

CMC³ SPRING 2026
CONFERENCE



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Can Music Help Students with Performance and Math Anxiety?

The Amazing Connection Between Mathematics and Music

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A decorative graphic on the left side of the slide features a light-colored background with a curved white border. It contains several musical staves with notes and stems, rendered in a soft, artistic style. The notes are dark blue or black, and the stems are thin lines. The overall aesthetic is clean and modern.

Introduction

"A surprising proportion of mathematicians are accomplished musicians. Is it because music and mathematics share patterns that are beautiful?"

— **Martin Gardner**

This observation hints at something deeper than coincidence. Math and music may share profound cognitive connections — activating overlapping regions of the brain, drawing on similar abstract reasoning, and resonating with the same sense of pattern and beauty. This presentation explores that connection and what it means for our students.



The Problem: Math Anxiety

Math anxiety is more than nervousness — it is a genuine cognitive and emotional barrier that affects millions of students at every level.

Fear of Math Tasks

Avoidance behaviors and dread before math-related activities.

Cognitive Freezing

Working memory is impaired under stress, blocking problem-solving.

Poor Exam Performance

Anxiety undermines results even when students know the material.

"Math anxiety: an intense lifelong fear of two trains approaching each other at speeds of 60 and 80 MPH." — **Rick Bayan**

Causes of Math Anxiety

Understanding the roots of math anxiety is the first step toward addressing it. Several common factors contribute to its development:

Time Pressure

The pressure of completing mathematics under timed conditions is a leading cause of anxiety.

Fear of Wrong Answers

Past experiences of humiliation and overemphasis on the "right" answer create lasting fear.

Negative Past Experiences

Early negative encounters with math can create lasting emotional associations.

Working Alone

Students are often more relaxed and successful when working together on new concepts.

While we have no control over our students' past experiences, we may be able to reduce classroom anxiety **with music**.



Why Music?

Music is far more than entertainment. It is a powerful neurological and physiological tool that affects emotion, concentration, and the body's stress response.

"Music has positive effects on people's emotions and creativity... activating three different centers of the brain at the same time: language, hearing, and rhythmic motor control. Words paired with music are far easier to retain."

— **Don McMannis**, Edutopia, 2009

How many ad jingles or song lyrics do you still remember from years ago? Can you still sing the ABC song from childhood? Music encodes information in a way that ordinary study cannot replicate.

The Power of Music

Footloose (174BPM)



Pachelbel's Canon in D(56-72BPM)



Did you experience any change in mood and energy?

Mathematics and Music: Structural Similarities

Mathematical Concepts in Music

- Patterns and sequences
- Ratios and proportions
- Equivalent fractions (note values)
- Counting beats and rests
- Geometry in instrument design

What the Experts Say

"Music and math together satisfied a sort of abstract appetite — partly intellectual, partly aesthetic, partly emotional, partly even physical."

— **Edward Rothstein**, *Emblems of Mind*

Musicians recognize patterns of chords, key changes, and harmonies — the same cognitive skills used in mathematical reasoning.

Music and Brain Activity

Neuroscience confirms what musicians and mathematicians have long suspected: the brain processes music and mathematics in remarkably similar ways.



fMRI Research

Functional MRI shows that math and music **activate the same brain regions**. Mathematical beauty correlates with activity in the medial orbito-frontal cortex — the same area activated by great art or music.
(University College London, 2014)



Stanford Study

Music engages brain areas involved with **paying attention, making predictions, and updating memory**.
(Stanford Medicine, 2007)

