

Interview With The Vampire Researcher: An Adventure In Applied Statistics

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Abstract

In this panel presentation attendees met three researchers of varied educational level who reported on a unique educational project. The focus is on mentoring an undergraduate math major in performing her first data analysis on actual survey data using applied statistical methods. A masters level media psychologist who is a non-statistician, qualitative researcher collected the data. The data were analyzed in a previous qualitative study (Vinney, 2011). While the undergraduate researcher acted as a statistical consultant and analyst for the first time, the master's level researcher had the opportunity to learn to frame quantitative research questions, develop hypotheses based on these questions, and learn to understand statistical results. The project was supervised by a PhD statistical consultant and researcher. The panelists each presented the project and the results of the project from their own point of view. The process and outcome will provide insight into the different perspectives of the three individuals involved in the process and the way their experiences may be applied to further educational endeavours in applied statistics. The presenters conclude that mentoring is an effective alternative method for teaching statistical consulting to undergraduates.

Key Words: statistics education, mentoring, undergraduate education, applied statistics

1. Introduction

1.1 Undergraduate Statistical Education

Despite the frequent implementation of improvements in methods of statistical education (MacGillivray 1998, Forster & MacGillivray 2010, Lipson & Kokonis 2005, Forster et al, 2005), such as those recommended by Cobb (1993) and Aliaga et al. (2004), many changes in statistical education practice still need to be applied in order to best serve the needs of students who are engaged in the early stages of learning and applying statistical methods. In light of the many technological advances that allow us to focus earlier and more often on teaching a broad scope of methods and models (such as those based on non-normal distributions, or Bayesian strategies) many educators continue to teach the introductory statistics course from a traditional perspective (Cobb 2007). Students generally learn how to *compute* statistics (whether by hand or using statistical computing software), as opposed to learning how to apply critical thinking and statistical knowledge to determine how and when to use specific statistics and analytic techniques. Another problem is that an integral understanding of research methodology and statistics is

generally not fostered in undergraduate courses. Students may emerge from such courses having learned little more than a few equations for basic descriptive and inferential statistics. All too often the introductory statistics course contains sample data (as opposed to real research data) that does little to stimulate students' interest in data analysis or research. Many students find such courses boring and struggle to see the relevance of such course material to their future work and lives. Another deficit in undergraduate statistics education is that while writing and thinking critically about statistics are key skills that can be learned and applied by undergraduates (Delcham & Sezer 2010), classes in statistics rarely address the development of these skills.

1.1.1 Undergraduate education in statistical consulting

For students who aspire to become statistical consultants, a career requiring the application of a very broad skill set, the shortcomings of typical undergraduate statistics courses can effectively delay the developmental process of becoming a professional. The knowledge, experience, and ability in statistics, writing, critical thinking, research methodology, advanced computing, and programming which are absolutely essential for this profession must be seamlessly integrated. A good statistical consultant should also possess excellent receptive and expressive communication skills. All of this requires maturity, but most of all – *practice*.

The training of students who wish to become statistical consultants is not typically begun at the undergraduate level; however, in instances where such training has been undertaken many positive outcomes have been observed (Boomer et al. 2007).

Aspiring consultants need opportunities to gain experience in applying mathematical and conceptual knowledge to real data analysis problems presented by real researchers; but unfortunately, opportunities are limited at best for undergraduates who wish to gain experience as statistical consultants. For highly motivated students with exceptional aptitude, the difficulties in progressing can be compounded if available consulting projects are not tailored to be at a sufficiently advanced level.

In this panel discussion we presented our recent work addressing the problems outlined above.

1.2 Mentoring

We maintain that mentoring, defined as a relationship whose purpose is the one-to-one transmission of information from a mentor to a mentee, is a practical alternative for teaching young statisticians the broad range of skills they need for their careers. Mentoring includes teaching activities such as giving information, answering questions, and supplying the mentee with resources and references; but also includes additional activities, such as providing the mentee with verbal and written feedback, encouragement and positive reinforcement; sharing stories about professional experiences; and bringing the mentee for “ride-alongs” in order to directly observe a variety of actual research, data analysis, and professional consultation situations. History is replete with accounts of students from every culture who have been successfully mentored in enumerable endeavours, including such diverse fields as baseball, the arts, business, law, science, and medicine (Barondess 1995). Statistics is no exception. For example, Gibbons and

MacGillivray (2010) describe how a mentored volunteer tutoring program provided an early opportunity to practice a variety of skills directly applicable to statisticians' careers.

