2017 NCTM Annual Meeting and Exposition

Changing the Rhythm of Math Class:

Using Educational Songs to Cultivate Learning and Community

Larry Lesser (The **U**niversity of **T**exas at **El P**aso)

joint work with Dennis Pearl (Pennsylvania State University), John Weber (Perimeter College at Georgia State University), and Dominic Dousa & Steve Haddad (UTEP)

http://www.math.utep.edu/Faculty/lesser/Fun.html

(or you can Google my “Mathemusician” page)

supported in part by NSF grant **Project** Smiles

Student-**M**ade **I**nteractive **L**earning with **E**ducational **S**ongs (for introductory statistics)

PSU (1544426); UTEP (1544237); GPC (1544243)

the math of UTEP’s Bhutanese architecture was in Sept. 2008 *Mathematics Teacher*!

the M in STEM/STEAM

295 "M"

Changing the Rhythm of Math Class: Using Educational Songs to Cultivate Learning and Community

General Interest Session

We'll discuss (and demo!) best practices (informed in part by our NSF grants) for creating and using educational songs for grades 8–14 mathematics/statistics. We address perceived barriers and hesitations by sharing low-risk, high bang-for-the-buck strategies, resources, and tips for finding, writing, and using songs aligned to learning objectives.

Lawrence Lesser
University of Texas at El Paso (UTEP), Texas
Dennis Pearl
Pennsylvania State University, University Park
John Weber
Perimeter College at Georgia State University, Clarkston

Henry B. Gonzalez Convention Center, 214C

OUTLINE

- *Background*
- Addressing Hesitations
- Finding Songs
- Using Songs
- Writing Songs
- Interactiveness
- Q&A

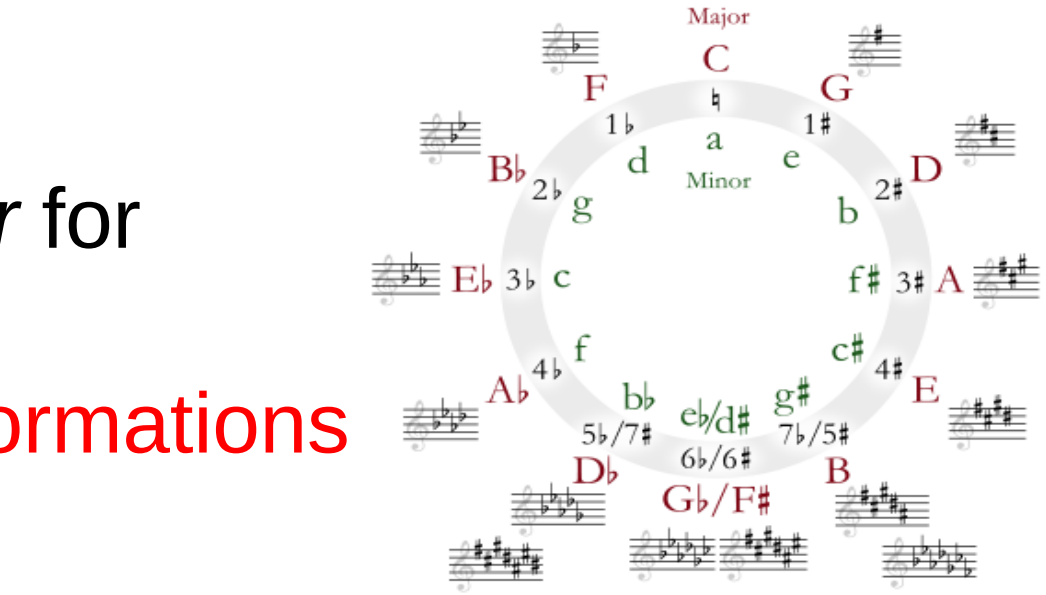
MATH	MUSIC
Ordinal numbers	naming intervals (e.g., fifths)
Geometric shapes	instrument shapes (e.g., triangle)
Geometric transformations	melodic transformations
Least common multiple	rhythm patterns; harmony (from pitches w/ low LCM)
Fractions	time signature; interval is a ratio of frequencies
Arithmetic sequence	overtones (f, 2f, 3f, 4f, …)
Geometric sequence	chromatic scale (in equal temperament)
Graph (pitch over time)	musical notes on a staff
Sine function	graph of (pure tone) sound wave
Permutations, Probability	“change ringing” of bells; Mozart’s “Musical dice game” (1793)
Statistics	DATA→SOUND: sonification SOUND→DATA: traits of hit songs
Group theory, modular arithmetic	analyze the set of pitches in a scale
Fourier series, partial differential equations	musical sound, acoustics