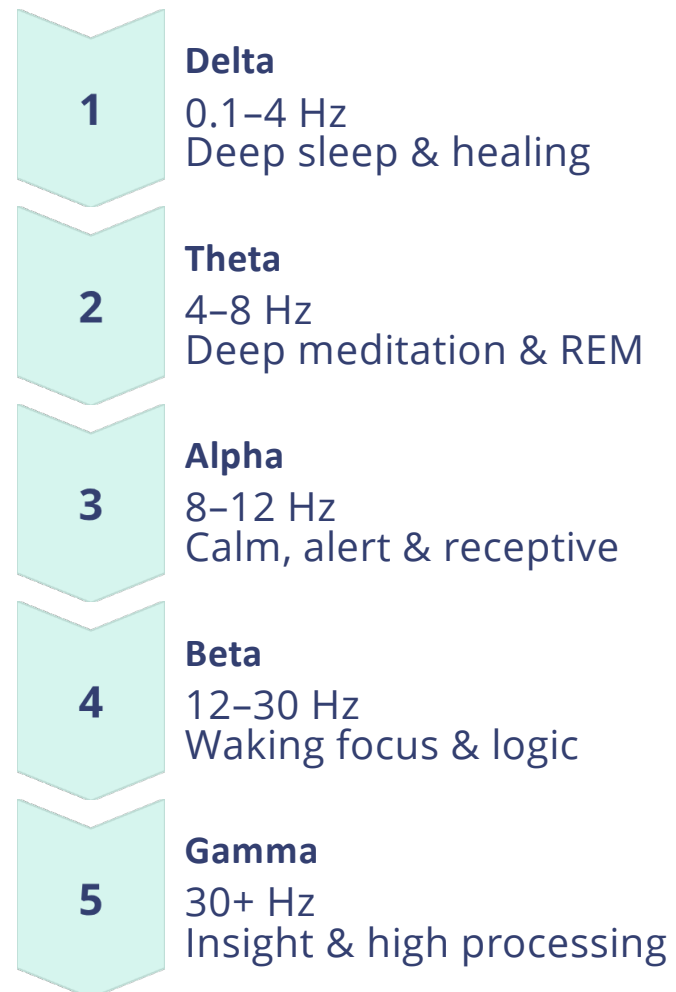


The Math Gene

"Brain images of musicians listening to music are similar to images of mathematicians solving problems." — **Keith Devlin**, *The Math Gene*

The Five Brainwave States

Our brain operates across five distinct frequency bands. Understanding these states helps us identify which conditions are most conducive to learning and anxiety reduction.



Learning occurs best in a mix of **Alpha and Low Beta** states. To help students with anxiety, we recommend music that encourages **Alpha (8–12 Hz)** and/or **Low Beta (12–15 Hz)** brainwaves.



Alpha Brainwaves and Learning

8-12 HZ THE OPTIMAL LEARNING STATE



Calm but Alert

Students are relaxed yet fully aware — the ideal state for absorbing new information.



Enhanced Concentration

The mind is clear and receptive, able to rapidly make connections between concepts.



Stress Release

Alpha state is ideal for releasing stress and reducing the physiological symptoms of anxiety.



Information Retention

Alpha is one of the brain's most important frequencies for learning and using information taught in the classroom.

Music Tempo and Cognitive State



The 50–80 BPM Sweet Spot

"Baroque music at 50–80 beats per minute creates an atmosphere of focus that leads students into deep concentration in the Alpha brain wave state."

— **Chris Brewer**, *Music and Learning*

Baroque composers like Bach, Handel, and Telemann naturally wrote within this tempo range — making their music ideal for study environments.

Heart-Rate Entrainment

Beyond brainwaves, music can influence the body's physiological state through a process called **heart-rate entrainment** — the synchronization of heartbeat to musical tempo.

01

Music Introduces a Steady Rhythm

A consistent tempo of 50–80 BPM is introduced during study or exam time.