The remainder of this paper is a summary of the panel discussion that occurred on August 2nd, 2012 at the Joint Statistical Meeting in San Diego, CA. The panel consisted of four individuals from educational institutions and one professional consultant from the private sector: (1) Brenda Osuna, PhD., senior statistics consultant at the University of Southern California, (2) Reagan Rose, undergraduate applied mathematics major at the University of Southern California, (3) Cynthia Vinney, MA, researcher from Fielding Graduate University, and (4) AnnMaria Demars, PhD, panel discussant, from the Julia Group. Steven Cen, PhD, from the University of Southern California acted as panel chair.

2. Mentoring an Undergraduate Statistical Consultant

2.1 The Dual Purpose of the Project

First, Osuna discussed the dual purpose of the project: (a) to provide a framework for intensive mentoring in statistics for an undergraduate applied mathematics major (Rose), while (b) simultaneously addressing quantitative research questions that emerged in the course of a previous qualitative study (Vinney 2011);

Osuna explained that her mentee, Rose, as an undergraduate applied mathematics major, is not required to take even one statistics course to earn her degree. At most, there is one elective course in statistics available to her. Without the opportunity to engage in extracurricular educational activities Rose would not encounter the opportunity to engage in learning and practicing the skills she will need in her chosen future career as a statistical consultant until she is a graduate student.

Rose had the opportunity in this project to experience and work on the process from beginning to end, starting with understanding the research question and hypotheses, setting up a database, screening and cleaning the data, testing assumptions, analyzing the data, interpreting the output, conducting diagnostics and post-hoc tests, writing up results, and finally communicating the results to the researcher. Rose achieved this without standard training in statistics. Instead, Rose observed Osuna as she provided numerous statistical consultations to faculty, staff, and students at the University of Southern California over the course of a term. Osuna personally mentored Rose and suggested books, software, and online resources that Rose could access on her own. The project also gave Rose experience in applying to present at a conference, presenting on a panel, and writing up her experience and results for publication. Some of the many other skills Rose learned in this process include researching literature in peer-reviewed journals, writing results in scientific style, using bibliographic software to keep track of references, and using IBM SPSS statistics software for analysis and graphing.

Osuna also discussed how social learning theory (Bandura 1986) provides a theoretical basis for understanding the superiority of the mentoring method as opposed to the didactic classroom learning experience. In addition to direct mentoring, Rose experienced vicarious learning when observing Osuna during consultations. Osuna modelled professional skills during consultations, trainings, and analysis sessions. Osuna also employed a role-playing strategy with Rose whereby Osuna would have Rose act as statistical consultant while Osuna would play the researcher. These episodes of role

rehearsal gave Rose the opportunity to develop feelings of mastery and self-efficacy that led to increasing confidence in her ability to perform in the role of statistical consultant. These feelings were reinforced over time so that gradually Rose began to operate more and more independently, needing less assistance from Osuna as time went on.

Next, Osuna explained that she had acted as thesis advisor on a previous qualitative research project with Vinney (2011). Vinney was left with data from the earlier project that she wished to analyze quantitatively; this provided an opportunity to assist Vinney with her continued research, while simultaneously providing Rose with an opportunity to take the reins as a mentored statistical consultant on a research project that appealed to her.

