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The T(ea) Test: Scripted Stories Increase Statistical Method Selection Skills

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Abstract

To teach statistics, teachers must attempt to overcome pedagogical obstacles, such as dread, anxiety, and boredom. There are many options available to teachers that facilitate a pedagogically conducive environment in the classroom. The current study examined the effectiveness of incorporating scripted stories and humor into statistical method selection skills. Over two semesters, students were taught various concepts either through traditional lecture, humor, or through the use of scripted fictional stories. The overall results indicate selection skills were higher for statistical concepts that were taught using stories. This suggests that statistics instructors should consider using scripted stories to improve students' ability to select the appropriate statistical technique for a given situation.

Keywords: Statistical method selection, humor, stories, teaching.

Alice was a young, curious, and incredibly bored college student. There is only so much one could do in her small town and she had already been to the local hangout four times this week. So, one day she decided to have a Tea Party. She put on her finest dress and invited the Mad Hatter and the March Hare over for tea. Later that afternoon, her friends showed up for her party and upon pouring their first glass of iced tea, she asked each of them "How many lumps of sugar would you like in your tea?"

"Sugar? In my tea?" screeched the March Hare. "I am from the North, and we do not put sugar in our iced tea. That is disgusting."

"I disagree" charged the Mad Hatter. "I am from the great state of Alabama, and no self-respecting Southerner would drink it any other way. I will take 12 sugars."

Alice looked at both of her friends, and as they growled like feral dogs at one another, she realized how different they were… BUT, was it a statistically significant difference?

Alice decided that she wanted to find out if there was a difference between Northerners and Southerners in their preference for tea sweetness. So she traveled to New York and asked 20 people how many lumps of sugar they like in their tea, and she traveled to Ala-

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bama and asked 20 people how many lumps of sugar they like in their tea. After visually examining her data, it appeared that there was a difference between Southerners and Northerners. But, how could she determine whether the difference between the two groups was statistically significant? To answer this question, Alice must use a T(ea) test.

Students often begin a statistics course under the impression that statistics is just another arithmetic class (Bond, Perkins, & Ramirez, 2012). Also, it is no secret that students have negative attitudes about statistics courses. Many past studies have shown that students dread taking statistics courses, procrastinate enrolling in them, and find them uninteresting (Conners, McCown, & Roskos-Ewoldsen, 1998; Onwuegbuzie, 2004). In fact, as much as 70–80% of students experience statistics anxiety (Onwuegbuzie & Wilson, 2003). However, it is important to keep in mind that it is not students' attitudes at the beginning of the semester that best predict outcomes. Instead, it is the student's attitudes *at the time* of the assessment that are the best predictors of performance (Dempster & McCorry, 2009). Thus, to teach statistics successfully, teachers must help students overcome dread, anxiety, boredom, and any other negative emotions that students might be experiencing at the time of learning and assessment.

The negative emotions, such as boredom, associated with statistics are counterproductive to learning and are negatively correlated with success in coursework (Onwuegbuzie & Wilson, 2003; Tremblay, Gardner, & Heipel, 2000). Most modern day teachers will agree that attempting to simply transfer knowledge from one's brain to the students' brains is simply not enough to maintain students' interest, attention, while also simultaneously increasing learning (McGlynn, 2005; Ziv, 1998). Some students need, desire, or even demand that their classrooms be entertaining, and feel that it is up to teachers to spark students' interest in the class or material (Kraus & Sears, 2008), and arguably most teachers would agree that some of these expectations aid in student learning. Inevitably, instructors who fulfill this need are rated higher on their end-of-semester evaluations than those who are unable to meet students' expectations for entertainment (Fortson & Brown, 1998).

Instructors in virtually all fields have multiple options when it comes to creating stimulating classrooms that support learning. Many instructors engage students with techniques such as classroom activities, demonstrations, debates, films, entertaining slide presentations (Wender & Muehlbeck, 2003), and experiments, among others. In statistics classrooms specifically, teachers can use hand-calculation exercises (Ricketts & Berry, 1994), demonstrations (Humphrey, 2011), experiential/service learning, in-class activities, and even field trips (Lesser, 2012). However, for some, these options may be too time-consuming, expensive, or merely infeasible. A brief and 'cheap' alternative suggested by some teachers is to discuss statistical content in humorous, silly, and ironic ways (Bruner, 1996; Hackathorn, 2008).

