

# Break into *SMILES*: exploring web-based “interactive” songs

With Dennis Pearl, Penn State University,  
Larry Lesser, The University of Texas at El Paso,  
& John Weber, GSU Perimeter College

# AGENDA

Where do things stand now?

- Please take Tiffany Getty's survey at

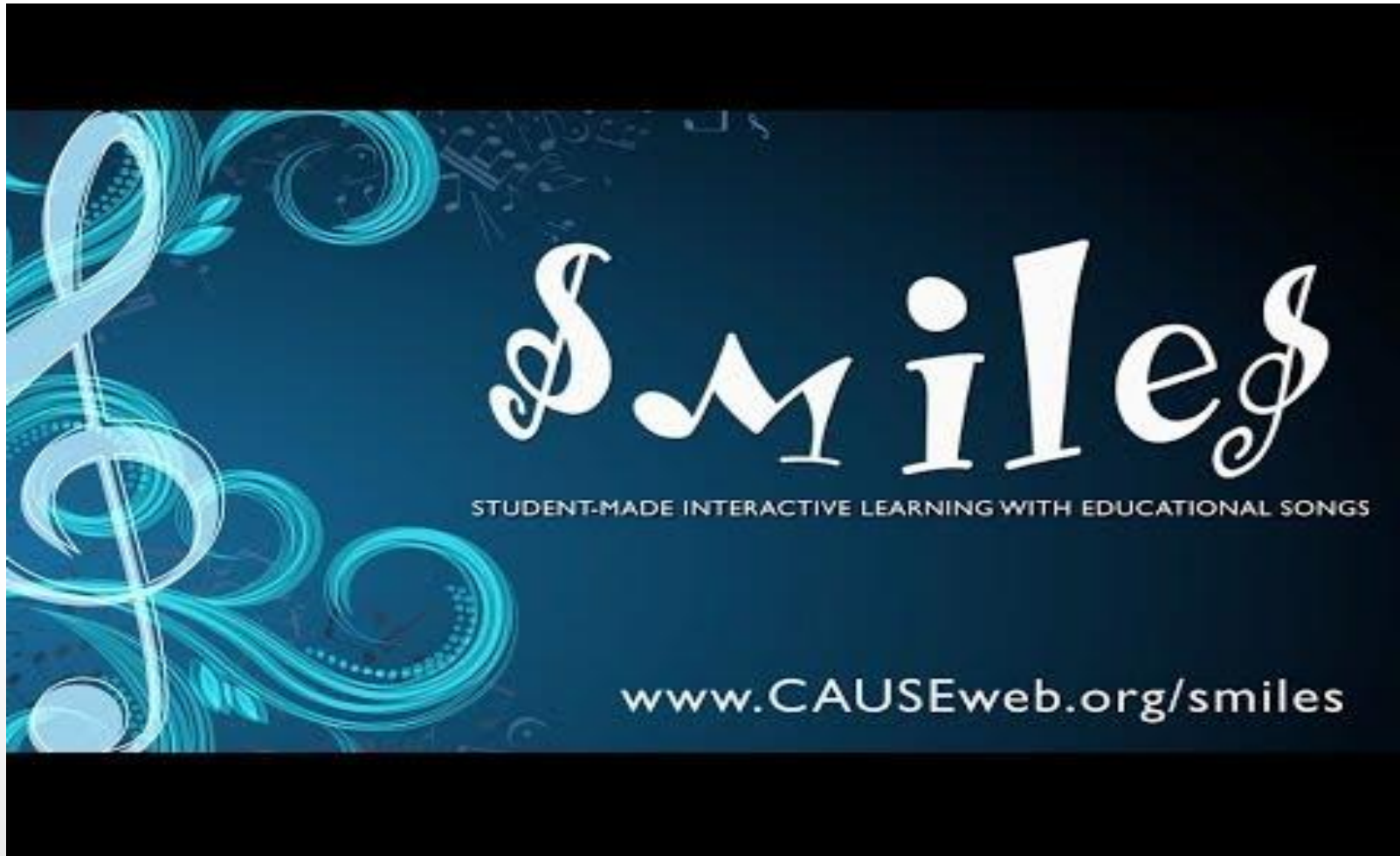
[www.surveygizmo.com/s3/5010795/USCOTS](http://www.surveygizmo.com/s3/5010795/USCOTS)