2.2 The Mentor's Perspective

As mentor, Osuna met with both Rose and Vinney in the early stages of the project. Rose was coached prior to meetings so that she could act as primary consultant. For example, Osuna assisted Rose in the creation of a list of questions to ask Vinney at the first consulting meeting. The questions were designed to help Rose and Vinney to communicate about the purpose of the research project and data analysis. The goal of the early meetings was to formulate a clear research question and hypotheses. In the early meetings, both Rose and Vinney would request guidance on most points discussed, and there was some mild confusion about roles and responsibilities. In the middle of the project, Rose and Vinney worked almost completely independently and only consulted Osuna infrequently. Once the results of the data analysis were obtained, Rose and Vinney relied on Osuna more often in order to interpret and understand the results. Once Rose and Vinney felt nearly finished with their part of the project, Osuna intervened once again with guidance about suggested further analysis and subsequent final interpretation of the data. In the end, the group performed well together and each member of the team contributed equally to the overall success of the project. Osuna briefly illustrated how, in retrospect, it was interesting to note that the team developed as a unit according to the stages of group development (forming, storming, norming, and performing) as described by Tuckman (1965).

Throughout the project, Rose received continued assistance with her work on the project whenever she requested it; however, Osuna was careful to allow her to work independently and to avoid unnecessary intrusions into Rose's work or learning process.

Osuna concluded that the process was very successful in that Rose, who began the project with only the most basic of statistical knowledge was able to work with Vinney to complete the entire process of statistical consultation, analysis, and reporting of findings to the satisfaction of her mentor and her client. Feedback from Vinney about Rose's performance was that she acted in a manner consistent with exceptional professionalism and scholarship. Rose successfully performed a large number of complex tasks including cleaning and screening of data; analysis of data using quantitative text analysis (Linguistic Inquiry Word Count) software, descriptive statistics, *t*-tests, logistic regression, and visual representation of data. In addition, Rose learned to write in a scholarly manner and she presented her work at a major professional conference – JSM 2012.

3. Statistical Consultation and Data Analysis: The Vampire Researcher

3.1 Reason for research

As popular media continues to permeate our culture, the effects such media have on individuals are of increasing interest. Given the perception of young people as particularly vulnerable to such effects and the fact that the major task of the adolescent years is the development of an individual identity, the effects media exposure may have on this process are especially ripe for investigation. In order to better understand some of these effects and why they occur, Vinney researched these issues in a qualitative study that examined how two recent works of popular culture, the television show *Buffy the Vampire Slayer* (“*BtVS*”) and the novels and movies of *The Twilight Series* (“*Twilight*”) were utilized by female fans in the development of their identities during adolescence and how these interactions continued to affect them as they enter future stages of the life cycle (Vinney, 2011).

The original research qualitatively analyzed survey data collected from fans of the two selected texts. *BtVS* and *Twilight* were chosen because both feature teenage girls as protagonists making them particularly appealing to female adolescents. *BtVS* which was broadcast from 1997 until 2003, told the story of the adolescent vampire slayer, Buffy Summers, and her band of allies in the fight against the evil undead, including her best friends Willow Rosenberg and Xander Harris, along with her romantic entanglements with the vampires, Angel and Spike. The books and films of *Twilight*, which were launched with the publication of the first novel in 2005, revolve around the relationship between the human teenager, Bella Swan, and the vampire, Edward Cullen, as they meet, fall in love, marry, and have a child. Because both works are part of the vampire genre, they overlap in many ways including their themes, storylines, and a use of metaphor that leaves the texts open to interpretation. Yet, each work’s central female protagonist differs in her characterization and motivations allowing for an examination of the ways such differences create variations in the textual information to which adolescents choose to attend and respond. Qualitative text analysis of the collected study data revealed that participants used *BtVS* and *Twilight* in a variety of ways, including to experience vicarious romantic relationships, to find role models, to spend time with characters who serve as an extension of their social worlds, and to express parts of their social and personal identities.

3.2 Participants

Participants were 60 women who completed a survey for either *BtVS* fans or for *Twilight* fans. Only participants who indicated they had become fans before or during adolescence were included in the sample, with adolescence being defined as between the ages of 13 and 25 years old to account for the period of extended adolescence mentioned above. Two participants were excluded because of this requirement. Thus, there were 58 surveys in the data set: 24 *Twilight* participants from 18 to 24 years old ($M = 21.7$, $SD = 1.97$) and 34 *BtVS* participants from 18 to 33 years old ($M = 23.6$, $SD = 4.79$). No identifying information outside of age was collected from participants.

