# INTERACTIVE SONG ACTIVITIES FOR INTRODUCTORY STATISTICS

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## Background:

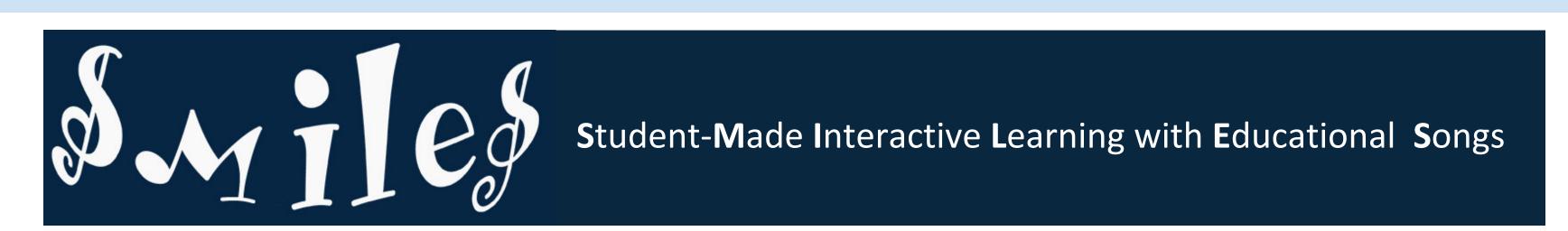
Using song in higher education spans many scientific disciplines (e.g.

www.CAUSEweb.org/voices) and has many putative benefits, including reduced stress or anxiety, improved recall, and increased motivation or engagement (Crowther et al., 2016; Crowther, 2016; Lesser, 2014). Based on prior findings (Lesser et al., 2016), we have developed a new web-based resource for teaching with song where students interact with online prompts to make conceptual connections and provide examples that become part of a song highlighting their contributions (www.CAUSEweb.org/smiles). Twenty-eight songs covering most introductory statistics topics were developed along with the associated prompts and assessment items to test their efficacy for learning (Figure 2).

