She is a mathematician and pianist and suffered from cardiac arrhythmia for years. Elaine Chew wants to find out how music affects the heart and circulation – and which playlist is the healthiest for whom.

ZEIT ONLINE: Mrs Chew, music touches our hearts in a metaphorical sense – it triggers emotions. But your research is about the heart as an organ. What do you know – as a researcher and as a pianist – about the connection between the heart and music?

Elaine Chew: Cardiologists have long known that emotions are an important factor in cardiovascular disease. There are many stories of people who have literally died of a broken heart, it is known as the Broken Heart Syndrome [https://pubmed.ncbi.nlm.nih.gov/35747479/]. Studies also show that heart attacks are more common after earthquakes [https://academic.oup.com/eurheartj/article/33/22/2796/532469], calamities or when an important football match [https://www.nejm.org/doi/full/10.1056/nejmoa0707427] is taking place, i.e. when emotions are very high, studies show that heart attacks and other acute cardiovascular diseases occur more frequently. So, if emotions affect the heart and music triggers emotions, then it is not surprising that music affects the heart. Like a chain reaction.

THE BROKEN HEART SYNDROME

A broken heart also exists in the medical sense. Extreme **psychological stress, such as after strokes of fate** or personal conflicts, can lead to so-called stress cardiomyopathy. Broken heart syndrome or Takotsubo syndrome are also often mentioned. The symptoms – such as **shortness of breath** and chest **pain – are similar to those of a heart attack**. The condition can be life-threatening and is particularly common in women after the menopause. The broken heart is caused by a **pumping disorder of the heart muscle**. It contracts very unevenly, and the movement of the left ventricle in particular is disturbed. The muscles of the apex of the heart are inflated like a balloon on this side.

ZEIT ONLINE: Studies show that music – from classical to folk music – can lower the heart rate and blood pressure, for example. How can this be explained?

Chew: Music affects the autonomic nervous system, which regulates all the unconscious bodily processes that keep us alive without us having to think about them – like heartbeat, breathing, digestion. There are two antagonists in this nervous system: the sympathetic and the parasympathetic nervous sytem. One makes us excited and puts us in a position to fight or flee. The other helps us to calm down, for example, to digest food. And music helps to balance both sides so that the nervous system does not remain in a state of tension over the long term.

ZEIT ONLINE: To put it simply: music helps you relax?

Chew: I have to admit, when a cardiologist first told me years ago that music could possibly improve the response of the vagus nerve – a part of the parasympathetic nervous system – and thereby promote relaxation, I didn't react well at all. As a classical musician who trained for so many years, I didn't particularly like hearing: Everything you're doing is just helping people relax!

ZEIT ONLINE: Like elevator music that just plays in the background.

Chew: Exactly! As if music was just meant to put people in a relaxed state. When you work so hard to trigger reactions in people with music, you want to achieve more than that. And of course, music can do much more than that. It creates tension in the moment, it can make our hearts beat faster and take our breath away. There are these tipping points [https://online.ucpress.edu/mp/article-abstract/33/3/344/62687/Playing-with-the- EdgeTipping-Points-and-the-Role], for example in classical music – when time seems to be stretched and the tension increases and increases because you are waiting for that moment when something happens. The effect of music is therefore quite complex. But it touches us in a way that is good for the cardiovascular system – and yes, also because it calms us down. In this respect you could say: Music is like a kind of Thai Chi for the autonomic nervous system.

ZEIT ONLINE: You are investigating this effect of music in detail. What exactly do you want to find out?

Chew: We know that beneficial effects occur after listening to music, but it is unclear what mechanisms in music trigger these reactions in the body. So, we want to find out whether certain structures in the music are the reason for this and how the reactions differ between individual people. In our first study, we organized live concerts for this purpose. We invited pacemaker patients and played them pieces by Chopin, Holst and Brahms(*) to measure how the music affected the electrical activity in their heart. On each of three days, a different small group of patients came to the concert. We realized that in the long term we would need a different solution for our research that would work on a larger scale. That's why we developed an app [https://heartfm.kcl.ac.uk/2023/02/01/high-blood-pressure-a-heart-app-prescribes-musical-therapy/].

ZEIT ONLINE: How can the app help with your research?