02

The Body Responds

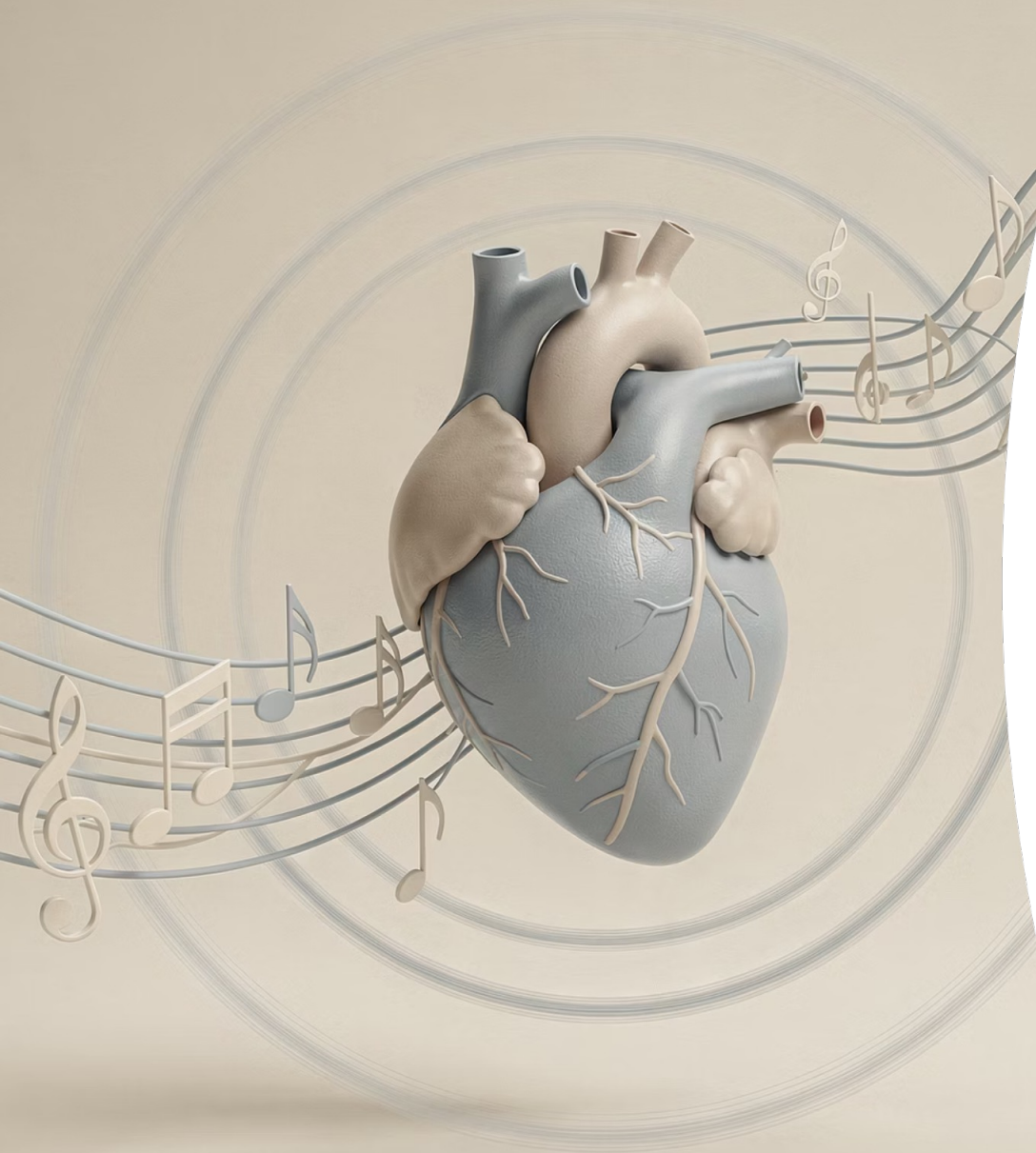
"When your body hears the even beat of music, your heart rate and pulse relax to the beat." — **Don Campbell**, *The Mozart Effect*

03

Relaxed but Alert State

In this state, the mind is able to concentrate more easily, supporting better math performance.

A 2009 review of 23 studies covering nearly 1,500 patients found that listening to music **reduced heart rate, blood pressure, and anxiety** in heart disease patients. (*PubMed, 2009*)





Faculty Survey: Math & Music

To understand the real-world intersection of math and music, we surveyed math instructors across **21 institutions** in Nevada, Maryland, Washington, California, and Oklahoma during Spring 2017. Institutions included high schools, community colleges, and universities.

21

Institutions

High schools, community colleges, and universities across 5 states.

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States Represented

NV, MD, WA, CA, and OK — a geographically diverse sample.

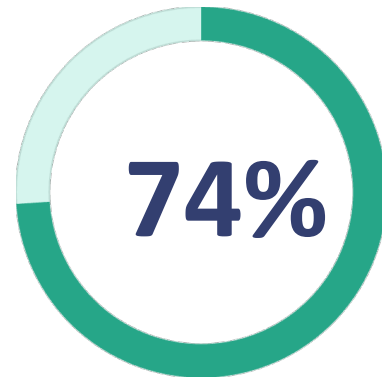
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Survey Questions

Covering instruments played, classroom use, anxiety, exams, and personal study habits.

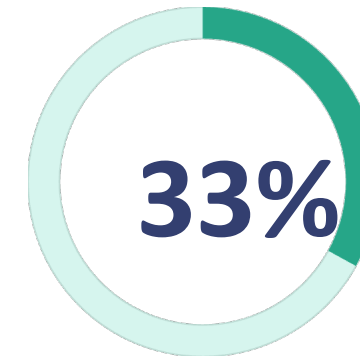
Results revealed a **strong overlap between the math and music communities** — and significant untapped potential for music in the math classroom.

Survey Findings: Key Results



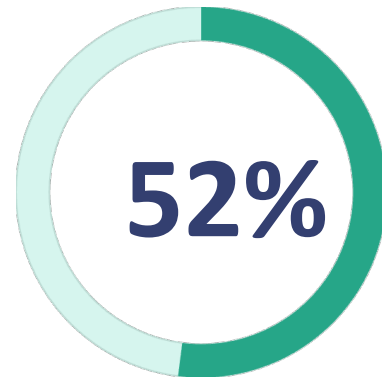
Play an Instrument

Respondents who play or have played a musical instrument (guitar, piano, violin, saxophone, and more).