Connections with <u>structure</u> of music:

demos with acoustics, music theory, etc.

(CCSSM Mathematical Practice standard #7: “look for and make use of structure”)

e.g., see Sept. 2009 *Mathematics Teacher* for how group theory and geometric transformations connect to music



“Circle Song”

you complete each rhyme!

Take your finger ‘round a jar --

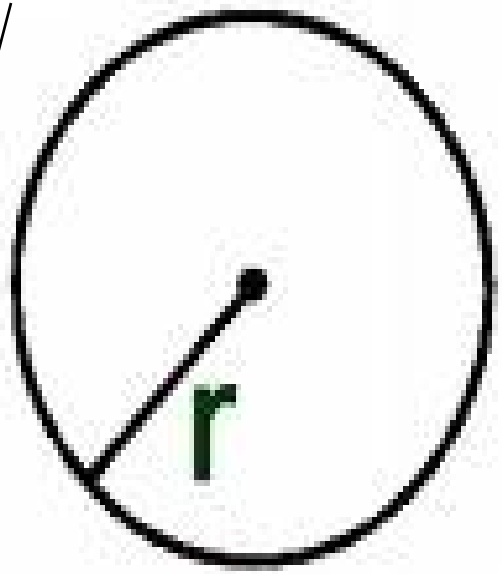
Circumf’rence equals 2 pi ____;

For area, you multiply

R squared by that number ____.

Twinkle, twinkle, you’re a star

Knowing math will take you____!



to recall (6 sig. figures of) π

Chorus of **“American Pi”** (lyric © L. Lesser):

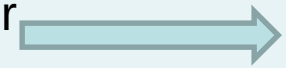
Find, find the value of pi, starts 3 point 1 4 1 5 9
A good ol’ fraction you may hope to define
But the decimal never dies,
The decimal never dies….

find this song on my “Pi Day” webpage!

addressing hesitations

found in Lesser et al. (2013)

Hesitations	Solutions
Can't quickly find good examples	CAUSEweb.org, etc.
No skills/talent	Press "PLAY"; tap student talent
Uses too much time	Use as students enter or papers handed back. Assign as HW. Streamline length. Have students access online outside class.
Incompatibility with students' cultures	Know your audience (week 1 survey, etc.)
Class size	Song works just as well in large classes
Need to be seen as serious by students	Make explicit connections to content (or assessment); make a mini-lesson plan
Need to be perceived as serious by colleagues/supervisor; weak evidence of helping learning	cite research studies, calls for engaging/active learning, etc.



in July 2016 *J. of Statistics Education*

JOURNAL OF STATISTICS EDUCATION
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Assessing Fun Items' Effectiveness in Increasing Learning of College Introductory Statistics Students: Results of a Randomized Experiment

Lawrence M. Lesser[a], Dennis K. Pearl[b], and John J. Weber, III[c]

[a]Department of Mathematical Sciences, The University of Texas at El Paso, El Paso, Texas, USA; [b]Department of Statistics, The Pennsylvania State University, University Park, Pennsylvania, USA; [c]Department of Mathematics, Computer Sciences, and Engineering, Perimeter College at Georgia State University, Clarkston, Georgia, USA

ABSTRACT

There has been a recent emergence of scholarship on the use of fun in the college statistics classroom, with at least 20 modalities identified. While there have been randomized experiments that suggest that fun can enhance student achievement or attitudes in statistics, these studies have generally been limited to one particular fun modality or have not been limited to the discipline of statistics. To address the efficacy of fun items in teaching statistics, a student-randomized experiment was designed to assess how specific items of fun may cause changes in statistical anxiety and learning statistics content. This experiment was conducted at two institutions of higher education with different and diverse student populations. Findings include a significant increase in correct responses to questions among students who were assigned online content with a song insert compared with those assigned content alone.