3.3 Instruments

The *BtVS* fan survey and the *Twilight* fan survey asked the same series of questions, only differing in the title of the work and names of the characters to which they referred. After

choosing their age and the age at which they became a fan of their favored work, participants were asked a series of questions about their fandom including why they are a fan, why they originally became a fan, their degree of fandom at its peak, the number of hours they spent with the text when their fandom was at its peak, and whether they were still a fan and, if not, why not. Next, participants identified their favorite character, the character with which they especially identified, the character they especially wished they were like, and the character or characters they saw as friends. Participants were asked to explain their choices, if their choice of the character had changed since they originally became a fan, and, if so, who their original choice of character would have been, and why their choice of character had changed. Finally, participants completed a series of open-ended questions about what they learned from their favored text, how their lives had been affected by their fandom, and whether they felt being a fan of their favored text had changed them.

3.4 Qualitative Results and Research Design

Qualitative text analysis of the collected study data revealed that participants used *BtVS* and *Twilight* in a variety of ways. Participants who were *Twilight* fans used their favored text to experience a vicarious romantic relationship. On the other hand, participants who were *BtVS* fans saw the main character of Buffy as a role model who set an example for how to handle and overcome hardships and difficult situations. The study also showed that participants used the texts as an extension of their social worlds and to express parts of their social and personal identities. In order to build upon this qualitative research and to look specifically at variables that could more clearly establish the reasons for the study results, statistical analysis was a valuable next step.

4. Statistical Consultation and Data Analysis: The Undergraduate Mentee Experience

4.1 Background

In the next section of the panel, Rose discussed her experiences acting as a statistical consultant and conducting the data analysis. First explaining her background in the field of statistics that consists of just one introductory statistics course, Rose gave a brief introduction about the purpose of the project, explaining how this study aimed to explore alternative methods of teaching statistics to undergraduate students, specifically through methods of independent research and mentoring.

Rose initially became involved in the study through her part-time job as an assistant to Osuna at the University of Southern California. Rose was interested in learning intermediate and advanced statistical methodology and its applications, but was not able to participate in the curriculum-based program available at the University. Through her job, Rose was able to obtain lessons and mentoring from Osuna both privately and during statistical consultations that she assisted Osuna with at the University. After a few months of training, Rose expressed a desire to try a data analysis project on her own.

4.2 Process and Methodology

Rose then outlined the methodology of the actual study, explaining the dynamic of the mentee-mentor relationship between her and Osuna and the consultant-researcher

relationship between her and Vinney. Rose described the resources she used to first get a basic understanding of the statistical software and methodology that would be necessary in order to act as a consultant and effectively perform the data analysis, explaining that she drew much of her knowledge from her experiences with Osuna. She detailed the process of learning how to conduct and interpret the data analysis using IBM's SPSS, explaining that much independent research was required on her part to absorb all of the information. Rose listed the sources she used to learn all of the material, including Mertler and Vannatta's *Advanced and Multivariate Statistical Methods* (2010), and referencing software-based sources such as SPSS's built in Statistics Coach feature.

The next part of the discussion described the development of the project and further detailed the specific methods Rose used to actually conduct the data analysis. Acting as a statistical consultant, Rose worked with Vinney frequently at the beginning of the process to find out Vinney's research questions and clarify Vinney's questions and concerns about statistics. Rose was also mentored frequently by Osuna at this stage in the process to help Rose learn the best ways to effectively communicate as a consultant so that she could accurately address all of Vinney's questions. Rose developed a template for basic statistical consulting that she used each time she communicated with Vinney to ensure clarity and organization. The template outlined basic questions to ask the researcher to find out what exactly she would like to know about her data, follow up questions that would help clarify which quantitative variables were involved in each of the researchers questions, and methodology suggestions that allowed Rose to plan what statistical method would be most appropriate to address the research question. After several meetings with Vinney Rose was able to finalize a list stating four central research questions which she would address in the data analysis, Vinney's hypotheses, and what statistical measures and tests would be used to analyze each question.