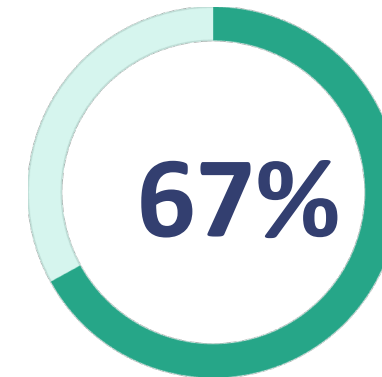
Use Music in Class

Have played music in their math classroom — for demonstrations, atmosphere, or formula memorization.



Allow Music on Exams

Allow students to listen to music during exams. Students report improved focus and reduced distraction.



Use Song/Rhythm

Have used song or rhythm to help students learn math concepts — most commonly for the quadratic formula.

Of the 89% who had never used music for math anxiety, **one-third commented that they would like to try.**



Our Experiment: Spring 2025 TMCC Earth Day Project

Blisin Hestiyas and Rebecca Porter — TMCC Earth Day Event, Thursday April 17th, 10:00 AM–11:30 AM

Students solved math problems while listening to three categories of music, recording physiological and emotional responses:

Slow Tempo

Songs at 40–80 BPM (Baroque and classical selections)

Fast Tempo

Songs at 92–220 BPM (contemporary and pop selections)

Favorite Songs

Student-selected personal favorites across all tempos

Goal: Observe changes in heart rate, focus, and emotional state before and after listening to each category while completing math work.

Data Collected

Each student recorded the following data points for every song session, creating a rich dataset across all three music categories:

What Students Recorded

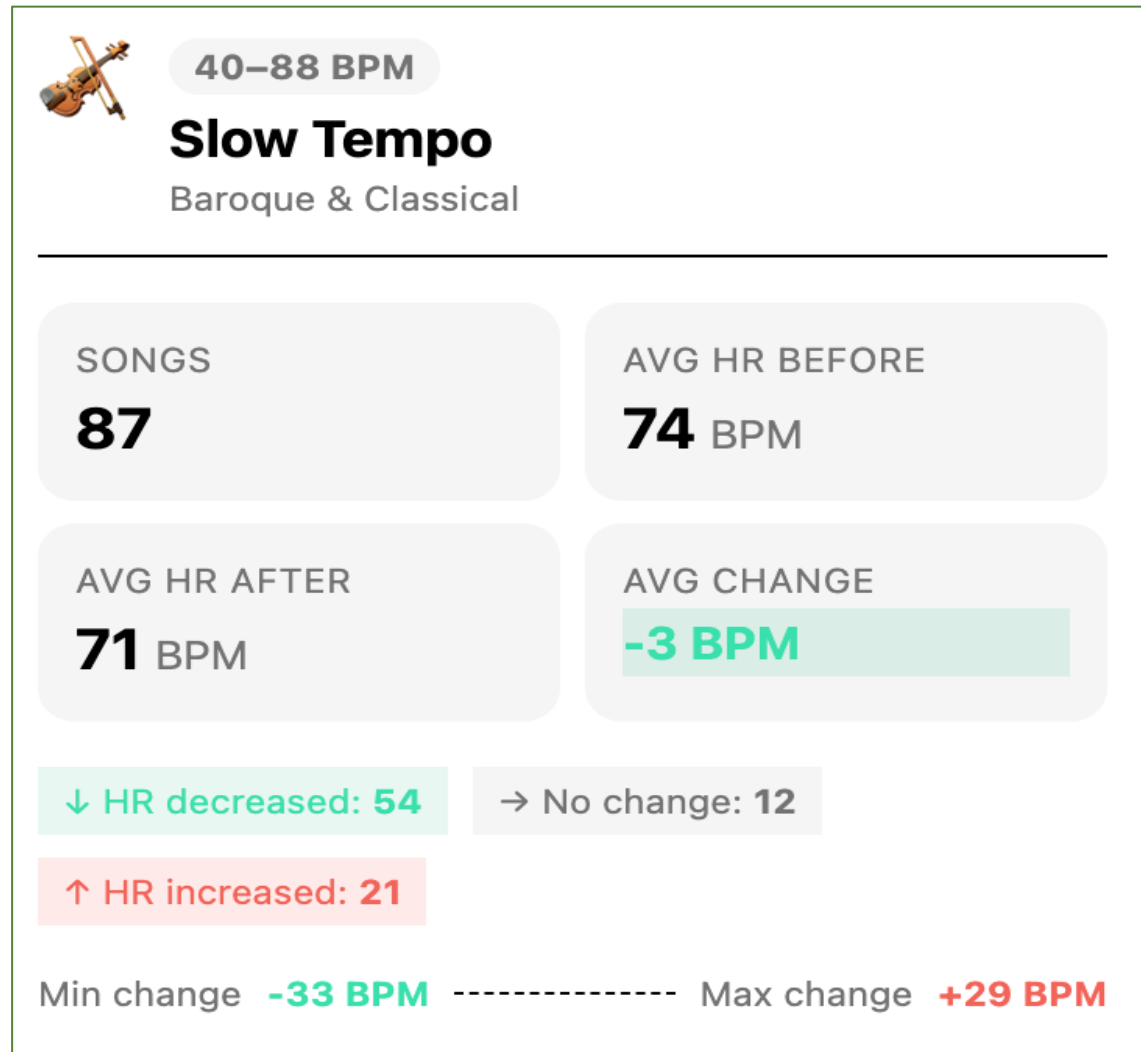
- Song title and artist
- Beats per minute (BPM)
- Heart rate **before** listening
- Heart rate **after** listening
- Emotional state and focus level