Chew: When you use the app, you can select and listen to songs from various playlists. There is also a live music mode for concerts. In both cases, wearable sensors record physiological signals like your heart rate while you listen to the music. The signals from your body are then compared with the music to evaluate how your body reacts to certain pieces or passages. The idea is to derive a kind of personal signature.

ZEIT ONLINE: Will I then receive recommendations for a playlist based on my individual pattern, for example to lower my blood pressure?

Chew: We're still in the research phase, but yes, that's the plan. We create a fingerprint of your reactions and based on that, the app recommends which piece you might listen to

next. In the analysis for our research, we do track blood pressure. Unfortunately, the sensors on the smartphone cannot currently measure blood pressure reliably enough. That's why we currently use the heart rate and heart rate variability in the app.

ZEIT ONLINE: What is heart rate variability?

Chew: This is a measure of how much the time interval between two heartbeats varies. This shows how well the body can react to stress. Heart rate variability is higher in healthy people – whereas low values can indicate an increased risk of mortality.

ZEIT ONLINE: If you want to derive individual patterns with the help of the app, then you obviously assume that every heart reacts differently to music?

Chew: We still have to prove that, but our data suggests so. We know from previous studies that people perceive musical structures and changes in pieces of music very differently. It stands to reason that the physical reactions also differ. In addition, people pay attention to different things in a piece of music. If my focus is drawn to the flute playing a beautiful melody and you, on the other hand, pay particular attention and entrain your movements to the repeating rhythmic pattern, then that is a very different experience.

ZEIT ONLINE: So there isn't one particular piece of music or genre that has the same effect on all hearts?

Chew: There are definitely features in music that many people react to in a similar way. That is because music expressivity emulates human expression: how we communicate anger, how we express sadness, and experience fear, for example. The tipping points I mentioned initially cause a growing tension in many people by building up expectation; the tension is then released when the expectation is fulfilled. But if you ask about the genre and style of music: personal, acquired taste plays a big role. Some people relax to heavy metal music because that's the music they like to listen to. That wouldn't be the case for me.

ZEIT ONLINE: So Bach can have the same influence on someone's heart as AC/DC has on someone else's?

Chew: Yeah, sure.

ZEIT ONLINE: What music do you listen to to bring your pulse and blood pressure down?

Chew: I really like listening to Schubert at the moment to combat stress. For example, the slow movement of his Trio opus 100 – Andante con moto [https://www.youtube.com/watch?v=52YSCPh_C0Q]. And, I love the opening movement

of the Cello Sonata No. 1 in E minor by Brahms [https://www.youtube.com/watch?v=9XiYrzsgWto].

"It seemed as if the hearts of the musicians were connected"

ZEIT ONLINE: Can music really protect against heart disease in the medium or long term?

Chew: There is no specific evidence of this yet, but one can definitely deduce it from the evidence so far. Most evidence shows that music can lower blood pressure. In this way, it could make a contribution – because high blood pressure is the number one risk factor for cardiovascular diseases. Even a slight reduction in blood pressure, for example from 140/90 to 135/85, reduces the risk of mortality [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)00590-0/fulltext]. And if music helps to positively regulate the autonomic nervous system, it could also prevent atrial fibrillation, for example, which is a very common arrhythmia, from getting worse. This is because such heart conditions become more severe when one is in a state of constant tension.

ZEIT ONLINE: So would you be in favour of prescribing tickets for live concerts?

Chew: Oh yeah. As a pianist, I think live music is even more powerful. That's why in our first study I insisted that all our participants listen to the music live. They should feel the presence and the vibrations of the piano and experience how the sound washes over them. It should be a real, visceral experience. Because if you only listen to music from a recording, it can happen that it fades into the background.

ZEIT ONLINE: If the live experience is so effective from your point of view – does it make a difference whether you just listen to music or play it yourself?

Chew: We need studies to prove this, but as a pianist, I'm sure that music is actually even healthier for the heart when you play it yourself. Maybe it also depends on who you play music with. We have just examined, for a study, a trio [https://kclpure.kcl.ac.uk/portal/en/publications/time- delay-stability-analysis-of-pairwise-interactions-amongst-en] who played Schubert together. And the interesting thing was that the musicians' hearts seemed to coordinate over time, as if they were linked to each other. So maybe it's useful to make music with people who have a good heart rhythm.