Discussion of motivations and hesitations for using song in teaching

## Project SMILES

- Introduction
- Test-drive
- Use in class
- Results
- Feedback

Project SMILES at  
[www.CAUSEweb.org/smiles](http://www.CAUSEweb.org/smiles)



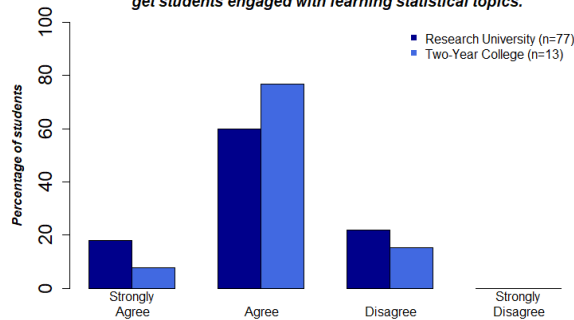
# Test-Drive

While trying these, think about:

- How do you feel students would react?
- How would you use this in teaching?
  - in class vs. out-of-class?
  - to introduce, explore, or review a concept?

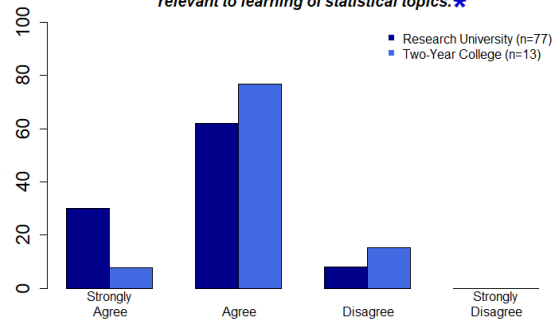
# Student Feedback (Spring/Summer 2017)

**The interactive song activity is a good way to get students engaged with learning statistical topics.**



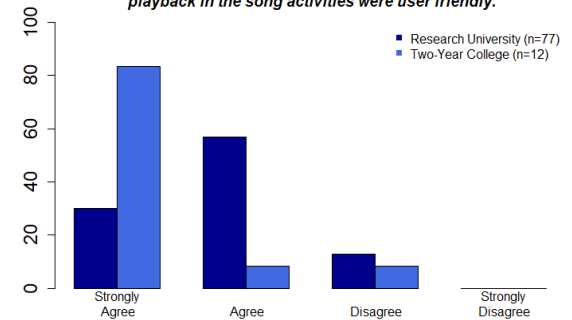
Survey Responses to the Statement in the Caption

**The interactive song activities we did in class were relevant to learning of statistical topics.\***



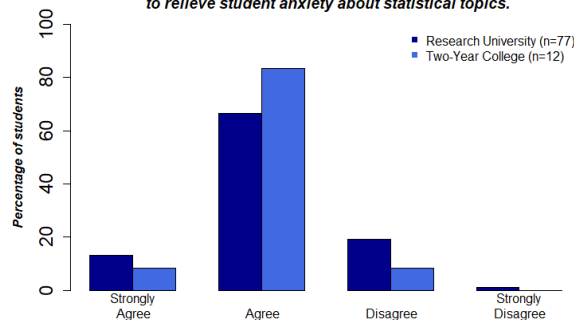
Survey Responses to the Statement in the Caption

**The web-based interface of prompts and playback in the song activities were user friendly.**



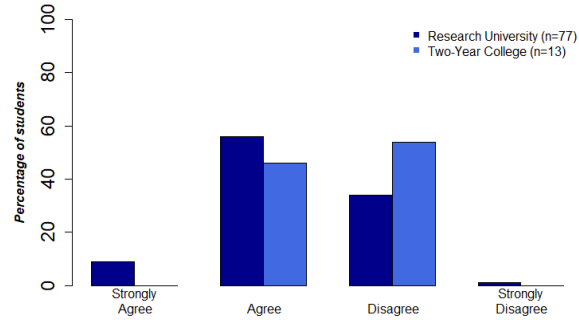
Survey Responses to the Statement in the Caption

**The interactive song activity is a good tool in helping to relieve student anxiety about statistical topics.**



Survey Responses to the Statement in the Caption

**The songs used in the activities we did in class were high quality.**



Survey Responses to the Statement in the Caption

\* At the two-year college, the following wording was used: "The interactive activities we did in class was relevant to *my* [italics added] learning of statistical topics."