The Mozart Effect — Student Activity

Students also read about the Mozart Effect and listened to Mozart while doing math. Key findings from the literature:

- Listening to Mozart may prime areas of the brain responsible for **spatial reasoning**
- Rhythm, metre, pitch, and melody are processed across multiple brain regions
- Several studies show positive results after at least **10 minutes** of listening
- Effects vary by individual; more research is needed

Slow Tempo Results



Slow Tempo — Best for Calming

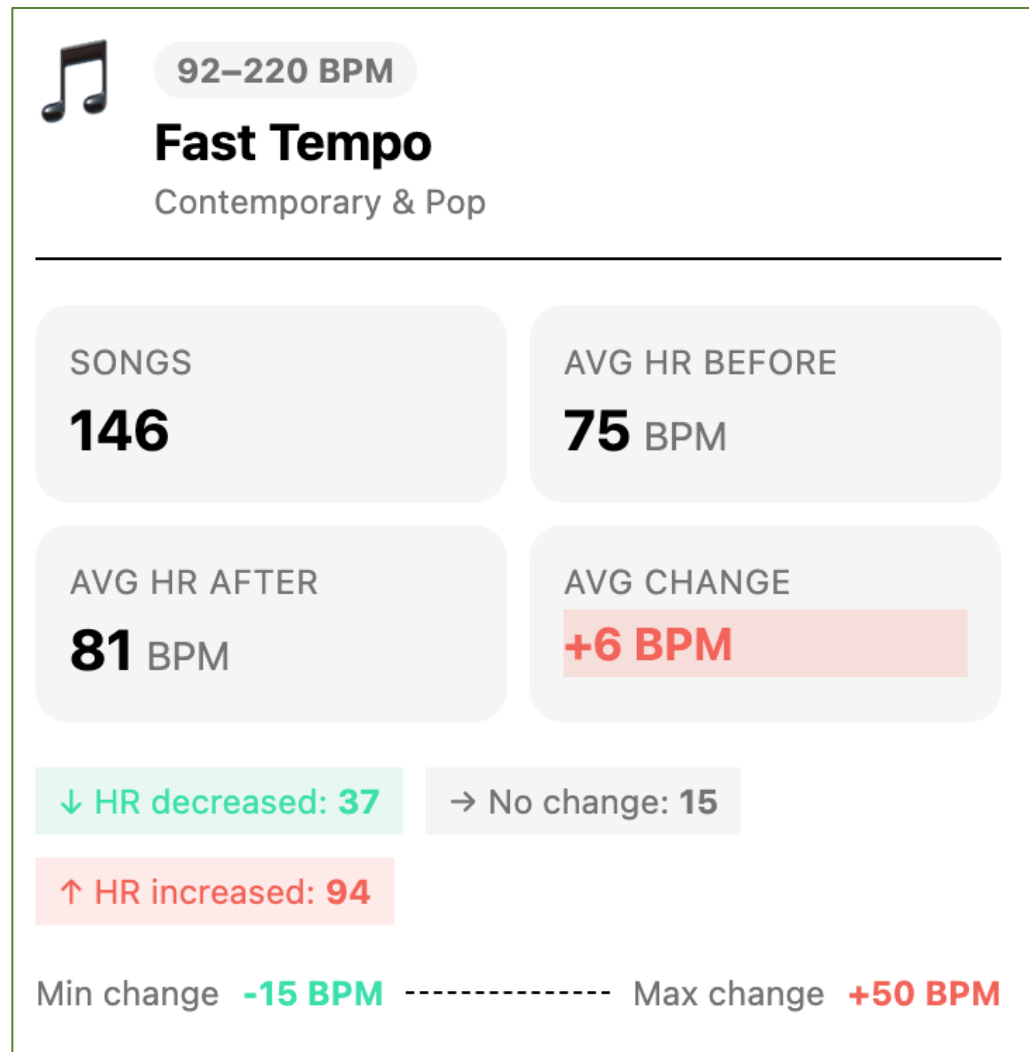
- 87 song sessions analysed (40–88 BPM)
- Avg HR dropped by 3 BPM on average
- 54 of 87 sessions showed HR decrease
- Largest drop: 33 BPM reduction
- Songs like Arcade, Alpha State Music, and All of Me showed strongest calming effect