KEY WORDS

CAUSEweb fun collection; Humor; Song; Statistics education research

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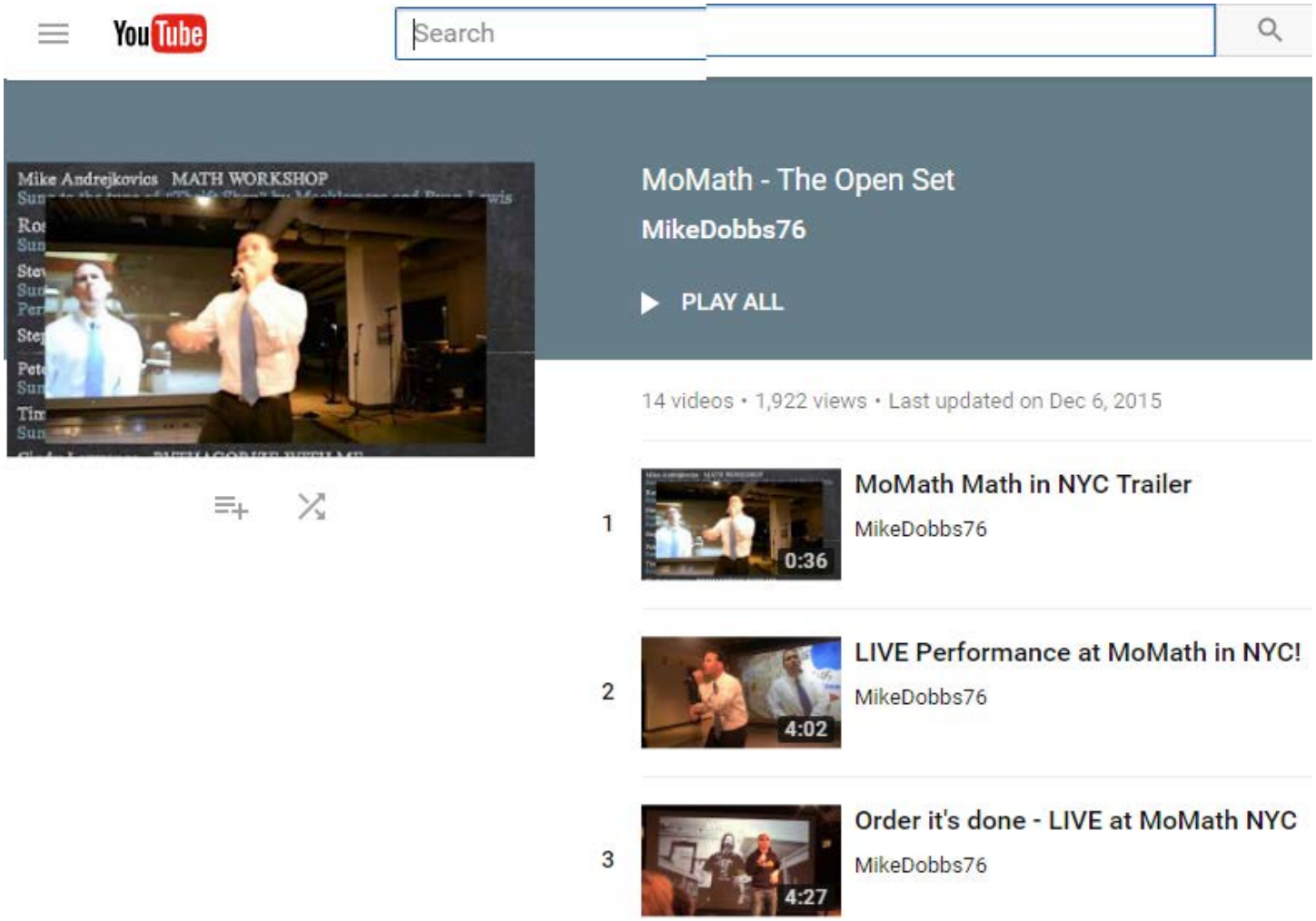
besides YouTube…..?