Research suggests that humor in the classroom, whether scripted or spontaneous, reduces students' anxiety, improves perceptions of the teacher, helps students to maintain attention, increases students' long-term memory, and improves understanding (Fortson & Brown, 1998; Hackathorn, Garczynski, Blankmeyer, Tennial, & Solomon, 2011; Schacht

& Stewart, 1990; Schmitz, 2002; Ziv 1998). For example, Ziv (1998) found that humor facilitated creativity by reducing students' anxiety levels. In another example, Hackathorn and colleagues (2011) found that using humor actually improved student's overall exam performance, but scores were especially increased on knowledge (i.e., memorization) and comprehension (i.e., understanding) level test items.

As it relates specifically to statistics, there are a few notable studies that have shown that humor is helpful (see Neumann, Hood, & Neumann, 2009 for a brief review). For example, Schacht and Stewart (1990) found that content taught in the form of cartoons/clip art reduced math anxiety. Additionally, Amoo, Friedman and Friedman (2000) found that embedding real data in entertaining or absurd situations, such as paranormal encounters, increased student engagement. Finally, Friedman, Friedman, and Amoo (2012) found that humor, in terms of poems, raps, and jokes, decreased boredom, increased engagement, and ultimately increased learning.

But, some instructors are uncomfortable using humor in the classroom; some may use it inappropriately, or some may feel too inexperienced as an instructor to purposefully incorporate humor into one's verbal repertoire (Fortson & Brown, 1998). However, one does not have to be an experienced comedian to effectively incorporate boredom-busting creativity into one's teaching strategies. One outlet that teachers can use is stories, whether fictional, scripted, or personal. Stories, which are narrative-based and conceptually organized to convey information (Stein, 1982), can take many forms, and have been shown to be very pedagogically useful in the classroom (Thorne, 1999). For example, a political science instructor might share the story of a personal experience campaigning for a local politician to highlight the importance of grassroots efforts. Or a biologist might explain the evolution of an organism in a narrative, story-like manner, to illustrate the organism's history in an entertaining way.

Although the literature regarding stories is relatively scarce, one notable exception has shown the effectiveness of using stories in the classroom. Kraus (2010) found that asking students to navigate an imaginary dungeon containing monsters helped students learn central tendency concepts. Although this is not necessarily a narrated story (Downs, Javidi, & Nussbaum, 1988), this particular example allowed students to use their imaginations in creative ways. The use of narratives and stories are effective pedagogical methods not only for various subjects, but also for students in all levels of education ranging from kindergarten to college (Casey, Erkut, Ceder, & Young, 2008; Herreid, 2007; Yang & Wu, 2012).

The current study examined the effectiveness of humor and scripted fictional stories to improve students' scores on specific topics – that is, statistical selection skills, (i.e., one's ability to choose the appropriate statistical analysis for a given research question and set of data; Ware & Chastain, 1991). Although students see statistics as an arithmetic, or algebraic, based math class, statistics courses are more about logic, critical thinking, and verbal reasoning (VanderStoep & Shaughnessy, 1997; Zerbolio, 1999). Acquiring statistical selection skills are difficult for most students (Hackathorn, Thornton, Tennial, & Bolton, 2009; Ware & Chastain, 1991). Choosing the appropriate statistical options re-

lies on a set of predetermined assumptions about the participants, the measures, the variables, the type of methodology used, and the research question itself. This is not to say that learning how to calculate statistics (e.g., standard deviation) is unimportant. On the contrary, it is just as important to know how to calculate a standard deviation as it is to know what that resulting number means (Ware & Chastain, 1991). If one understands the numbers and the point of the underlying statistical computations, then, arguably, statistical selection skills would be improved.