ZEIT ONLINE: You are not only a researcher and pianist, but have also been treated as a heart patient yourself. Is that the reason why you came to this research?

Chew: Yes. I had cardiac arrhythmias as a child. Some kind of a short circuit would sporadically cause my heart to suddenly beat twice as fast. A very unpleasant feeling. So,

for much of my life I was constantly on guard for when it would happen. Until finally there was a cure for it and doctors could treat me. After that, I lived happily for two years and pushed my limits professionally without thinking about my heart. The stress was probably too much because I developed atrial fibrillation, another arrhythmia. So, I had to be treated again, and when I saw all the beautiful recordings of my heartbeat in the cardiac catheterization lab, I thought, maybe I can at least do something with it.

ZEIT ONLINE: You mean the ECG? What did you want to make of it?

Chew: Yes. A young cardiology doctor-in-training told me that he had played techno music to his colleagues at the last Christmas party and they had to guess what kind of cardiac arrhythmia he was referring to. I liked that. Of course, I was also nervous about this cardiac catheterisation procedure. So I distracted myself during the procedure by thinking about how I could turn my heartbeats into music. Later, I asked my cardiologist to give me my data and put the idea into practice.

ZEIT ONLINE: How exactly did you do that?

Chew: I translated my heart rhythms into musical rhythms using matching fragments of music that already existed. Initially these were very short examples of music lasting about ten seconds each. Later, I asked for longer sequences of ECG recorded from cathlab procedures that showed a patient's arrhythmia (not mine) starting then stopping. For the first of these examples, I used samples from the piece Mars by the English composer Gustav Holst. The short bursts of electrical activity that triggered the cardiac arrhythmia sounded like the beginning of Mars. So the entire piece was developed from fragments of Mars that matched the ECG rhythms.

ZEIT ONLINE: You played the resulting pieces publicly at concerts [https://www.youtube.com/watch?v=uMP7cHo9nIk]. What did you want to achieve with this?

Chew: On the one hand, it was good fun. The music was an unusual combination of familiar sounds and rhythmic sequences [https://www.youtube.com/watch?v=z8aspgwes1o]. On the other hand, this music has helped other people understand what cardiac arrhythmias are [https://www.youtube.com/watch?v=42TRIL9MeOA] – how unpleasant it is to feel such a rhythm. It was also at this moment that I started working professionally with my cardiologist, Pier Lambiase, who had treated me. I wanted to find out more about the interaction between music and the heart.

ZEIT ONLINE: Does the connection between heart and music also work in the other direction? Does your own heartbeat influence the way you make music or compose?

Chew: Because the rhythms in his music are so distinctive, there is actually a long-standing theory that Beethoven had cardiac arrhythmia [https://academic.oup.com/eurheartj/article/42/28/2721/6200611]. That famous da-da-da-daaaa from his Fifth Symphony does indeed occur in cardiac arrhythmias: a short burst of rapid beats followed by a pause. And the rhythms of his "Les Adieux" Sonata – daa dittaaa daa dittaaa – are also very reminiscent of a heart that is experiencing ventricular early beats and each ensuing pause. However, I hesitate to draw this conclusion because many rhythms that can be found in music today occur in cardiac arrhythmia.

ZEIT ONLINE: Beethoven was deaf, at least in the last years of his life. Could that have played a role?

Chew: Yes. The supporters of the theory argue exactly this way: When you are deaf, your perception of your internal bodily signals increases. You notice the pulsation of the blood more strongly. This increased interoception could have contributed to Beethoven's translating his internal rhythms into music. It is possible. I did that myself, albeit in a different way and quite consciously.

I think that we musicians are fundamentally very conscious of our internal processes, such as our heartbeat. My inner state affects how I play the piano. I am very much aware of it. My perception even includes the people in the audience. When I play, I feel connected to them – I can sense how they react to my music, and this feeds into how I play in a live setting.

Elaine Chew is a guest at the Falling Walls science conference in Berlin this week [https://falling-walls.com/]. The event, which is being held to mark the anniversary of the fall of the Berlin Wall, brings together decision-makers and people from politics, business, science, the media and society.

(*) Correction: Chopin, Berger, Bach, and arrhythmia music by Holst/Chopin and Chew et al.