my math/stat song resource page

just Google: “Larry Lesser” or “Mathemusician”

www.math.utep.edu/Faculty/lesser/Mathemusician.html

Resources & Bibliography	SONGS!	Cool Math & Music Quotes
More on Lesser	Presentations & Press	Contact Info

The MatheMusician

“Find, find the value of pi -- starts 3 point 1 4 1 5 9.
A good ol’ fraction you may hope to define, but the decimal never dies ....”
-- from Larry Lesser’s award-winning “American Pi”

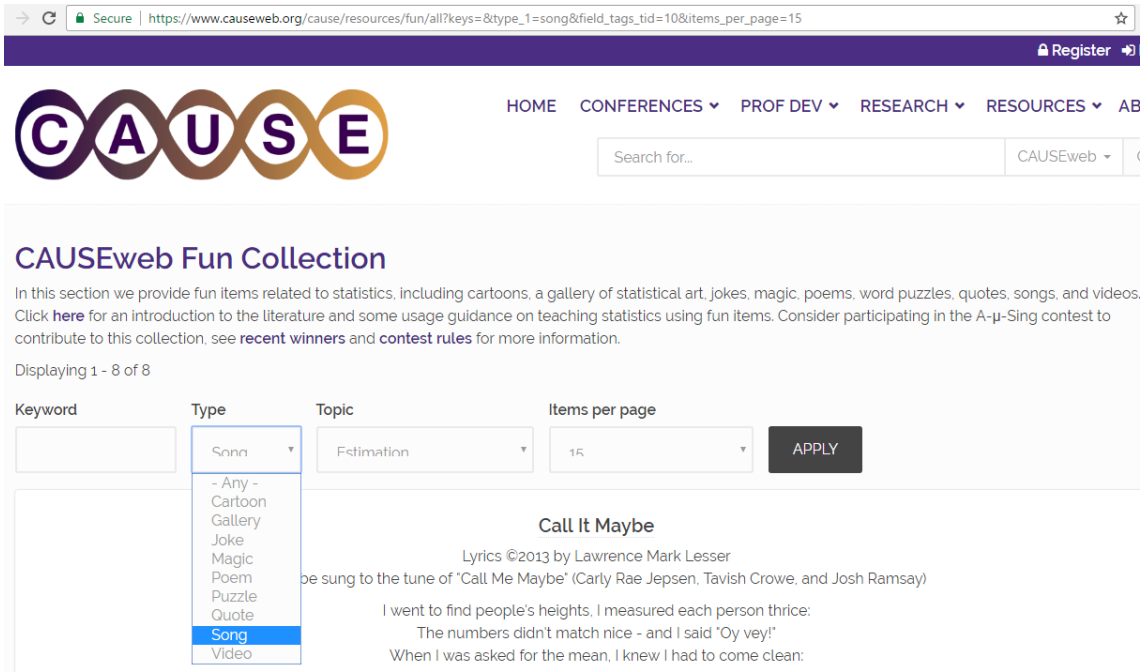
ABOUT THE *MATHEMUSICIAN*: To support his mission to motivate learning mathematics/statistics, Professor Lesser integrates two great loves – math and music! An award-winning songwriter in general songwriting contests, Lesser has also won awards for educational songs and song videos in recent national contests (ASA, National Museum of Mathematics, CAUSE, QL-SIGMAA) and a video of songs was shown at Bridges 2014. His songs have yielded statistically significant learning gains in an NSF-funded randomized experiment, helped

statistics songs

causeweb.org/cause/resources/fun/

- site launched in 2005 (part of NSF's National Science Digital Library)
- searchable fun collection now has 600+ items (including 100+ songs almost all with MP3s),