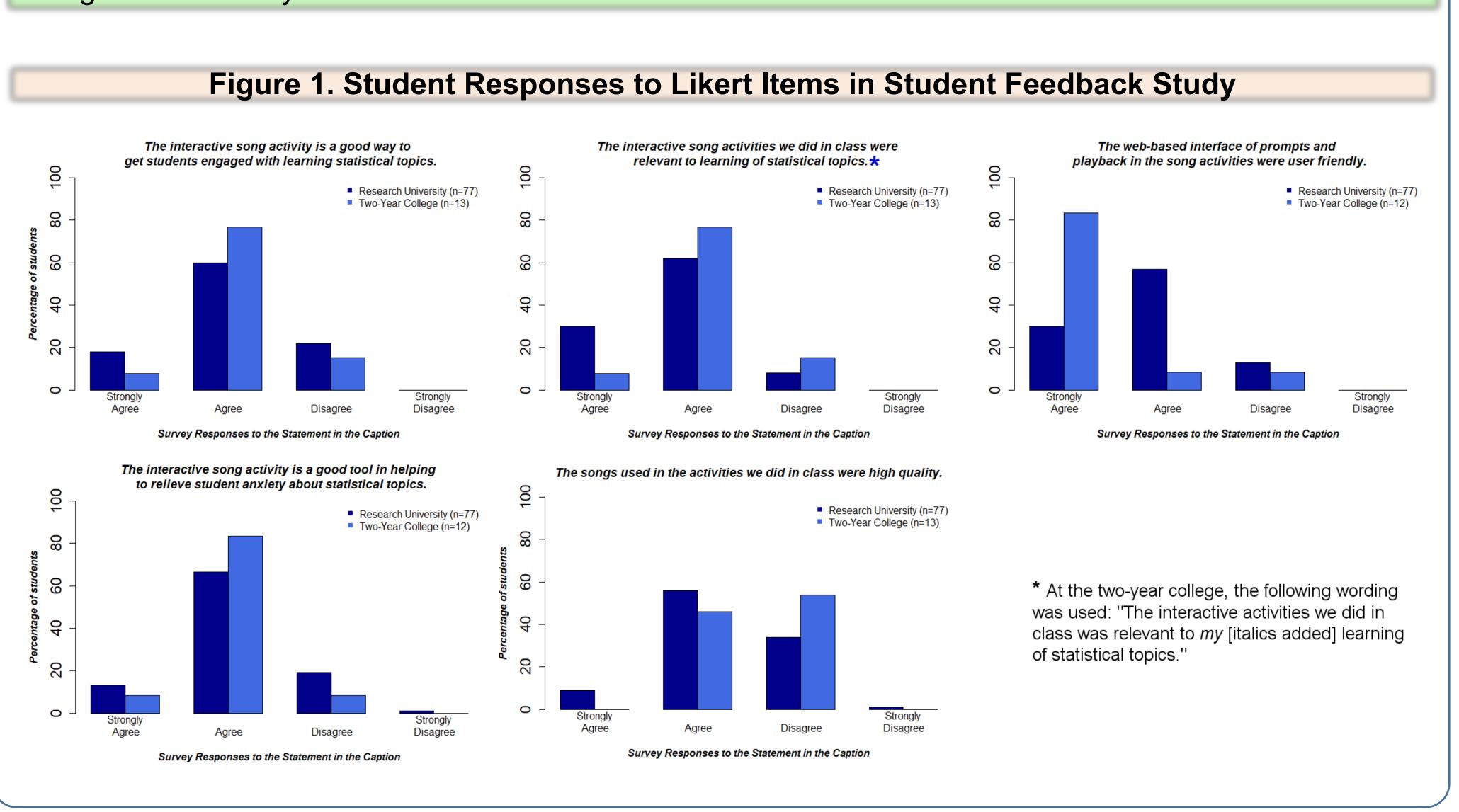
#### **Motivation:**

Interactive songs are a novel learning resource that holds great potential for teaching literacy and reasoning skills in statistics and other STEM disciplines. The web-based, machine-run, and auto-graded characteristic of this resource is designed to provide easy access to students anywhere anytime, and will address instructor hesitations regarding in-class use. For instructors, interactive songs will be readily adaptable regardless of pedagogy (e.g., as easily incorporated in a flipped class as in an online class, or a lecture/lab course), and provide an easily implemented bridge to the statistics education reform movement for groups like adjuncts who are less connected. Most importantly, for students, these professionalquality interactive songs are designed to engage, lessen anxiety, and foster active learning that enhances statistical reasoning skills. To enhance their value, the interactive songs developed by the SMILES project involved a unique artist/scientist collaborative to create original high-quality musical resources.

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(including requests for instructor login)



Ninety students from two institutions (one research university and one two-year college) were asked to respond to Likert scale items on agreement with key project goals. Students self-reported the tool was helpful in reducing anxiety, increasing engagement with the material, being relevant to their learning, and having a user-friendly interface.



#### Figure 2. Example Prompts and Assessment Levels of Measuremen Height of Confidence Nominal, ordinal, interval, ratio are levels of measurement. Let's show that progression with examples that we present Pick your favorite NFL team; if you don't have a favorite, just pick a team you think might Here are brief definitions of four levels of measurement in scrambled order: A pollster changes the sample size (n), and confidence level from time to time in a series of polls on A ratio variable is a numerical variable where the value of zero indicates an absence of With a variable that's **nominal**, values are just like names. So ordering or averaging **genotype** would really be a shame! An ordinal variable is a categorical variable that has a natural ordering to the The margin of error for a **sample proportion** for a survey of 1000 people would be about the widest interval A variable that's **ordinal** sorts values like a chain, 7 × %. Hint A nominal variable just puts values into groups without any ordering the second widest interva But don't assume with **pain level** each jump would mean the same! An interval variable is a numerical variable where differences between values makes the third widest (or second narrowest) interval the narrowest interval With a variable that's interval, differences are sound . If 17% is the **sample percentage**, then the **margin of error** you entered in the above Drag the variable types into the slots for order of increasing information content But Fahrenheit ratios would only just confound. item gives an interval estimate as low as \ % and as high as With a variable that's <u>ratio</u>, zero means there's none. nominal 🗸 💮 ordinal 🗸 🧪 interval 🗸 ratio 🗸 If you multiplied the **sample size** by a factor of nine, that would Select vo the **margin of** B. n = 500 with 80% confidence C. n = 100 with 95% confidence Examples help us learn what measurement levels are D. n = 500 with 95% confidence Pick four variables that interest you so that you have one variable of each type and then An acronym recalls them: drag them into the corresponding slots below It's the French word NOIR The screenshot above Second widest interval A. n = 100 with 99% confidence B. n = 500 with 80% confidence So ordering or averaging genotype would really be a shame! shows another song's n = 100 with 95% confidence □ 5 & ≠ D. n = 500 with 95% confidence prompts interface, which 3. Third widest (or second narrowest) interv has an example of The screenshots above A. n = 100 with 99% confidence B. n = 500 with 80% confidence C. n = 100 with 95% confidence machine-generated and to the left show a o. n = 500 with 95% confidence feedback and a hint button. song's pre-song prompts Narrowest interval . *n* = 100 with 99% confidence The screenshot to the right interface and the playback n = 100 with 95% confidence D. n = 500 with 95% confidence interface (with student shows a song's matching inserts highlighted). assessment item.

### Results using Web Logfiles

Using xAPI logfiles allows us to examine how students interact with the software. By seeing where students struggle, we can design better feedback and hints – which become especially important when the interactive songs are used outside of class. As expected, students using the interactive songs in-class with a facilitator overwhelmingly completed all of the prompts in a single session while students at home were less likely to do so. The value added by the songs can be seen in the percentage of students giving correct responses to specific prompts and then asking about the same material in a different context after the song activity (Table 1).

Table 1. Completion Rates & Assessment Results

		Completion of Prompts		In-class Assessments		
	Song	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 <i>n</i> & CI level on CI width
	"Super Bowl Poll"	87%	41%	15%	58%	MOE varies with square root of <i>n</i>
	•	87%	41%	15%	58%	square root of n

# **Associated Arts Integration**

The SMILES Library of 28 interactive songs is one component of a collection of approximately 800 "fun" resources for teaching statistics maintained by the Consortium for the Advancement of Undergraduate Statistics Education at <a href="https://www.CAUSEweb.org/fun">www.CAUSEweb.org/fun</a>. The collection includes about 200 items in each of the cartoon, song, and quote categories and about 50 items in the video, joke, and poetry categories.

#### References

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