Over the course of two semesters, students were taught various concepts either through traditional lectures (e.g., computations, explanations, demonstrations, and in-class activities), scripted humor (e.g., jokes, humorous examples, or cartoons), or through the use of scripted stories (e.g., Alice and the T(ea) Test). A final comprehensive exam contained a section of multiple choice questions specific to statistical selection. We hypothesized that exam scores for concepts taught using either humorous examples or scripted stories would be higher than concepts taught using traditional lecture methods. However, it was unclear which one, humor or stories would be the most effective.

Method

Participants

Participants (N = 68) consisted of students over two semesters that completed a junior level introduction to statistics course in a mid-sized public university in the southern United States. There were 32 students in the fall semester course and 36 students in the spring semester course of the same academic year. Student participants' ages ranged from 18 years to 48 years of age (M = 24.67, SD = 8.20, Med = 21). The demographic composition of the sample consisted of predominantly females (69%), Caucasians (87%), junior classmen (66%), and psychology majors (51%).

Materials and Procedure

Throughout each semester, students were taught material ranging from data presentation to simple linear regressions. Concepts were taught using a variety of methods, categorized for the purposes of this study as traditional, humorous, or stories. Content taught through the use of traditional methods included lecture, demonstrations, in-class activities, and real-world examples. For example, in an attempt to teach variance related concepts, a real-world example was used by having students calculate and discuss how much money would be needed to eat at a local restaurant. Traditional lecture methods covered content such as descriptive statistics, t-test of dependence, chi-square test of independence, spearman's rho, repeated measures ANOVA, and simple linear regression.

Content taught with the use of humor included jokes, funny examples, or relevant static cartoon clips in addition to lecture. An example of humorous content was to use ridiculous examples for correlations, such as a negative relationship between the times spent playing a popular video game and success in dating. Concepts taught with humor included Pearson's correlations, one-way ANOVAs, and Factorial ANOVAs. Content taught

through the use of scripted stories encompassed fictional stories, such as Alice and the T(ea) Test presented at the beginning of this article. Other stories presented included a murder mystery, a romantic triangle, and a king's attempt to find the richest prince in the land. The scripted stories covered z-scores, t-test of independence, and the chi-square goodness of fit.

The final exam took place on the last day of each semester. Students were told in advance that they would receive a comprehensive final exam, and also received an exam review in the class day prior to the final exam. The first section of the final exam consisted of a lengthy set of comprehensive multiple choice questions. Each question consisted of a small vignette and a corresponding research question. Students were asked to identify which analysis would be the most appropriate. For example, here is a question from the final exam: "Jake scored in the top 10% of his statistics class. However, his friend Sally also scored in the top 10% of her statistics class. But, Jake wants to know who actually scored better. What statistical calculation could Jake do to find out?" To answer the example question, students were required to choose one of four multiple choice options. Final scores in the analysis were created by the proportion of correct answers in each of the respective conditions (i.e., traditional, humor, and stories). Answers were either coded as completely correct or completely wrong; no partial credit was recorded.

Results

We hypothesized that exam scores for concepts taught using humorous examples or scripted stories would be higher than concepts taught using traditional lecture methods. Preliminary analyses indicated that there were no differences between the two courses (that is, between fall semester and spring semester) in scores on the final exam for any of the conditions (humor $t(66) = .64$, $p = .526$; stories $t(66) = .44$, $p = .661$; traditional $t(66) = .18$, $p = .861$). Thus, although this study was conducted using two classes, data from both semesters were joined together for the primary test of the hypothesis as a means of increasing statistical power.

As the results of the dependent variable were in regards to proportion of items correct, the appropriate arcsine transformation was conducted for the data. The results of a one-way repeated measures ANOVA indicated a significant difference between the lecture types, $F(2, 134) = 7.82$, $p < .001$. Planned pairwise comparisons indicated performance on test items that were taught through the use of scripted stories were significantly higher than concepts taught through the use of humor ($p < .012$) and traditional methods ($p < .001$). However, performance on concepts taught with the use of humor was not significantly higher than performance on concepts taught through traditional methods ($p > .05$). For the sake of simplicity in interpreting the results, Figure 1 illustrates the differences between groups using the original (untransformed) data values.