4.3 Results

Rose then explained the results of the data analysis. A binary logistic regression was run to test whether or not the length of time of fandom had an effect on whether or not fans had ever changed the character they identified with. The test resulted with a significance level of $p=.499$, allowing us to conclude that the length of time fandom of the participants has no statistically significant effect on their likelihood to change the character they identify with over time.

Table 1: Binary logistic regression results.
(Variables entered on step 1: Length of Fandom.)

	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
<i>Length of Fandom</i>	.051	.075	.457	1	.499	1.052
<i>Constant</i>	-1.545	.591	6.822	1	.009	.213

A chi-squared test was conducted to see if the sex of the participants' favorite character was dependent on the text that the individual was a fan of. The researcher hypothesized that *Twilight* fans were more likely to favor a male character while *Buffy the Vampire Slayer* fans were more likely to favor a female character. The tested resulted in a significance level of $p=.006$, allowing us to conclude that there is a statistically significant association between the two variables.

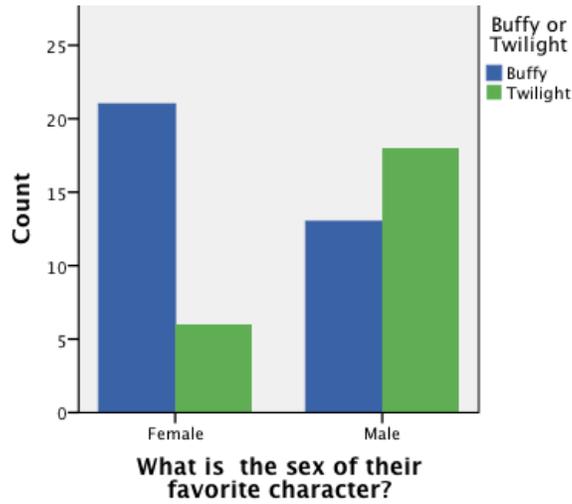


Figure 1: Bar graph displaying the counts for the sex of participants’ favorite characters grouped by text, *Buffy* and *Twilight*.

Table 2: Crosstabulation Count

		What is the sex of their favorite character?		Total
		Female	Male	
Buffy or Twilight	Buffy	21	13	34
	Twilight	6	18	24
Total		27	31	58

Table 3: Chi-Squared Test

	Value	Df	Asymp. Sig (2-sided)
Pearson Chi-Square	1.330	1	.006

Next, a linear regression was conducted to assess whether or not age affected how positive or negative *Twilight* fans are about finding a relationship similar to the central relationship in the text. The researcher hypothesized that as age increases, fans express more negative emotions about finding such a relationship. The linear regression resulted in a significance level of $p=.852$ and a correlation $r=.040$ with a Pearson Chi-Square value of 1.330 with one degree of freedom. These results allow us to conclude that there is no statistically significant association between the sex of the characters fans identify with and the text that participants are fans of.

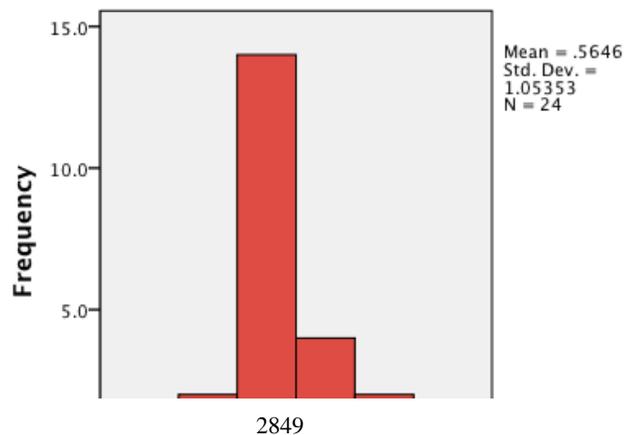


Figure 2: Histogram showing the distribution of the positive to negative ratio of *Twilight* ratio. Distribution was calculated to be approximately normal.