9 modalities, bibliography, & lesson plan guidance



science/math songs
http://singaboutscience.org/

SEARCH OUR DATABASE OF 7000+ SONGS

Keyword/Phrase: Go!
Keyword/Phrase: Go!
Performer/Songwriter: Go!
Song Title: Go!
Song Template: Go!
(i.e., the original song upon which a parody is based)
Album Title: Go!
Website URL: Go!
(e.g., youtube.com [omit http://www.])

Additional (optional) search restrictions:

☑ Only include songs intended for students between ages 0 and 99
ages" or adults will not be included if the range is narrowed to less than 0-
☐ Only include songs known to be parodies.
☐ Only include songs with online lyrics.
☐ Only include songs with free full-length online recordings.
☐ Only include songs with free full-length online videos.
☐ Don't include songs that may contain adult language.

Go! Clear all

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Roles of Song (Lesser, 2014)

- recall
- introduce concepts/terms
- reinforce thinking process
- connect to history/real-world
- humanize

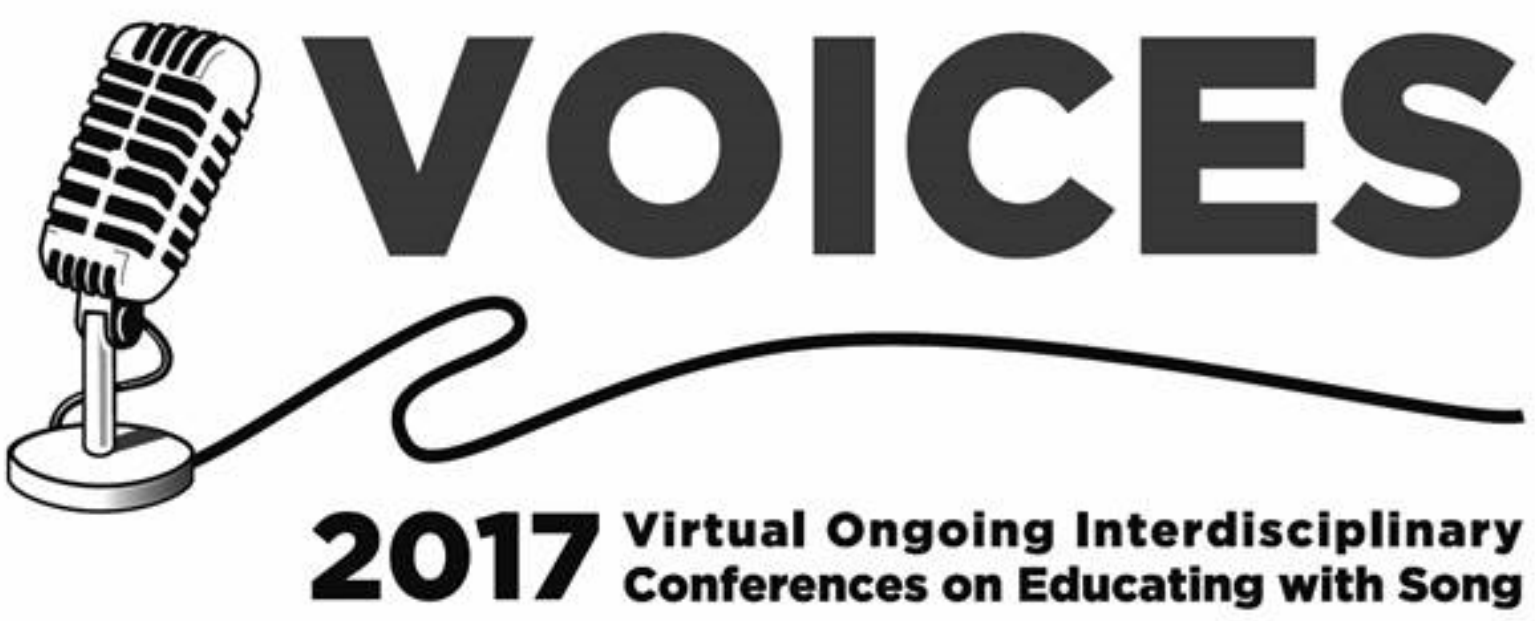
Things to consider

- Alignment with content learning objectives and standards (CCSSM? PSSM? GAISE?)
- Setup or pre-assessment
- Delivery: in class (a capella, live instrument, karaoke, or MP3?) or offline?
- Student level of participation
- Follow-up or post-assessment/exploration (e.g., the “American Pi” questions)

coming….Sept. 27-28!

(STEM-focused, almost free, pedagogy/research/practitioner angles)

info: crowther@uw.edu



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song (title) ideas

- Songs with numbers or math terms (modulo a pun): several songs have used “50 Ways to…”
- Steven Galbraith’s “List of Unintentionally Mathematical Songs”
- *The Green Book*
- SongSet.net
- Common misconceptions (my “1 in 2”, “Losing Cause”, etc.)

some of my math song titles	topic
Mean	Measure of center
The Gambler	lottery literacy
From a Distance	graphing
American ~~Pie~~ Pi	History of the number pi
Hotel ~~California~~ Called Infinity	exploring infinity via Hilbert's Hotel
Call ~~Me~~ It Maybe	variation
~~Home on the~~ Domain and Range	domain and range