# Completion & Assessment (from web Logfiles)

Song	Completion of Prompts		In-class Assessments		
	In-class % students	Out-of-class % sessions	Pre-song % correct	Post-song % correct	Learning Objective
“Levels of Measurement”	99%	46%	34%	82%	Identify data type in context
“Height of Confidence”	98%	66%	40%	62%	Effect of $n$ & CI level on CI width
“Super Bowl Poll”	87%	41%	15%	58%	MOE varies with square root of $n$

# What can we do to help you?

Learning Objectives you want songs developed for

Other teaching with song efforts

- Podcast,
- workshops,
- webinars,
- virtual conferences,
- other song resources, ...

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# Our earlier NSF-funded Project UPLIFT

(July 2016 *Journal of Statistics Education*)

JOURNAL OF STATISTICS EDUCATION  
2016, VOL. 24, NO. 2, 54–62  
<http://dx.doi.org/10.1080/10691898.2016.1190190>



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## Assessing Fun Items' Effectiveness in Increasing Learning of College Introductory Statistics Students: Results of a Randomized Experiment

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### 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





- Half of students randomized to get “inserts” into LMS mini-readings

My Home > Introduction t...

### *It's a Sign: A Connection between Correlation and Slope*

The correlation coefficient  $r$  tells us something about the strength and linear relationship of a scatterplot of data. By strength, we mean how tightly the points cluster around the regression line (i.e., the line of best fit). All else being equal, a correlation value of  $r = 0.7$  (or  $r = -0.7$ ) generally indicates a stronger linear relationship than a value such as  $r = 0.3$  (or  $r = -0.3$ ).

The direction of the relationship has to do with the sign of  $r$ . If  $r > 0$ , we have positive correlation, which means higher values of  $Y$  are associated with higher values of  $x$ , and lower values of  $Y$  are associated with lower values of  $X$ . In other words,  $X$  and  $Y$  go up and down together. Such a scatterplot would be described best with a line of fit that has a positive slope, and indeed this is always the case: positive correlation happens when the regression line slope is positive. Likewise,  $r < 0$  means negative correlation, with  $X$  and  $Y$  moving in opposite directions from each other, thus suggesting a line of fit with a negative slope. Finally, a scatterplot with no real linear trend at all (i.e.,  $r = 0$ ) would have a line of fit that is horizontal, which means slope of 0. Whether positive, negative, or zero, the sign of the correlation  $r$  is the same as the sign of the slope of the line.

Here are lyrics to a song (sung to the tune of the familiar folk tune "Twinkle, Twinkle Little Star" that helped you learn the alphabet) to help you rehearse and permanently acquire this fact in your mind:

***Correlation Song (lyric © 2013 Lawrence M. Lesser)***

Are points near a line, or far?  
What's the correlation,  $r$ ?  
If the fit supports a line,  
Its slope and  $r$  would share the sign.  
Twinkle, twinkle, you're a star:  
Knowing stats will take you far!

Click on this MP3 file (<https://www.causeweb.org/resources/fun/mp3/CorrelationSong.mp3>) so you can hear this 20-second jingle. Now play it one more time (and sing along!).

