



Musical mathematical talent
Elaine Chew was herself a heart patient when she came across an exciting research approach

Musical Beats For a Healthy Heart

Elaine Chew, mathematician and pianist, explores the impact of Chopin, Bach and Berger on circulation and blood pressure. She also performs for people with pacemakers.

At the Paris-based research laboratory Sciences et Technologies de la Musique et du Son, you developed a mathematical model for analyzing the perception of music. You commute between Paris and London and also between your main job as a mathematician and your training as a musician – why?

Elaine Chew: Yes, I am very happy that I can fully immerse myself in my two passions, mathematics and music. The so-called spiral array model was part of my doctoral thesis at the MIT Operations Research Center. The model formed the basis for algorithms to solve problems in music perception, such as key determination and quantification of harmonic tension. The mathematical language provided a means of expressing and communicating aspects of musical know-how. My work is now at the STMS laboratory at the Institut de Recherche et Coordination Acoustique/Musique, a mecca for composers and researchers who are interested in combining music and technology. My family is still in London because of my daughter's schooling, hence my commuting.

You yourself suffered from cardiac arrhythmia – to what extent did this give you the idea of investigating the influence of classical music on circulation and blood pressure?

Chew: When I was lying on a table in a catheterization laboratory at St. Bartholomew's Hospital (Barts) in London – with tubes reaching into my heart – looking up at the marvelous signals and images on the monitors, a conversation with the registrar about his guess-the-arrhythmia music game at the cardiology department's Christmas party sparked a train of thoughts about the crossovers between music and EKG signal analysis. Abnormal heart rhythms form musical patterns and I wondered if all natural sounding musical rhythms have a physi-

ological basis. By notating the abnormal heart rhythms as is done in contemporary classical music and matching them to musical fragments, collage compositions emerge that convey an individual's experience of that arrhythmia at a particular point in time. From a scientific viewpoint, this means that techniques for analyzing musical rhythms can be applied to abnormal heartbeats, with implications for individualized treatment and medical education. Coming full circle back to Barts, I embarked on a study on cardiac response to live music performance for patients with biventricular pacemakers with Professor Pier Lambiase, who co-

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directs cardiovascular research at the Barts Heart Centre. Data was downloaded from the left ventricular lead of the patients' pacemakers/ICDs while I performed classical music from Bach to Berger and two arrhythmia pieces to them. These experiences led to our upcoming project using physiological feedback to tailor music interventions to lower blood pressure and improve cardiovascular health.

Which compositional characteristics of classical music have a particularly favorable effect on the cardiovascular system?

Chew: Music that encourages long breaths, which increases heart rate variability, is widely regarded to benefit cardiovascular health. This points to some level of continuity and periodic structure. Another theory is that feelings of safety bolsters heart health; such feelings, and having a sense of predictability, is good for the heart.

We do know that the strongest musical experiences result from anticipatory processes, which are usually consummated through moments of change. That is why, in our work, we have examined changes in cardiac electrophysiology at such moments of change. To some degree, music provides a safe environment through which to explore a plethora of experiences. So the safety requirement underlies most musical experiences. Even if music excites, it could be like exercise, where the therapeutic effects are only seen afterwards during rest or ambulatory monitoring.

How exactly could you prove that classical music has a calming and hypotensive effect on people's stress levels?

Chew: Research studies of heart patients listening to music found that music can stabilize life signs and alleviate symptoms; it can modulate heart rate and heart rate variability, alter cerebral blood flow, reduce anxiety and lower cortisol levels. Classical music, like many other types of music, has the ability to transport us to other worlds and induce feelings of calmness, exhilaration or despair. It can delight us, and make us laugh, which can be hypotensive, or it can make our hair stand on end. What we hope to determine is if certain music or musical parts have a hypotensive effect on a particular person. And this we can do by tracking their physiological response to the musical and linking it to music features. ■

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