Student Findings

At lower BPM ranges (40–80), heart rate generally **decreased or remained stable** after listening.

"I felt calmer while working and less distracted. When I got stumped on a question I didn't feel like I internally panicked at all."

Fast Tempo Results



Student Findings

Higher BPM music frequently resulted in **increased heart rate** and **reduced concentration** during math work.

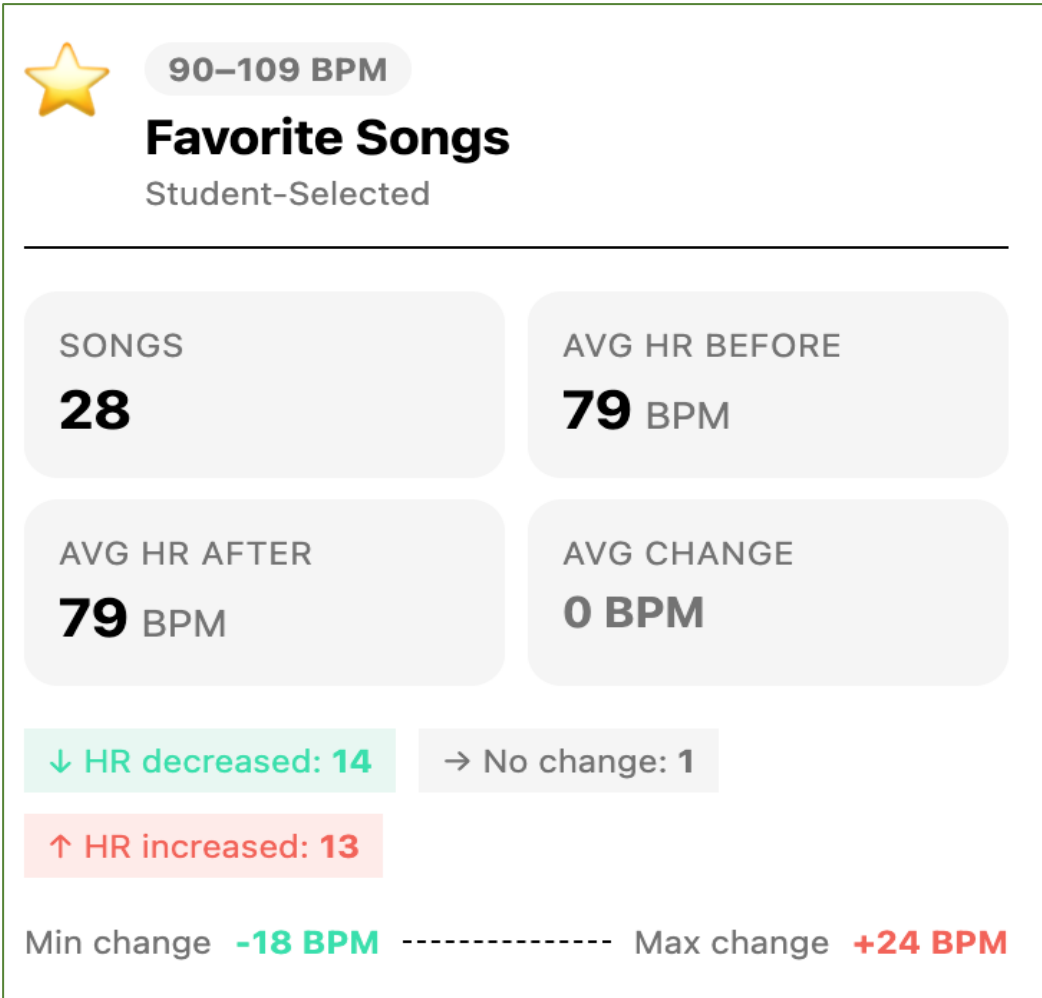


Fast Tempo – Most Stimulating

- 146 song sessions analysed (92–220 BPM)
- Avg HR increased by +6 BPM on average
- 94 of 146 sessions showed HR increase
- Largest spikes: +50 BPM (Il Adante, Run the World)
- High BPM songs like Uptown Funk, Blinding Lights caused biggest increases

"I enjoyed this music a bit more, but I didn't feel as focused as with the slower music."