Reading

Song  
Insert

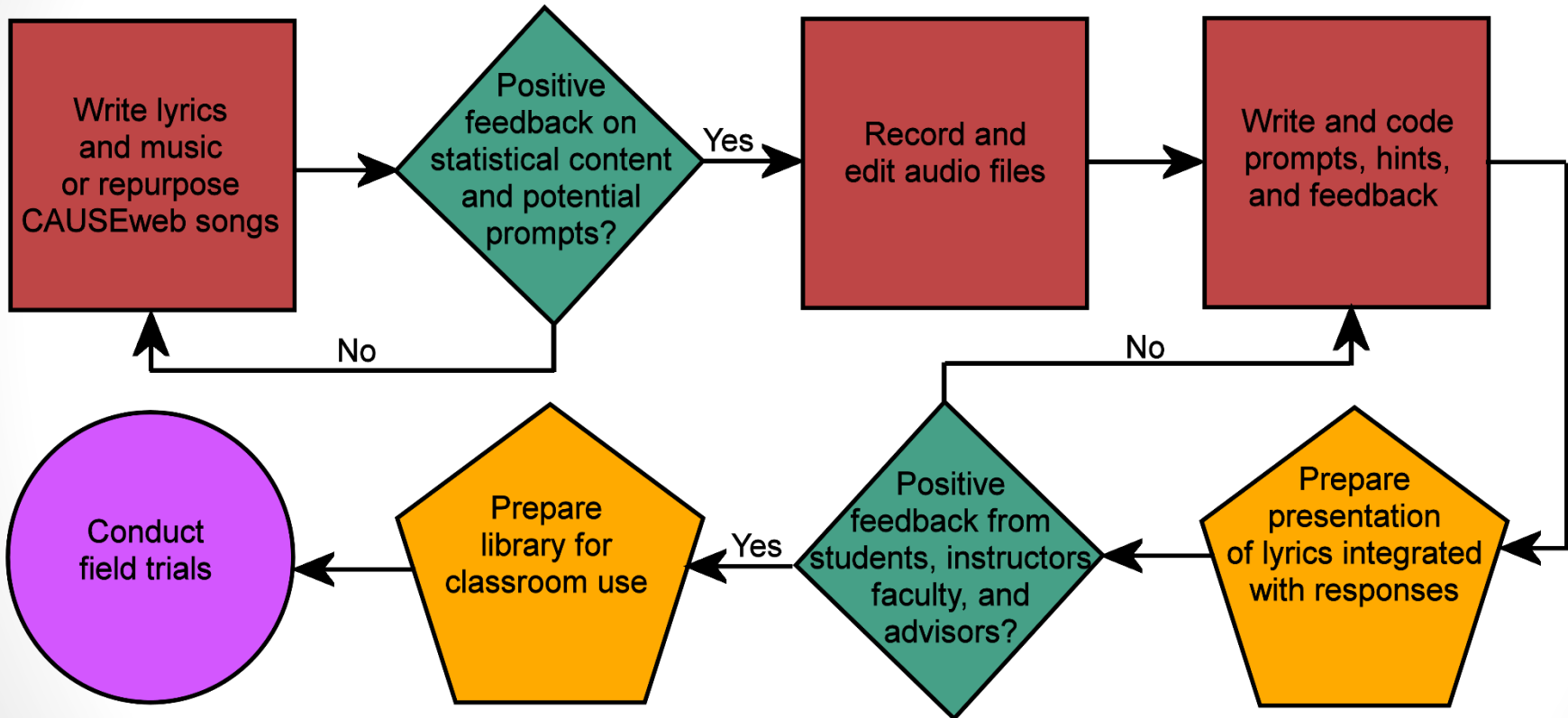
# % correct on embedded exam questions related to readings

- Students ( $n = 88$ ) without song insert: 42.3%
- Students ( $n = 80$ ) with song insert: 50.0%

Practical significance:  $\frac{3}{4}$  of a letter grade

Statistical significance: 2-tailed  $p$ -value = .04

# SMILES interactive development process



# SMILES song criteria

- Short (median length: 90 seconds)
- Built for inputs (robust for # of syllables, end-rhyme spots avoided, etc.)
- Connect to real-world data if possible
- Lyrics: help learning of intro statistics learning objective (aligned with GOALS, GAISE, etc.)
- Music: original or public domain
- Genre: lyrics not too fast or buried
- Maximize intelligibility of the synthetic voice singing student inputs



# Diversity factors/feedback

- Try to vary singer gender, genre, etc.
- Red/green colorblindness addressed in feedback on student inputs

Insert the name of a visual graph you could view to decide if there is a linear relationship between the heights and weights of students in your class. **Hint**

scatterplot



# Equity: ELL support

- Lyrics' direct, conversational sentence structure and less jargon/formality than textbook prose
- Students can pause, rewind, replay songs (which are slower than speech)
- Scaffolding for those new to English or US:

## Hypothesis on Trial

1. At the beginning of the courtroom criminal trial in the United States, the defendant is presumed to be  of the crime.

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2. If we think of the null hypothesis as the person (defendant) on trial, then "failing to reject the null hypothesis" would be analogous to a decision to  the defendant on trial.

To **convict** means to decide that there is a sufficient level of evidence that someone accused of a crime is guilty. To **acquit** means to decide that there is **NOT** a sufficient level of evidence that someone accused of a crime is guilty.