Furthermore, a post-hoc complex comparison (combining humor and traditional lecture conditions) using a t-test of dependence indicated that students scored higher on concepts

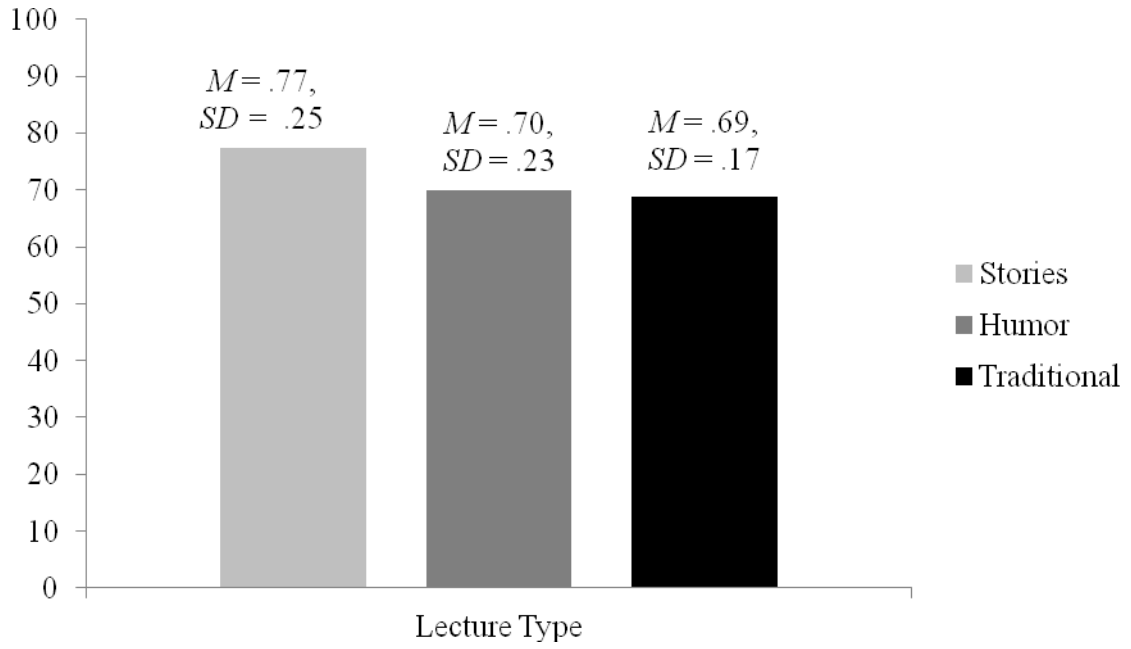

Figure 1. An illustration of the difference between lecture types on performance on final exam.

taught with scripted stories than concepts taught without stories, $t(67) = 4.03$, $p < .001$, $d = .49$.

Discussion

The current study examined the effectiveness of incorporating scripted stories (e.g., Alice and the T(ea) Test) to improve students' statistical selection skills. In two courses over two semesters, results from the data combined from both semesters indicated the same pattern. That is, selection skills were higher for statistical concepts that were taught using scripted stories than concepts taught traditionally and higher than concepts taught through the use of humor (although there was no difference between concepts taught traditionally and those taught with humor).

Statistical based scripted stories have the ability to lead students through an entire research project in a very short amount of time. For example, in the case of Alice's tea test, the students are presented with the research question, the data collection procedure, the data, and the selection of an appropriate test. Additionally, Alice's actual data as well as the hand-calculation of the statistical analysis are shown to students (but were omitted in this paper for simplicity). As the PowerPoint slides show cartoon pictures of Alice, the statistical test is presented under the pretense of fiction. Thus, the scripted stories may have improved learning because students were engaged and interested in the material and perhaps simultaneously distracted by it as well, thus reducing boredom or anxiety. However, these constructs were not directly assessed in the current study. There is some anecdotal evidence that students enjoyed the stories: in the instructor's evaluations, when

asked what aspects of the teaching or content of this course do you feel were especially good, students wrote things such as: "I liked all of the 'story time' examples", "The short stories made stats enjoyable", and "liked (sic) how the stories were used to develop the bigger picture". However, these are merely anecdotal, and future studies may want to include a direct assessment of student interest.