Favorite Music Results



Student Findings

At lower BPM ranges (40–80), heart rate generally **decreased or remained stable** after listening.



Favorite Songs — Moderate Effect

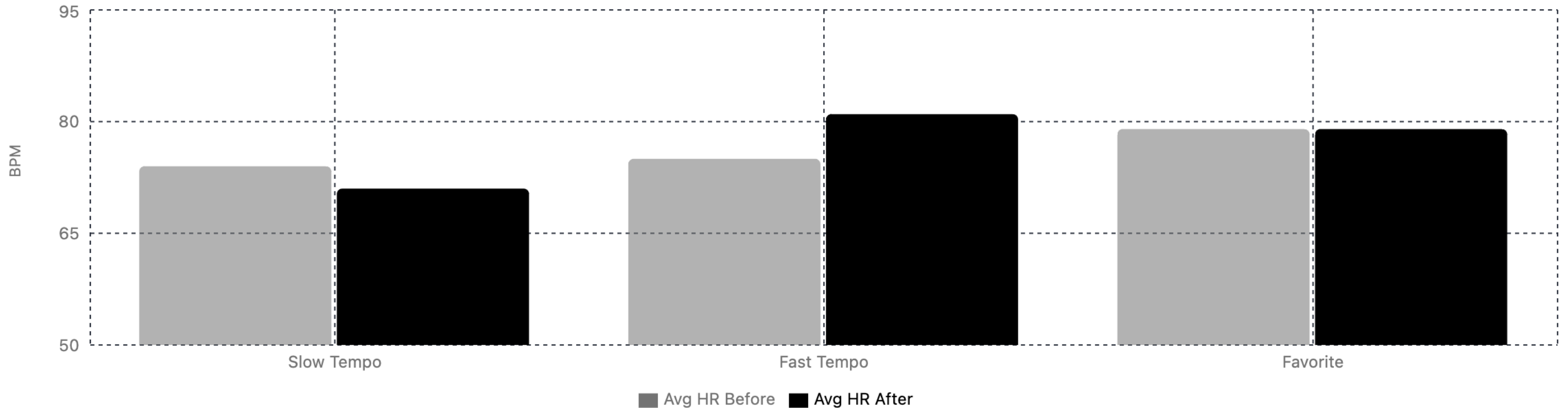
- 28 song sessions analysed (90–109 BPM)
- Near-neutral avg HR change: 0 BPM
- 14 sessions calming, 13 stimulating
- Medium BPM range produced the most balanced physiological response
- Most consistent heart rate stability across sessions

"I felt calmer while working and less distracted. When I got stumped on a question, I didn't feel like I internally panicked at all."

Average Heart Rate Comparison

Average Heart Rate: Before vs. After

Mean resting heart rate recorded immediately before and after each music category session (BPM).



- **Slow-tempo music lowers heart rate and reduces anxiety.**
- **Fast-tempo music increases stimulation and heart rate.**
- **Favorite music provides emotional comfort with minimal heart rate change.**

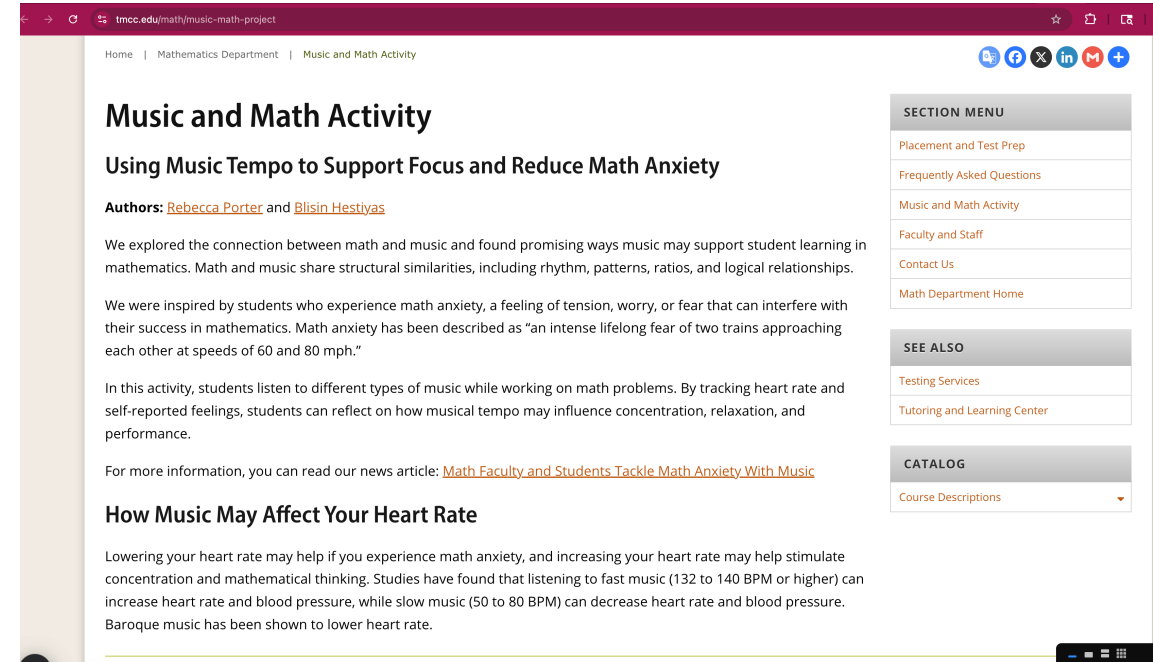
Music tempo directly influences physiological responses, with slower music promoting relaxation and faster music increasing stimulation.