# Pre-song prompts


- About 5 prompts/song
- More than  $\frac{1}{4}$  of prompts have *hints*
- 43% have free response (words or numbers) with synthetic voice on playback; 57% have forced answers sung with human voice
- 96% require statistical knowledge

# Many open-ended prompts solicit **context**

## Correlation Does Not Imply Causation

For questions 1 – 3, consider this sentence:

"She likes to \_\_\_\_\_ in order to get \_\_\_\_\_."

1. For the first blank, please give a one-syllable  **action verb** that is an activity someone does. **Hint**

## Chi-Squared Dance

1. Provide a nominal variable that might be displayed in the rows or columns of a table.

A *nominal variable* is a categorical or qualitative variable with no ordering to the categories.

2. How many categories does your variable have?

For example, someone categorizing eye color as *brown*, *blue*, *green*, or *other* would be using 4 categories.

## Simpson's Paradox

Please fill in the blanks below with words that are as short as possible. Refer to these examples if you need help. Show examples: **Example 1** **Example 2** **Example 3** .

1. Give the name of a group that people could leave or join, comprised of two mutually exclusive types of people or individuals. **Hint**

2. Give a general label for any individual in your group (plural noun). **Hint**

3. Give a label (plural noun) for one type of individual in your group, ideally a type likely to score the higher average measure of your variable. **Hint**

4. Give a label (plural noun) for a second type of individual in your group, ideally a type likely to score the lower average measure of your variable. **Hint**



# Responsiveness to student inputs

- Accepts **synonyms** (scatterplot, scattergram, XY plot; normal, Gaussian, bell-shaped; bigger, larger, greater) and British spelling

Provide a nominal variable that

A *nominal variable* is a categorical or qu

- **Auto-corrects** grammar and spelling errors
- **Screens** for profanity, too many syllables, out of range (e.g.,  $r > 1$ ), and inconsistency (sign of  $r$  &  $b$ )

colour ✓

- **Suggestions** from first letters:

2. Give the name of a type of animal and what a group of those animals is called.

Hint

Animal: ca|

Group: camels

cats

cattle

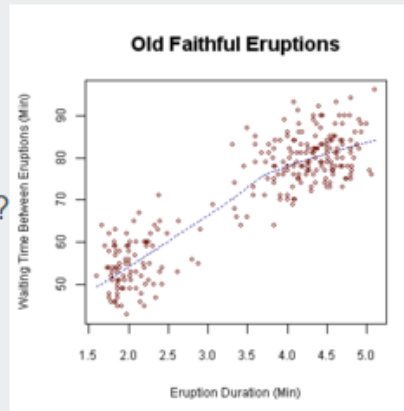
caterpillars

3. Give a simple example of something that is something that can be **quantitatively** measured in question 2. (one or two syllables please)

Hint

Insert the name of a visual graph you could view to decide if there is a linear relationship between the heights and weights of students in your class. **Hint**

What is a name for this type of graph?



For a given scatterplot the correlation coefficient and the slope of the regression line would **Select** share the same sign. **Hint**

Try plugging in values into the applet at <http://illuminations.nctm.org/Activity.aspx?id=4186> with the "show line of best fit" checked and watch how  $r$  and the slope behave (the slope is the number that  $x$  is multiplied by to get  $y$ ).

always

sometimes

never

# Informed by feedback from...

- Piloting in Spring/Summer 2017 classes
- Randomized trials (Fall 2017 & Spring 2018)
- Conference talks/posters (2016 – present)
- Workshops (e.g., USCOTS 2017 had faculty from 3 continents; eCOTS 2018)
- NSF video showcases
  - (winner “We are Mathematics” video competition)
- Advisory Board communications
- External Evaluator recommendations

# Tips for Using SMILES

- Choose songs aligned with your curriculum
- Introduce or review a topic; vary a lecture
- Try whole-room **teacher-led mode** (drop-down prompts can be clicker questions, fill-in items be class discussion items) or have students with earbuds in **lab mode**
- Formative assessment (website lets teachers access a MC item)
- Let students write their own songs  
(see Lesser 2018 eCOTS poster)

# These ideas apply across STEM!

See archived 2017 & 2018 VOICES meetings & plan to attend

VOICES 2019: Sept. 22-23

email [leadvoices@causeweb.org](mailto:leadvoices@causeweb.org) to request to join VOICES e-list  
(STEM-focused, almost free, for pedagogy/research/practitioner)

[causeweb.org/voices/](http://causeweb.org/voices/)