What is interesting and unexpected is the lack of support for improved learning through the use of humorous lecture content. A multitude of past studies have shown that humor in the classroom is beneficial, and this study does not dispute that. Hackathorn and colleagues (2011) found that humor helped students on knowledge and comprehension level items, but was not especially helpful on application level items. Statistical selection is arguably at the application level of Bloom's taxonomy. Thus, humorous static cartoons or jokes may help a student remember a given statistical test, or even understand its purpose, but may not be helpful in choosing the appropriate test to go with a set of data. For example, a static cartoon strip may not demonstrate when to choose a Pearson's r correlation test, although it may give some hidden insight into the nature of the test itself. Thus, extra steps must be taken to ensure that the humor is matched to the skill. For example, it should be noted that there is a semblance of fun and humor in each of the scripted stories used for this study. That is, the stories use colorful clip art, propose interesting plot twists, make relevant references to local venues, and are not told in monotone voice (i.e., playful voices, 'terrible' accents, and slang are used). The students often remark that the stories are entertaining; they often laugh during the stories; and even sometimes clap afterwards. Thus, the stories may be the answer to the humor dilemma mentioned previously because students may remember the story and its entire plot because it was fun and humorous, but it was helpful because it was matched specifically to the goal of statistical selection. In sum, future studies may want to manipulate the cognitive levels of the humor presented, to see specifically what types of humor aid the student in what situations and for what types of statistical problems.

As in any study that has ecological validity, there are some inherent limitations. Specifically, this study is limited by the teacher's repertoire. That is, the concepts were not randomly assigned to their conditions. Although great care was taken to ensure that the level of difficulty of concepts was dispersed evenly across conditions (i.e., easier concepts did not appear in one group while harder concepts were all in another group), the instructor had pre-created stories and materials that put the topics in its corresponding condition. Thus, one could argue that perhaps this positively affected the results. However, due to the wide range of concepts included, we find this unlikely. Arguably, the easiest of all the concepts to learn in this course (i.e., measures of central tendency), were in the traditional condition. Additionally, the humor condition contained correlations, which is another concept students tend to find easy to understand. Taking this into to consideration, we argue that our findings are likely subdued. That is, students should have scored higher in the 'control' conditions than the experimental, due to the ease of topics contained in those conditions. The notion that we found positive effects in the story condition, suggests that effects may be even larger than is reported here. In the future, it may be beneficial to conduct a true experiment in which one class received stories, and the other class

did not. This may help to better determine the effectiveness of the stories across the various levels of concept difficulty.

While this study focused specifically on the statistics classroom, instructors in any field can utilize stories to increase their students' attention and learning. It may seem daunting to create stories for use in the classroom, but with a good understanding of the material and some time, it is a task any instructor can successfully tackle. In fact, many instructors probably already use narratives and stories in their teaching, and could simply develop those narratives into scripted, structured stories. Students find the narrative structure of a story helpful when trying to recall important information because that information is more memorable than information shared via traditional lectures (Amoo et al., 2000) – benefits that are not constrained to just a statistics class. By taking the basic information that needs to be conveyed to students and structuring it into a narrative form, instructors will be aiding their students by decreasing boredom and increasing engagement (Amoo, et al., 2000; Friedman et al., 2012).

The current study provides some helpful and fun information for statistics teachers. Using fictional scripted stories, such as Alice and the T(ea) Test, students are led down the 'rabbit-hole' of statistical selection by introducing the nature of the data, the research question, and how to discern the appropriate analysis. Because learning statistics is made difficult by student's negative attitudes and trepidation, it is important for teachers to have an arsenal of tools ready to minimize these tendencies. Through the use of scripted stories, it would appear that students are entertained while they simultaneously learn the material. In conjunction with the use of humor, perhaps these stories are effective because they distract students from their statistical boredom and anxiety.

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