Next Steps

Our Goal

To explore how music tempo may influence concentration and reduce math anxiety during mathematical problem solving.

👉 We invite you to encourage your students to participate and contribute to this collaborative research effort.



[Math and Music Activity](#)

Classroom Applications

Based on our research, survey findings, and student experiment data, here are practical strategies for math instructors:



Headphones During Exams

Allow students to listen to music (50–80 BPM suggested) during tests. Students report improved focus and reduced distraction.



Background Music in Class

Play soft classical or Baroque music during group work and problem-solving sessions at low volume.



Songs & Chants for Formulas

Use the quadratic formula song ("Pop Goes the Weasel"), math raps, and chants to help students memorize key concepts.



Music During Study Time

Encourage students to experiment with music at home — especially Alpha-range or low Beta-range selections during study breaks.



Conclusion

"Music is the pleasure the human soul experiences from counting without being aware that it is counting."

— **Gottfried Wilhelm von Leibniz**

→ **Music Targets the Brain**

Music stimulates spatial-temporal reasoning and overlaps with mathematical cognition.

→ **Music Reduces Anxiety**

50–80 BPM music promotes Alpha brainwaves and heart-rate entrainment, calming students during math work.

→ **Music Builds Community**

Song, chant, and rhythm increase joy and engagement, strengthening the classroom environment.

"If you learn music, you'll learn history. If you learn music, you'll learn mathematics. If you learn music, you'll learn most all there is to learn." — **Edgar Cayce**



References

1 Rebecca Porter

Spring sabbatical project. of 2017, Truckee Meadows Community College, Reno, NV

4 Gardner, Martin

"A surprising proportion of mathematicians are accomplished musicians. Is it because music and mathematics share patterns that are beautiful?" (Used in: Opening Quote slide)

7 PubMed (2009)

Review of 23 studies (~1,500 patients): music reduced heart rate, blood pressure, and anxiety in heart disease patients. (Used in: Heart-Rate Entrainment)

10 University College London (2014)

fMRI research: mathematical beauty correlates with activity in the medial orbito-frontal cortex — same area activated by great art or music. (Used in: Music and Brain Activity)

2 Campbell, Don. *The Mozart Effect*

"When your body hears the even beat of music, your heart rate and pulse relax to the beat." (Used in: Heart-Rate Entrainment)

5 Hestiyas, Blisin & Porter, Rebecca

Spring 2025 TMCC Earth Day Project Experiment. TMCC Earth Day Event, April 17, 2025. (Used in: Our Experiment)

8 Rothstein, Edward. *Emblems of Mind*

"Music and math together satisfied a sort of abstract appetite — partly intellectual, partly aesthetic, partly emotional, partly even physical." (Used in: Math-Music Structural Similarities)

11 Faculty Survey (Spring 2017)

Survey of math instructors across 21 institutions in NV, MD, WA, CA, and OK. (Used in: Faculty Survey: Math & Music)

3 Devlin, Keith. *The Math Gene*

"Brain images of musicians listening to music are similar to images of mathematicians solving problems." (Used in: Music and Brain Activity)

6 McMannis, Don

"Music has positive effects on people's emotions and creativity... activating three different centers of the brain at the same time." Edutopia, 2009. (Used in: Why Music?)

9 Stanford Medicine (2007)

Music engages brain areas involved with paying attention, making predictions, and updating memory. (Used in: Music and Brain Activity)

12 Bayan, Rick

Quote on math anxiety. (Used in: The Problem: Math Anxiety)