Table 4: Linear regression model summary

<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std. Error of the Estimate</i>	<i>R Square Change</i>	<i>F Change</i>	<i>Change Statistics</i>		<i>Sig. Change</i>
						<i>Df1</i>	<i>Df2</i>	
.040	.002	-.044	1.07634	.002	.036	1	22	.852

Next, a Mann-Whitney U test for independent samples was conducted to explore the possible association between the text that the participant is a fan of and the number of sexual references made by the participant when answering open-ending questions. The researcher hypothesized that *Twilight* fans are more likely than *Buffy the Vampire Slayer* fans to make sexual references when describing what they have learned from the text, how the text has changed their life, and how the text has affected them. The test resulted with significance level of $p=.012$ suggesting that there is a statistically significant difference in the number of sexual references made between *Buffy* and *Twilight* fans.

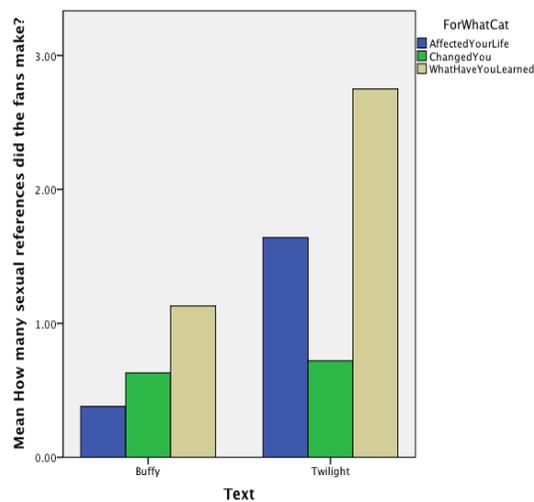


Figure 3: Bar graph of mean number of sexual references made by *Buffy* and *Twilight* fans across categories.

Table 5: Independent Samples Mann-Whitney U Hypothesis Test

<i>Mann-Whitney U</i>	555.000
<i>Asymptotic Sig. (2-sided test)</i>	.012

4.4 Conclusion

Overall, as Rose explained, the data analysis component of the project resulted in valuable statistical findings that quantitatively help support Vinney's ideas about the influence of popular media in adolescent identity development. Through the analysis, Rose was able to more closely examine the quantitative relationships between variables that had previously been qualitatively analyzed, giving the Vinney more depth to her scope of analysis and more support to her conclusions.

Concluding her discussion of the project, Rose explored the results of the experimental learning and statistical consulting parts of the project. Through this project Rose, Osuna, and Vinney were able to obtain a first hand account of the process of learning basic and intermediate statistical methodology as an undergraduate student. They were able to examine, document, and further analyze all of the different factors and phases of learning which must take place in order to achieve mastery of statistical skills, allowing them to make some generalizations about statistical education in the undergraduate environment as a whole. The results of the experiential learning experiment suggested that individual mentoring and independent-research tasks can be an extremely effective way to teach statistics to students in a way that provides more real-world applicability than traditional undergraduate introductory statistics courses. Rose finally explained that, if implemented correctly, these alternative methods of teaching could completely reorganize and renew the current processes of statistical education in the collegiate environment and allow students a learning experience more deeply ingrained in application.

5. Closing Remarks

Demars acted as discussant for the panel. In her closing remarks she noted that it was valuable to try new methods for engaging students in statistical education. In particular, she noted that providing students with opportunities to apply statistical knowledge to actual research studies is more engaging than traditional didactic learning; therefore, the more experiential our educational experiences are designed to be, the more we can expect students to develop sustained interest in statistical learning. Providing students with the chance to experience real-world applications of statistical methods makes learning more concrete, as opposed to the abstract learning that occurs in a typical undergraduate course.

Demars also noted that the use of research topics related to popular culture and entertainment is likely to be attractive and interesting to many undergraduates. Such projects may assist in attracting and retaining students who may go on to career in statistics.

In closing, Demars encouraged attendees to think about statistical education in new and creative ways in order to attract the best students to our field and train them to be prepared for the challenges they will face as statisticians in our increasingly data driven society.

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