Hit Me with Your Best ~~Shot~~ Plot	graphing
~~Imagine~~ Imaginary	imaginary numbers
~~Livin' La Vida Loca~~ Findin' Extrema Local	finding local extrema

free (or nearly free) song apps

- Rhymezone.com, Rhymer.com, b-rhymes
- GarageBand
- SoundCloud
- Evernote, FourTrack, Songwriter's Pad, Suggester, Simple Songwriter, Nanostudio, Song Box Lyric Writer, Songboard, Hum, Band Creator, SongSet, etc.

student-made examples

- Class project/enrichment: rubric can assess creativity, accuracy, how well lyrics go beyond just mentioning a term, etc.; students can put song on YouTube, SoundCloud, etc.
- Contest: National (e.g., MoMath “The Open Set”, CAUSE “A-mu-sing”) or classroom

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a continuum of song “interactiveness”

- Listen to recording
- Listen to performer
- Provide accompanying rhythm
- Sing along (with lyric displayed)
- Complete each rhyme with only 1 right answer
- Provide inputs to help create the song
- Write your own song (with scaffolding offered)

2015 - present NSF grant (DUE 1544237)

Project Smiles

Student-**M**ade **I**nteractive **L**earning with **E**ducational **S**ongs (for introductory statistics)

GOAL: to write (and assess) *interactive* songs
of high aesthetic and pedagogical quality
to maximize learning and engagement

part of our larger ongoing efforts…

http://www.math.utep.edu/Faculty/lesser/Fun.html

- Nov. 2008 *J. of Statistics Education*: review paper of 20 modalities of fun (e.g., humor, songs, games, cartoons) in statistics education
- March 2013 *J. of Statistics Education*: survey of 249 statistics instructors on **hesitations** and motivations for using fun
- Spring 2014 *J. of Mathematics and the Arts*: rationale, strategies, and resources for using **lyrics** in mathematics/statistics class
- June 2015 *Transformative Dialogues*: **case study** of an instructor's use of fun (including song) in statistics
- July 2016 *J. of Statistics Education*: randomized experiment on fun **inserts** (e.g., songs or cartoons) into intro statistics readings in LMS
- June 2016: *To Improve the Academy*: survey on use of song in **educational development**